SECOND EDITION

WITH 1274 ILLUSTRATIONS ON 597 FIGURES

Clinical Procedures in OCCLUSAL REHABILITATION

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W. B. SAUNDERS COMPANY

Philadelphia and London, 1966

W. B. Saunders Company: West Washington Square,
Philadelphia, Pa. 19105

12 Dyott Street,
London, W.C. 1.

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Press of W. B. Saunders Company. Library of Congress catalog card number 66-12404.

Dedicated to My Wife

ELEANOR KADES BRECKER

Foreword

The introduction of physiology to the treatment of occlusal surfaces has been the most notable advance in occlusal rehabilitation during the last ten years. According to this concept, individuality and anatomic and neuromuscular variations influence the type and the design of restorations. Normal jaw movements conform to occlusal surfaces to provide comfortable and functioning restorations. Furthermore, the natural development of vertical dimensions and occlusal planes is maintained as much as possible. This text shows how to make comfortable, functioning, efficient, and esthetic restorations by using the individual's chewing, rubbing, and swallowing muscles for occlusal reconstruction. This eliminates the need for elaborate time-consuming mechanical devices. Dr. S. Charles Brecker is one of the few dentists in the United States to apply dental and oral physiology to clinical procedures in occlusal rehabilitation. He was among the first of a small group to recognize the vast differences between the physiological and mechanical concepts of rehabilitating the dental organ. He clearly outlines the physiological approach and profusely illustrates the procedures used.

When discomfort results from rehabilitation based upon mechanical concepts, it is mainly because that rehabilitation is out of harmony with the individual's mouth functions. As the patients have difficulty in adjusting to unnatural vertical dimensions, occlusal planes, vertical and horizontal overlaps or eccentric bilateral balance, mechanical restorations must eventually be replaced with physiologic restorations. In bringing out this revised edition, Dr. Brecker has incorporated his latest studies so that the dental practitioner and dental student may be informed of the progress that has been made in physiologic occlusal rehabilitation.

T. E. J. Shanahan, D.D.S.

Preface to Second Edition

The primary purpose of this edition is to organize the treatment procedures of malfunctioning dentitions so that the reader can approach the problems with definite steps in mind. *The individual's functioning occlusal concept* is again presented because there is no single plan of treatment that will apply to all occlusions. This concept was used for the patients treated and illustrated in the first edition, and they are shown nine to twenty years after treatment.

There is a marked difference between the theoretical approach and the clinical approach to occlusal rehabilitation. To dwell upon philosophy and theory alone offers little to the dental practitioner who is concerned with methods to guide him in practice. I have stressed the HOW in rehabilitating occlusions. As a result, which occlusions to alter, which to duplicate, and which to leave alone receive special attention. Existing functioning occlusions which are normal for the individual must not be destroyed just because they do not follow the preconceived plan the dentist has adopted. We are qualified to remedy—not create—occlusions.

There are new chapters on the management of common although not typical occlusions requiring rehabilitation, such as the occlusion with a prognathic jaw, a cross-bite, the terminal dentition, occlusions with excessive vertical and excessive horizontal overlaps, and the previously treated occlusion. The uncontrollable symptom of bruxism, responsible for excessive attrition of teeth, is described in detail in a special chapter on wear. Bruxism dictates the type and the design of the restoration, and five methods of treating worn dentitions are introduced. There are great demands today for esthetic improvement and the average patient undergoing occlusal rehabilitation expects such improvement. The chapter on esthetics has been revised to include six prosthodontic plans of correcting objectionably spaced teeth. The preparation of teeth for full coverage restorations includes high speed techniques. A new chapter on the three-quarter crown by Dr. Maurice J. Saklad is added because a full crown of any type and of any material should be advocated only in cases of absolute necessity. Other new chapters describe porcelain fused to gold restorations, the importance of occlusal planes, cementation and maintenance, and primary reasons for failures in rehabilitation. In my lectures throughout the world and over the many years, many questions have been asked regarding rehabilitation. I have always tried to keep note of such questions and, as a result, present in this edition a chapter of frequently asked questions and their answers.

Inasmuch as the practice of occlusal rehabilitation is a series of complex procedures, there is no necessity to add to these by insisting upon the use of complicated, time-consuming instruments. The articulator is a tool of personal preference and, as such, plays only a secondary role in occlusal rehabilitation.

I am indebted to Dr. Thomas E. J. Shanahan, my friend and colleague, for his continual encouragement in formulating the philosophy on occlusion—the difference between the physiological approach and the mechanical approach, to use his words. To Dr. Maurice J. Saklad, a devoted friend and colleague, who has contributed so much to the profession, my thanks for his contribution of the chapter on the three-quarter crown. I am indebted to Agnes Ericson, my girl Friday, for her able assistance not only in my practice but in the writing of this edition. Nu-Dent Porcelain Studio is acknowledged for the untiring efforts of Sol Altshuler, Nickie Argentieri, Dominic Mater, Bill Olsen, Igor Schreiber, Lou Mazzone, and the entire staff—my technicians for over 30 years. The profession owes a debt of gratitude to David Feinson for his contributions in the ceramic field. My thanks go to the Ralph Dental Laboratories for their assistance with internal attachments and to Clarence Frucht, my technician, who is always at my beck and call. I am grateful to Irving Feinland of Noble Metals for his contribution of an understanding chapter on porcelain fused to gold restorations. His gold was the first metal outside of iridioplatinum and palladium alloys to be used for the fusion of porcelain in our research group. Thanks go to the staff of The Camera House for their help in the photography and to the artist Ted Collangelo for the art work. To the entire staff of W. B. Saunders Co. goes my appreciation for their cooperation in the publication of this text.

S. Charles Brecker

New York City

Preface to First Edition

Over the years, I have had the good fortune to be called upon to consult with regard to the diagnosis of many cases of my colleagues. I call it my good fortune because I have been able to collect and organize data on problems in occlusal rehabilitation that, as an individual, I might not have had the opportunity to see.

The subject of occlusal rehabilitation comprises a correlation of the various phases in restorative dentistry. Today, the demand for esthetics is great, but the patient is not familiar with the limitations in this phase. Existing uncontrollable conditions and anatomic anomalies are only a few of the restrictions the operator is confronted with in attempting to produce an esthetic result acceptable to the patient.

In this book the preparation of teeth for complete coverage, the impression technique, and fixed and removable partial dentures receive some consideration in the first few chapters. Because the use of internal attachments contributes so much to occlusal rehabilitation, the clinical procedures in the construction of a practical case from beginning to completion are introduced.

A classification of cases in the treatment of disorganized occlusions is presented to form the basis of teaching the subject for undergraduate and postgraduate curricula. Of prime importance is the treatment of patients in the various classifications in step by step procedures, from start to completion. Emphasis is placed on pictures for each clinical step. Throughout the chapters, the fact is stressed that an existing occlusion must never be altered unless the operator is certain that a change is necessary. The influence of bruxism in occlusal design of the restorations cannot be minimized. A grouping of patients suffering from this common habit is presented, along with the management of the manifestations of abnormal wear in restorative dentistry. The limitations of the materials used in the restorations and the anatomic abnormalities plus the muscle habits of the patient over the years are only a few of the reasons why the approach to occlusal rehabilitation should be a conservative one. Little emphasis is given the articulator. The type of articulator and face-bow is primarily a matter of personal preference. There is no need to extol the virtues of one instrument over another.

The philosophy of occlusion as presented in this text has taken many years of planning. I cannot present this material without giving full credit to my friend and colleague, Bercu Fischer. His vast knowledge and experience in occlusion, as influenced by his practice of orthodontics, motivated my thinking so much that some of my opinions may have actually originated with him.

The success of treatment involving extensive restorations is not solely dependent upon the individual operator. The technician is an important cog in the wheel that turns the dysfunctioning occlusion into a successful one. I am deeply grateful to Mr. Dave Feinson and the Nu-Dent Porcelain Studio for the aid and consideration offered me in the preparation of this text. I am indebted to Sol Altshuler, Nickie Argentieri and Louis Mazzone for their excellent technical work; to Bill Olsen for the ceramics; to Dom Mater and Max Stimm for their help in acrylic resin, and the entire staff for their cooperation; and to Nat Gold and Irving Feinland for their chemical and metallurgical guidance.

In the construction of the many removable partial dentures with internal attachments, I express my appreciation to Peter Joffe, an artisan and a true friend. My thanks go to many of my colleagues for aiding me with some of the data, directly and indirectly. In particular, these include Drs. Ira Klein, Thomas E. J. Shanahan, Maurice Saklad, Robert McKay, Louis Blatterfein, and William Diamond. No practitioner can claim credit for work accomplished without the capable assistance of his assistant. To Miss Agnes Ericson, my thanks for her loyalty and help. I wish also to record my appreciation to the artist, Margot Suffrain, and to the staff of the W. B. Saunders Company.

S. Charles Brecker

New York City

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THE MEANING AND PHILOSOPHY OF OCCLUSAL REHABILITATION

INTRODUCTION

The dental profession has been interested in rehabilitating the masticatory apparatus as a unit for many years. Every effort is stressed to preserve and rebuild the teeth rather than to remove them. The importance of replacing missing teeth is preached to the public as an essential step in delaying the necessity for complete dentures.

The practice of occlusal rehabilitation is not limited to the select few. The operator who is capable of preparing teeth, designing most of the present-day restorations, diagnosing abnormalities, and recognizing what not to treat as well as what to treat, can undertake rehabilitation of a dysfunctioning occlusion. He should, however, participate in postgraduate training, regular reading, and study on the various concepts of occlusion, and add this knowledge to his practical experience. After an evaluation of his capabilities and training, it is for the individual operator to decide which philosophy, technique, and instruments he finds most practical, expedient and efficient to adopt. Whether he has a dental technician in his office will also be a factor influencing his technique. We must be aware that one technician cannot be proficient in making every type of restoration, such as acrylic resin, porcelain, cast gold crowns and bridges, removable partial dentures with internal attachments, and complete dentures.

The practice of dentistry is a busy and trying undertaking; therefore, time is also important in treating a collapsed dentition. The quicker the rehabilitation is completed, the better it is for the prepared teeth, the occlusion, the dentist, and the patient. It is advisable, therefore, that the operator select a technique that does not entail involved, time-consuming procedures which his practice does not permit. He should not treat too many rehabilitation cases which are prone to bring pressure and tension upon him.

DEFINITIONS OF REHABILITATION

Oral rehabilitation refers to the correction, treatment, and improvement of the dentition. In one instance, a single amalgam restoration or successful periodontic treatment rehabilitates the mouth, whereas, in another extensive crowns and bridges are required. *Occlusal rehabilitation* refers to the treatment of the entire occlusion: It is the correction of all dental ailments for a particular patient in order to restore his occlusion to optimum function, improve upon the esthetics, and preserve the teeth and periodontium. The operator treats the dental mechanism as a unit rather than managing the abnormalities separately when the occlusion is collapsed, lost, or reduced. *Treating the teeth as a unit does not necessarily mean the radical cutting of all remaining teeth and covering them with full coverage restorations.* Healthy teeth which are in acceptable alignment and are not used as abutment retainers should

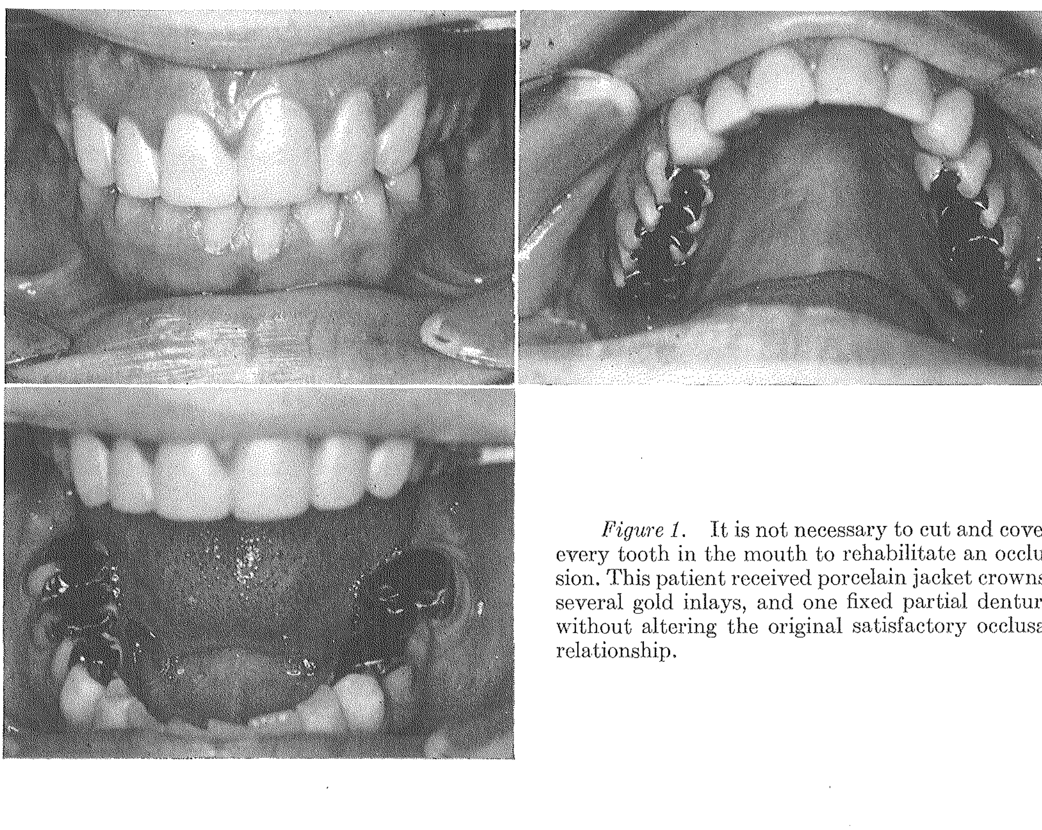

Figure 1. It is not necessary to cut and cover every tooth in the mouth to rehabilitate an occlusion. This patient received porcelain jacket crowns, several gold inlays, and one fixed partial denture without altering the original satisfactory occlusal relationship.

be left intact (Fig. 1). The operator should bear in mind that three-quarter crowns, pin- and pitledge restorations, inlays, gold foils, amalgams, and silicate cements also contribute to successful rehabilitation.

The subject of occlusal rehabilitation is vast and debatable because of the many conflicting opinions and procedures recommended in the correction of abnormal oral and occlusal manifestations. Both the success of treatment and the methods used are governed by inescapable limitations. The correct approach to the treatment of a dysfunctioning occlusion depends upon the foresight, the ability, and the practical experience of the operator and his technician. No set rule can be recommended that will apply to the treatment of all patients.

CARDINAL PRINCIPLES IN THE TREATMENT OF PATIENTS REQUIRING REHABILITATION

To the dentist who undertakes the treatment of a dysfunctioning occlusion I present the following precautions and advice as guides in his undertaking:

1. Do not alter the occlusion of a patient unless you are certain that such a change is necessary.
2. Do not rehabilitate the occlusion beyond the limits of the patient's physiologic rest position and interocclusal space.
3. Occlusions are like fingerprints—no two are exactly alike; therefore, all occlusions cannot be treated the same, like dresses from one pattern.
4. If the existing occlusal curve is not a factor in any temporomandibular joint area disturbance, if it contributes to a healthy periodontium, and if it participates in a comfortable and functional occlusion, then it is advisable to duplicate that curve in occlusal rehabilitation. This does not mean a curve that has been distorted by the extrusion of some teeth because of failure to replace missing ones.
5. Corrective and restorative dentistry is controlled by many limitations, and the dentist and patient must take these limitations into consideration.
6. Do not hesitate to consult with other practitioners in the planning of your case.
7. Do not permit yourself to be placed in the position of having to create a beautiful esthetic result in the restoration that will first have to be approved by the patient.
8. What a patient can tolerate and what he cannot in occlusal rehabilitation cannot be determined beforehand.
9. Complete the occlusal rehabilitation as quickly as possible.
10. Preparing teeth with ultra high speed instruments does not mean working in haste.
11. Not all patients who come to the dental office require occlusal rehabilitation.
12. Do not persuade the patient to undergo occlusal rehabilitation by implying that failure to do so will cause all the remaining teeth to be lost and that he will have to wear complete dentures. It does no credit to the profession to instill the element of fear in order to obtain the patient's consent for drastic rehabilitation.

13. It is not necessary to cut and cover every tooth in order to rehabilitate the occlusion.

14. Do not resort to full coverage restorations if those that conserve more tooth structure are indicated.

15. Inform the patient that nothing of a material nature lasts indefinitely and that restorations may last two years in one patient and perhaps ten or more years in another.

16. Do not plan your case according to the denture type of tooth-to-tooth occlusal relationship unless all the posterior teeth are missing or the occlusion is collapsed or lost.

17. Be sure the patient understands the plan of treatment presented, the approximate time required for completion, the importance of keeping appointments, and the problems that may occur.

18. Reserve the right to alter your original diagnosis and treatment plan because of unavoidable and unseen conditions.

THE PHILOSOPHY OF OCCLUSAL REHABILITATION

The philosophy of rehabilitating a collapsed, reduced, or lost occlusion is primarily determined by the premise the operator adopts regarding the movements of the mandible. This premise tends to determine the methods and instruments that he uses in recording and transferring the jaw relations and orienting the working casts. Each technique, in the hands of the individual who gets results that benefit his patient, can be considered an acceptable philosophy to follow. Some operators, however, seem to have an unusual regard for certain face-bows and articulators, and believe that these accessories make possible extremely accurate recording and duplication of functional movements of the jaw. They also regard the use of these particular accessories as indispensable in occlusal rehabilitation. Such devotion to a mechanical contrivance often complicates progress in the practice of rehabilitation. According to this reasoning, dentists may be divided between those who have a firm conviction regarding what can be accomplished with a mechanical instrument and those who favor the individual physiologic concept that the articulator cannot do exactly what the mouth can, and vice versa. To say that final tests in the mouth for occlusal discrepancies cannot be accurate because of periodontally involved teeth that become depressed during such tests is not a valid reason for making all corrections on the articulator, because the articulator is a solid object. It is an accepted fact that any periodontally involved tooth having vertical movement is a condemned tooth and should be removed. The dentist who uses gnathological concepts and recordings with time-consuming devices, yet obtains satisfactory results, should be encouraged and complimented; by the same token, we should not criticize the operator who obtains successful results by using different and less intricate instruments and methods. What is important is the fact that no matter which philosophy or instruments are used, the limitations in treatment of an individual case are ever-present and the plan of procedure is influenced.

The most troublesome branch of dental practice is occlusion. It is most hazardous to disturb an articulation by destroying all the teeth for full coverage restorations, by futile attempts to improve esthetics in individuals whose particular conditions are not amenable to improvement, the indiscriminate splinting of teeth, the disregard for uncontrollable rubbing habits, and increasing the vertical dimension of occlusion beyond the limits of tolerance under the guise of restoring an occlusion. We should be ultraconservative in our procedures and create necessary restorations that are harmonious with their surroundings and we should conserve tooth structure whenever possible.

We strive for the ideal in occlusion despite the fact that we are not certain what is ideal. We adhere to a hypothetical plan of cross-tooth contacts in cross-jaw excursions and we are disappointed because such a plan fails to succeed in most cases. We stress the importance of the temporomandibular joints, some claiming that they dictate and control mandibular movements, whereas it is the neuromuscular system that controls these movements. We refer to pain and discomfort in the temporomandibular joints when in most instances we mean pain and discomfort in the joint areas, such as muscle spasms, strained ligaments, and nerves. We define balance and equilibration in perplexing and muddled terms but refer to these terms to obtain the so-called ideal occlusion. We are constantly reminded of the importance of a hinge axis recording, the center of rotation, and mathematical equations that must be done when we use certain instruments, when these factors have little bearing upon the success of our restorations.

Nature is not concerned with the so-called ideal occlusion formulated by man. Uniformity of teeth, uniformity of occlusal carvings, and a single type of occlusal plane do not exist in all patients. As long as the occlusion functions satisfactorily, without pain or discomfort to the surrounding and supporting structures, no change in the pattern is advocated despite the excessive overlaps, the prognathisms, the cross-bites, the different levels of occlusion, and the developmentally spaced teeth.

THEORETICAL AND CLINICAL APPROACH TO OCCLUSION

A normal occlusion is an individual phenomenon, not typical. What is ideal theoretically is not necessarily normal clinically. The approach to occlusion may be theoretical or clinical. The theoretical approach is primarily a philosophy, determined chiefly by the premise the dentist adopts regarding the movements of the jaw, the instruments he uses to record and transfer the jaw movements, the unrealistic "perfect" preparations, and geometric occlusal carvings; according to this view, one type of tooth arrangement is considered ideal for all patients. The dentist is constantly learning, and theory is important in dentistry because it is the basis for teaching; however, clinical application must be a practical reality for the individual. Clinical success is influenced by consideration for the many limitations, and is also based upon the individual's physiology, which determines the extent of damage to the teeth and supporting structures.

It is not necessary to alter an occlusion just because it does not conform to a plan considered ideal in theory. Aside from pathologic conditions and accidents that may occur, all organs of the body deteriorate with age, and there is no reason to assume that the teeth and supporting structures are exempt. *At the same time, we should realize that restoring, replacing and altering the teeth so that they appear to be stereotyped, arithmetical shapes and carvings in every case may look correct but may not be functionally accepted by the patient.* Wheeler writes, "Nothing anatomic may be reduced to the mathematical exactitude of geometrical terms."[12] The success of treatment and the longevity of the teeth and restorations are controlled not only by the many limitations in and around the mouth but by the materials we use in our restorations. It is also based upon the health and behavior of the patient, the ability and experience of the dentist and his technicians, oral hygiene, and maintenance. Theory, therefore, can be considered only a guide in the treatment plan of an individual case. Restorations may last ten years in one patient and only one or two years in another because *no two patients react to dental treatment in exactly the same manner.*

THE DIFFERENCE IN OCCLUSION BETWEEN COMPLETE DENTURES AND FIXED DENTITION[1]

The treatment procedures in rehabilitating an occlusion in a fixed dentition must be considered different from those in complete dentures. Some prosthodontists have stated repeatedly that "occlusion is occlusion," whether for complete dentures or for a fixed dentition, implying that the occlusal relationship is the same in all cases; yet the treatment plan, the mandibular registrations, the interocclusal distance, and so forth are all different:

COMPLETE DENTURES	FIXED DENTITION
No natural teeth to use as guides	May have sufficient teeth to use as guides
No centric occlusion present	Satisfactory centric occlusion may be present
No individual interocclusal space	Interocclusal space may be registered
Compelled to use 2 to 3 mm. average free-way space	Space may be anywhere between 0 and 10 or more mm.
Incisal guide angle under control of operator	Incisal guide angle may be present
No individual occlusal planes	Individual occlusal planes may be present
Must have stability of denture	No stability necessary
Operator can set teeth off ridge	Cannot set teeth off ridge
Denture slides over mucosa	Rehabilitated fixed dentition does not slide over mucosa
Denture can be removed by the patient	Fixed restorations cannot be removed by the patient

INDICATIONS FOR OCCLUSAL REHABILITATION

Before the operator commits himself to altering an existing occlusion he must be firmly convinced that a change is necessary and that he is capable of making that change. Occlusal rehabilitation is indicated when it is necessary to do any of the following:

1. Restore impaired or lost occlusion to obtain optimum function.
2. Preserve the remaining teeth and restorations.
3. Improve upon unsatisfactory esthetics within existing limitations.
4. Maintain or create a healthy periodontium.
5. Eliminate pain and discomfort in the teeth, the gingivae, and the underlying and supporting structures.

THE TEMPOROMANDIBULAR JOINT

Too much emphasis is placed upon the temporomandibular joint in occlusal rehabilitation, but it is not the predominant factor. To say that the joints dictate the movements of the mandible is to put the cart before the horse. The joint is not a precise unit, like a door on a hinge or like a ball in a socket. The convexity of the ball conforms closely and uniformly to the concavity of the socket, whereas the odd-shaped condyle heads are incongruous with the fossae. *The mandible, separated from the fossae of the maxillae by articulating disks, cushioned and loosely sandwiched between compressible synovial membranes and fluid and performing as a flexible pivot, is suspended in a hammock of muscles, nerves, and ligaments.*[2] The human jaw should not be considered a mechanical hinge in the skull of a robot, with geometric circular condyle heads, similar to those on articulators, revolving like balls in sockets around a hypothetical axis.

It should be possible to restore the occlusal vertical dimension without the use of mathematical formulae, complex instruments, and theories respecting the temporomandibular joint. *We should stress the physiology of the patient's masticatory apparatus, rather than assign to an instrument or to the temporomandibular joint the major role of rehabilitation.* Mindful that in differences of opinion there is progress, I shall submit, in the various chapters, a philosophy and treatment approach to occlusal rehabilitation in a simplified form. This concept does not accept the view that the temporomandibular joints dictate the establishment of the occlusion. Some improper and unsatisfactory occlusions may contribute to disturbances around the temporomandibular joint areas, but the joints are not the important agents in formulating the occlusion of the teeth.

Fischer[3] writes, "If the temporomandibular joint is the omnipotent factor in establishing the occlusion and articulation of the teeth which it is made out to be, it seems difficult to understand why this factor would not assert itself during the period of a mixed dentition. During this transition period the permanent teeth are practically without roots and the deciduous teeth have lost most of theirs. Furthermore, at this age, the alveolar process, the medium that makes orthodontic movements of teeth possible, is at its maximum plasticity. Certainly, under such conditions the teeth could not offer much resistance to their being naturally positioned in accordance with the dictates of the temporomandibular articulation. Yet few are the children who do not show some irregularity of occlusion, and a balanced articulation is a rare phenomenon even in children with 'normal' occlusion of teeth.

This evidence is on the side of the argument that the temporomandibular joint is not the important factor in establishing the occlusion and articulation of the teeth. It must, therefore, be assumed that the primary factors in establishing the occlusion and articulation of the teeth, as well as the movements of the condyle in the glenoid fossa, are the forces exerted by the muscles surrounding the teeth and the ligaments supporting the mandible that limit these forces." The neuromuscular system, therefore, is the dominant part of the masticatory system which determines the position of the mandible in relation to the maxillae before the teeth erupt and also dictates the movements of the mandible.

In discussing the beginning of occlusion, Linghorne[7] expresses the belief that the teeth are guided into approximate position by the muscles of the lips, cheeks, and tongue until contact is made. Then the inclined planes of the cusps guide the teeth in their permanent position. Later on, these occluding teeth are held in position by the underlying structures. *This occlusion is established in man before the temporomandibular joint is sufficiently developed to influence occlusion.*

TEMPOROMANDIBULAR JOINT DISTURBANCES

Temporomandibular *joint* disturbances are rarely attributed to the teeth. Because of conflicting opinions, the role of the joints in restorative dentistry leaves the operator confused. Temporomandibular joint syndromes are usually manifested in arthritis, inflammation, a pathologic condition, or an injury due to an accident. If the patient has a predisposition to joint disturbances or a tendency toward discomfort in the *area*, the condition may be aggravated by dental treatment. Stafne writes, "Most patients with distress in the temporomandibular joint present with pain in the condylar and preauricular regions, but rarely are the roentgenographic findings positive. . . . 'Clicking' or 'popping' is another source of disturbance to the patient. Roentgenograms are again of little value, since they rarely show any evidence of disease."[10]

TEMPOROMANDIBULAR JOINT AREA DISTURBANCES

It is important that the operator differentiate between symptoms in the joint proper and pain and discomfort in the area around the joint. Pain and discomfort around the joint are usually neuromuscular in origin (Fig. 2). An interference from a tooth or teeth may create painful manifestations and correction of occlusal disharmonies usually corrects the discomfort. Increasing the vertical dimension of occlusion beyond the limits of tolerance is a common cause of joint area discomfort. Abnormal manifestations around the temporomandibular joint areas may be due to the following:

1. Changing the patient's functional and comfortable pattern of occlusion.
2. Establishing the occlusion beyond the limits of the physiologic rest position (raising the bite).
3. Constructing restorations which are not compatible or in harmony with abnormal uncontrollable habits, such as bruxism, and eccentric movements of the mandible.

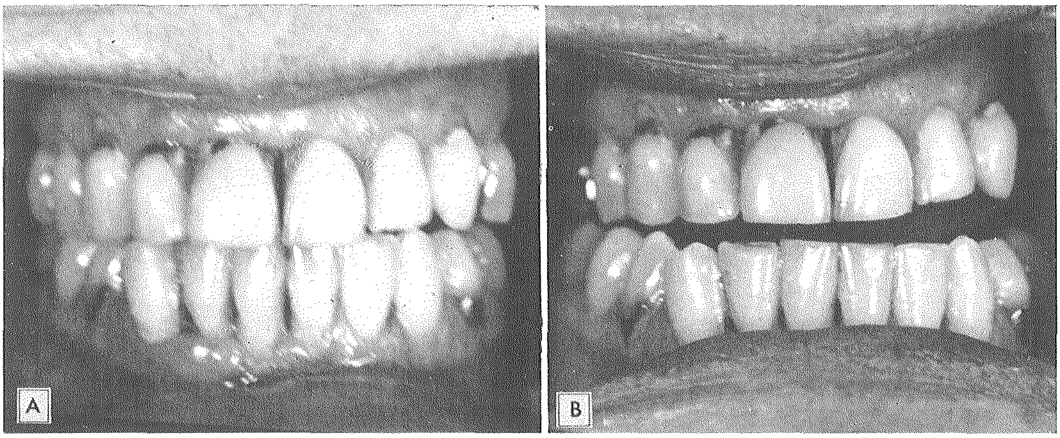

Figure 2. *A*, Severe muscle spasm producing premature contact on the right side in centric. *B*, Right lateral demonstrates more clearly the degree of prematurity created by the spasm. No occlusal correction should be attempted until the spasm is corrected. In most instances, it then becomes unnecessary to interfere with occlusal positions. (Courtesy Dr. Homer C. Vaughan.)

4. Clenching and clamping of the mandible.
5. Interferences or occlusal disharmonies responsible for forced or voluntary deviation of the mandible to one side. According to Vaughan,[11] "Muscle spasms will interfere with function, produce distorted movements and occlusal relationship and destroy proprioceptive function sometimes producing pain."

The subject of temporomandibular joint syndromes is a branch of dentistry best described by other authors.

CARDINAL FACTORS THAT INFLUENCE THE TREATMENT OF OCCLUSION

Mershon[8] wrote, "In the quest for relief of every human ill, medicine has met with defeat every time it has ignored one unalterable condition of humanity, individual limitations. . . . When we realize that each germ cell is different from all others and that each of the millions of changes which takes place during the process of development to maturity makes each individual a being different from all other beings, how can we hope to lay down rules such as one might use in engineering?" Here we have a scientific factor that is too practical to ignore, namely, individual limitations. With this philosophy in mind, one can readily see the impracticability of trying to impose uniformity of occlusal curves, occlusal carvings with architectural designs, equal bilateral and protrusive movements of the mandible, etc. *Individual factors have a direct bearing upon any treatment for each patient requiring restorations in a dysfunctioning occlusion, whether that plan entails the gnathological, the transographic, the Pankey-Mann approach, or approaches of hundreds of other philosophies.* The primary factors that limit corrective and restorative dentistry are:

1. Neuromuscular and osseous asymmetries.
2. The patient's individual pattern of chewing.
3. The patient's intolerance to any change in occlusion by prosthodontic means.
4. The physical and psychological health of the patient.

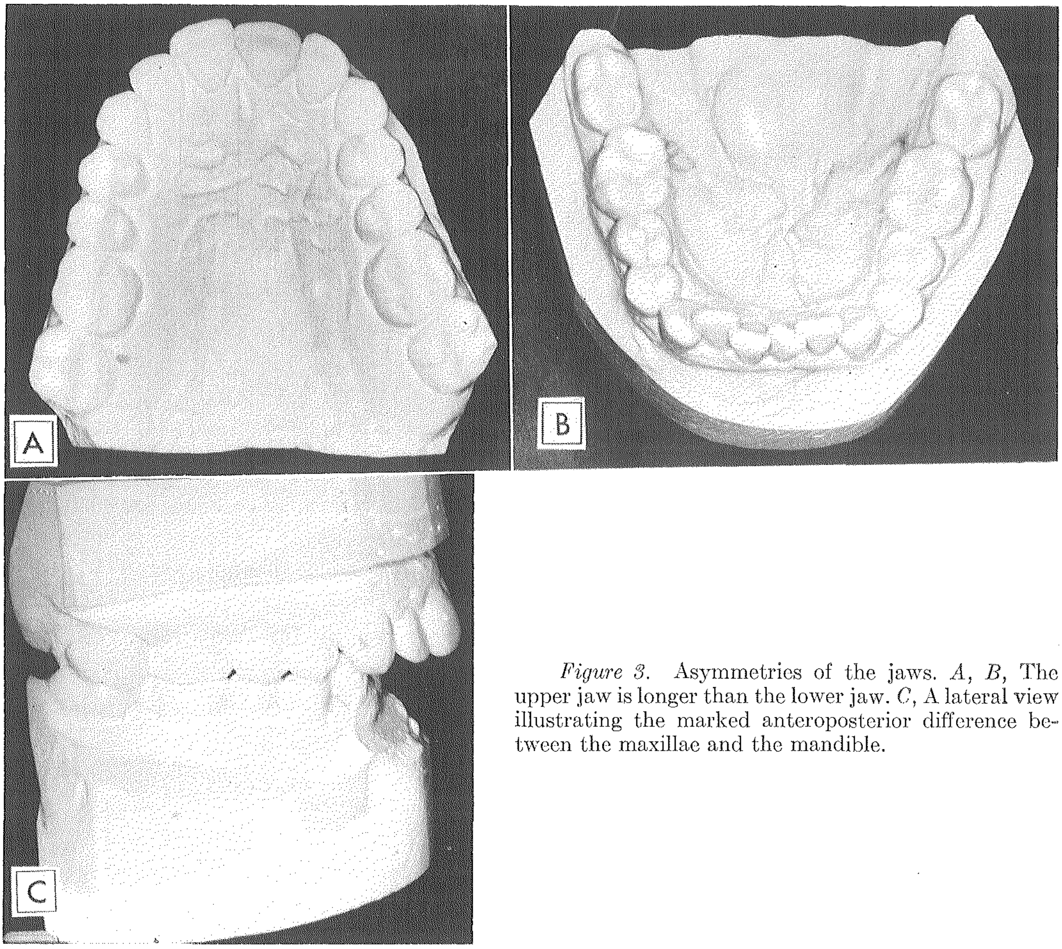

Figure 3. Asymmetries of the jaws. *A, B,* The upper jaw is longer than the lower jaw. *C,* A lateral view illustrating the marked anteroposterior difference between the maxillae and the mandible.

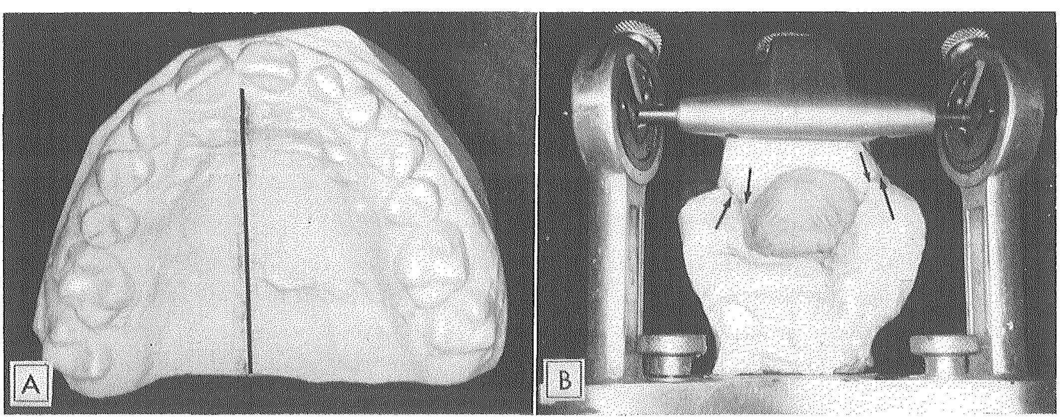

Figure 4. *A,* The left side of this upper jaw is wider than the right side. The median line of the maxillae is to the right. *B,* The lower jaw is much wider than the upper one. Arrows denote the approximate centers of the ridges.

5. The materials used in the restorations.
6. The patient's wishes.
7. The economic factor.

NEUROMUSCULAR AND OSSEOUS ASYMMETRIES

Nature does not construct uniformity. Fischer[4] believes that "nature is primarily concerned with function. The manner in which she accomplishes this in the body proves this to be true. She distorts or inhibits certain anatomic parts belonging to a complex physiologic unit in order to produce the best functional potential. The results of these compensatory adjustments are the various asymmetries in the body. Despite the fact that some of these are frequently of a marked degree, function is not impaired." Asymmetric jaws, teeth, muscles, condyles, or other structures definitely influence the treatment plan in restorative dentistry (Figs. 2, 3, and 4). How can we accept accurate restorations constructed on an articulator that is based upon the *principle of the sphere,* when we know that the right side of the head and face is seldom the same as the left side? Asymmetries of the lips, alveolar bone, and gingivae prevent the successful esthetic improvement in rehabilitation procedures that the patient expects. Anatomic asymmetries should be pointed out to the patient before rehabilitation is done.

INDIVIDUAL PATTERN OF CHEWING

The second important factor that limits the operator in occlusal rehabilitation is the patient's pattern of chewing, which is an individual phenomenon. Farrell states, "It is unfortunate, perhaps, that chewing habits are so variable. If they were not individual, masticatory requirements could be assessed with mathematical certainty by the application of a simple and impersonal formula. How easy this

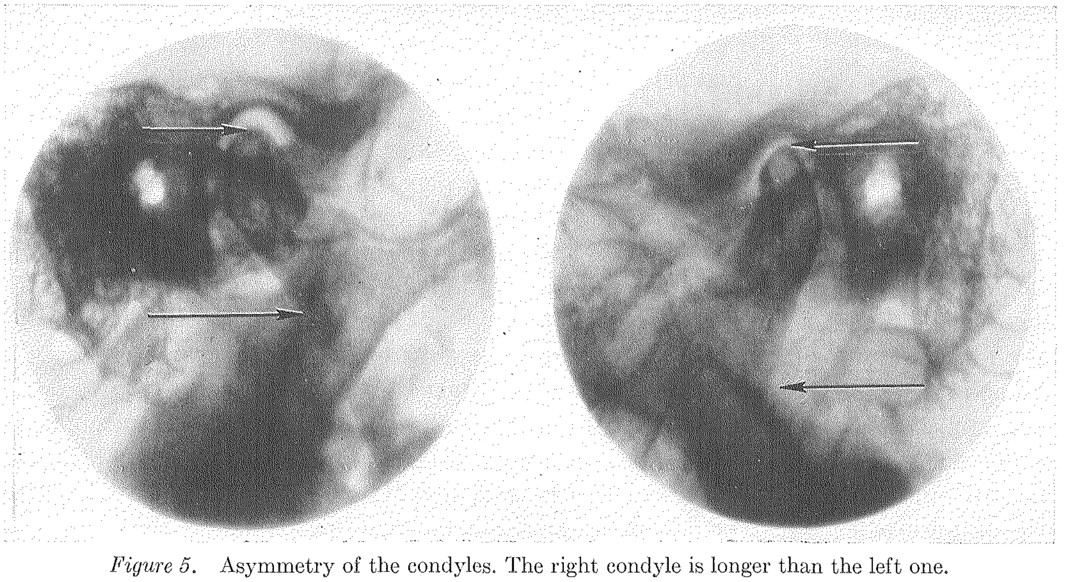

Figure 5. Asymmetry of the condyles. The right condyle is longer than the left one.

would be . . . and how dull."[5] Attempts to change the patient's pattern of chewing by rehabilitation may not always be successful because the habits are of long duration. Chewing and swallowing habits begin in early childhood and the operator cannot disregard these factors when planning occlusal restorations. People chew in various ways for convenience, to avoid pain and discomfort, for better mastication, or because of a long-time habit. The introduction of restorations with theoretically carved and shaped forms may not be able to overcome the acquired habit of chewing a certain way.

INTOLERANCE TO ANY CHANGE IN OCCLUSION

Inasmuch as a functional occlusion is controlled by the muscles and nerves, radical alteration of occlusal patterns in a patient of middle age may affect the nervous system and the harmony of the muscles and the hard and soft tissues of his mouth so adversely that he cannot tolerate the change. Teeth that once possessed sharp inclined planes have become flatter through wear, and the operator should bear this fact in mind when planning restorations of crowns and bridges. It is not always advisable to construct deep-fissured, overcarved interdigitating cusps that tend to contribute to trauma. Invariably, when one constructs deeply carved cusps he is compelled to reduce them in order to make the patient comfortable. The jaw of a man of 50 years cannot always tolerate restorations constructed to resemble those of a young man of 20 years. By the same token, restorations with completely flat occlusal patterns frequently prove inadequate in masticatory function. The preference is for crowns and bridges with low cuspal inclines, possessing sluiceways and with lesser buccolingual widths than the natural teeth. Unfortunately, the patient's tolerance to a change in occlusion cannot be predetermined. The operator is cautioned not to construct the same type of occlusion for all patients. *The mouth can grow accustomed to even the wrong occlusion, and getting used to man-made changes in articulation does not mean that damage is prevented.* Prevention of damage is not always under the control of the operator.

THE PHYSICAL HEALTH OF THE PATIENT

Extensive restorative dentistry involving the entire occlusion is more often indicated in persons of middle and advanced age than in young people. In most instances physically healthy individuals respond favorably to occlusal rehabilitation. If the patient has a cardiac condition, the operator must bear in mind the hazards to which the individual may be exposed; all dental operations should be accomplished under the guidance of the cardiac patient's physician. Of course, the same holds true for diabetic patients and those who have any other physical disorder. It is necessary that the individual be physically as well as mentally prepared for occlusal rehabilitation. With ill patients, it may be necessary to institute partial treatment of the occlusion over extended periods, so that the physical strain and mental tension of dental therapy can be reduced. The dentist is cautioned in the use of premedication or sedation of any sort in such patients. In these days of dieting and slim figures, a patient may suffer from malnutrition. The gingivae may become diseased and the teeth may drift. Unless the physical health of such an individual is improved, restorative dentistry will not be successful.

BEHAVIOR OF THE PATIENT REQUIRING REHABILITATION

The behavior patterns of the average patient who requires occlusal rehabilitation can be so disturbing as to upset the dentist. Roentgenographs, clinical examinations, occlusal registrations, study casts, and the like do not disclose psychoneurotic tendencies or behavior patterns. Some patients become resentful of the aging process and disclose this resentment by their behavior. It is my belief that in most cases requiring extensive dental treatment, esthetic improvement is the patient's first consideration. When limitations exist in the face, osseous structures, lips, or gingivae, the operator may become emotionally upset because the patient expects the imagined ideal in beauty of the teeth: the crowns and bridges must look absolutely natural; they must be light in color and even in alignment; they should be undetectable and unbreakable and should remain so indefinitely; the restorations must remove facial folds and wrinkles and improve the smile. These unreasonable expectations should be a warning to the operator not to attempt rehabilitation. The dentist must be firm though considerate in his case presentation. If the patient is unreasonable before treatment, rest assured he will be more unreasonable when treatment is completed. The operator must never lose his temper with the patient. The word, patient, implies illness, in a broad sense, and consideration, politeness, and kindness will go a long way not to upset the emotionally ill patient any further.

Most psychological clashes between the dentist and his patient are due to the patient's lack of understanding and failure to comprehend what is to be done, the limitations, and why these procedures have to be executed. The operator should ask himself, "Is the patient listening to my presentation? Is he or she familiar with the esthetic and occlusal problems? Does he or she want to know these problems?"

It is sometimes necessary to emphasize the limitations, the problems, the plan of treatment, the shortcomings of certain restorations, the time needed for completion, and the importance of maintenance. When the operator is confronted with a complicated and tedious task of restoring a collapsed or mutilated dentition, the personality of the difficult patient is sometimes injected and may be a stumbling block in the treatment procedures and a barrier to the ultimate success of the rehabilitation. The dentist should always be in control of his patient psychologically. When the person seeks the dentist's services to restore a faulty occlusion he brings with him his established personality and neuroses.[6] An emotional and erratic patient can upset the routine of the doctor's office, affect the dentist's disposition, and even impair his emotional adjustment. It is often better to refuse treatment graciously if the operator senses that the patient is emotionally disturbed. The dentist's approach to restorative rehabilitation should be in accordance with the mental and emotional capabilities of the patient.

Ruth Moulton,[9] in discussing the patient who is unprepared for occlusal rehabilitation, writes, "Some minor abnormality of the occlusion was noticed, and the overzealous dentist became anxious to correct this to prevent difficulty. Since most of these patients were older women, in the menopausal age, they had become accustomed to whatever peculiarities of occlusion they had for many years, and to change the occlusion at this point in life was a much more difficult undertaking than the dentist seemed to realize. Had the patient been relaxed, the dental procedure might have been tolerated."

LIMITATIONS OF MATERIALS USED IN RESTORATIONS

The three materials most frequently used in restorations for occlusal rehabilitation are gold, acrylic resin, and fused porcelain. The unsatisfactory properties of gold are its color and sometimes its hardness. For durability and adaptability to the preparation, this material has always been considered the most practical used in dentistry, but because of the demands for esthetic improvement, the operator is forced to compromise and construct restorations of a fragile material such as porcelain. No material satisfies the esthetic requirements as well as porcelain; despite its fragility, its color and form are excellent. Acrylic resin is weak in color and form, but its resistance to fracture and its ability to wear make it an acceptable medium to use where indicated. The patient must be given to understand that porcelain may break, gold is visible, and acrylic resin discolors. Crowns of any material have a certain artificial "jacket" appearance. The patient must be informed that nothing of a material nature lasts indefinitely.

The Patient's Wishes. The wishes of the patient undergoing occlusal rehabilitation often influence the treatment plan. When these wishes do not affect the health of the patient, the operator must consider them. If the wishes interfere with the success of the rehabilitation, then it is better to refuse treatment to such an individual. Furthermore, if the patient has a preconceived notion of what he would like to have regardless of the limitations in and around the mouth, then the operator is open to unpleasant relations. Sometimes the patient is willing to sacrifice longevity of a restoration for esthetics. In this situation the operator may construct porcelain crowns (though they may fracture) instead of displaying gold in more durable restorations

The Economic Factor. The seventh limitation, and a very important one, is the economic factor. The high cost of occlusal rehabilitation in private practice influences the plan of treatment. Because of the cost, it may be advisable to undertake partial or sectional treatment wherever possible. There are occasions when the operator can rehabilitate a quadrant of the jaw at one time and do another at a much later date.

THE NATURE OF THE OCCLUSION

Occlusion is the contacting of opposing teeth when the jaws are closed. It is established in functional harmony with the muscles, the temporomandibular joint, the nerves, the proprioceptors, and the ligaments. Occlusion constantly changes with the gliding movements of the teeth, and the articulation of the mandible with the skull permits a great variety of movements. These functional movements, rotary and translatory, participate in the chewing of food and in speaking, laughing, yawning, etc. Vaughan[10] believes, "The voluntary neuromuscular skeletal action of mandibular movement can be divided into two essential phases which are capable of independent movement. First, an opening and closing tilt, accomplished principally by the suprahyoid musculature and the external pterygoid muscles which gives to the mandible the glide or its movements in the third dimension."

MUSCLES THAT PARTICIPATE IN OCCLUSION

The masticatory apparatus is controlled by the muscles that take part in occlusal function after a nerve impulse is sent to the muscles to perform that function. Muscles concerned with the movements of the mandible are:

Muscles That Raise the Mandible

The temporal, the masseter, and the internal pterygoid muscles contribute to the raising of the lower jaw.

The temporal muscle arises from the temporal bone and inserts on the coronoid process of the mandible. This muscle pulls the coronoid process upward and backward. It also acts to elevate and retract the jaw and contributes to protrusive movements.

The masseter muscle arises from the zygomatic arch and inserts on the coronoid process and the ramus of the mandible. This muscle pulls the ramus of the mandible upward and forward during function.

The internal pterygoid muscle arises from the lateral pterygoid process on the underside of the sphenoid bone and inserts at the angle of the mandible. When the muscle contracts on one side, the jaw is drawn upward, forward and to the side. When both internal pterygoid muscles contract, the mandible is raised.

Muscles That Close the Mandible

The digastric muscle, aided by the *mylohyoid and geniohyoid muscles*, closes the mandible. These muscles arise in the region of the lower jaw and insert on the hyoid bone. When these muscles contract, they raise the hyoid bone and the mandible. The digastric can also draw the mandible to one side when acting alone.

Muscles That Control Lateral and Protrusive Movements

The external pterygoid muscles, when they act separately, move the mandible laterally. They arise from the lateral pterygoid process on the underside of the sphenoid bone and insert on the condyles of the mandible. When these muscles function simultaneously, the jaw is drawn downward and forward.

Muscles That Control Grinding Movements

The elevators (*temporal, masseter,* and *internal pterygoid*), the *external pterygoid muscles,* and perhaps the *depressors* participate in mulling and grinding movements. Should a fractured condyle incapacitate the action of the external pterygoid muscle, all of these elevator and depressor muscles take over the lateral movements.

Proprioceptors in the muscles respond to stimuli originating within the body itself. The stimuli are furnished by the strains and stresses set up in the muscles, the tendons and the capsular ligament of the temporomandibular joint during muscular contraction.[2] If a patient functions in eccentric positions with teeth, the functional positions are changed when the teeth are lost. When the teeth are lost, the proprioceptors in the membranes are lost too. The jaw does not close in a fixed vertical direction when participating in grinding movements. It closes from slightly right and slightly left positions. This is one reason why it is difficult to reproduce or transfer such movements to an articulator. An articulator closes in a fixed vertical direction.

CENTRIC OCCLUSION

Centric occlusion is "the relation of opposing occlusal surfaces which provides the maximum planned contact and/or intercuspation."[1]

BALANCED OCCLUSION

A balanced occlusion is "the simultaneous contacting of the upper and lower teeth on the right and left side and in the anterior and posterior occlusal areas. This occlusion is developed to prevent a tipping or rotating of the denture bases in relation to the supporting structures."[1] *But this definition applies only to complete dentures.* Balance in a fixed dentition should not be considered in the same category as balance in complete dentures. In the vast majority of natural dentitions that function satisfactorily, there is no working-side–balancing-side arrangement as in complete dentures. A fixed dentition may intercuspate in gliding movements unilaterally, but protrusive and bilateral balance in occlusal rehabilitation is not required and in fact may prove detrimental to the masticatory apparatus. A compatible distribution of stress on the working side is most desirable but without the necessity of the teeth touching on the opposite side. Bilateral balance in complete dentures is considered by many authorities as essential to stability and comfort. But when we speak of balance in a fixed dentition we speak of an occlusal arrangement peculiar to that individual alone. The occlusion is characterized by comfort and function, without detriment to the masticatory organ. We should not compare that which is different in each individual with a uniform contacting arrangement of teeth, the same for all patients.

It is the opinion of some that no restorations involving the entire occlusion should be constructed in a mouth containing natural teeth until these natural teeth have been made to occlude like balanced complete dentures, by grinding and covering them with crowns possessing ideal interdigitating cusps. There is no reason to balance natural teeth where no pathosis of the periodontium is present, just because the patient's occlusion does not meet the operator's ideals of what a balanced occlusion should be.[6] There are patients, and I think there are many, whose occlusions function most satisfactorily in eccentric positions without detriment to the hard and soft tissues. The presumably correct occlusal balance in one case may disturb the harmony of the masticatory machine in another. *We should not refer to a single plan to reproduce an ideal picture-book type of balanced occlusion for all individuals.*

The operator should distinguish between interfering cusps and so-called balance in all excursions. Not all prematurities interfere with the occlusion. Sometimes such a prematurity may even be beneficial because it may act as a stop in preventing the wearing away of certain areas on some teeth or even traumatizing them. The grinding of prematurities can be a continual operation, because it is easy to grind but difficult to know when to stop grinding. When a prematurity does damage it should be called an interference, and all interferences should be removed.

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2

THE FULL COVERAGE RESTORATIONS

The operator must always bear in mind that conservation of tooth structure is of prime importance. If a pin- or pitledge casting is indicated, the full crown should not be considered. If a three-quarter crown can best serve the purpose, there is no need to recommend a complete veneer restoration. The preparation of any full coverage restoration exposes a great amount of dentin and as a result the vitality of the pulp is jeopardized. *It is advisable, therefore, that full crowns of any type and any material be limited to cases of absolute necessity.*[1]

INDICATIONS FOR FULL COVERAGE RESTORATIONS (CROWNS)

As a replacement, the full coverage restoration is primarily indicated when decay, fracture, or abnormal formation or alignment has made it impossible to restore the clinical crown by less radical means. To be specific, crowns are indicated for the following:

1. Abnormal teeth.
2. Teeth requiring esthetic improvement because of faulty development and abnormal position in the arch.
3. Occlusal correction and improvement of function.
4. Abutment retainers in fixed and removable partial dentures.
5. Splinting of slightly mobile teeth.
6. Restoring teeth susceptible to uncontrollable, rampant caries.
7. Maintaining or creating a healthy periodontium.

TYPES OF FULL COVERAGE RESTORATIONS

1. Porcelain jacket crown.
2. Acrylic resin crowns:
    a. Acrylic resin cured to a gold coping.
    b. Acrylic resin cured to a fused porcelain coping.
3. Cast gold crown.
4. Banded and cast occlusal gold crown.
5. Cast gold crown with a porcelain pin veneer.
6. Cast gold crown with acrylic resin veneer.
7. Porcelain fused to a cast metal alloy:
    a. High melting range gold alloy.
    b. Iridioplatinum alloy.
    c. Palladium alloy.

THE PORCELAIN JACKET CROWN

No restoration approaches the esthetic qualities of the natural tooth as closely as the porcelain jacket crown. This type of restoration is primarily indicated on anterior teeth in both jaws, including the bicuspids. On occasion the first molar may receive this type of restoration. The porcelain jacket crown is the crown that pleases the patient most, when occlusal rehabilitation of an occlusion is completed. A close second is the porcelain fused to gold restoration. The two important factors in porcelain jacket crown construction are that the completed restoration be baked to nearly equal thickness and that it have sufficient tooth structure to support it. These factors minimize fracture and dislodgement of the porcelain crown and contribute to uniformity of color. For the patient treated in occlusion it is sometimes advisable that duplicate porcelain jacket crowns be constructed so that the patient will be prepared for any emergency should a porcelain jacket crown fracture. All patients for whom this type of restoration is made are advised to be careful in their eating habits and to cut their food into small pieces. Porcelain is fragile, and some sacrifices must be made by the patient for the sake of appearance.

PREPARATION FOR THE FULL COVERAGE RESTORATIONS

The preparation of a tooth for any type of crown is influenced by the anatomy, the condition, or the position that tooth presents in the dental arch.[2] The preparation may possess a full shoulder, a partial shoulder, or may even be shoulderless but with a definite finishing line. If the crown is to be a porcelain jacket crown, a complete uniform shoulder is not always advisable. Some teeth cannot have a complete uniform shoulder which would allow the ceramist to fuse a jacket of nearly equal thickness. In the veneer crown, it is advantageous to prepare shoulders, not necessarily of uniform widths. It is advisable to remove sufficient interproximal, labial, or buccal tooth structure so that the technician can construct restorations that will accommodate both metal and porcelain or acrylic resin, and still be within the contours of the natural tooth.

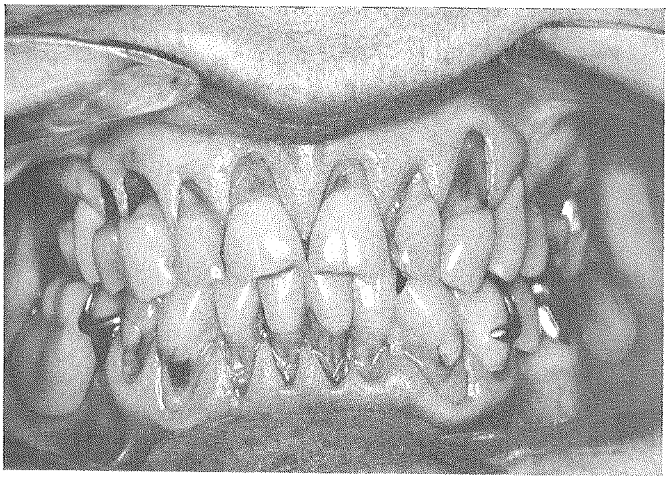


Figure 6. To insist upon uniform shoulders in every case, regardless of the condition, position, and anatomical form of the tooth, shows a lack of regard for the health and vitality of the pulp. It is impractical to prepare a complete shoulder on each of these teeth possessing large cervical excavations.

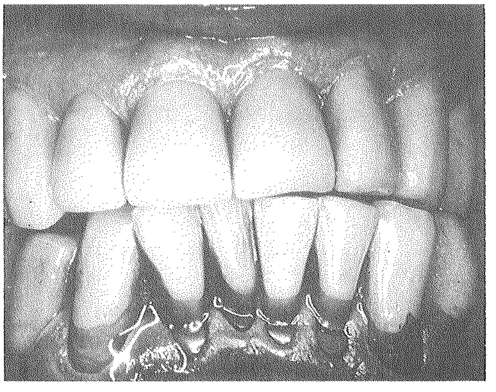


Figure 7. Crowded mandibular incisors are better left alone in occlusal rehabilitation. When esthetic crowns are indicated such tapering small teeth should not receive full shoulders.

With the introduction of higher speeds with stones and burs that remove tooth structure very rapidly, many teeth suffer pulp deterioration. In the operator's endeavors to create an ideal preparation, he must be careful not to remove too much protective tooth structure. It is better to preserve a live, healthy pulp under a less attractive preparation than to destroy the pulp under the so-called ideal theoretical type of preparation. *To insist that full uniform shoulders be prepared on all teeth, regardless of their anatomic forms and regardless of their condition and position in the arches shows a lack of understanding of the function of the vital pulps* (Figs. 6 and 7). If it is impossible to create a full or partial shoulder in a tooth for a porcelain jacket crown, a shoulderless one with a definite finishing is advisable.

THE SHOULDERLESS PREPARATION

A shoulderless preparation is not recommended to take the place of the shoulder preparation. It is indicated when conservation of tooth structure is necessary in the preparation because the tooth is bulbous, displays exposed cementum, is peg-shaped, is extensively decayed, or possesses large old restorations; when the tooth is abnormally spaced or overlapped or is a small, thin, and delicate tooth; or in the case of teen-age and young adult patients. The preparation for a shoulderless porcelain jacket crown is basically the same as for a gold crown on a posterior tooth. All the exaggerated contours of the tooth are reduced to eliminating undercuts, and sufficient tooth structure is removed all around to allow for nearly equal thickness of porcelain. The problem that confronts the operator and technician is to know where to terminate the porcelain over the shoulderless preparation.

SOLVING THE FINISHING LINE IN A SHOULDERLESS PREPARATION

Since porcelain cannot be burnished or handled like gold and cannot be fused to a uniform feathered edge, we must resort to some means of determining and obtaining a finishing line for the jacket so that it will not be a source of irritation to the gingival tissues. After the shoulderless preparation is completed, the copper band is festooned and fitted. The operator is advised to take time fitting the band so that its festooned edge fits just slightly beneath the gingiva. Some operators choose to scratch a line around the festooned band to indicate the termination, and insert the filled band over the tooth until the scratched line on the band barely disappears under the free margin of the gum. When the amalgam die is constructed and the band and compound are trimmed, a false shoulder (a mere semblance of a finishing line) is created at the junction of the die and band. The die is then trimmed carefully, about 0.5 mm. beyond the contoured false finishing line. When the porcelain jacket is completed, the thickened cervical border of the porcelain, which has been baked to the false shoulder, is ground thin with stones or disks and then polished with a rubber wheel or Dedico Flexie Wheel (Fig. 8).

The operator may prefer to construct a Bastian cast gold shoulder for the shoulderless preparation. Of course, the gold collar will be visible. The technique of the Bastian gold shoulder is described in detail on page 428.

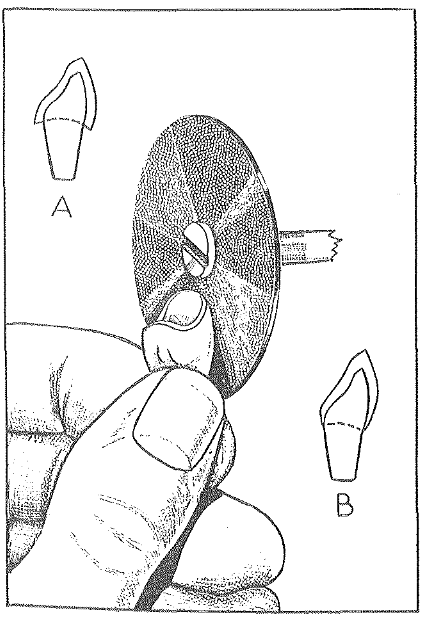


Figure 8. Porcelain cannot be fused to a thin feathered edge like gold. *A,* The porcelain is thick in the cervical region of a jacket constructed on a shoulderless preparation. *B,* It is ground thin and polished smooth with fine disks and stones and a rubber wheel.

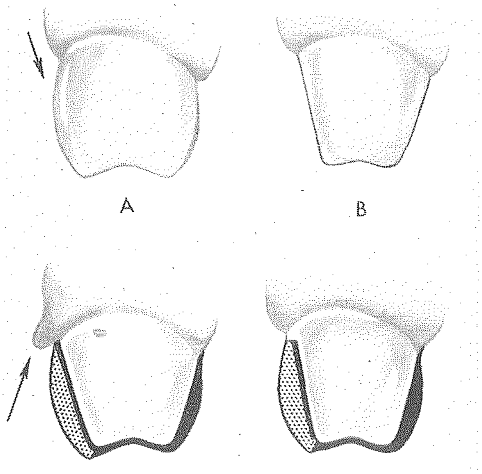


Figure 9. *A*, Tooth crowns have fairly uniform curvatures at the cervical thirds. The deflecting contour of the gum must be in harmony with the deflecting contour of the tooth in order to remain healthy. *B*, A shoulderless preparation for a veneer crown is not recommended. *C*, In order for such a preparation to accommodate thickness of gold plus sufficient thickness of esthetic material, the completed restoration will have to be over-contoured, and gingival irritation and inflammation is set up. *D*, A shoulder in the preparation provides room for both materials and the completed restoration can be constructed to be within the confines of the original contour of the tooth. If a shoulder is not possible, then a gold collar will have to be visible.

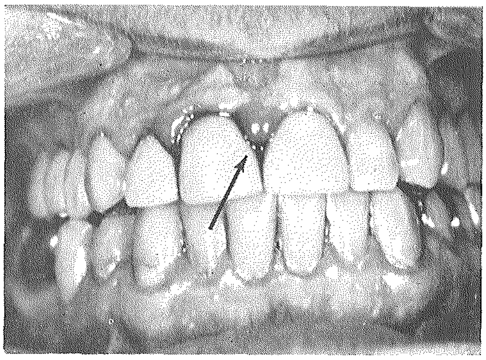


Figure 10. Exaggerated cervical contour. Food material and debris pack around the exaggerated contour and the gingiva becomes inflamed.

INFLAMMATORY CONDITIONS AROUND THE COMPLETED CROWN

An inflammatory condition around a completed full coverage restoration that develops a short time after insertion is due to overextension, improper carving, and sometimes the shoulderless type of preparation. Wheeler[7] states, "It will be found that the tooth crowns have fairly uniform curvatures at the cervical thirds. These contours must be recognized as having considerable physiologic importance." A boxing has to be cut in the gold casting and a shoulderless preparation makes it impossible to receive sufficient bulk of porcelain or acrylic resin. Bulk of either material contributes to good color. As a result, the cervical third of the completed restoration is bulky and distends the gingival tissue (Fig. 9). Food material and debris pack around this exaggerated contour and an inflammation is set up (Fig. 10). A shoulder on the buccal or labial surface of the preparation for a veneer crown will make it possible to construct a crown within the confines of the natural contour of the tooth. There are, of course, some teeth for which it is impossible to prepare shoulders. In such cases, a finishing line is prepared and the gold collar of the restoration covers the area where insufficient tooth structure was removed. As a result, a metal collar will have to be visible.

HOW TO DETERMINE WHETHER SUFFICIENT TOOTH STRUCTURE HAS BEEN REDUCED FROM THE LINGUAL, INCISAL, AND OCCLUSAL SURFACES OF THE PREPARATION FOR A CROWN

Frequently, the operator is faced with the problem of a high spot on a veneer, full cast gold, porcelain fused to metal, or all porcelain jacket crown after completion. The operator grinds these high spots and suddenly finds that he has perforated the restoration or exposed the gold under the porcelain. To prevent this occurrence, the following procedure is suggested. After the preparation is practically completed, take a regular size strip of thin articulating paper and fold it over upon itself three or more times, depending upon the type of restoration. This makes a total thickness of eight layers or more of articulating paper. Hold this small wad between a cotton plier and the occlusal or incisal surface of the reduced preparation. Instruct the patient to tap, tap, tap the teeth together in centric. Examine the lingual or occlusal or incisal surfaces for any markings. If the paper leaves a mark, you have not reduced sufficient tooth structure to accommodate sufficient thickness of the material for the crown. Grind that surface until the wad of paper of eight thicknesses does not leave any markings in centric occlusion. Make a fresh wad of articulating paper and place it between the prepared tooth and the opposing one and instruct the patient to close in centric and hold that closed position. Now instruct him to rub his teeth in his habitual rubbing movement. New markings will appear. Reduce the marked tooth structure until no further markings are made with the rubbing movements. This rubbing movement may be circular, shearing, side lateral, full lateral, or protrusively contacting.

RELATION OF THE BORDER OF THE PREPARATION TO THE GINGIVA

Whatever the type of crown, consideration must be given to the relation of the surrounding tissues and the cervical border of the completed restoration. It is wishful thinking to assume that extending the gingival border of the crown as far beneath the gingival tissue as possible will forestall the exposure of tooth structure when normal recession takes place. Overextension of any restoration beneath the tissue will not be tolerated by the gingiva in most cases. The gum tissue manifests this intolerance by becoming irritated and inflamed. To recommend extending the border of the preparation up to the epithelial attachment or close to it is misleading. One cannot see an attachment from the gingiva to the tooth, clinically. Histologists inform us that the epithelial attachment is rarely at the same level on the same tooth. Were we able to locate these different levels of attachment, we would then construct a crown with uneven scalloped margins. The epithelial attachment prevents infection from penetrating into the underlying dermis. Therefore, the operator should exercise care in the preparation of a tooth for a full coverage restoration so as

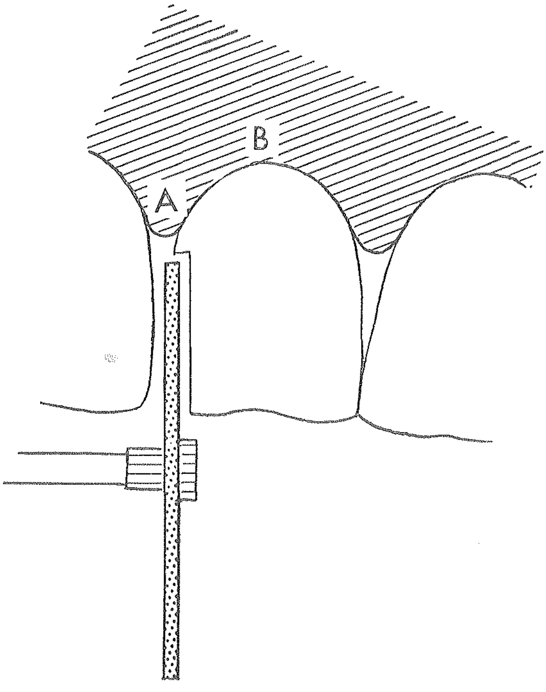


Figure 11. The gingiva interproximally (*A*) is not at the same level as the gingiva on the labial surface (*B*). The operator must be careful not to permit the disk to engage the interdental papillae.

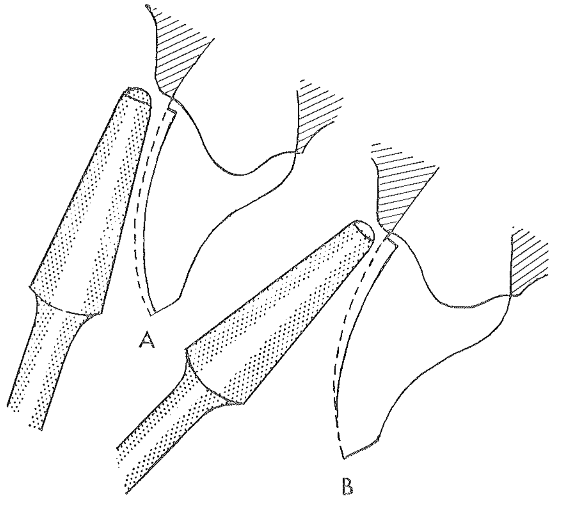


Figure 12. *A*, The tapered cylinder stone held parallel to the long axis of the tooth. *B*, Incorrect position of the cylinder stone, creating an undercut.

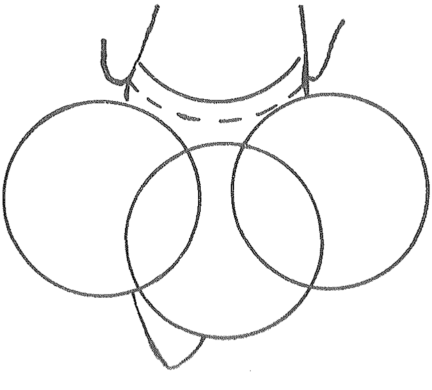


Figure 13. To prevent laceration of the interdental papilla when using the disk, direct the instrument in such a manner that the shoulder or finishing line follows the natural contour of the interproximal, labial, and lingual gingiva. The disk will start close to the gum labially, then drop interproximally to avoid engaging the tissue, and emerge lingually close to the gingiva. (After Kösters.)

not to damage the surrounding soft tissues. The mere fact that the gingival tissues possess such wonderful recuperative powers is no reason why the attachment should be cut. The preparation can be accomplished without laceration of the tissues and with practically no bleeding. Where should we terminate the preparation for any full coverage restoration? No matter how deep the gingival crevice, the preparation should extend very slightly into that crevice.

AVOIDANCE OF INJURY TO TEETH AND SOFT TISSUES

Control of a rapidly revolving disk or stone is of paramount importance in the prevention of tooth mutilation and injury to the soft tissues. The lip and tongue should be protected, and the assistant can retract the cheek while the operator or the patient can retract the tongue. For some areas, the use of a disk guard is helpful and assures the operator of some degree of safety. We must never lose sight of the fact that a constantly moving tongue, a closely approximating cheek, a full and often anesthetized lip in an anxious patient do offer interferences, and a stone or disk moving at a moderate speed offers some assurance of safety. Today, the use of diamond stones and carbide burs makes it imperative that a steady flow of water be directed upon the tooth during the preparation.

ANESTHESIA, COOLANTS, AND INSTRUMENTARIUM

It is advisable that the tooth to be prepared for a full coverage restoration be anesthetized by a local injection of procaine. A 30 gauge disposable Mizzy needle causes less trauma to the tissues and should be used in anesthetizing all teeth.

The operator must be careful in his procedures so as not to remove too much tooth structure or to overheat the tooth, because the patient does not feel the warning signal of pain. The importance of pouring water on the tooth while reducing it cannot be stressed enough. If the saliva ejector is not capable of taking up the water in the mouth, then the Vacudent or similar equipment can be used to remove the water, old fillings, tooth shavings, and debris.

ULTRA HIGH SPEED IN THE PREPARATION

The use of ultra high speed in the preparation of teeth does not necessarily mean that conventional speeds are to be discarded. The removal of tooth structure for a restoration is a serious undertaking because we are dealing with a live important cog of the masticatory apparatus. It is advisable to consider ultra high speed equipment as an important adjunct, necessary in the reduction of bulbous enamel, removal of old restorations, and the major portion of the preparation. For final finishing and treatment of the preparation under the gingiva, hand instruments and stones and burs used at moderate speeds are more often essential. The advantage derived from such high speeds—100,000 r.p.m. to over 350,000 r.p.m.—is the ease with which bulk of tooth structure can be reduced. Comfort to the patient is brought about during the preparation because the vibration created by the rotary instrument is usually above the threshold of perception.

The greatest disadvantages with the use of such high speeds are the operator's inability to see exactly what is being accomplished (because he is working in a field flooded with water from the coolant apparatus) and the fact that tooth structure is sometimes reduced too rapidly. Small diamond stones and special carbide burs are recommended. The pressure required to cut tooth structure is between 2 and 4 ounces and the stone or bur is brushed over the surface of the tooth to be reduced.

STEPS IN THE PREPARATION OF AN ANTERIOR TOOTH FOR A VENEER OR PORCELAIN JACKET CROWN

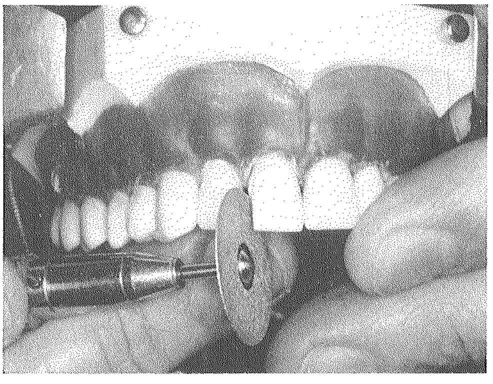


Figure 14. Break through the mesial and distal surfaces with a ¾ or ⅞ inch diamond disk in the regular handpiece at conventional speed. Remove sufficient tooth structure to establish a mesial and distal shoulder as close to the gingiva as possible without lacerating the tissues. Carry the proximal slices toward the lingual so as to cut a start of a shoulder on the lingual area. Prepare a slight taper toward the incisal edge.

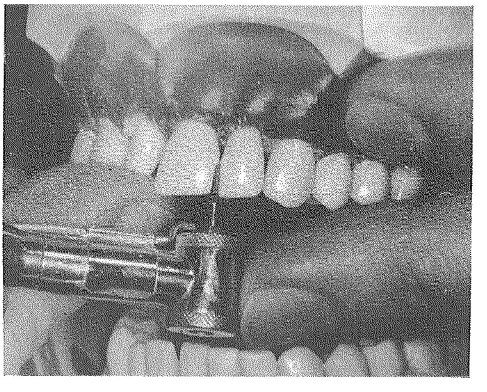


Figure 15. The operator may decide to break through the proximal surfaces with a thin tapering fissure bur in the high speed handpiece. Extreme care must be exercised not to touch the approximating teeth. The mesial and distal surfaces are reduced and the proximal shoulders created with this bur. It is primarily recommended when multiple approximating teeth are to be prepared.

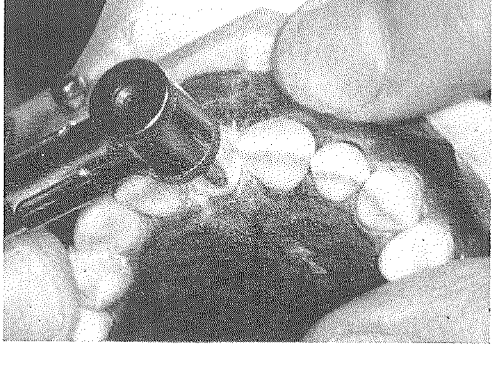
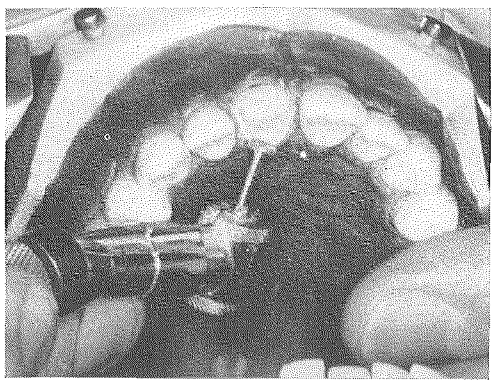


Figure 16. Reduce the lingual surface from the edge of the crest of the cingulum to the incisal edge with a Star pear-shaped diamond stone in the high-speed handpiece. Roll this stone from mesial to distal and reduce sufficient tooth structure to accommodate the thickness of the restoration. Be careful not to touch the approximating teeth with this stone.

(*Text continued on page 29.*)

Figure 17. Raise the patient in the chair and tilt back the head so that you can see the mesial and distal shoulders you created in the first step. Use a small diamond wheel in the high speed handpiece and cut a shoulder on the lingual surface connecting it with the mesial and distal shoulders. This wheel stone has a cutting edge and a cutting face. While the edge cuts the shoulder the face reduces the cingulum and still maintains its outline form.



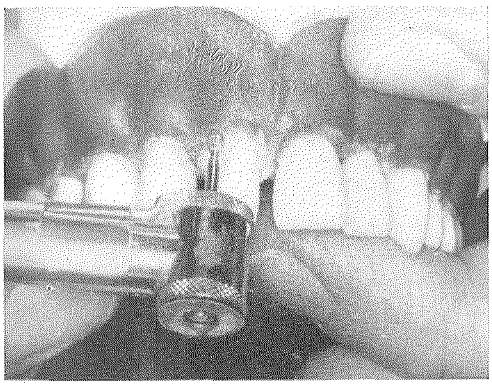
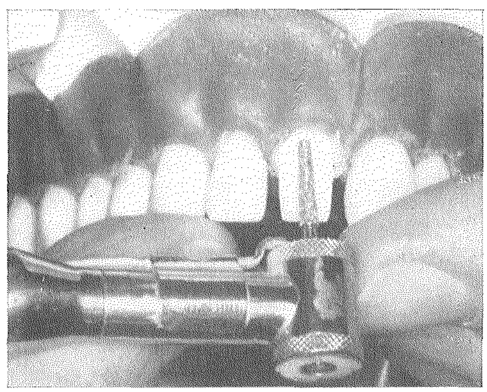


Figure 18. Adjust the chair and headrest. Cut a labial groove with the small inverted cone diamond stone in the high-speed handpiece. Extend the groove down to the dentin on the labial surface close to the gingiva and follow the labial contour of the gum. Connect this groove with the mesial and distal shoulders. This groove will be the guide when reducing the entire labial surface. It is a good stone for creating the shoulder at the junction of the mesial and distal shoulders, frequently referred to as "devils' corners" because of the difficulty of rounding the shoulder mesially and distally.

Figure 19. Reduce the labial surface with the tapered cylinder diamond stone in the high-speed handpiece. Roll this instrument from mesial to distal, removing tooth structure from the groove previously prepared down to the incisal edge, avoid a labial undercut. If the tooth is a long canine, then a long diamond cylinder stone is recommended because it covers the entire labial surfaces of most long teeth. Direct the stone in such a manner that the convexity of the surface is maintained.



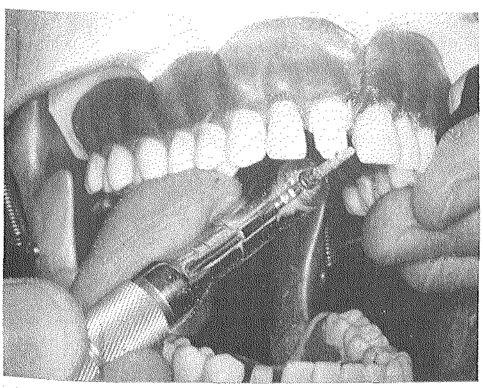


Figure 20. The operator may use the same cylinder diamond stone to reduce the incisal edge. Care must be taken not to permit the stone to touch the approximating teeth. Some operators prefer to use a diamond wheel stone to reduce the incisal edge. If the tooth is a thin, delicate one, then all that is necessary usually is to sandpaper this edge because most of it would have been reduced in the preparation of the labial and lingual surfaces.

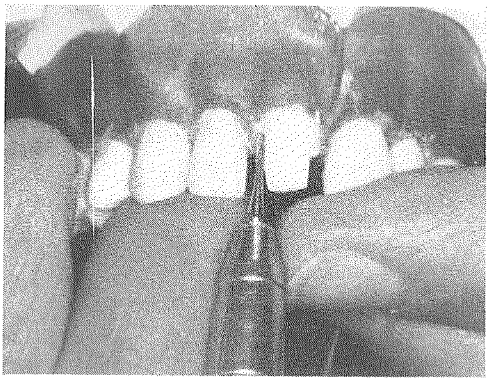
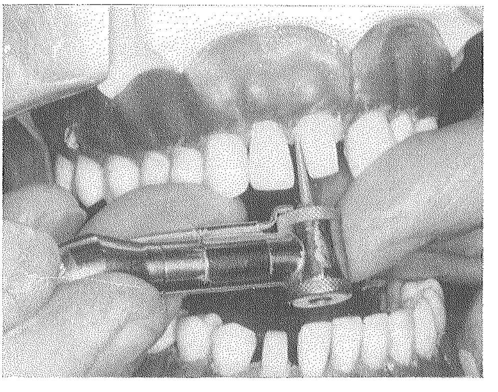


Figure 21. To extend the shoulder of the preparation very slightly into the gingival crevice, it is advisable to use a 556 or 557 carbide crosscut fissure bur in the regular handpiece at conventional speed. Remove the enamel from the shoulder tissue-ward, extending the shoulder beneath the gum. Proper finger rest and finger support keeps this bur under control so that it does not lacerate the tissues. It may be necessary to use the same bur in the contra-angle handpiece for the lingual shoulder extension.

Figure 22. Smooth out all nicks and irregularities with a thin tapering diamond cylinder finishing stone in the high speed handpiece. Do not revolve it at the maximum speed that was used in the prior preparation of surfaces. This stone can usually reach and treat all cut surfaces except the shoulder. Sandpaper disks of fine grit are also recommended to smooth the preparation.



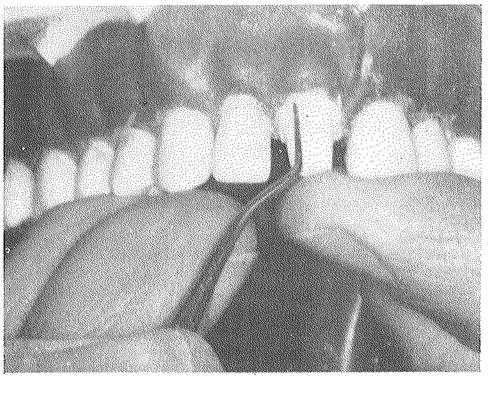


Figure 23. Smooth and finish the shoulder with a sharp bin-angle or hoe chisel or any preferred hand instrument. At the same time, if the restoration is to be gold veneer or a coping casting, create a small bevel at the cavosurface margin of the shoulder to accommodate the gold in the same manner as the enamel border in the preparation for a gold inlay.

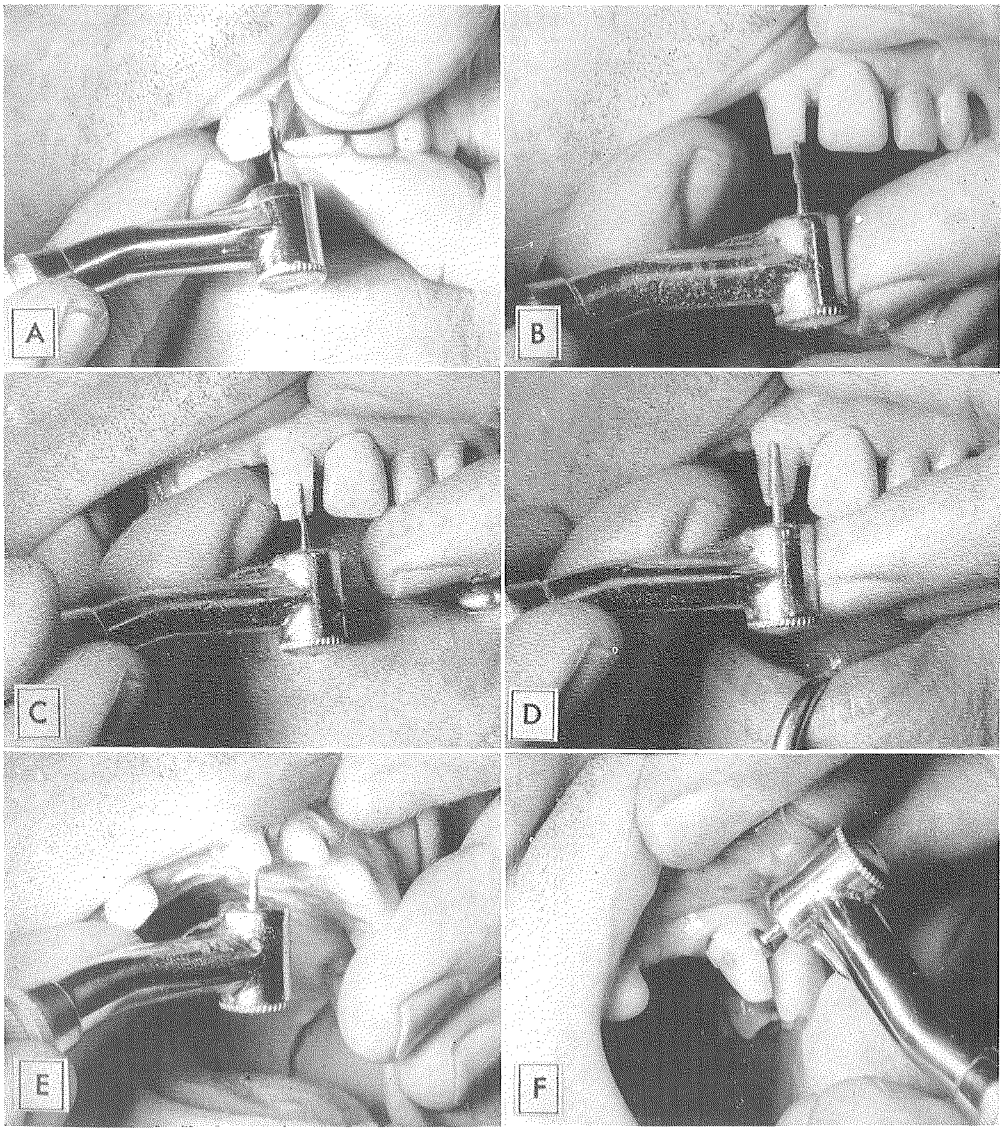


Figure 24. Preparation of an anterior tooth for porcelain jacket or veneer crown using a minimum number of stones and burs at high speed. *A*, Break through the proximal areas with a tapering fissure bur cutting the shoulders proximally as the areas are reduced. *B*, Remove the labial enamel in stages with a cross cut fissure bur, cutting and starting the shoulder in the incisal third of the tooth and connecting it in stages with the proximal ones. *C*, Extend the shoulder with the same high speed bur up to the gingiva. *D*, Smooth and finish the labial area with a high speed finishing diamond stone. *E*, Reduce the lingual surface and the cingulum, cutting the lingual shoulder at the same time with a small diamond wheel. *F*, Extend the shoulder labially and lingually with the same small diamond wheel.

STEPS IN THE PREPARATION OF A POSTERIOR TOOTH FOR A VENEER OR PORCELAIN CROWN

The steps in the preparation for the veneer crowns are practically the same as for the porcelain jacket crowns. There are three types of veneer crowns: the cast

(*Text continued on page 33.*)

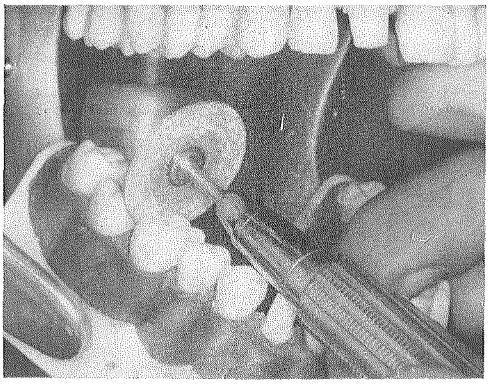


Figure 25. Break through the contact areas mesially and distally with a ⅛ or ¾ inch safe sided diamond disk in the straight or contra-angle handpiece at moderate speed. Direct the disk parallel to the long axis of the tooth, creating a mesial and distal shoulder or finishing line. Some operators prefer to use the thin tapering carbide bur in the high speed handpiece to break through the proximal areas.

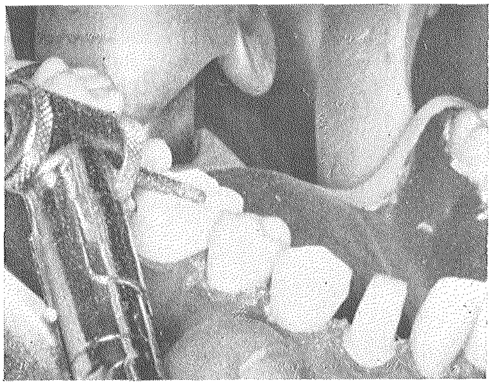


Figure 26. With a diamond tapering cylinder stone in the high speed handpiece, reduce the buccal cusps at an angle toward the center of the tooth. Run this stone from mesial to distal, removing sufficient tooth structure to accommodate the thickness of the desired restoration. When the surface is to be a gold restoration, it is advisable to follow the cuspal outlines in the reduction, thus conserving tooth structure.

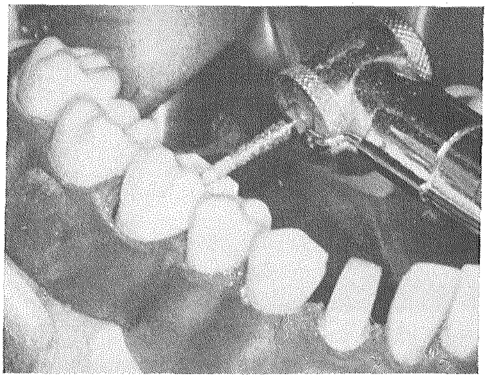


Figure 27. Turn the stone around and direct the diamond tapered cylinder in such a way as to reduce the lingual occlusal area at an angle from the crest of the cusps to the center of the tooth. Run this stone from mesial to distal, reducing sufficient tooth structure to accommodate the thickness of the restoration. The assistant or the patient can retract and protect the tongue with a mouth mirror or tongue depressor while the operator retracts the cheek.

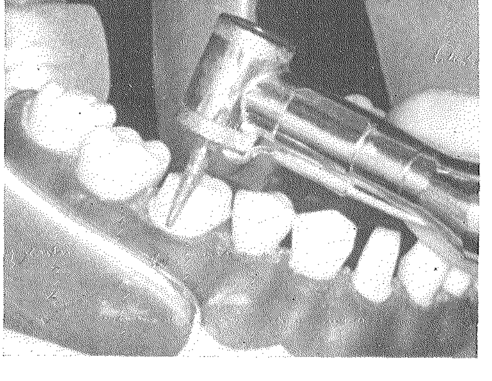


Figure 28. If the occlusal surface is to receive gold, then a tapering cylinder diamond stone is used in the high-speed handpiece to reduce the bulk of the buccal and lingual surfaces. This stone removes the convexities of these areas until the finishing lines are established in the cervical regions. If the restoration is to be a veneer or a porcelain jacket crown, then a thinner tapered cylinder diamond stone is advisable to reduce these surfaces and establish the shoulders.

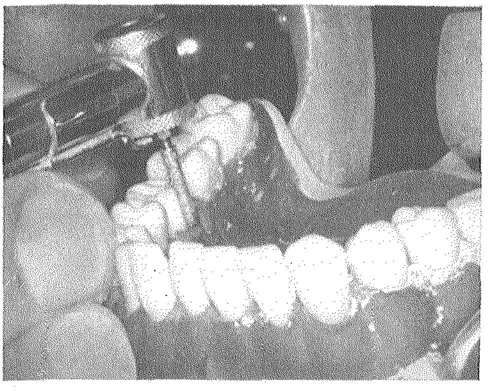
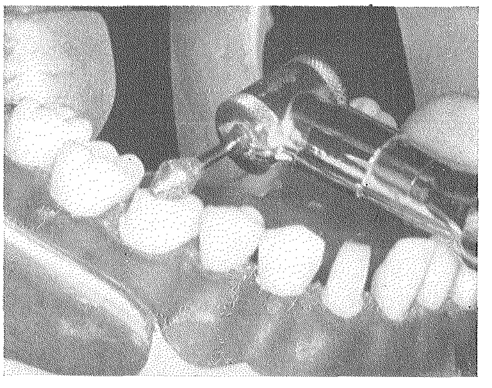


Figure 29. Use the same stones in the reduction of the lingual surface and the establishment of a shoulder or finishing line. Run this stone from mesial to distal, being careful not to touch the approximating teeth with the instrument. Create a very slight taper toward the occlusal region.

Figure 30. Some operators prefer a deep V-shaped prepared occlusal surface to make it possible to carve inclined planes in the completed restoration. A small barrel shaped diamond stone in the high speed handpiece is held in such a position that the widest diameter of the stone rests in the center of the occlusal surface. Run this stone from mesial to distal, creating buccal and lingual occlusal incline planes.



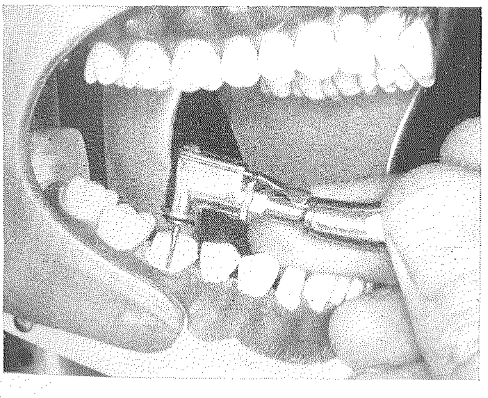
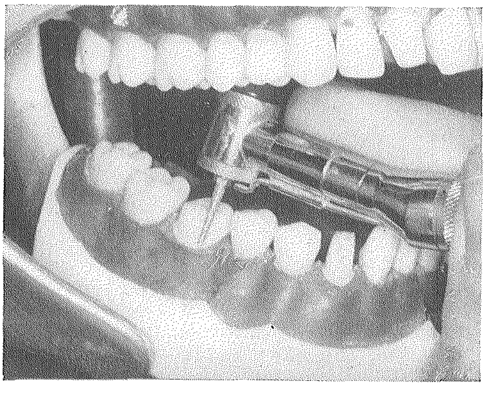


Figure 31. Use a 556 or a 557 crosscut carbide fissure bur in the conventional contra-angle handpiece; running at moderate speed, extend the shoulder very slightly below the gingiva without lacerating the tissues. If the restoration is to be a gold coping for porcelain fused to metal then a shoulder is advisable all around the tooth.

Figure 32. Round off and smooth all sharp line angles, particularly at the junction of the mesial and distal surfaces with a thin tapering diamond finishing stone. *This stone should be run at slower revolutions in the high-speed handpiece.* Do the same for the buccal and lingual surfaces, creating a slight taper at the same time.



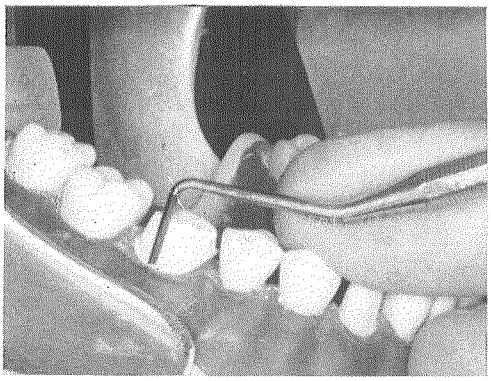


Figure 33. When the preparation has a shoulder, smooth and finish the shoulder with a sharp bin-angle chisel or any cutting hand instrument of choice. Create a slight broad bevel all around the shoulder if the preparation is to receive a gold casting. Smooth the entire preparation with fine sandpaper disks.

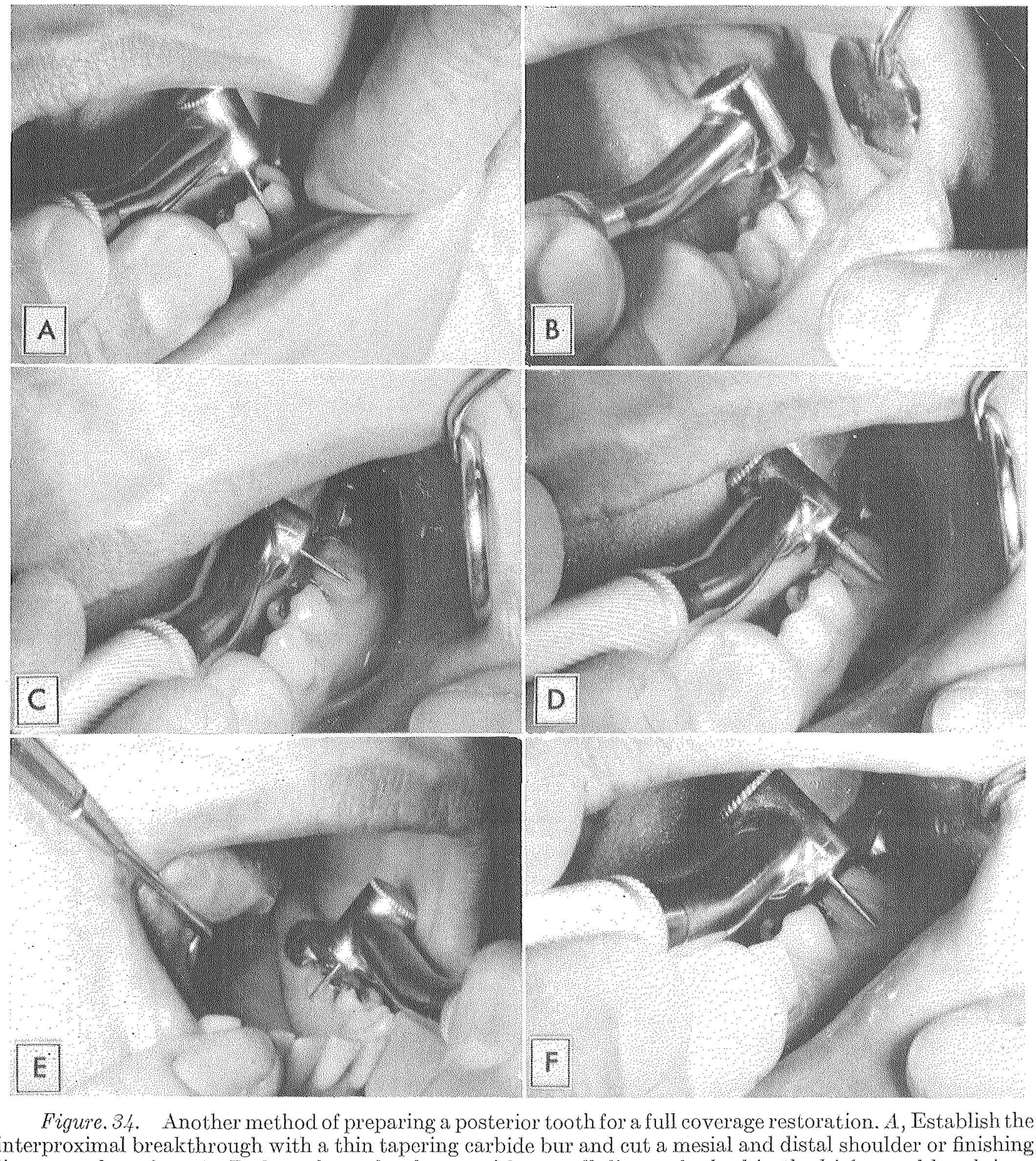


Figure. 34. Another method of preparing a posterior tooth for a full coverage restoration. *A*, Establish the interproximal breakthrough with a thin tapering carbide bur and cut a mesial and distal shoulder or finishing line on each surface. *B*, Reduce the occlusal area with a small diamond wheel in the high speed handpiece. *C, D, E, F*, The buccal and lingual areas may be reduced with a 558 crosscut fissure bur in the high-speed handpiece, followed with a tapering diamond cylinder stone, creating a shoulder or finishing line. Smooth the preparation with fine sandpaper disks.

crown with the acrylic resin facing (plastic veneer crown), the cast gold crown with the fused porcelain pin facing (porcelain veneer crown with iridioplatinum pins), and the porcelain fused directly to a high-melting-range cast gold crown. In the preparation of these restorations, an attempt should be made to create a shoulder all around. If this is impossible, then it is imperative that sufficient tooth structure be removed from the mesial and distal surfaces to accommodate loops in the veneer casting for retention of acrylic or iridioplatinum pins, for retention of porcelain, and to provide sufficient room to accommodate porcelain fused to gold—all to obtain esthetic crowns. The preparation for a cast gold crown is practically the same, with the exception that less tooth structure is reduced and a definite finishing line, not a shoulder, is recommended.

THE BISCUIT BAKE PORCELAIN JACKET CROWN

The biscuit bake porcelain jacket crown is the unglazed porcelain restoration with the platinum matrix still intact. It is advantageous to try the biscuit bake crown on the prepared tooth in order to test the occlusion, the contour, the contact areas, and the alignment. If the restorations require reshaping, mark the biscuit bake crowns with a pencil and then place them back on the dies. To obtain a good seat on the die, be sure that the platinum matrix is not curled within. Grind the pencil marks carefully with a Busch soft stone used only for porcelain. Reshaping of porcelain restorations in the biscuit bakes for occlusal rehabilitation is imperative, particularly in the final try-in session. Once the platinum matrix is stripped from the restoration and the glaze applied, it is not practical to add porcelain.

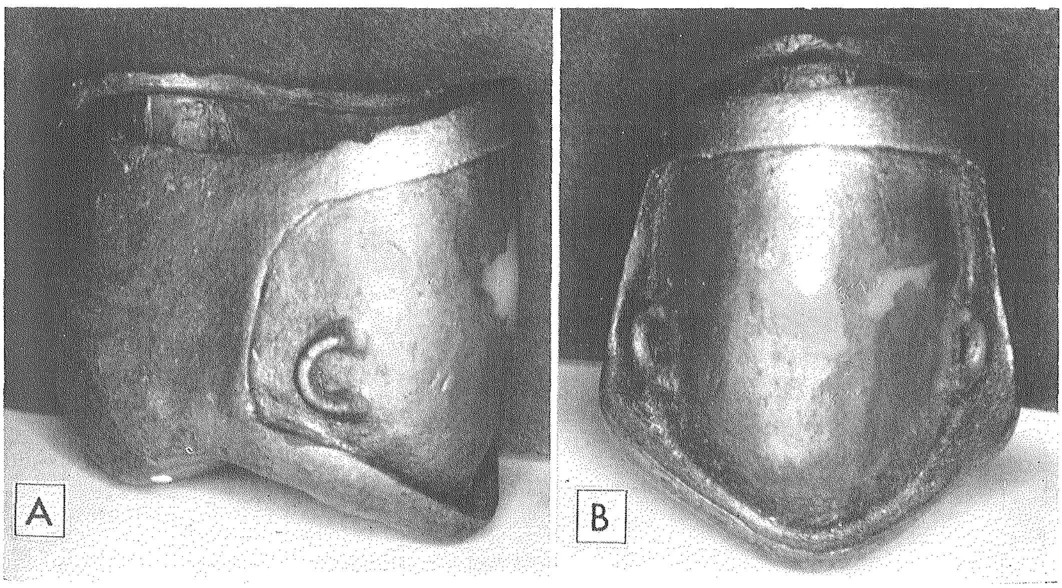


Figure 35. The removal of sufficient tooth structure interproximally enables the operator to place gold loops in these regions to retain the acrylic resin. *A*, The loops are placed as far toward the lingual as possible. *B*, This procedure makes it possible to have bulk of plastic on the buccal or labial surface where thickness of this material is conducive to good color.

THE GOLD CROWN WITH THE ACRYLIC RESIN FACE (PLASTIC VENEER)

The removal of sufficient tooth structure interproximally enables the operator to place gold loops in these regions (Fig. 35). These loops will help retain the acrylic resin and make it possible to have bulk of acrylic in an area where thickness of this material is conducive to good color. Wax and cast the veneer so that sufficient thickness of gold remains at the base of the boxing near the occlusal or incisal surface (Fig. 36). This extra thickness of gold permits the operator to reduce the occlusal or incisal surface during the try-in adjustment of the crown without eliminating the ledge of metal and thus destroying the base of the boxing. Sharp undercuts made in the casting by the use of an inverted cone bur aid in retention of the acrylic resin. Retention knobs, mesh creations, or perforations of the metal on the labial surfaces of the castings do not contribute to satisfactory color in the completed restorations. Lamstein and Blechman[4] conclude from their experiments that the use of cast gold acrylic resin veneer crowns with perforated gold windows is contraindicated. It is evident that crowns so constructed are subject to marked seepage.

The shoulder of the preparation for any veneer crown is finished with the chisel so that the gold will adapt itself closely to the gingivocavosurface margin (Fig. 38). Avoid overhanging collars; they contribute to gingival disturbance and subsequent

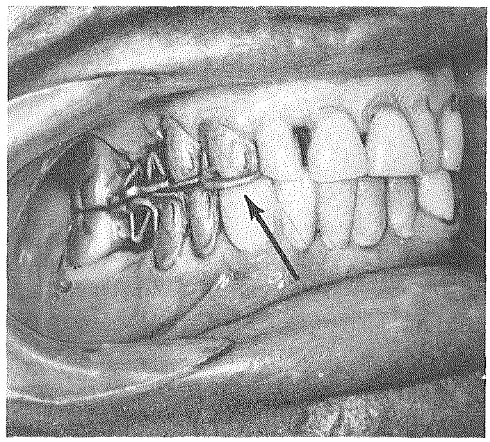


Figure 36. Wax and cast the veneer crown so that sufficient thickness of gold remains at the base of the boxing. This thickness of gold permits the operator to reduce the occlusal surface during the try-in adjustment of the crown without eliminating the ledge of metal to destroy the base of the boxing.

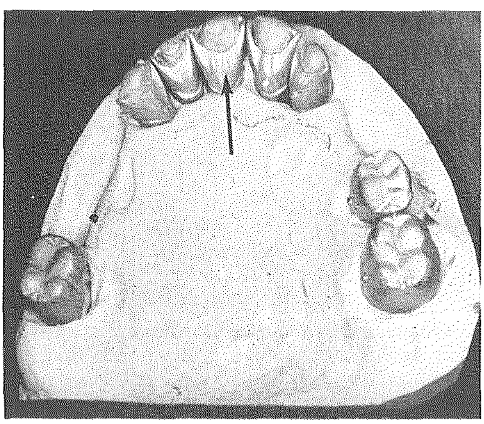


Figure 37. A special type of full coverage restoration. Acrylic resin can be cured to modified gold castings. The opposing teeth come in contact with the gold on the lingual surface. The acrylic resin occupies the labial and most of the incisal third of the lingual surfaces of the restoration. If the occlusion permits, this type of crown is indicated where esthetics are important.

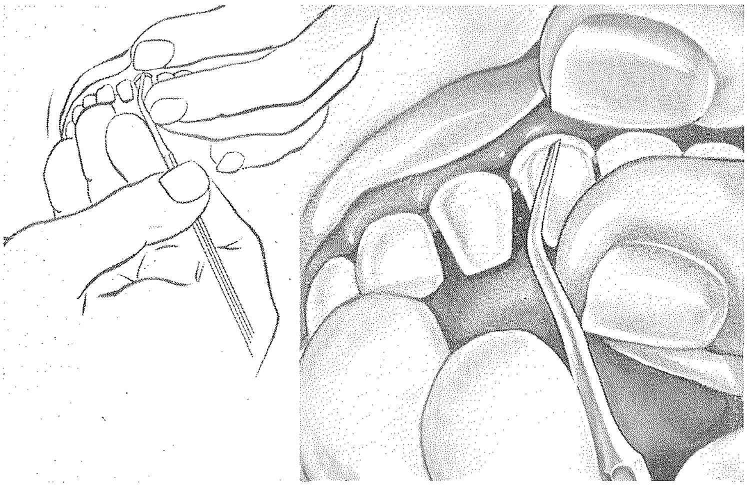


Figure 38. The shoulder of the preparation for the veneer crown is smoothed with Black's hoe No. 32 or 34. Finish the sharp border of the shoulder with the chisel so that the casting will adapt itself closely to the margin like a gold inlay.

bone loss. All castings should be tried in the mouth before the acrylic resin is cured. Test the crown for gingival impingement, correct occlusion and alignment, and make the necessary adjustments. It is imperative that the restoration possess a gold collar all around to seal in the acrylic, and the patient should be advised that the metal will be visible in many cases. Hiding the gold collars into deep gingival crevices is not considered a correct procedure because the tissue will not tolerate such metal, and will manifest such intolerance by becoming irritated and inflamed.

THE PORCELAIN VENEER CROWN

The porcelain of the veneer crown can be a fused facing with a bent iridioplatinum wire; a fused porcelain facing retained within a gold boxing by the burnished peripheral gold and cement; a prefabricated porcelain facing from a manufactured denture or bridge pontic which is ground, shaped, glazed, and stained; or porcelain fused to a high melting range alloy. The second and third types of veneer depend primarily upon cement for retention and are frequently dislodged. The iridioplatinum pin or wire and fused porcelain is the porcelain veneer of choice because of the added retention of the pins. Furthermore, an amalgam die of the pin holes and boxing in the gold can be fabricated (Fig. 39). Should it become necessary to fuse porcelain replacements when fracture occurs, duplicate facings can be constructed. The facing can be butted against the labial or buccal shoulder like a porcelain jacket crown, thus avoiding any gold collar. In most instances a gold collar is advantageous because it affords added retention. This type of restoration is not recommended in large bridge spans nor on an abutment tooth which is to receive internal attachments. The force of mastication tends to break the porcelain with the pins acting as wedges.

PREPARATION FOR THE PORCELAIN VENEER CROWN

The ideal preparation for any veneer crown is one with a shoulder labially or buccally and mesially and distally. The proximal shoulders terminate in a definite finishing line on the lingual surface. If shoulders cannot be prepared in these areas because of the anatomy, condition, or position of the tooth, then sufficient tooth structure must be removed to accommodate thickness of porcelain or acrylic. Less gold will be visible because of the "cut-back" of the gold in the mesial and distal areas.

CONSTRUCTION OF THE PORCELAIN PIN VENEER CROWN

The wax crown is carved just like a full crown, then a boxing is cut out on the buccal or labial surface with a sharp lance creating no undercuts. The boxing is cut far into the mesial and distal areas, leaving a small rim of wax around the cervical portion over the short bevel of the shoulder on the die. The incisal or occlusal third of the wax is then flared from the boxing to the edge. This is cut in such a manner as to permit the cast gold to protect the fused porcelain from the force of mastication, yet is sufficient so that no display of gold will be visible. A piece of graphite pencil lead, about 22 or 24 gauge, is selected, depending upon the size of the tooth to receive the veneer. Break a piece about ¼ inch in length and hold it in the flame with a pair of strong cotton pliers until it is red hot. One hot piece of graphite is inserted carefully into the mesial and one into the distal regions of the wax boxing. The two pieces are placed parallel, in an upward direction, from the incisal or occlusal third toward the cervical. These graphite pins must be parallel to the incisal or occlusal flare of the wax. Sprue the waxed veneer and graphite pins, invest, and cast.

Use a No. ½ round or 700 fissure bur in the straight handpiece to ream out the graphite. The operator should be extremely careful to guide the bur in the proper direction, removing the graphite but not the gold. The next step is taking the impression of the boxing of the gold from which an amalgam die is to be constructed. Imbed the lingual surface of the cast crown into a platform of wax. This wax is built flush with the cavosurface and outer margins of the gold. The top

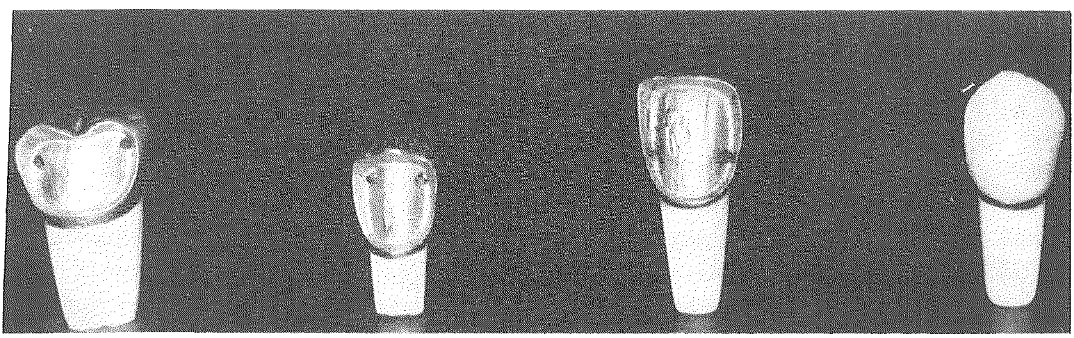


Figure 39. In the preparation for a porcelain veneer crown it is important to prepare a shoulder in the proximal regions of the tooth to accommodate the iridioplatinum pins.

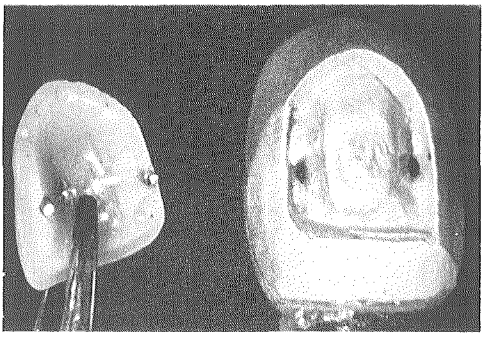


Figure 40. An amalgam die is packed as a permanent record upon which to bake a replacement, should the porcelain facing of the porcelain veneer crown fracture.

surface of the wax platform, extended about ⅛ inch from the gold crown, is straight and smooth. A piece of a straight dressmaker pin, cut to size, is slipped into each reamed hole in the casting and made secure with only a small amount of wax to prevent movement. Wrap a thin piece of baseplate wax around the platform. Make a creamy mix of hard stone and gently vibrate some of it into the boxed platform. Allow the stone to set and remove the rim of wax. This stone will be the impression of the gold boxing. Trim the stone so that it rests flush on the workbench. Trim the sides that hold the gold casting and avoid any undercuts in the stone from the periphery of the casting to the ⅛ inch width of the impression. Warm the imbedded casting gently over the flame and separate the casting and the pins from the stone impression. Replace the pins into the holes and paint them with a layer of nail polish to prevent amalgamation by the mercury when the stone impression is packed with amalgam. Box in the stone impression and pack silver amalgam for the die. Do not disturb the level amalgam extension from the boxing to the periphery of the die, thus avoiding undercuts. Pull out the metal pieces of dressmaker pins with a pair of pliers. The porcelain facing is constructed on this die, using 0.001 gauge platinum matrix and 22 or 24 gauge iridioplatinum wire in pins or in the form of a staple.

THE CAST GOLD CROWN

The cast gold crown is indicated on the posterior teeth where the visibility of the metal is not objectionable. All excessive contours and undercuts are removed with disks and stones. No shoulder is necessary in the preparation, but a definite finishing line is. The border of the preparation should extend slightly beneath the free margin of the gingival tissue. Sufficient tooth structure is removed from the buccal and lingual surfaces to be able to cast a crown with a narrower buccolingual width than the natural tooth. The crown can be waxed directly on the tooth in the mouth or indirectly on the die. In occlusal reconstruction procedures, it is sometimes beneficial to try in the waxed crowns on the teeth (Fig. 41). In order to handle such crowns without fear of breaking or spreading the wax, it is recommended that a burnished matrix be used. This procedure also facilitates an accurate casting because the investment material seems to adapt itself better to this thin matrix. The matrix becomes a part of the casting. The procedure is as follows: Hold the die with the

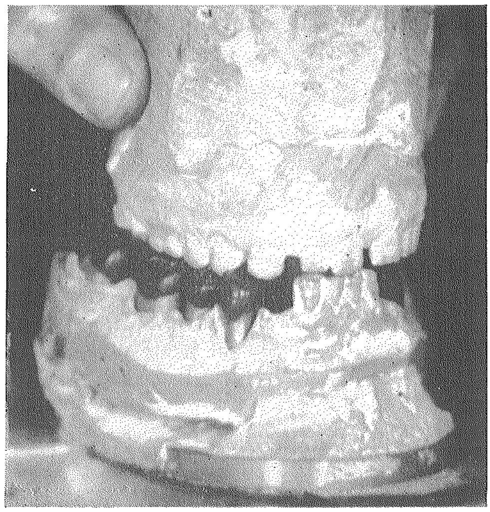


Figure 41. In occlusal reconstruction, it is sometimes beneficial to try in the waxed crowns on the teeth. In order to handle such crowns without fear of breaking or spreading the wax, it is recommended that a burnished gold or platinum matrix be used.

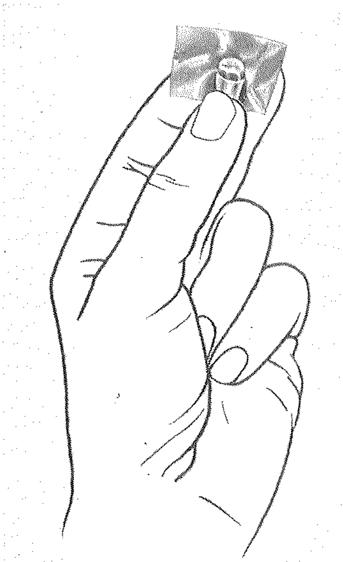


Figure 42. Constructing the gold matrix. Hold the die with the fingers in such a position that it is convenient to manipulate a piece of gold leaf.

fingers in such a position that it is convenient to manipulate a piece of gold leaf (Fig. 42). Cut and adapt 0.001 thickness of gold foil over the die. Fold it in a tinner's joint, the same way as for a platinum matrix used in the construction of a porcelain jacket crown. Burnish the matrix well over the die and wax up over this matrix (Fig. 43). This procedure can be followed in the construction of a plastic veneer and in porcelain fused to metal crowns. In the latter, however, a platinum matrix is necessary.

CARE OF THE PREPARED TOOTH

Despite all precaution, some pulps die after the preparation. Sometimes a tooth prepared for a crown may possess minute pulp exposures which are impossible to

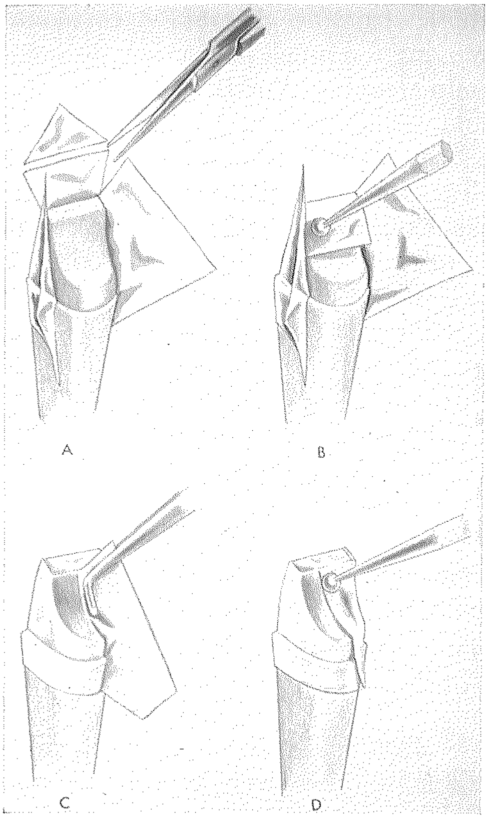


Figure 43. Adapting the matrix. *A*, Cut and adapt 0.001 thickness of gold foil over the die. *B*, Burnish the top piece of foil. *C*, Fold the extension pieces in a tinner's joint, the same way as for a platinum matrix used in the construction of a porcelain jacket crown. *D*, Burnish the matrix smooth and then swage it. Wax the crown over this matrix and then cast. (After Nickie Argentieri.)

detect. They are not painful and often do not bleed, but these minute openings, usually prevalent when the preparation is close to the pulp, are prone to receive harmful bacteria and to cause death of the pulp, sometimes a year later. Therefore, it is a good policy to protect the entire surface of the tooth denuded of its enamel, with coatings of either calcium hydroxide, copalite, or any other acceptable and recommended medium to protect the pulp. It is not necessary to bathe the preparation with phenol, alcohol, and the like. Such medicaments dehydrate the dentin and irritate the pulp by their caustic action. Wash the prepared tooth with warm water and dry with a pledget of cotton. Apply several coats of the protective medium. The convenient way of application is with a small sable or camel's hair brush.

FACTORS RESPONSIBLE FOR INJURY TO THE PULP

The preparation of a tooth for a full coverage restoration is usually accomplished under a local anesthetic. As a result, the warning of pain is not disclosed.

Hot impression compounds can increase the hyperemia of the pulp to such a degree as to influence and hasten its death. When heating impression compound for the band impression over the direct flame, it is advisable to temper it in the water bath of 130° to 140° F. prior to insertion over the tooth.

High speed in operative procedures is here to stay. There is a tendency for the specially designed instruments, revolving at an increased rate of speed and cutting tooth structure so rapidly, to remove too much tooth structure. Obviously, removing too much protective enamel and dentin will endanger the live tissue in the pulp chamber. Furthermore, it is an accepted fact that the use of diamond stones and carbide burs at increased speeds necessitates the continual use of water on the tooth. A spray of water is not always efficient. Heat is one of the causes for pulp degeneration, and the more tepid the water that is poured over the tooth, the less chance there is for damage to the live tissues.

The sooner the prepared tooth receives the permanent restoration the healthier it is for the pulp tissue. The operator should plan his case so that it does not stretch out for months and months before completion. Good temporary restorations, cemented with mediums that quiet the pulp by allaying the pain from thermal influences, are recommended. Instruct the patient to return to the office for immediate temporary replacement should the temporary crown be dislodged.

Another factor injurious to the pulp is the permanent cementing medium. The use of zinc phosphate cement as a base in deep cavities should be discontinued and replaced by a palliative type of base material such as a fast-setting zinc oxide and eugenol cement.[6]

TREATMENT OF THE PREPARED TOOTH PRIOR TO INSERTION OF THE TEMPORARY CROWN

Just before the temporary crown is to be inserted the application of Prednisolone (Mosteller) Desensitizing Solution is recommended. The solution is applied to all cut dentin of the prepared tooth, allowed to remain one minute, then dried thoroughly with compressed air. When dry, seat the temporary crown with a zinc oxide and eugenol paste. The prednisolone practically eliminates sensitivity while the eugenol in zinc oxide stimulates the growth of secondary dentin. Injudicious use of alcohol, phenol, silver nitrate, and the like are factors that may affect the vitality of the pulp. The dentinal tubules are wide open after radical reduction of tooth structure, and application of an irritating drug often does more harm than good. Silver nitrate is dangerous to use. Englander, James, and Massler subjected 26 carious human teeth to a standard series of applications with silver nitrate, ammoniacal and plain.[3] Histologic examination revealed the following: Silver nitrate frequently damaged the pulp. The odontoblasts were disrupted with increasing degrees of inflammation and edema of the pulp, as the silver nitrate (not a self-limiting drug) came closer to the pulp. In view of the limited sterilizing action of silver nitrate and its potentially injurious action to the vital dentinal tubules and the odontoblasts as well as to the pulp itself, the value of its continued use is questioned on an empirical basis. Bathing the prepared tooth with warm water, then drying with cotton pellets prior to the application of Prednisolone receives preference over any one of the irritating drugs.

TEMPORARY REPLACEMENTS

All prepared teeth should receive temporary replacements to protect the cut surfaces and to relieve pain. The requirements of a satisfactory temporary replacement are:

1. It must be esthetically presentable.
2. It must be retainable yet readily removable by the dentist.
3. It must be comfortable to the patient.
4. It must allay thermal shock.
5. It must not be injurious to the prepared teeth or surrounding tissues.
6. It must be economical.

Sometimes the temporary crown or bridge satisfies the esthetic demands of the patient to such a degree that the permanent restoration may not be acceptable. Gold cusps on the fixed restoration often meet with objection after the patient has had temporary acrylic resin crowns. The operator should explain these conditions before dental treatment is begun.

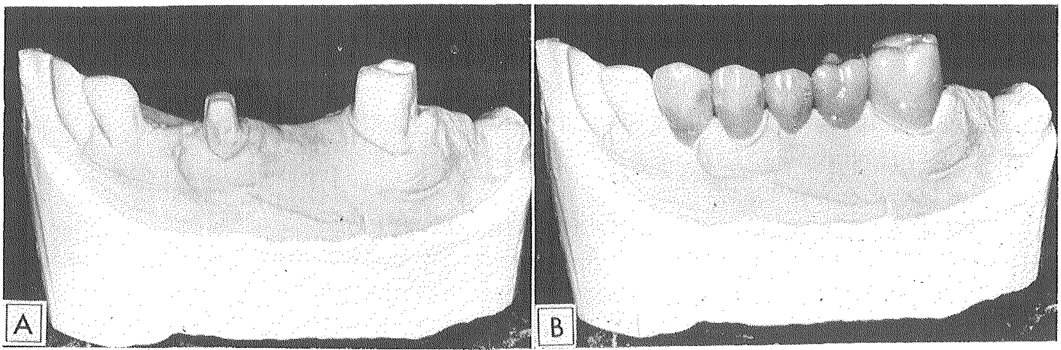
Prepared Posterior Teeth. The aluminum crown is frequently used as a temporary restoration for molars and premolars. The precarved crowns are made of soft polished aluminum, the same gauge as an average cast gold crown. This type of temporary restoration adapts quickly to tooth contours and to the occlusion. The aluminum band is trimmed and festooned accurately, so that the cervical margins do not impinge upon the soft tissues. The edges are smoothed with fine disks and then filled with an anodyne temporary cement and carefully seated over the prepared tooth. Be sure to remove all of the excess temporary cement exuded from the crown into the gingival crevice; hardened zinc oxide and eugenol cement can act as an irritant to the soft tissues and set up an inflammatory condition.

Posterior acetate crown forms for molars and bicuspids can also be used. The operator can fill this tooth form with self-curing acrylic resin and insert it over the lubricated prepared tooth. When it is cured it is trimmed and smoothed, then cemented with the temporary medium.

LEFF TECHNIQUE FOR TEMPORARY ACRYLIC CROWNS AND BRIDGES

Alexander Leff[5] recommends an alginate impression (full arch) of the jaw, and his procedure is as follows: "In that section of the impression containing the teeth to be prepared and/or replaced, the interproximal septal areas of alginate are cut away with a small rounded scraper or other suitable instrument. Where there are missing teeth, the pontic areas are also carved out in the alginate impression (or a wax pontic may be added to the study cast and an alginate impression made of the study cast). Rapid curing acrylic powder and liquid are placed in separate dappen dishes and a camel's hair brush is used to paint the acrylic into the alginate impression. The tip of the brush is moistened in the acrylic liquid, and a small ball of powder is picked up by the moistened brush and carefully painted into the impression which has been dried with air. The acrylic is applied to the gingival areas, and gravity will cause the material to flow occlusally. The occlusal surfaces of the posterior teeth can then be painted in. The incisal areas should not be painted in, as sufficient acrylic will flow down the labial and lingual surfaces of the anterior teeth to cover the incisal edges.

"The build up of thick areas of acrylic should be avoided by limiting the amount of acrylic liquid on the brush in order to help control the flow of acrylic.



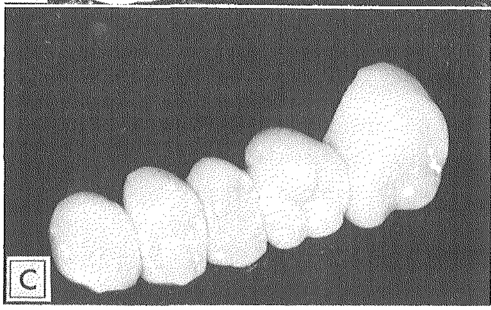


Figure 44. The acrylic provisional splint. *A*, The abutment plaster teeth are prepared on the study cast. *B*, *C*, A fixed partial denture is fabricated of acrylic resin, with acceptable carvings, shade, and occlusal relationship.

The acrylic shell should be of uniform eggshell thickness. Thick areas of acrylic in the shell cause excessive shrinkage and also prevent proper seating over prepared teeth. . . . When the teeth have been prepared and the copper band impressions are completed, a thin mix of acrylic powder and liquid is made. This mix is permitted to stand several minutes until the 'hairy' stage is reached. By permitting a thin mix of acrylic powder and liquid to stand for several minutes, a proper consistency of the acrylic will result which will produce less porosity and shrinkage in the temporary acrylic bridge (crown). The impression is seated in the mouth and held with moderate finger pressure for several minutes. Where gagging is a problem, a lower tray can be used in the upper arch. A reference or guide line can be drawn with a pencil on the outside surface of the alginate impression in order to facilitate seating the impression back in the mouth. Extensions of the alginate onto the soft palate or below the mylohyoid ridge should be trimmed away.

"When the acrylic splint has attained a rubbery consistency, but has not as yet reached its final set, it should be gently pried out of the alginate impression by undermining it with a small instrument. The excess flash should be trimmed with scissors and the still unset splint quickly placed over the prepared teeth and the patient instructed to close fully. The acrylic splint should be lifted on and off repeatedly during setting to avoid binding when fully set. The splint may be rinsed with cool tap water several times during this period, in order to minimize the effect of the heat produced during the setting of the acrylic. Pontic areas can be adjusted by adding an additional mix of acrylic, and occlusal adjustments made by grinding. . . ."*

* Leff, A.: An improved temporary acrylic fixed bridge. J. Pros. Dent., *3*:245, 1953. Reprinted courtesy of the author and The C. V. Mosby Company.

PROVISIONAL SPLINTS

Provisional splints are temporary splinted restorations made out of plastic or metal, to protect the prepared teeth and to maintain an occlusion for function while the permanent work is being constructed. The acrylic splint can be fabricated from the study casts after the plaster teeth have been prepared for full coverage restorations (Fig. 44).

PREPARED ANTERIOR TEETH

For individual anterior preparations, the tooth form filled with self-curing acrylic resin or silicate cement is the replacement frequently used. Plastic temporary crowns are cemented with a zinc oxide and eugenol paste to allay pain and stimulate the growth of secondary dentin.

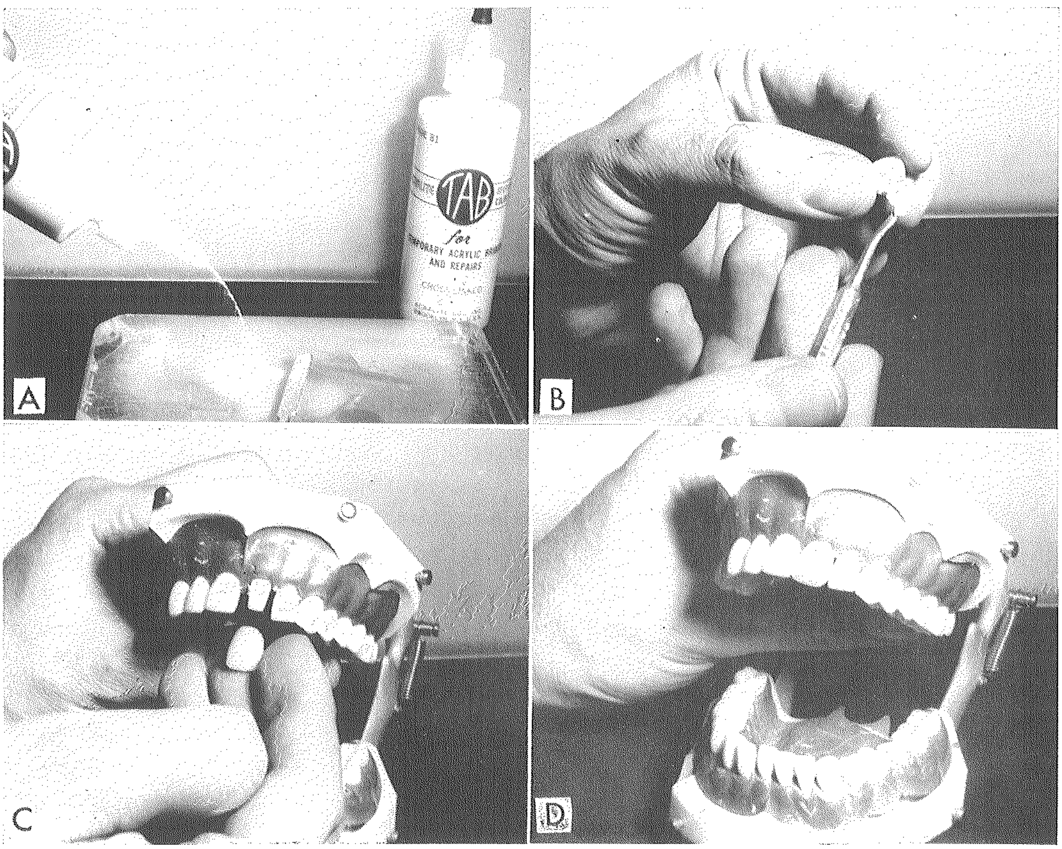


Figure 45. Another method of temporary protective crown construction. *A*, Use a rapid setting acrylic resin for a festooned temporary tooth form. *B*, Fill the tooth form with the doughy mix. *C*, Seat the filled tooth form over a moistened preparation. *D*, Trim the excess as soon as possible. Remove and reseat several times, cutting away and trimming the overflow. Use a zinc oxide and eugenol temporary cement for insertion and pulp protection.

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3

THE THREE-QUARTER CROWN

by MAURICE J. SAKLAD, D.D.S., F.A.C.D., F.I.C.D.

Today, because of the high mortality of the pulps of teeth prepared for full coverage restorations, the profession is considering the three-quarter crown whenever possible. It has been stated that a full crown of any type and of any material be limited to cases of absolute necessity. The three-quarter or partial veneer crown requires consideration in any discussion relating to occlusal rehabilitation. It is a cast restoration that actually covers more than three-fourths of the clinical crown of a tooth. It involves the mesial, distal, lingual, and occlusal surfaces of a posterior tooth. The same areas are involved in an anterior tooth except that the incisal surface replaces the occlusal surface. The buccal and labial surfaces are omitted. The preservation of the buccal and labial surfaces of the natural teeth contributes to a healthy periodontium because of their contours. On rare occasions, this crown may be reversed so as to omit only the lingual surface.

BASIC REQUIREMENTS FOR A SATISFACTORY THREE-QUARTER CROWN

All restorations are influenced by the anatomy, condition, and position of the tooth or teeth. The tooth should be in relatively normal position. This means that it should have a clinical crown situated in acceptable alignment, supported by solid and sufficient alveolar bone. This will permit proper surface reduction. It will enable

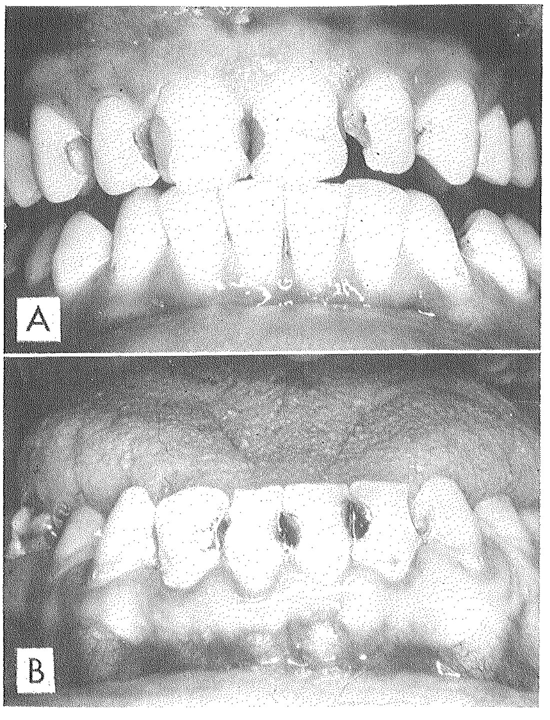


Figure 46. Porcelain or acrylic resin jacket crowns are indicated on maxillary and mandibular anterior teeth for esthetics. Such teeth are contraindicated for three-quarter crowns.

the operator to construct a three-quarter crown of maximum tenso-frictional retention through the making of proper surface reduction, grooves, and accessory anchorage pits. The degree of tenso-frictional grip is related to the parallelism and length of the opposing reduced proximal walls and the length and depth of the accessory anchorage pit. Longer slices have more retention than shorter ones, and the same applies to the grooves and pits. All grooves should be placed in dentin, never in cement or old restorations, and they should not undermine the enamel rods.

CONTRAINDICATIONS

A tooth with a short clinical crown provides inadequate surfaces for groove retention. A bell-shaped tooth requires removal of too much proximal tooth structure to receive a partial veneer restoration. Peg-shaped lateral incisors and spear-pointed canines are contraindicated for three-quarter crowns because of the inability to obtain sufficient tenso-frictional grip and because too much gold will be visible. The thin translucent anterior tooth will not receive a satisfactory three-quarter crown because it is too narrow from its buccal lingual aspect to offer adequate areas for retention. In addition, there is objection from an esthetic point of view. The gold background of the restored surfaces will not reflect light rays and therefore will cause the tooth to appear darkened as compared to the adjacent tooth. The three-quarter crown is not recommended as an abutment retainer in large span fixed partial dentures nor as an abutment retainer receiving an internal attachment in a removable partial denture.

The condition of the tooth is an equally important consideration. Retention of this form of restoration must be within solid tooth structure to enhance its position of support. This should be in dentin. Any deformity to caries involvement as well as large old silicate or acrylic resin restorations leads to a weakened support of the final restoration. It is not advisable to replace large silicate or acrylic fillings with cement and depend solely upon the use of a lingual cingulum post or pit for retention of the three-quarter crown. Replacing the cement with new silicate after such a crown is permanently cemented weakens the retention further. Inasmuch as silicate cement or acrylic resin has to be repeatedly inserted for esthetic reasons, the retention of the three-quarter crown is practically nil. A porcelain jacket or veneer crown is the restoration of choice (Fig. 46). Seldom does a three-quarter crown, patched with any esthetic material, offer desirable esthetics. The severely abraded, the mobile, and the pulpless tooth are contraindicated for the partial veneer crown. To these may be added teeth with enlarged pulps as found in children and young adults.

The position of the tooth frequently contraindicates this type of restoration. An abnormally aligned tooth, such as the lingually locked, the labially protruding, or the overlapped tooth, should receive full coverage restorations when required (Fig. 47). The poor alignment leads to obstacles that tend to complicate the work as well as to lessen the quality of the restoration. To a degree, this applies to the tilted and the extruded tooth.

ADVANTAGES OF THE THREE-QUARTER CROWN

The most important feature of this type of restoration is the fact that the preparation of the tooth conserves tooth structure. Less dentin is exposed, hence there is less damage to the pulpal tissue. This restoration is indicated for an abutment retainer supporting a three unit fixed partial denture. When weakened teeth are properly aligned it may be possible to form a splint out of soldered multiple three-quarter crowns (Fig. 48).

FACTORS CONSIDERED IN THE PREPARATION

The occlusion is an important factor to consider. The lingual surface of an anterior tooth must be adequately reduced to accommodate gold that will not interfere with the individual's contacting occlusal movements. The occlusion will

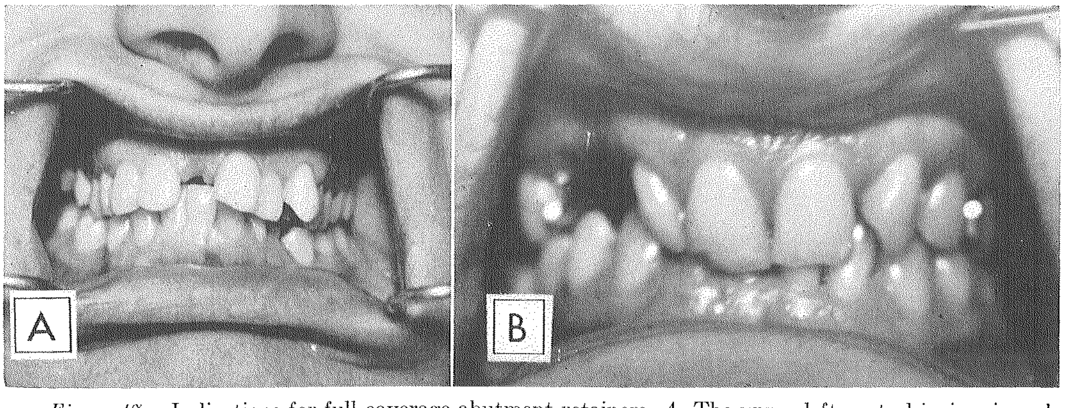


Figure 47. Indications for full coverage abutment retainers. *A*, The upper left central incisor is malturned and slightly protrusive. *B*, The upper right lateral incisor is peg-shaped.

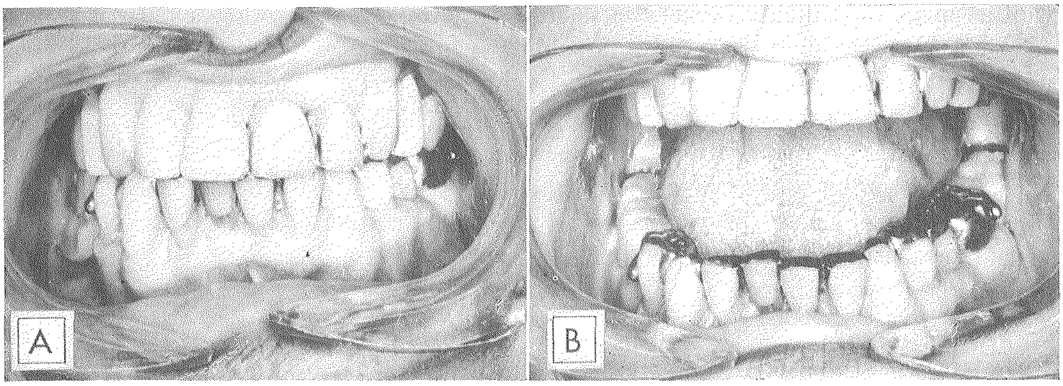


Figure. 48. *A*, *B*, Splinting with three quarter crowns. The alignment of the mandibular right central incisor was not disturbed. Conservative restorations of three quarter crowns and inlays in the rehabilitation procedures make for practical rehabilitation. (Courtesy Dr. W. Diamond, New York.)

determine where the accessory anchorage pits are to be placed. An incisal off-set groove on the lingual, extending between the proximal grooves, is another form of retention depending upon the width of the tooth and its occlusal relationship.

In restoring a tooth, the operator must abide by the usual principles essential to good operative technique. The rule of extension for prevention must be followed and the restoration should terminate in self-cleansing areas. Only the necessary amount of tooth structure should be reduced. The completed three-quarter crown in turn should equal the amount of tooth structure removed. The tooth must be restored to its original size, shape, and function. The completed crown should reveal only an amount of gold consistent with good retention, proper maintenance, and esthetics.

It is worth recalling that the tooth is made up of enamel rods which radiate outward from the dentoenamel junction. When undermined, they have a tendency to fracture. When supported, however, they are able to withstand the usual forces transmitted by this restoration. The outward flare of the enamel rods makes it possible to terminate the restoration so as to mask the peripheral edges of the restoration and achieve complete enamel and dentin support. The gingival termination of the proximal and lingual peripheral edge must terminate just at the free margin of the gingiva. Overextension into the gingival crevice will not be tolerated by the tissue and inflammation will result. The incisal edge of an anterior tooth should not be reduced so as to display gold. It should be reduced, starting at a point lingual to the labiolingual line angle, then proceeding lingually, sufficiently so as to permit a minimum thickness of 0.5 mm. cast gold. The same applies to the occlusal areas of a posterior tooth which is also subjected to many forces. A general principle to be observed is that the incisal and occlusal tooth reduction should be executed so as to absorb forces in direction parallel to the long axis of the tooth.

For an anterior tooth, it is suggested that the operator score with a sharp-pointed pencil, the complete labial interproximal contacting area (Fig. 49). The scored pencil line on the tooth to be prepared acts as a guide in establishing the labial termination of the final restoration. In other words, medially to this line, the gold will be visible, laterally it will not be noticeable. Occasionally, the operator may be confronted by a tooth which appears rotated. Regardless of the position or shape, the same procedure should be followed. Similar markings should be scored, which will in turn act as reference planes for the proximal tooth reduction. Where contacting teeth are present, a slight separation should be obtained with the insertion of a tapered wedge. This will permit the application of a Mizzy safe-sided band separator. This is held manually between the thumb and index finger. The abrasive side is applied to the proximal surface that is to be reduced until sufficient access is obtained that will allow the application of a safe-sided diamond disk in the straight handpiece. Some operators prefer to use a disk guard (Fig. 50), to protect the tongue and other soft tissues.

STEPS IN THE PREPARATION OF AN ANTERIOR TOOTH FOR THE THREE-QUARTER CROWN

It is worthwhile to add that for those who wish an additional trussing beam across the linguoincisal portion of the casting, an incisal off-set is recommended.

Figure 49. For an anterior tooth, it is suggested that the operator score with a sharp pointed pencil, the complete labial interproximal contacting area, to act as a guide in establishing the labial termination of the final restoration.

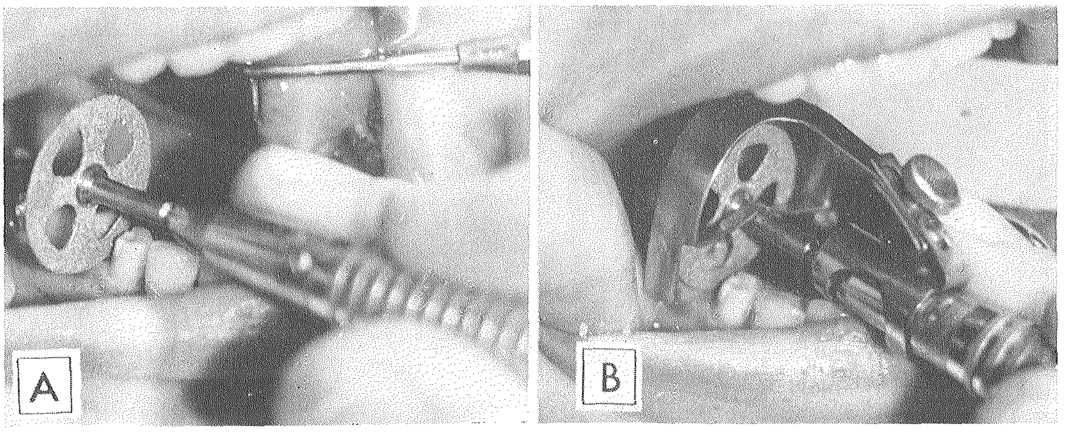


Figure 50. *A*, A rapidly revolving disk may slip or zoom out of control to damage the lip or tongue. *B*, The use of a disk guard is helpful and assures the operator of some degree of safety.

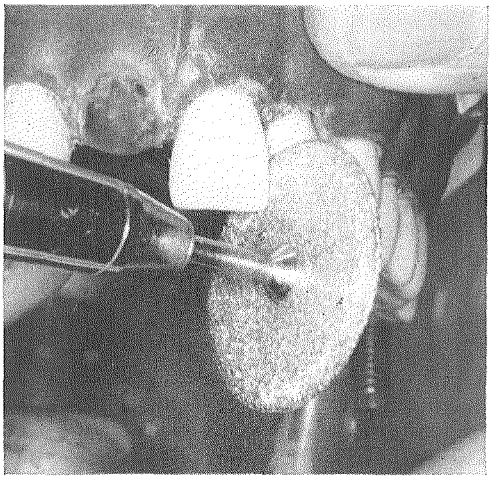
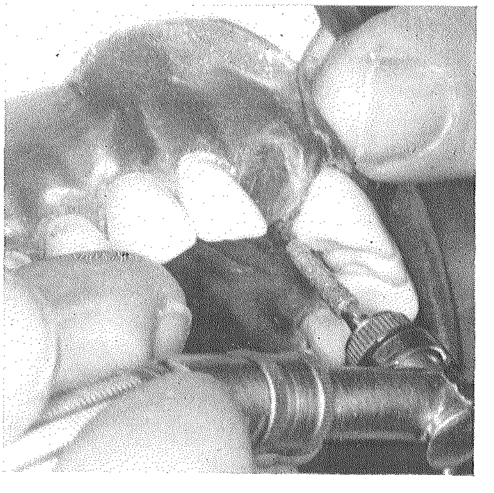


Figure 51. Hold the handpiece parallel to the incisal edges of the adjacent teeth and apply the diamond disk to the previously treated surface until a slice is accomplished that will extend from the incisal edge to the gingiva. The disk should slice the proximal surface to the pencil line. Turn the disk in to the lingual at an angle of about 30 degrees toward the lingual midline. The gingival finishing line should terminate at the interproximal gingival crest without lacerating the tissue. The labial termination of the slice should appear in a vertical line so as to be least obvious to the eye. Prepare the other proximal surface in the same manner.

Figure 52. The two proximal reductions should be connected on the lingual by a surface reduction of the cingulum gingival wall. The gingival finishing line should terminate at the gingiva or very slightly below the tissue. Use a tapered cylinder diamond stone in the contra-angle handpiece to reduce this area and to provide the greatest axial length to this portion of the restoration. Run this stone carefully from mesial to distal on the lingual surface, maintaining the cingulum area. Be sure not to engage the palatal tissue with the stone.



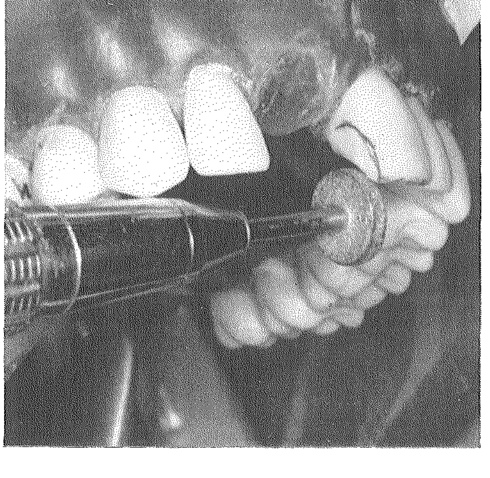


Figure 53. The next step is the reduction of the lingual surface with a diamond wheel stone in the straight handpiece at conventional speed. Run this stone from mesial to distal, reducing tooth structure from the crest of the cingulum to about 2 mm. short of the incisal edge. Sufficient tooth structure must be removed to accommodate a thickness of gold of about ½ to 1 mm. It is advisable that the surface be reduced short of the incisal lingual area because of the danger of removing too much tooth structure and thereby destroying the natural translucent edge of the tooth.

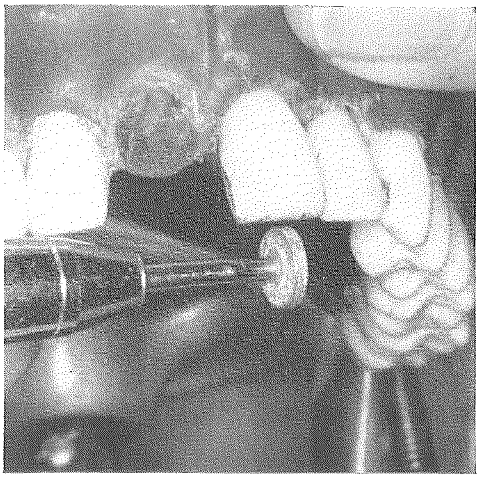


Figure 54. The linguoincisal surface must be carefully executed and the incisal edge must not be disturbed for esthetic reasons. Use the same diamond stone to complete the remaining 2 mm. lingual reduction, in the form of a flare or a bevel. This reduction connects both proximal surfaces at an angle of about 45 degrees toward the lingual. This permits the restoration to have sufficient gold at the incisal so as to withstand the opposing incisal forces.

Figure 55. Attention is now turned to completion of the retention form. This is accomplished by means of grooves and an accessory anchorage pit or pin. The grooves are placed on the proximal sliced surfaces in a position parallel to the incisal two-thirds of the labial surface. Usually they are placed at about the junction of the incisal bevel and lingual reduction or at a point that permits creation of the longest possible grooves. These grooves should extend just short of the gingival termination of the sliced areas without undermining the labial enamel rods. Use a 701 tapered fissure bur in the contra-angle handpiece.

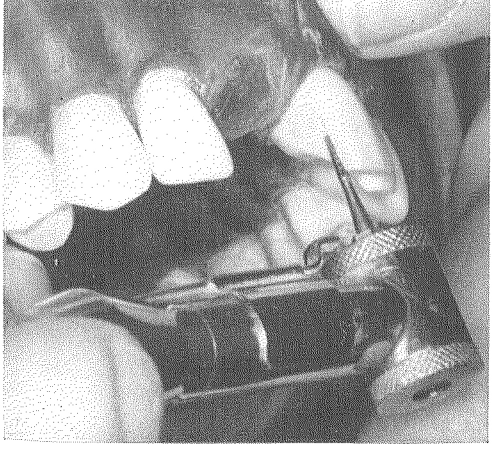


Figure. 56. These grooves should be imbedded in dentin with an ovoid shape or lock. This lock is created with a number 700 tapered fissure bur in the contra-angle handpiece. Move this bur within the original groove created in the previous step in a labiolingual direction so as to make the groove ovoid. This lock-in affords maximum retention for the restoration

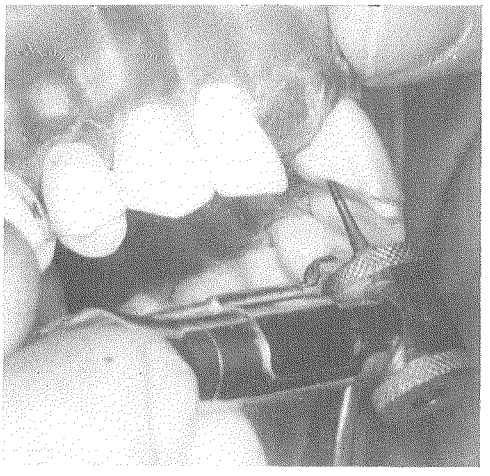


Figure 57. Further retention is secured by creating an accessory anchorage pit or pin. This is placed at the height of contour or adjacent to the crest of the cingulum area of the tooth because the enamel is thick in this region. The pit is made parallel or keyed to the proximal grooves. A ½ round bur mounted in the contra-angle handpiece is recommended to break the surface. This is followed by a 556 or 557 fissure bur. The pit is completed to a depth of about 1½ mm. parallel to the ovoid proximal grooves.

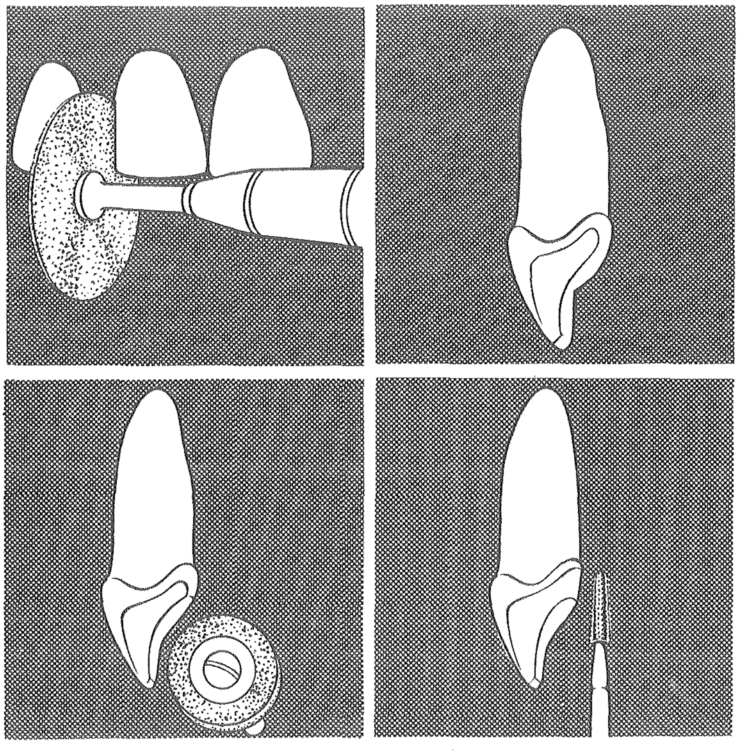


Figure 58. K. W. Knapp method of preparing an anterior tooth for a three-quarter crown. (Courtesy Star Dental Manufacturing Co., Philadelphia.)

The Densco No. 5 J T or the Star diamond stone in the angle handpiece is recommended. A step of about 1 mm. thickness is cut into the enamel of the linguoincisal surface connecting the proximal grooves. This procedure adds strength and helps the restoration resist distortion when placed under stress.

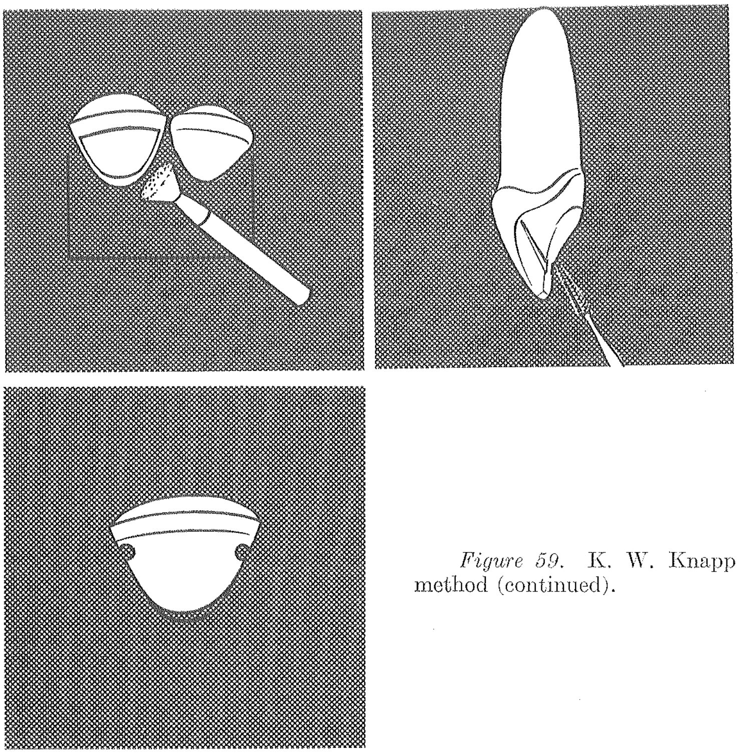


Figure 59. K. W. Knapp method (continued).

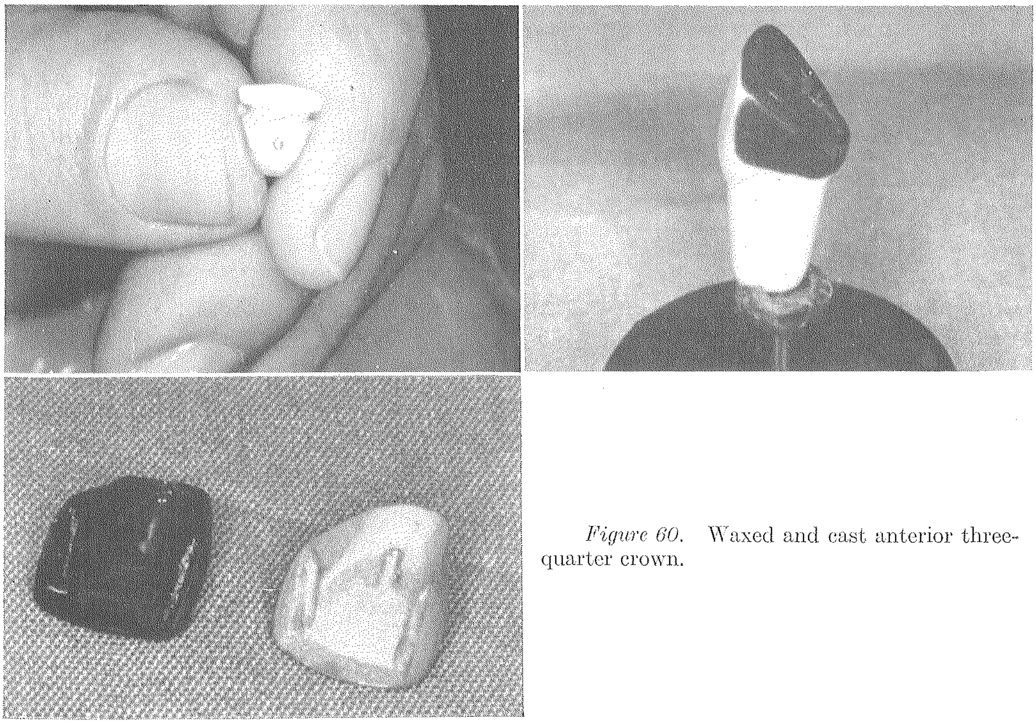


Figure 60. Waxed and cast anterior three-quarter crown.

THE MODIFIED THREE-QUARTER CROWN

The modified three-quarter crown varies from the usual restoration in that one proximal slice and locked groove are omitted from the proximal surface. The preparation is finished on the lingual surface just medial to the marginal ridge on the untouched side. It is used only on teeth that have ideal anatomical form and are in good condition and correct position. The tooth should be free of caries and have ideal periodontal support, usually from the canine and sometimes the central incisor. It is frequently utilized as an abutment for a simple fixed partial prosthesis supplying one pontic. The procedure is the same as that for a typical three-quarter crown except for the single proximal surface which is left intact. The finishing line on the lingual surface is created with a small wheel stone and extends from the incisal labial margin along the medial surface of the marginal ridge to the outside of the cingulum, terminating at the linguogingival margin of the reduced cingulum. For added retention, it is recommended that the operator place two accessory anchorage pits parallel to the cingulum pit and the proximal locked groove. These additional pits are placed about 1 mm. beyond the incisal bend on the lingual surface, forming a triangle with the cingulum pit. They are made with a ½ round bur followed by a 556 fissure bur and parallel or keyed to the cingulum pit and the single proximal locked groove. Frequently, an anterior tooth may present proximal caries. In such instances, a box is created in the area of the excavated decay which is similarly locked in buccal or lingual dentin.

THREE-QUARTER CROWN FOR THE POSTERIOR TOOTH

In preparing a posterior tooth, essentially the same procedures for slicing the proximal surfaces are followed. The lingual wall between the slices is reduced by means of the tapered cylinder diamond stone in the angle handpiece. The occlusal area is reduced about 1 or 2 mm. with the large diamond wheel stone. For an upper posterior, the reduction should extend from the buccal occlusal line angle. For a lower posterior tooth the occlusal reduction should extend to include the bucco-occlusal line angle which extends between the proximal slices.

The grooves are fashioned with the same burs following identical technique except that they are placed on the proximal surfaces at the junction of the buccal and middle thirds. They are keyed in a direction parallel to the long axis of the tooth. The accessory anchorage pit is placed on the occlusal surface at the center of the lingual cusp. The occlusal lingual line angle is rolled in with a hollow-ground wheel stone.

Posterior teeth frequently appear tipped, rotated, or extruded. These teeth should be treated as though they were true-standing or they should be ground into the desired occlusal plane and then treated. Any inclination or rotation should be disregarded. The locked retention grooves should be placed at right angles to the mean occlusal plane in line with all slices as well as the lingual reduction.

4

FIXED PARTIAL DENTURES

The fixed partial denture plays an important role in occlusal rehabilitation and should receive preference over the removable restoration whenever and wherever possible.

The operator is advised to examine the mucosa of the edentulous area thoroughly. Observe whether the ridge is spiny, broad, or so-called normal. Note whether any tissue attachments or frena stretch from the gingiva to the crest of the ridge area (Fig. 61). A pontic of a fixed or removable partial denture abutting upon such an attachment of tissue contributes to a painful, irritating inflammation a short time after the insertion of the partial denture.

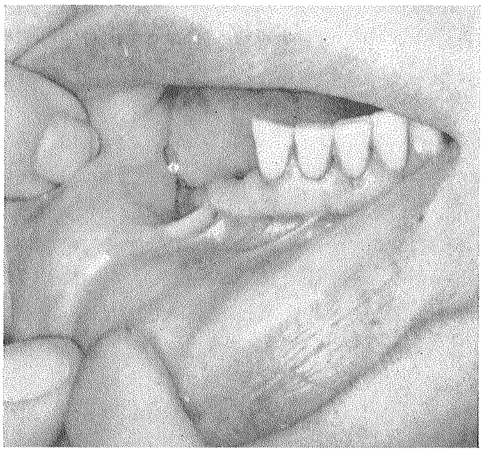


Figure 61. A tissue attachment or frenum is apt to interfere with a fixed or removable partial denture and become painfully inflamed. Recognition of such an attachment will influence the design of the restoration.

Examine the interocclusal clearance and the anatomical shape, condition, and position of the abutment teeth as well as the ridge area and determine the type of abutment retainer and type of pontic indicated. Observe the chewing habits of the

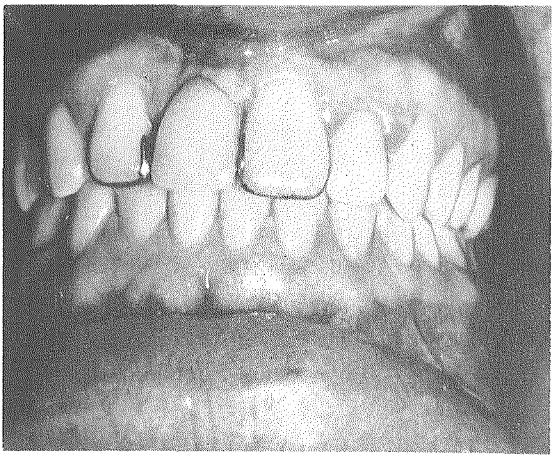


Figure 62. The three-quarter crown is not recommended on thin delicate anterior teeth, for it is usually esthetically unacceptable.

patient. These preliminary considerations will decide the material to be used in the bridge construction. The three materials used in fixed partial dentures are porcelain, plastic (acrylic resin), and metal. Porcelain may be used for the occluding and incisal surfaces, depending upon the patient's occlusion and habits. Acrylic resin is usually protected by gold because of its inability to withstand contact. There are occasions, however, when acrylic resin may be used on the occlusal and incisal surfaces, particularly in occlusions that participate in abnormal attrition.

RETAINERS FOR FIXED PARTIAL DENTURES

The restoration to replace missing teeth should meet the basic requirements of function, physiology, and esthetics. The abutment retainer contributes an important part in the satisfaction of these three requirements. Conservation of the health and vitality of the teeth that support the bridge is imperative.

THREE-QUARTER CROWNS FOR ABUTMENT TEETH

It is not always necessary to resort to the full coverage restoration as the abutment retainer. For many abutment teeth, the three-quarter crown can serve as a practical restoration. This type of crown, however, is not recommended on thin, delicate anterior teeth, on badly decayed and broken down teeth, or on malposed or malaligned teeth (Fig. 62). Nor is the three-quarter crown recommended in long-span bridges or on teeth with a high susceptibility to caries.

FULL COVERAGE ABUTMENT RETAINERS

There are many types of full coverage restorations used as abutment retainers in fixed and removable partial dentures. In most instances, the full jacket crowns afford greater retention and esthetic and functional improvement, and more often conservation of the abutment tooth. Primarily the retainer that covers the entire abutment tooth is indicated as follows:

1. When the abutment tooth is to support more than one pontic.
2. When the tooth is in such a condition that only a complete covering can render it serviceable to the bridge.
3. When the tooth is malposed or malaligned.
4. When the abutment tooth does not possess satisfactory anatomic form.
5. When the abutment tooth is to be splinted to an adjacent tooth for additional support.
6. When the tooth is to receive a retainer with an internal attachment, precision rest, or lock-in device for the fixed partial denture.
7. When the abutment tooth is to be brought into occlusion.
8. When the tooth is an important factor in creating or maintaining esthetics.
9. When the tooth exists in a mouth that is susceptible to caries.

On anterior teeth to be used as abutments, sufficient tooth structure must be removed in the preparations to accommodate thickness of metal as well as thickness of esthetic material. The occlusal surfaces of posterior abutment teeth should be reduced sufficiently to accommodate thickness of gold in all excursions of the mandible.

When molar teeth are to be replaced it is often indicated to replace such wide teeth with narrow buccolingual widths. These pontics look like bicuspids, but the reduction in impact areas is advantageous in a mouth that is susceptible to periodontal disturbances (Fig. 65).

MULTIPLE ABUTMENT RETAINERS

The splinting of approximating abutment retainers for additional support of a fixed or removable partial denture is frequently recommended in occlusal rehabilitation. *Its recommendation is not predicated upon the fact that the abutment tooth or teeth are mobile.* All abutment teeth must be healthy and strong and surrounded by sufficient bone and tissue. One weak link in the completed restoration can be responsible for the failure of the partial denture. The bridge is as strong and as serviceable as the abutment teeth. The underlying bone and tissues are of prime importance in the treatment plan and bridge design.

Multiple retainers must have the soldering connections close to the occlusal or incisal surfaces. The interproximal spaces are not closed up and the interdental papillae are not irritated. The gingival tissue between each tooth can be properly stimulated by the toothbrush or other mediums. Multiple abutment retainers of porcelain jacket crowns are not practical in mouths that are susceptible to periodontal disturbances. Such crowns are supported by gold copings soldered together. These soldered joints exist close to the gingival sulci and remain as a source of gingival irritation. Multiple abutment retainers may be joined by solder (fixed) or by rests or lock-in devices (movable).

Vertical stresses on malturned or tilted abutment teeth will not be received in the direction of the long axis of each tooth. When such a malposed tooth is solid and healthy and considered to be an important cog in the design of the fixed bridge, splinting it to an adjacent tooth will prolong its usefulness. The stresses on the bridge are absorbed and tolerated better when more than one retainer is used. A short root of an abutment tooth offers problematic retention of the fixed prosthesis, particularly if the clinical crown is long. Multirooted teeth support a fixed partial denture with greater assurance of longevity and function. Joining an abutment tooth possessing a single root to an approximating tooth gives an additional root or roots for support.

Indications for Multiple Retainers

Many factors determine the use of joined abutment teeth. These are:

1. Relation of the clinical crown to the clinical root.
2. Length of the span.
3. Occlusion.
4. Number of remaining teeth.
5. Location of the primary abutment teeth.
6. Anatomy, condition, and position of the abutment teeth.
7. Whether the abutment tooth possesses one, two, or three roots.
8. Esthetics.
9. Amount and condition of bone support.
10. Oral hygiene habits of the patient.
11. Abnormal habits such as bruxism, clenching, etc.
12. Slight mobility of the abutment tooth.

REQUIREMENTS AND TYPES OF FIXED PARTIAL DENTURES

ANTERIOR FIXED PARTIAL DENTURES

The esthetics can be considered the primary prerequisite of an anterior bridge. The types most often used in occlusal rehabilitation may be grouped as:

Acrylic and Gold Bridges

1. Acrylic resin veneer bridge with the entire lingual surface in gold, acrylic resin, or gold saddles.
2. Acrylic resin crowns cured to cast gold coping retainers and pontics.
3. Acrylic veneer retainers and replaceable acrylic resin tube teeth as pontics.
4. Acrylic resin cured to fused porcelain copings.
5. Three-quarter or pinledge crown retainers with acrylic resin pontics.

Porcelain Bridges

1. Cantilever all porcelain bridges.
2. All porcelain individual coping or unit bilt bridge.
3. Fused porcelain jacket crowns as abutment retainers with manufactured porcelain pontics.
4. Porcelain fused to metal bridge.
5. Three-quarter or pinledge crown retainers with porcelain pontic.

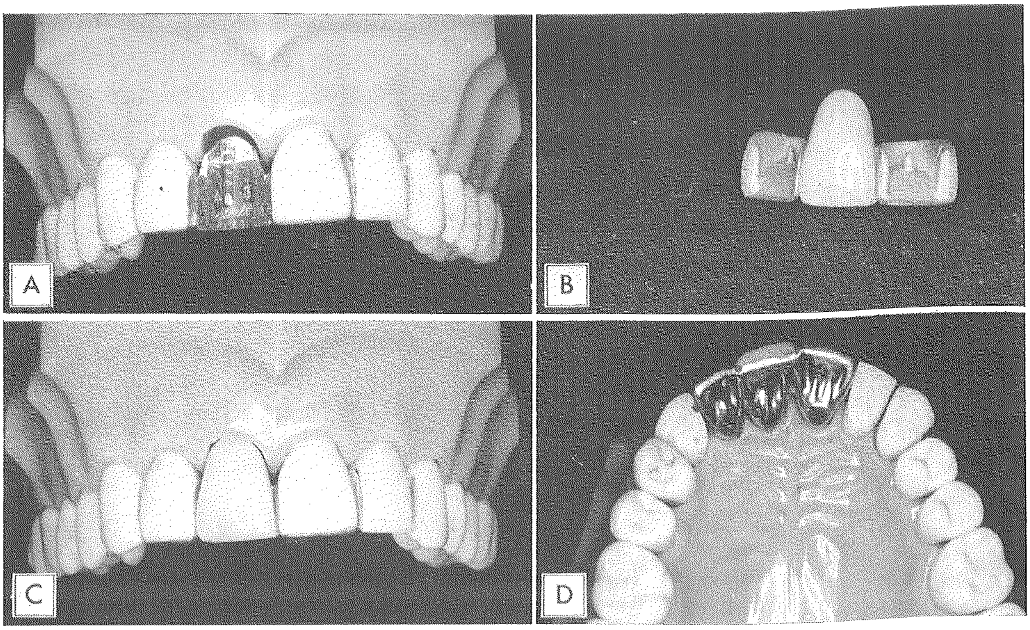


Figure 63. The three-quarter crown anterior fixed partial denture. *A*, The bridge frame and Steele's backing. *B*, Completed bridge with the porcelain Steele's facing. *C*, Completed bridge on the typodont showing a minimum amount of gold. *D*, Lingual view.

POSTERIOR FIXED PARTIAL DENTURES

Function and durability can be considered the primary requisites of a posterior bridge. The types most often used in occlusal rehabilitation may be grouped as:

1. Acrylic resin with cast gold occlusal surfaces. The saddle area may be in acrylic resin or in gold.
2. Porcelain pontics with the anterior abutment retainer a porcelain jacket crown or a plastic veneer crown.
3. Porcelain fused to metal bridge.
4. Three-quarter crown retainers with acrylic resin or porcelain Steele's facing pontics.
5. So-called sanitary bridge (cast gold occlusal without acrylic or porcelain pontic).
6. One abutment retainer a gold inlay with a lock-in device.

THE SADDLE AREA

The ridge on the working cast should not be scraped and the technician should be so advised. Inflammation of the ridge under a fixed partial denture and displaced inflamed tissue are primarily due to scraping of the cast. It is not always the material used in the saddle of the bridge that inflames the tissue. Acrylic resin must be thoroughly cured. Many of us have seen diseased tissue after the removal of glazed porcelain pontics. The bridge saddle must be smooth, highly polished, or glazed and must not exert undue pressure upon the edentulous area. Klaffenbach[2] states, "It is essential, however, that the contacting area of the saddle be reduced to a minimum, and that only contact without pressure be made against the ridge tissues. Pressure will eventually produce inflammation or hypertrophy and will prevent the stimulating effect of intermittent pressure." And Bastian[1] is of the belief, "Clinical observation has demonstrated to the profession that the soft tissue remains just as healthy in opposition with a properly constructed platinum saddle as it does with a porcelain saddle."

If the saddle area is broad, it is frequently advisable to construct the pontics like the nose of bullets touching the tissue. Of course the interproximal spaces will be wide. This is advantageous because the patient can clean and stimulate the interdental papillae with Stimudents or the rubber tip of the toothbrush. Advise the patient of the necessity of such pontics before constructing the bridge. If the ridge is narrow, the operator can construct the pontics so that they follow the contour of the ridge.

CONSTRUCTION OF FIXED PARTIAL DENTURES

THE ANTERIOR ACRYLIC VENEER FIXED PARTIAL DENTURE

A fixed bridge frequently used to replace anterior teeth is the acrylic veneer restoration with cast gold lingual pontics. This type of restoration is indicated in close, shearing occlusions and where the use of porcelain is contraindicated.

Figure 66 illustrates a patient with a missing central incisor. Notice the close occlusion and the marked vertical overlap. The two abutment teeth are prepared

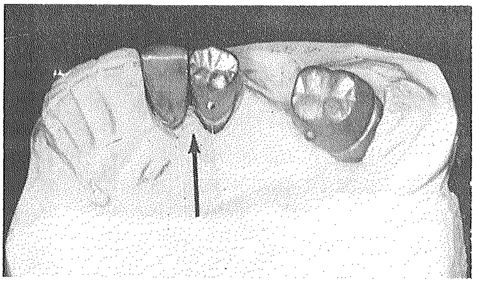


Figure 64. When the abutment tooth is to be splinted to an adjacent tooth for additional support, full coverage abutment retainers should receive preference.

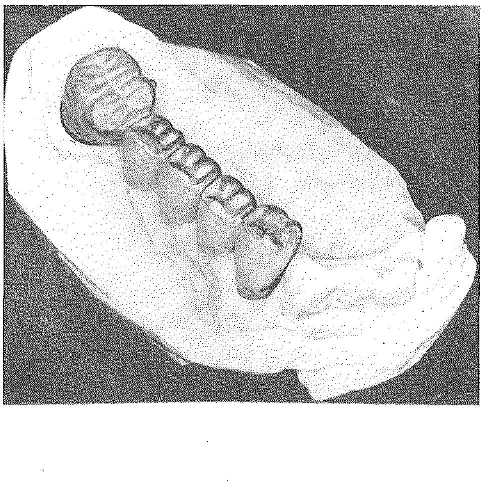


Figure 65. Narrow buccolingual widths are recommended in fixed bridges. When wide molar teeth are to be replaced, it is often indicated to replace these missing teeth with narrow bicuspids.

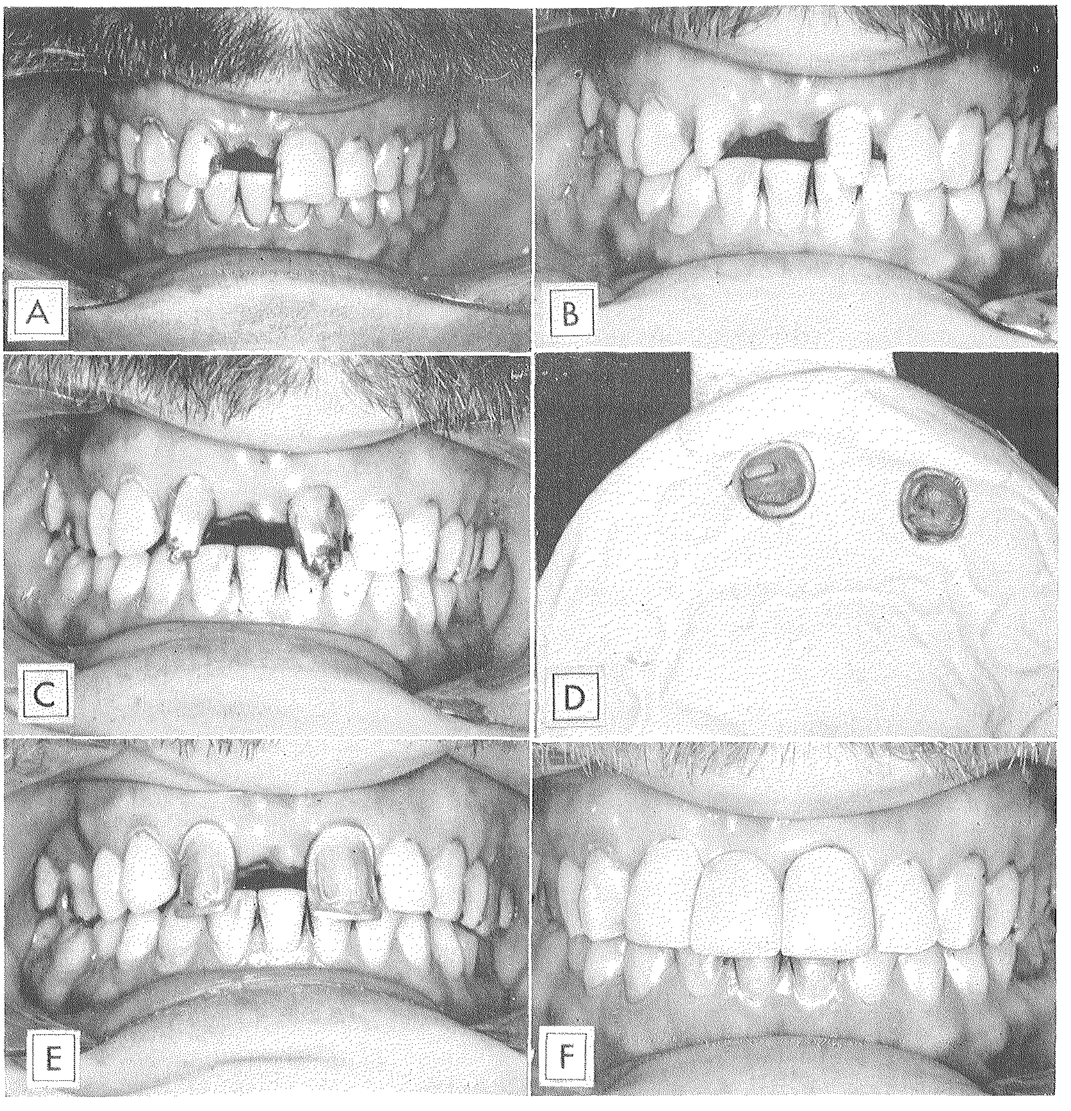


Figure 66. Anterior acrylic veneer fixed partial denture. *A*, The patient with the right maxillary central incisor missing; notice the close occlusion. *B*, The right lateral and left central incisors are prepared to receive veneer gold castings. *C*, Cast transfer copings are constructed and seated over the prepared teeth. *D*, A full plaster impression is taken with the transfer copings in place. A wax occlusal registration and a counter alginate impression will aid in articulating the working cast. *E*, A veneer crown is cast for each abutment tooth, with a boxing to receive acrylic resin. *F*, The bridge is completed with gold lingual surfaces to accommodate the close occlusion and acrylic resin on the labial surfaces.

for veneer crowns with complete shoulders. Transfer copings are cast for each die and a plaster impression is taken of the edentulous area and the teeth with the copings in place. After the working cast is poured and mounted, veneer crowns are cast for each abutment tooth. These are tried in the mouth and the necessary corrections are made as to occlusion, contact areas, and marginal fits. Sometimes a new plaster impression is indicated with the abutment retainers in place. The bridge is assembled and soldered. It is a good procedure to try in the framework and waxed teeth, before curing the acrylic to the metal.

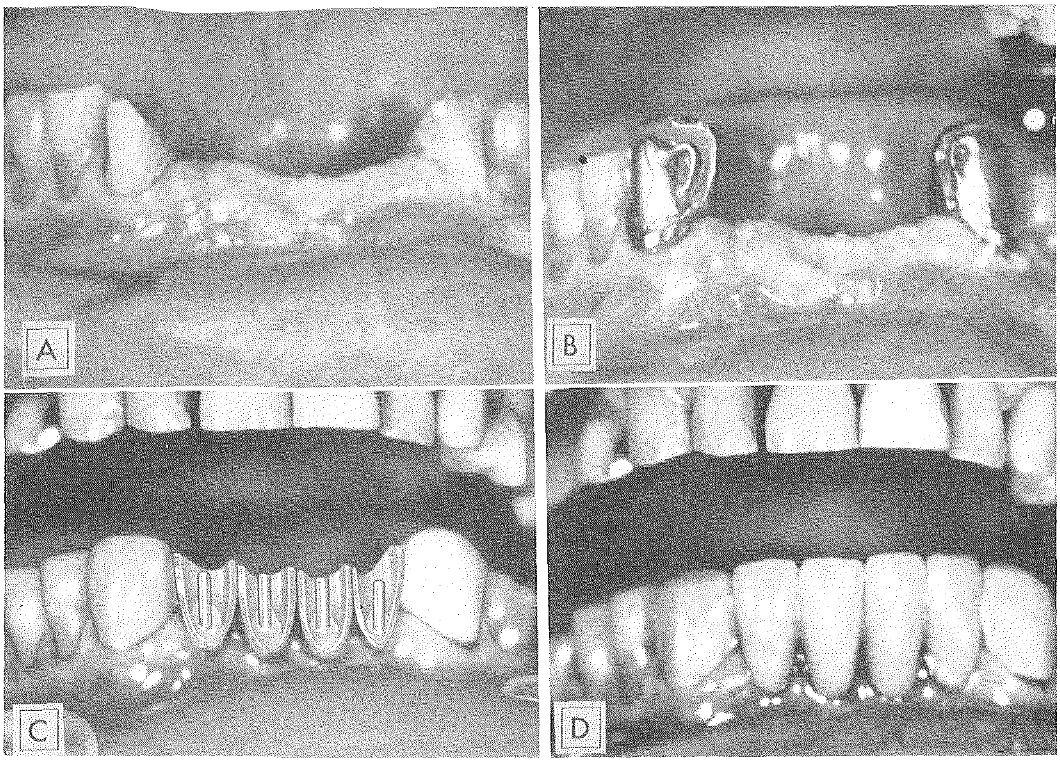


Figure 67. Replacement of the four mandibular incisors. *A*, The two canines are used as abutments when these teeth have long roots and healthy bone support. Otherwise the first bicuspids are used as additional support for the missing teeth. *B*, The plastic veneer crowns are constructed with the gold cut back toward the lingual surfaces. *C*, The pontics are replaceable porcelain or acrylic resin tube teeth with bullet-like castings just touching the tissues. *D*, These tube teeth are carved and stained to blend in with the abutment retainers.

One of the most difficult bridges to construct is the one to replace the four mandibular incisors. Esthetics and durability are the two factors most desired, yet most difficult to accomplish. These four mandibular teeth are frequently lost because of a periodontal disturbance and subsequent mobility. After their removal, there is usually little alveolus left, necessitating extra-long pontic teeth. If the occlusion permits and if the canines are healthy with strong long roots, then only these two canines may be used as abutment teeth to support the bridge. On occasion, it is necessary to use the first bicuspid on each side as additional abutment teeth to support the four mandibular incisor pontics. Figure 67 illustrates a patient in whom only the two canines will receive retainers. The plastic veneer crowns are constructed with the gold cut back toward the lingual surfaces. The pontics are replaceable porcelain or acrylic resin tube teeth with bullet-like castings just touching the tissues. These teeth are carved and stained to blend with the abutment retainers.

THE ALL PORCELAIN INDIVIDUAL COPING OR "UNIT-BILT" BRIDGE

This fixed partial denture is practical because, should a tooth fracture, it can be readily replaced without removing and remaking the entire bridge. It is an excellent

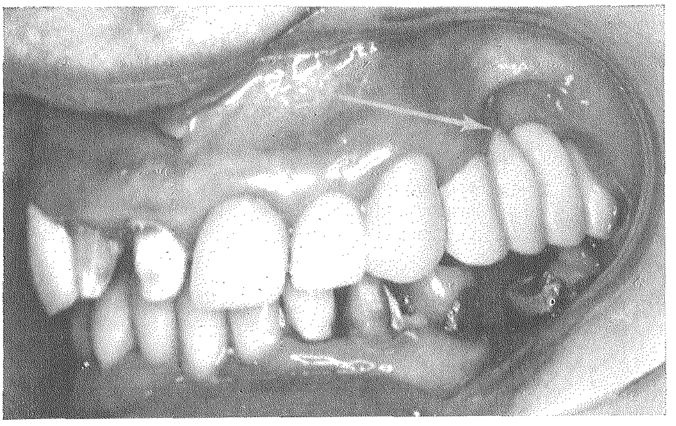


Figure 68. When a fixed partial denture is inserted in an area where much of the alveolus has been removed, the pontics, in proper alignment, frequently create a food trap which cannot be avoided. The patient should be advised regarding this condition before construction of the bridge and the necessity of "sweeping" the area clean with a toothbrush after eating.

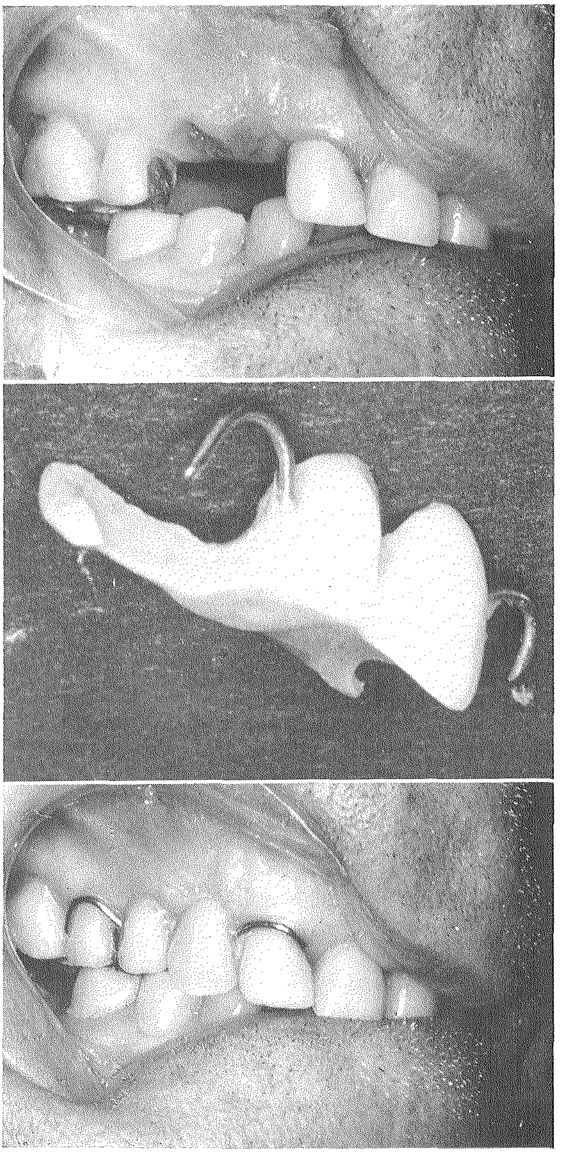


Figure 69. Before the condemned teeth are removed, a temporary removable partial denture is constructed from the study cast, primarily for esthetics, until the tissues have healed for the construction of the permanent fixed partial denture.

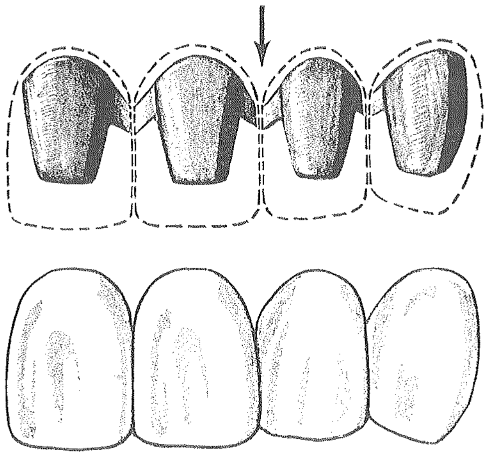


Figure 70. All porcelain individual coping bridge The operator has no choice but to bake square-necked teeth in order to conceal the gold soldering connections

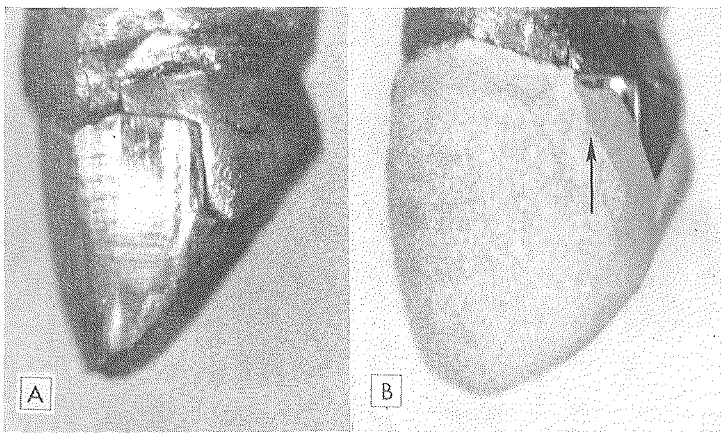


Figure 71. Minimizing the square-necked effect in a porcelain coping bridge. *A*, Bring the soldering connection as far lingually as possible. *B*, When the porcelain pontic is baked, constrict this crown at the neck.

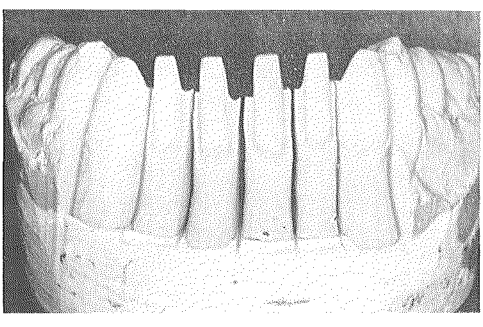


Figure 72. Duplicated dies in the all porcelain individual coping bridge. Most duplicated dies are packed in amalgam alloy. However, dies poured in hard stone from hydrocolloid impressions may also be used. Individual porcelain jacket crowns baked over these duplicated dies are interchangeable from the dies to the bridge framework.

restoration where esthetics are desired and it is recommended primarily for the replacement of missing anterior teeth in both jaws. The operator, however, has no choice but to bake a square-neck type of porcelain teeth in order to conceal the gold soldering connections (Fig. 70). To minimize this square effect of the crowns, bring the soldering connections as far lingually as possible. This procedure will make it possible to constrict the porcelain at the necks to give the effect of tapering teeth (Fig. 71).

The porcelain pontics are supported by gold castings resembling porcelain jacket crown preparations, joined by a strong bar connecting the two abutment retainer copings. Each coping has a shoulder all around, except on the labial or buccal surface where the finishing line is at the crest of the gingival tissue. After the copings are cast and the gold pontics are assembled and soldered, separate impressions are taken of each gold preparation and coping retainer. Dies are constructed in amalgam alloy. Individual porcelain jacket crowns will then be baked to swaged matrices over the dies. These porcelain jacket crowns are interchangeable from the dies to the bridge framework. A rubber base impression of the bridge frame is an accurate method of duplication, and the impression and dies can be silver plated. Other methods are hydrocolloid and silicone procedures, with the dies poured in hard stone.

Figures 73 and 74 illustrate the steps in the construction of such a bridge. The abutment teeth are so prepared as to accommodate both porcelain and gold. A plaster impression is taken with cast transfer copings in place on the prepared teeth. A wax occlusal registration and an alginate impression of the opposing teeth complete the step. Articulate the working cast and construct a gold coping for each abutment tooth, with the soldering connection as far lingually as possible. There is

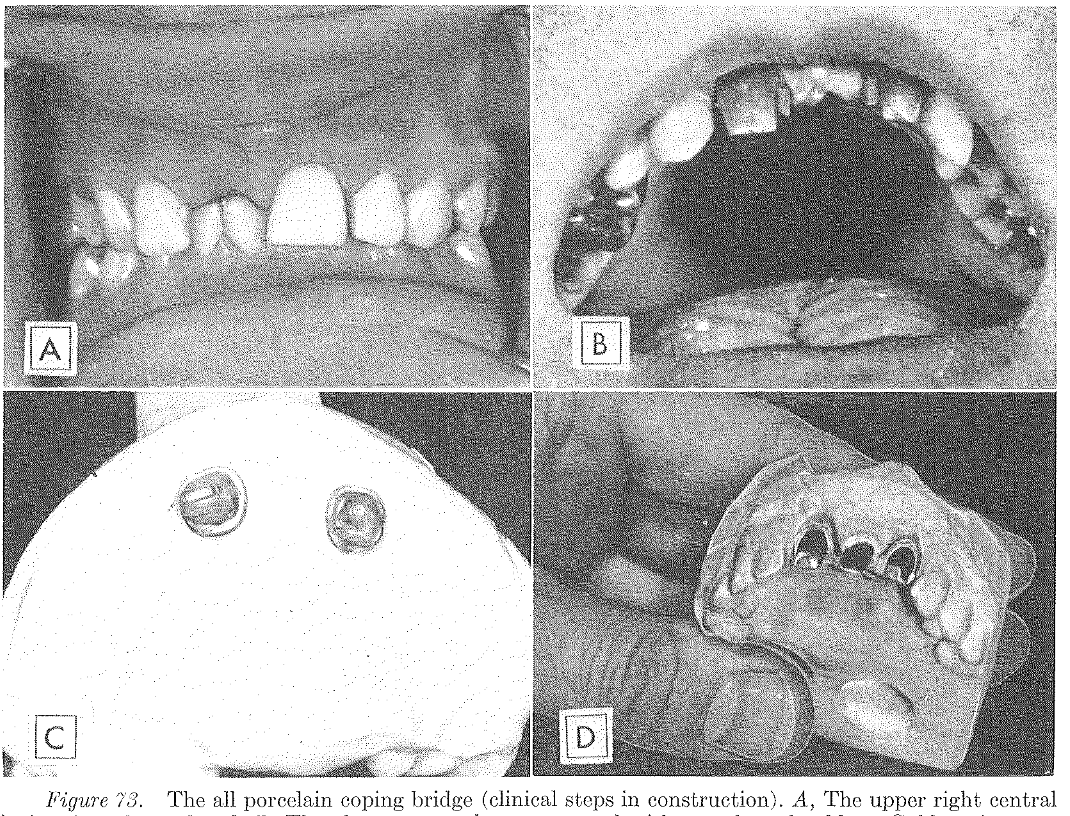


Figure 73. The all porcelain coping bridge (clinical steps in construction). *A*, The upper right central incisor is to be replaced. *B*, The abutment teeth are prepared with complete shoulders. Gold copings are cast and fitted on the prepared teeth. *C*, A plaster impression is taken with the cast abutment copings in position. A wax occlusal registration and an alginate counter impression aid in articulating the working cast. *D*, A pontic, resembling a porcelain jacket crown preparation, is waxed and cast in gold and then soldered to the two abutment retainers.

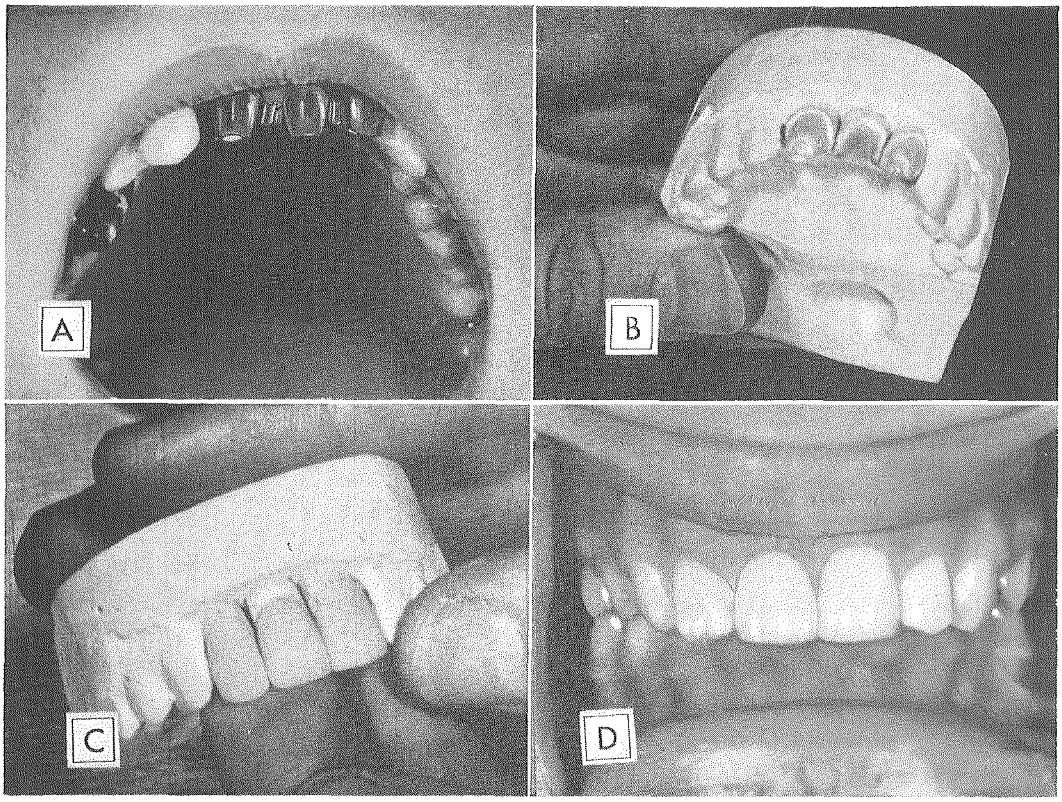


Figure 74. The all porcelain coping bridge (clinical steps in construction). *A*, The metal framework is tried on the teeth. *B*, Impressions are taken separately of each casting preparation and amalgam dies are duplicated. *C*, Individual porcelain jacket crowns are fired. *D*, After a try in of the framework and biscuit bake jacket crowns, the porcelain restorations are glazed and stained and the bridge is cemented on the teeth.

no collar of gold on the labial surface and the porcelain retainer will be butted up against this bared shoulder. Try the gold copings in the mouth and take another plaster impression. At this appointment with the patient, the operator is advised to take the shade and color for the porcelain.

Wax up and cast the gold copings, resembling porcelain jacket crown preparations. These castings do not have any shoulders on the labial surfaces either. Solder these castings to the abutment retainer copings and then try this bridge frame in the mouth. Remove all overhanging collars that impinge upon the tissue; such overhang can be a contributing factor in gingival irritation and bone resorption (Fig. 75). If the gold on the coping retainers takes up too much room on the labial or incisal surface, remove some of it. This procedure enables the ceramist to bake thicker porcelain in these areas.

Take individual impressions of each pontic tooth preparation and abutment retainer on the bridge framework and construct the individual dies. Fire biscuit bake porcelain jacket crowns that are interchangeable from the dies to the metal framework. Try the bridge and individual porcelain jacket crowns on the teeth and make all the required adjustments as to occlusion, contour, contact, and carvings.

The next procedure is the staining and glazing of the porcelain teeth. The metal framework is cemented first, with an oxyphosphate of zinc cement. The operator can then paint the labial surfaces of the gold retainers with a quick-setting ivory-colored opacifier, to help block out the influence of the gold upon the color of the porcelain. Cement each porcelain jacket crown with Caulk's Lucent or Ceramic Blend Oxyphosphate (Mizzy) Cement so as not to distort the color.

The operator is advised to retain the casts and dies for future use should a porcelain jacket crown fracture. Only an overall impression in the mouth to secure contact areas is necessary, and a duplicate restoration can be baked.

This type of porcelain bridge can sometimes be used in the posterior part of the mouth, particularly in the bicuspid regions (Fig. 76). The occlusion must be favor-

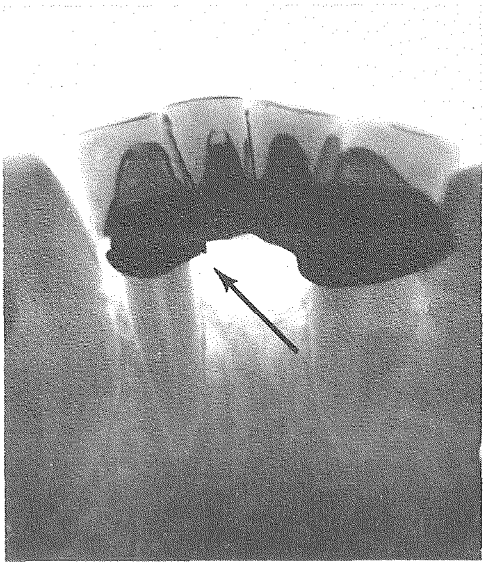


Figure 75. Overhanging gold collars are contributing factors in gingival irritation and bone resorption.

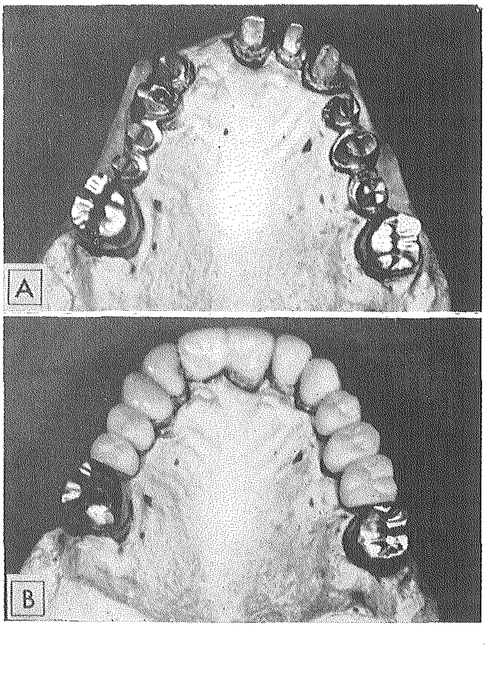


Figure 76. The porcelain crowns and coping bridge may be used in the posterior part of the mouth. *A*, The molar pontics of the posterior bridges are cast gold crowns while the bicuspids are the individual copings. *B*, The completed bridges with individual porcelain jacket crowns as abutment retainers; the pontics are porcelain jacket crowns, too.

able and the patient must be prepared for possible breakage and the cost of replacements.

THE PORCELAIN JACKET CROWN AS ABUTMENT RETAINER WITH MANUFACTURED PORCELAIN PONTICS

The porcelain jacket crown over a gold coping may be used with any manufactured porcelain pontic such as the interchangeable facing, the tube tooth, the long pin facing, the Tru-pontic, etc. In such instances, a gold coping is constructed over the abutment tooth prepared for a porcelain jacket crown. This casting has a soldering connection best suited to the type of manufactured pontic selected. The factory glaze of the pontic tooth is removed and the tooth is recarved and recontoured. A gold strut is cast to receive the porcelain pontic. This porcelain tooth is then stained and glazed along with the biscuit bake porcelain jacket crown retainer (Figs. 77 and 78).

This type of retainer and manufactured pontic may also be used to replace missing teeth in the posterior segment of the jaw, particularly in the mandible where esthetics are so important to some people (Fig. 79).

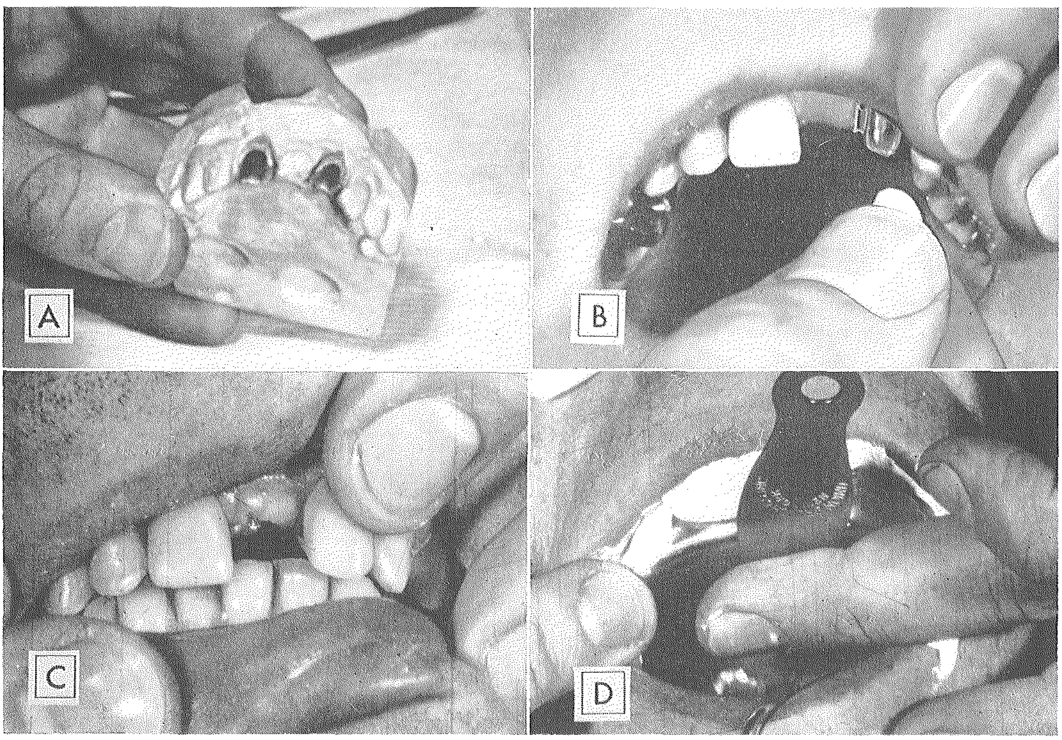


Figure 77. The porcelain jacket crown as an abutment retainer with manufactured porcelain pontic bridge (clinical steps in construction). *A*, The abutment teeth are prepared and gold copings are cast as abutment retainers. Biscuit bake porcelain jacket crowns are baked over the castings. *B*, Try in the castings and porcelain jacket crowns on the prepared abutment teeth. *C*, Make the necessary occlusal corrections. *D*, Take a plaster impression with the gold copings and porcelain jacket crowns on the teeth. Follow with a wax occlusal registration and articulate the casts.

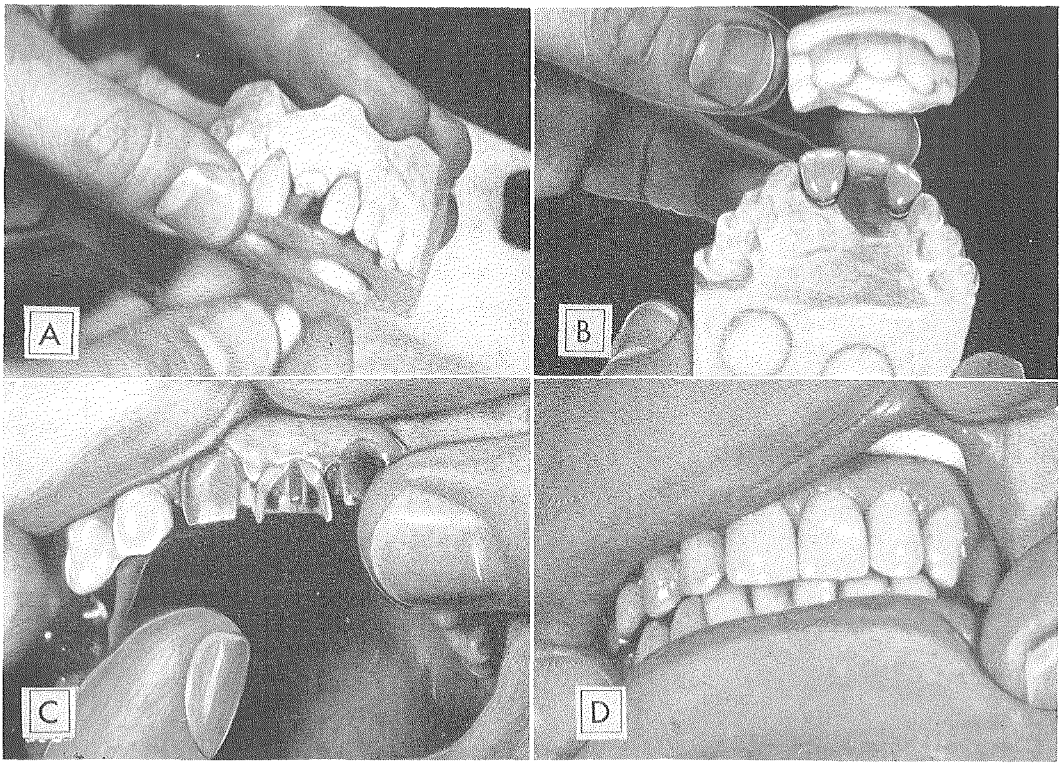


Figure 78. The porcelain jacket crown as an abutment retainer with manufactured porcelain pontic bridge (clinical steps in construction). *A,* Select a suitable manufactured pontic tube tooth. *B,* Grind this tooth and cast the metal strut to support it. *C,* Try in the metal framework on the teeth. *D,* Remove the factory glaze of the manufactured tube tooth and glaze and stain all three porcelain crowns. Cement in the framework and porcelain teeth.

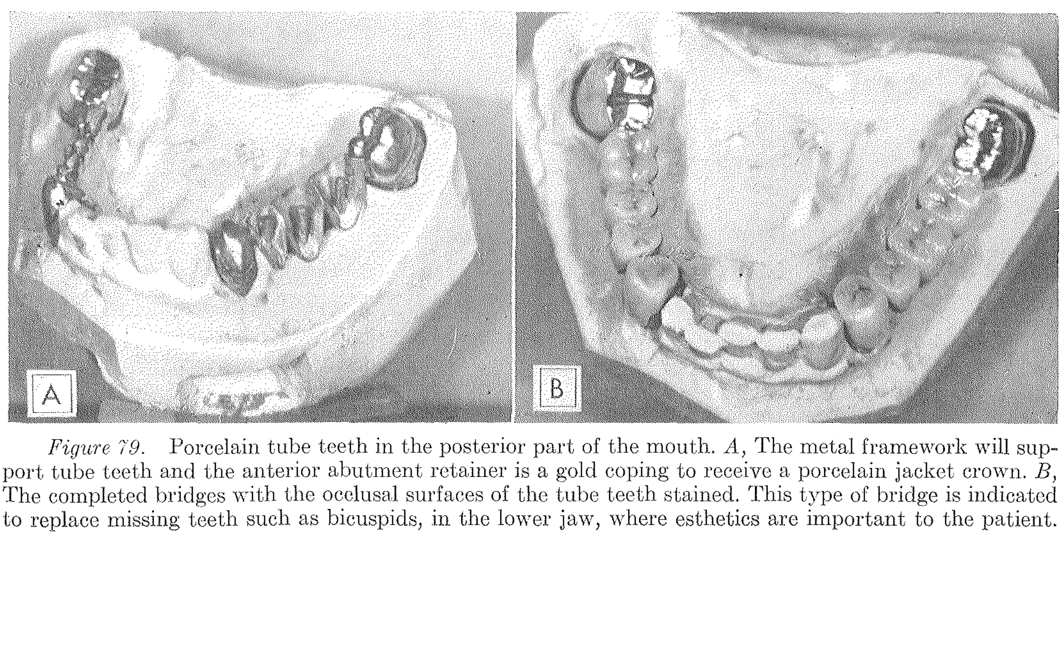


Figure 79. Porcelain tube teeth in the posterior part of the mouth. *A,* The metal framework will support tube teeth and the anterior abutment retainer is a gold coping to receive a porcelain jacket crown. *B,* The completed bridges with the occlusal surfaces of the tube teeth stained. This type of bridge is indicated to replace missing teeth such as bicuspids, in the lower jaw, where esthetics are important to the patient.

THE ACRYLIC RESIN WITH CAST GOLD OCCLUSAL SURFACES POSTERIOR FIXED PARTIAL DENTURE

A posterior bridge that is frequently used is the acrylic resin with cast gold occlusal surfaces. The saddle area may be acrylic resin or cast gold.

In Figure 80*A* the mandibular left first molar and second bicuspid are missing. The second molar is prepared to receive a full cast gold crown and the canine and

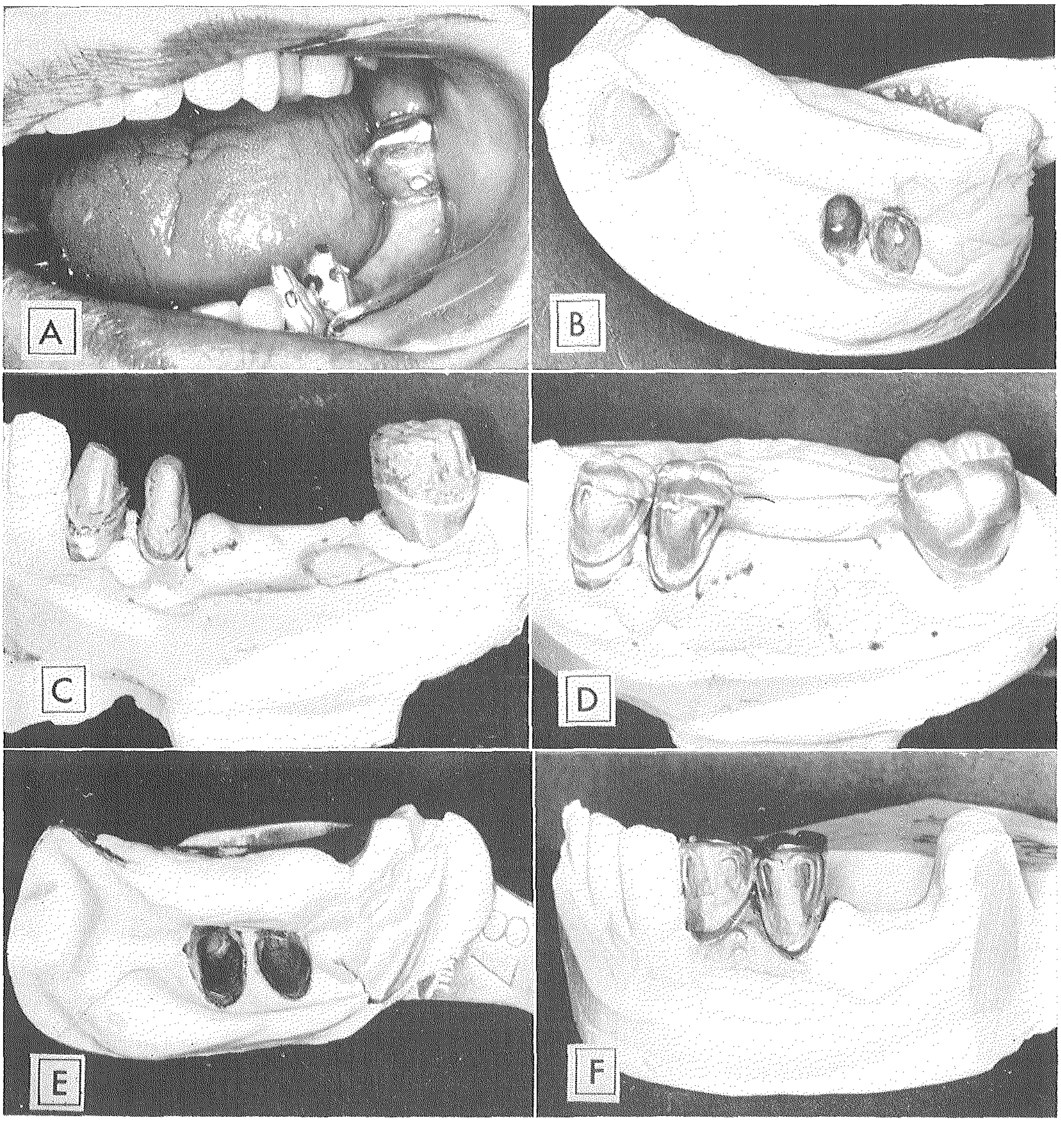


Figure 80. Acrylic resin with cast gold occlusal surfaces, posterior fixed partial denture (clinical steps). *A*, The mandibular left first molar and second bicuspid are missing. The second molar is prepared for a cast gold crown. The canine and first bicuspid are prepared to receive acrylic veneer crowns. Transfer copings are constructed and seated on the prepared teeth. *B*, A plaster impression is taken with the transfer copings in position. Include a wax occlusal registration and an alginate impression of the opposing jaw. *C*, The working cast is poured and articulated. *D*, Cast the gold crown and the two acrylic veneer restorations. *E*, Seat the canine and first bicuspid retainers on the teeth and take a separate plaster impression of these two castings. *F*, Solder the canine and bicuspid retainers together to act as multiple support.

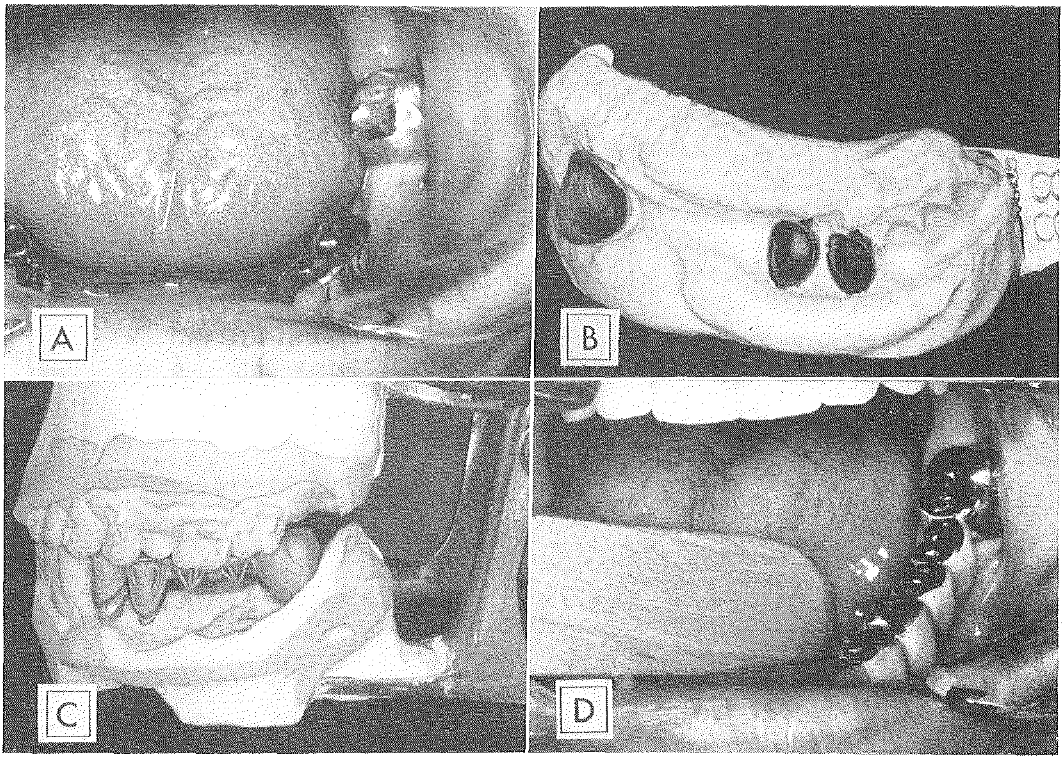


Figure 81. Acrylic resin with cast gold occlusal surfaces, posterior fixed partial denture (clinical steps). *A,* Try all the castings in the mouth and again check the occlusion. *B,* Take a plaster impression of the retainers in the mouth. A wax occlusal registration is taken to assist in re-articulating the casts. *C,* Wax, cast and solder the metal pontic framework and try it in the mouth. *D,* Acrylic resin is cured to the metal frame and the completed restoration is cemented in the mouth.

first bicuspid are prepared to receive acrylic resin veneer crowns. Impressions are taken of these prepared teeth and transfer copings are cast to the fabricated dies. These transfer copings are tried on the teeth. A plaster impression is then taken of the teeth with the transfer copings in place (Fig. 80*B*). Include a wax occlusal registration and an alginate impression of the opposing jaw. The working casts are poured and articulated (Fig. 80*C*). Cast the gold crown and the two acrylic resin veneer crowns (Fig. 80*D*). Try these in the mouth and check the occlusion and contact areas. The bicuspid and canine retainers will be soldered together to serve as a multiple retainer. Take a separate plaster impression of these two castings (Fig. 80*E*). Solder the canine retainer to the bicuspid retainer (Fig. 80*F*).

Try all the castings in the mouth and again check the occlusion (Fig. 81*A*). A plaster impression of these abutment retainers in the mouth is the next procedure (Fig. 81*B*). A wax registration is taken of the occlusal relationship to assist in re-articulating the casts. The previously poured counter cast is used in the articulation. Cast and solder the metal pontic framework and try it in the mouth (Fig. 81*C*). Acrylic resin is cured to the metal frame and the restoration is completed (Fig. 81*D*). Cement the bridge temporarily; after all adjustments are made and the patient experiences no discomfort, the restoration is cemented permanently.

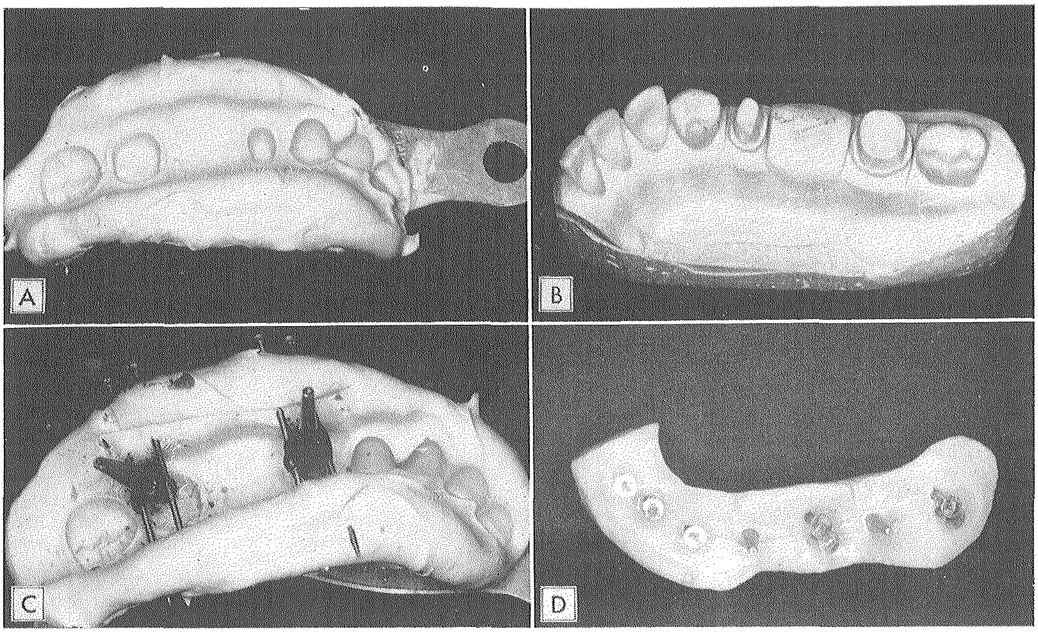


Figure 82. Construction of a posterior fixed partial denture from one Molloflex silicone impression. *A*, Molloflex impression of both prepared teeth. *B*, The poured impression in Vel-Mix stone. *C*, Duplicated impression of master cast with luted brad heads for the stone dies. *D*, Poured second cast with protruding die tails and small tacks for retention to the stone base. The surface is scored around the metal tailpiece of the dies for accurate seating and easy removal of the stone dies.

POSTERIOR CANTILEVER BRIDGES

In occlusal rehabilitation, the use of a cantilever bridge in the posterior segment of the jaw is sometimes indicated. Multiple abutment retainers carrying a cantilever pontic may be used.

Indications for Cantilever Bridges

1. When no abutment tooth is present posterior to the pontic and the conditions are favorable. If the addition of just one extra tooth means a removable partial denture, it is advisable to construct a fixed denture without the extra tooth (Fig. 84).

2. When the maxillary canine has to be replaced and the anterior abutment tooth is the weak lateral incisor (Fig. 85). The first and second bicuspids are joined and carry a cantilever pontic.

3. When the anterior abutment tooth is the maxillary canine, perfectly sound and not previously filled, and when esthetics are of prime importance or the age of the patient has to be considered. The patient may be apprehensive of having the canine reduced for the replacement of the first bicuspid (Fig. 86). In such a situation, the molar and second bicuspid are joined and support a cantilever first bicuspid pontic, usually without cusps. Sometimes, in a young girl, only the bicuspid is used to carry a small cuspless cantilever pontic (Fig. 87).

It should be understood that the aforementioned recommendations in fixed partial denture construction are not to be considered standard routine procedures.

The conditions in each individual case, as well as the reasonable wishes of the patient, influence the choice of appliance and the details of construction.

Sometimes attaching a pontic to a single tooth places rotational strain upon the tooth and the tooth may loosen. To minimize this occurrence, a single stress-breaker is constructed, consisting of a pin or cast projection. This fits into a compatible recess on a casting on the abutment tooth (Fig. 88). A metal projection jutting from the pontic and merely resting on the enamel of the lingual surface of the approximating tooth is not recommended. Such a rest does not afford any resistance to rotational strain and it facilitates attack by the organisms that are responsible for caries.

(*Text continued on page 77.*)

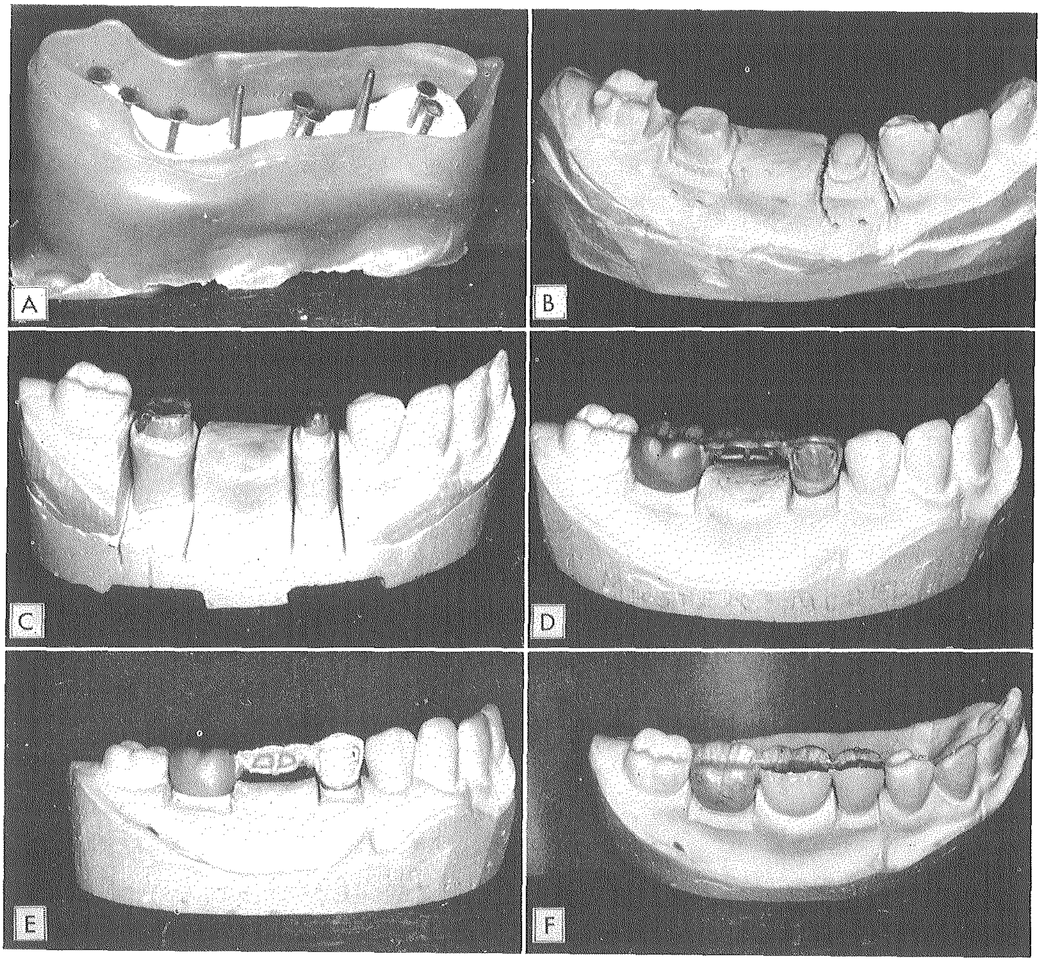


Figure 83. Construction of a posterior bridge continued. *A*, The working cast with the stone dies is walled with a sheet of wax and the base is poured in a stone of a different color. *B*, The poured cast showing the start of separating the stone dies with a saw. *C*, The cast with the removable stone dies. The occlusal surfaces of the dies are painted with a layer of red nail polish to make for easy removal of the castings. *D*, The bridge frame on the working master cast with a full cast crown on the molar and a veneer casting on the premolar. *E*, The pontic and premolar veneer casting are treated with opaque and fired to about 200 degrees F. in the casting oven to mask the gold prior to packing the acrylic resin mix. *F*, The completed bridge constructed from only one master silicone impression.

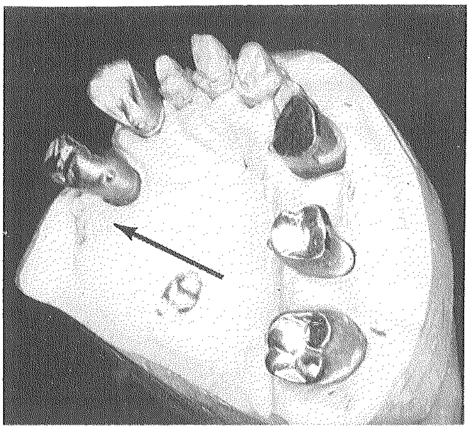


Figure 84. Indication for a cantilever bridge: when no abutment tooth is present posterior to the pontic and the conditions are favorable, a cantilever pontic may be added distally.

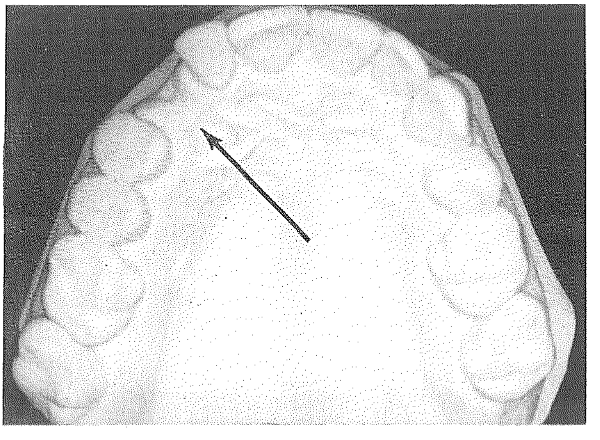
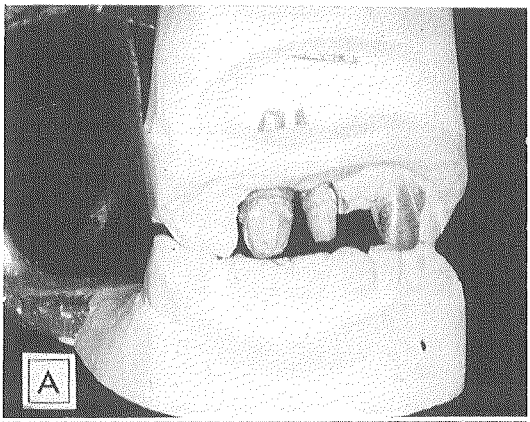
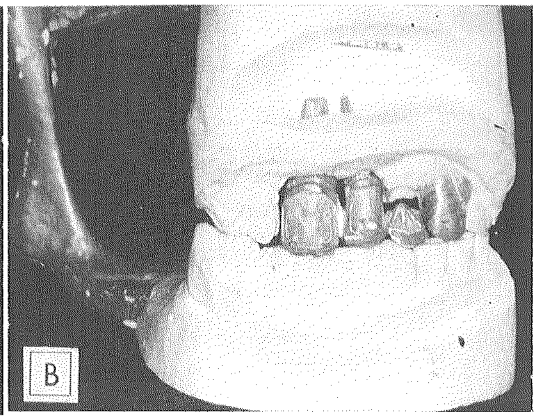


Figure 85. When the maxillary canine has to be replaced and the anterior abutment tooth is the weak lateral incisor, a cantilever bridge is recommended, with the first and second bicuspids joined and carrying a cantilever pontic.





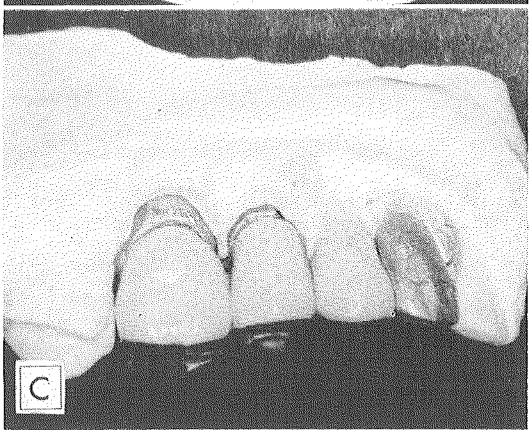
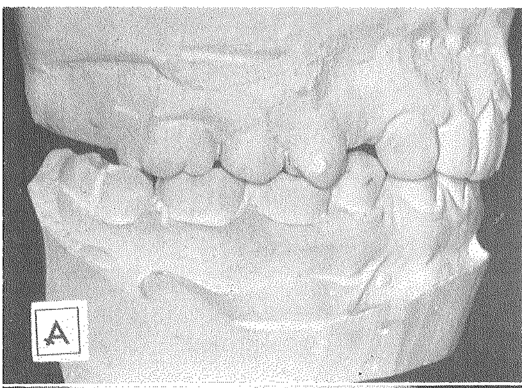
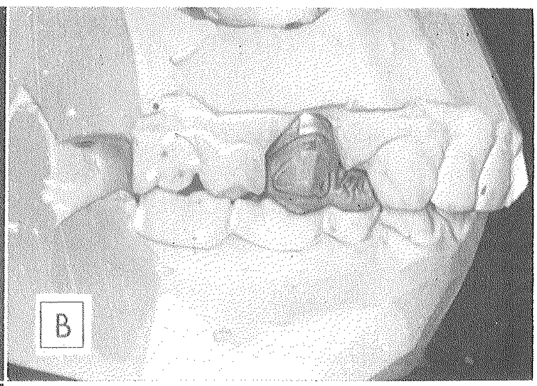


Figure 86. *A,* When the anterior abutment tooth is sound and not previously filled, or when the patient is young and apprehensive of having the healthy canine reduced, the molar and second bicuspid are joined to support a cantilever first bicuspid pontic, usually without cusps. *B,* The metal framework of the cantilever bridge. *C,* The completed bridge.





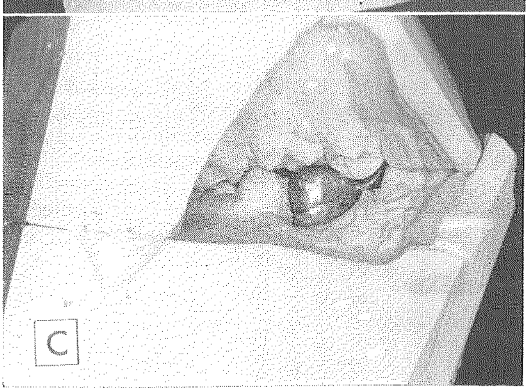


Figure 87. Sometimes, in a young girl, when the missing bicuspid is narrow, the first bicuspid may be used to carry a small cuspless cantilever pontic. *A,* The occlusion does not permit any lingual cusp in the restoration. *B,* Buccal view of the restoration. *C,* Lingual view.

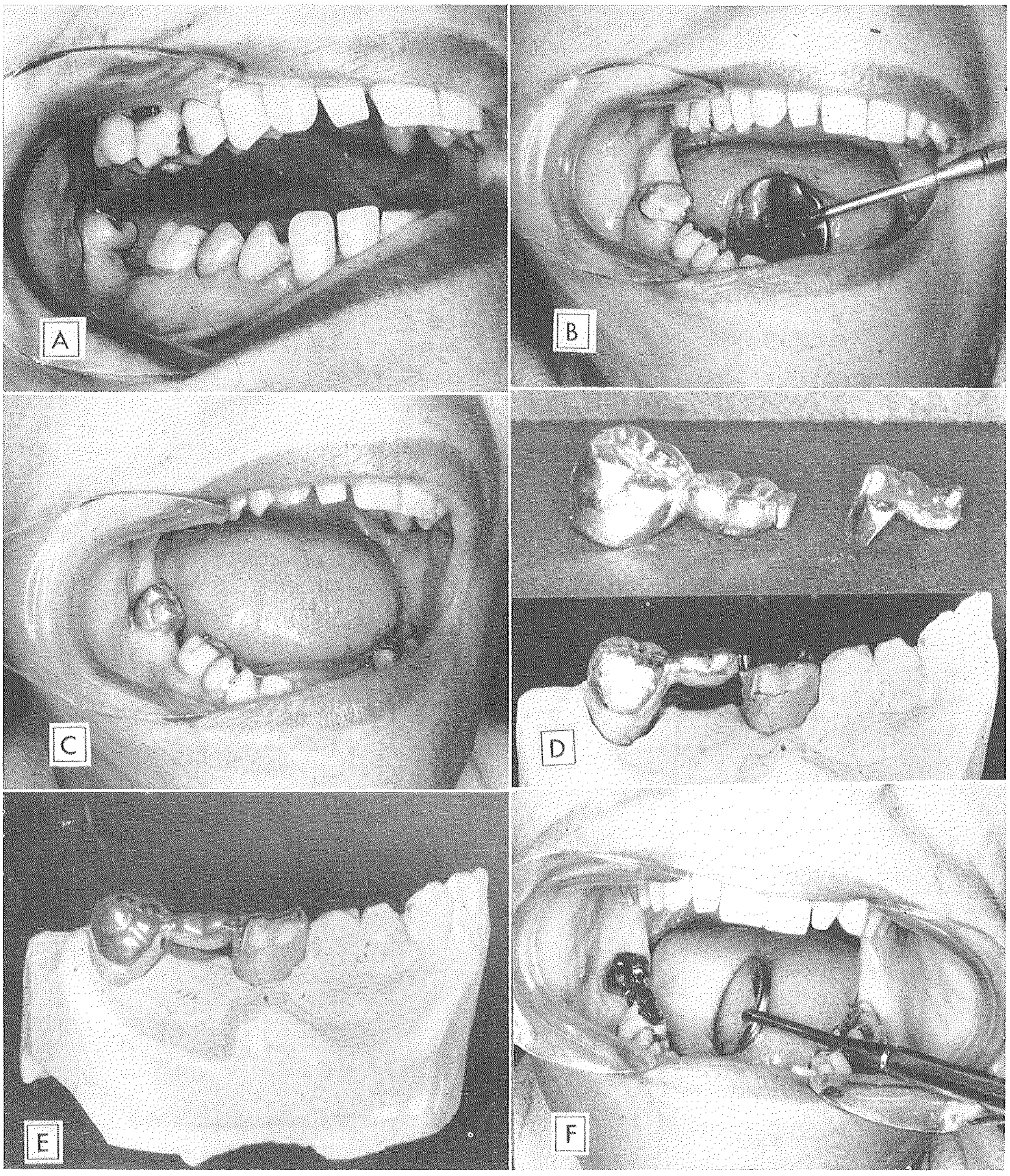


Figure 88. Cantilever and stressbreaker bridge. When conditions are favorable, one retainer is fixed and the other may be a cast projection on the pontic that fits into a compatible recess on a casting on the other abutment retainer. *A*, The second molar is missing. The third molar will receive a full cast gold crown. The first molar is sound and will receive a distal occlusal gold inlay. *B*, The third molar is prepared and a transfer coping is constructed, to act as a seat for the amalgam die, constructed from a band impression. The distal occlusal inlay preparation on the first molar is waxed up directly. *C*, After articulation of the working cast, the molar crown and gold inlay are cast and tried in the mouth. A master impression is taken and the working cast is re-articulated. *D*, The pontic framework is soldered to the cast gold crown. The so-called free end of the pontic is a dovetail projection that fits into a slot on the gold inlay. *E*, When such a bridge is seated, rotational strain upon the molar abutment tooth is prevented. *F*, The completed bridge.

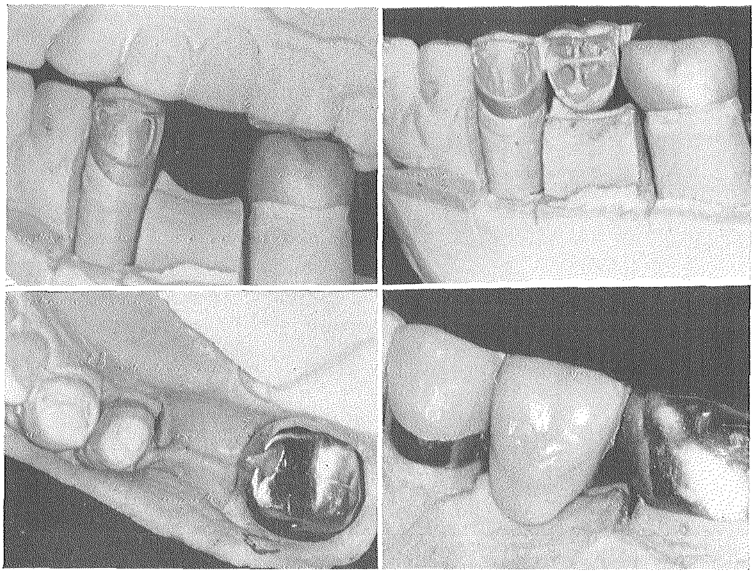


Figure 89. Fixed partial denture with a cast gold saddle and a lock-in device which slips into the cut-out on the cast molar crown, sometimes called a fixed-removable bridge.

THE ACRYLIC RESIN WITH CAST GOLD SADDLE POSTERIOR FIXED PARTIAL DENTURE

Some operators prefer a polished gold surface abuting the saddle area rather than a cured acrylic resin saddle. Figure 89 illustrates such a restoration with a lock-in device on one abutment retainer. After the retainers have been cast and tried on the teeth, a wax pontic with an open window on the labial or buccal surface for retention of acrylic resin is constructed. The wax touches the saddle area in a slight taper tissue-ward and the occlusal area is carved. The wax pontic is cast and soldered to the abutment retainer(s). It is advisable to try the fixed frame in the mouth before the acrylic facing is fabricated.

CAST OCCLUSAL PONTIC (SANITARY BRIDGE)

This type of fixed partial denture is indicated for the replacement of one, sometimes two missing teeth in the lower jaw only (Fig. 90). It is often used when the saddle area is extra broad or razor sharp. The abutment retainers may be full coverage or three-quarter crown restorations. The occlusal surface is cast gold and soldered to the retainers. There isn't any tooth pontic on the saddle area. The patient can keep the space underneath the span clean. The operator is advised that the patient must agree to this type of restoration before he starts construction.

THE INLAY BRIDGE

In a mouth comparatively free of caries, when the abutment teeth (tooth) are sound and only one missing tooth is to be replaced, an inlay bridge frequently satisfies the fixed partial denture requirements. It would be a shame to reduce two

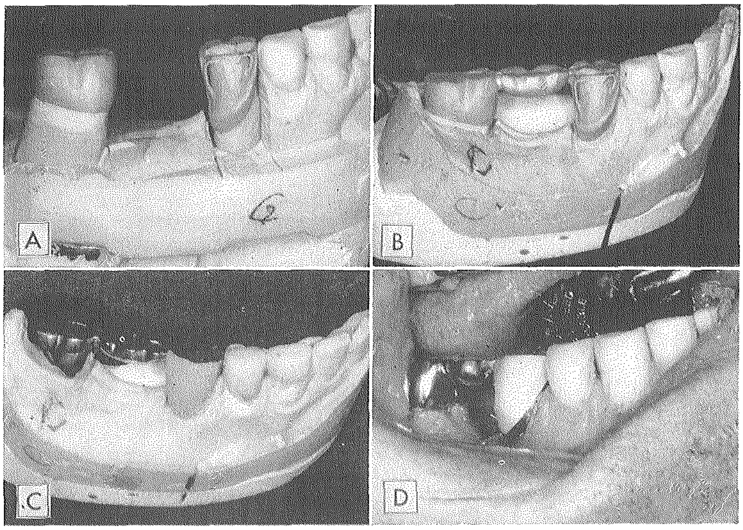


Figure 90. Fixed partial denture with a cast occlusal pontic only, so-called sanitary bridge, indicated only in the lower jaw. *A*, The abutment retainers on the working cast. *B*, A cast occlusal pontic is soldered to the retainers. *C*, Acrylic resin is cured to the boxing of the premolar veneer crown. *D*, Completed bridge in the mouth.

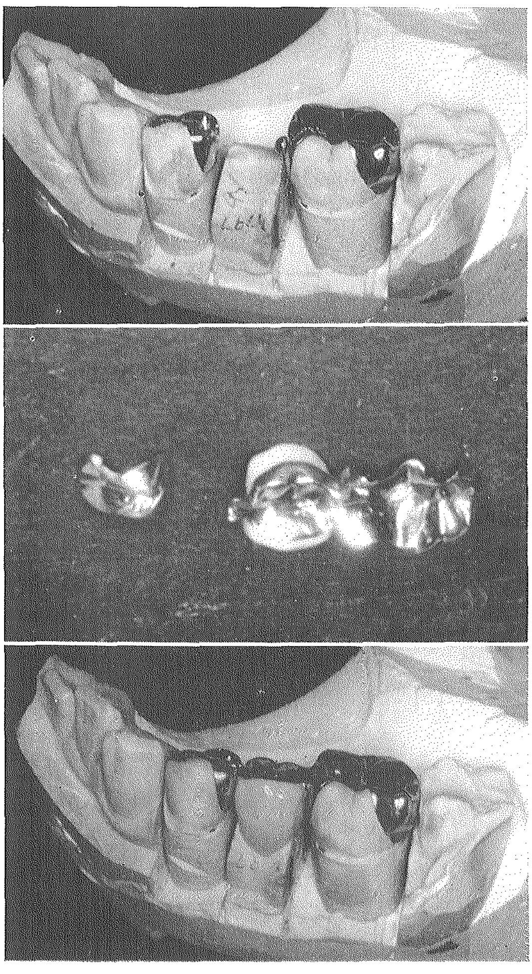


Figure 91. The inlay bridge is often recommended in a comparatively caries-free dentition. This type of restoration is a conservative one.

perfectly sound teeth for radical retainers unless esthetics is a factor. When the occlusion is satisfactory an inlay restoration as an abutment is indicated. Figure 91 illustrates such a restoration on a young woman. The preparations for the inlay retainers should be sufficiently retentive. Sometimes the inlays can be constructed with pins to obtain additional retention that will counteract torque in mastication.

THE TILTED TOOTH AS AN ABUTMENT IN FIXED PARTIAL DENTURES

When the tilted tooth is to be used as an abutment, several factors must be considered and evaluated. Clinical examination and the study casts will determine whether the tooth is tilted mesially, lingually, or buccally. On rare occasions a tooth may be tilted distally. The operator should evaluate the degree of the tilt and the number of pontics involved. He should consider whether the restoration will be better as a fixed partial denture, as a bridge with a stressbreaker (loose end lock-in device), or as a removable partial denture. Sometimes the use of a telescope crown may be the solution. If there is a tooth posterior to the tilted one that approximates it, it is frequently advisable to splint the adjacent tooth to the tilted one. Double abutment retainers will minimize recurrence of a periodontal condition by eliminating the food pack in the space created by the malposed tooth.

Figure 92 illustrates a marked mesial tilt of the molar abutment. Removal of sufficient tooth structure from the mesial surface to create a straight surface will jeopardize the vitality of this important tooth. Inasmuch as the mesial tilt cannot be completely eliminated, a loose-end fixed bridge is advisable with a precision rest or a lock-in device on the tilted retainer. The bridge can then be inserted occlusally.

When one abutment tooth tilts lingually or buccally, both abutment teeth are so prepared that the completed fixed partial denture can be inserted linguo-occlu-

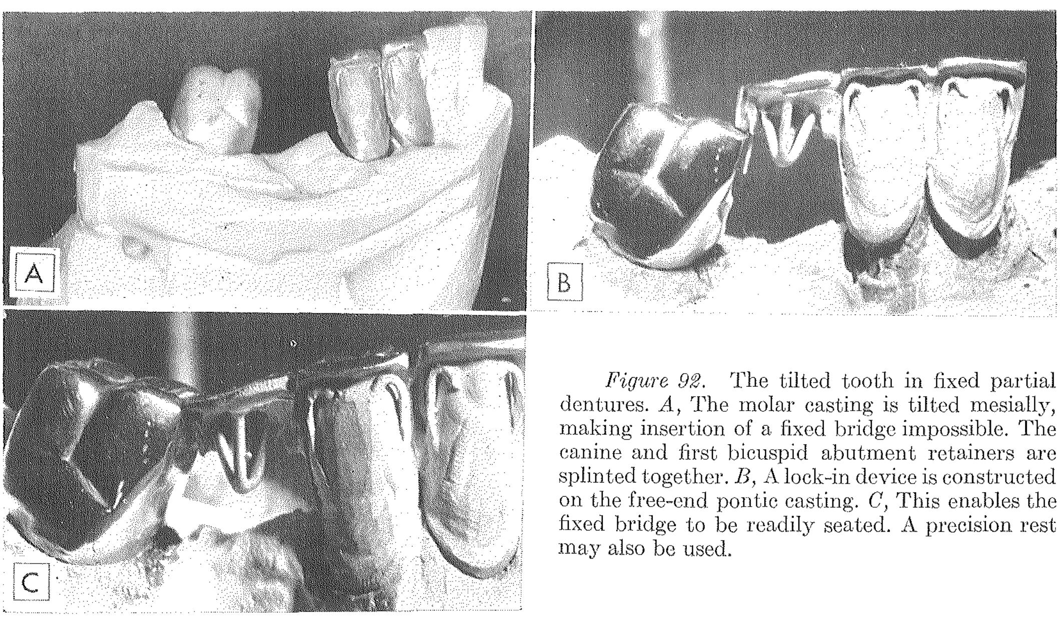


Figure 92. The tilted tooth in fixed partial dentures. *A*, The molar casting is tilted mesially, making insertion of a fixed bridge impossible. The canine and first bicuspid abutment retainers are splinted together. *B*, A lock-in device is constructed on the free-end pontic casting. *C*, This enables the fixed bridge to be readily seated. A precision rest may also be used.

sally. Another and practical choice is to construct a free-end bridge with the lock-in device. The molar tooth tilts lingually. A full cast gold crown is constructed with a lock-in device in such a way that it can be inserted from the lingual. The anterior abutment and soldered pontic and lock-in projection is inserted occlusally. Cement both segments with the same mix of cement, first seating the cast crown from the lingual and the rest of the bridge from the occlusal.

Porcelain fused to gold fixed partial dentures are described in Chapter Five.

References

1. Bastian, C. C.: The individual unit porcelain bridge. J.A.D.A., *29:*1372, 1942.
2. Klaffenbach, A. O.: *Handbook of Dental Practice.* Philadelphia, J. B. Lippincott Co., 1948, p. 340.

5

PORCELAIN FUSED TO GOLD ALLOY

It is gratifying that the use of fused porcelain in restorative dentistry has resumed its rightful place in the dental profession. Acrylic resin crowns and bridges satisfy to some degree the esthetic demands we are constantly confronted with. The fact that the resin materials are not stable with regard to color compels us to seek new methods and new materials. Epoxy resin has not proved satisfactory because it is also an organic material and we may expect the same deficiencies as we find in acrylic resin. Fused porcelain is always the first choice of the dentist and the patient; however, when porcelain cannot be used, the operator has to turn to the second best material, acrylic resin. Porcelain fused to metal can be considered a new material that has a definite place in dentistry. When used where indicated and constructed with skill and experience, these restorations can play an important part in restorative dentistry.

REASONS FOR UNSATISFACTORY RESULTS

The fusing of porcelain is becoming a lost art. Most capable older ceramists keep their tricks of the trade secret. Dental colleges, for the most part, do not teach or practice the actual firing of porcelain and the young dentist is not familiar with the shortcomings and limitations of porcelain. Manufacturers have contributed much toward developing methods of fusing porcelain to metal; however, laboratory research with these materials is quite different from clinical research. Hurried procedures in completing the restoration contribute to a poor result. Improper tooth preparations and the insertion of porcelain fused to metal restorations in areas and

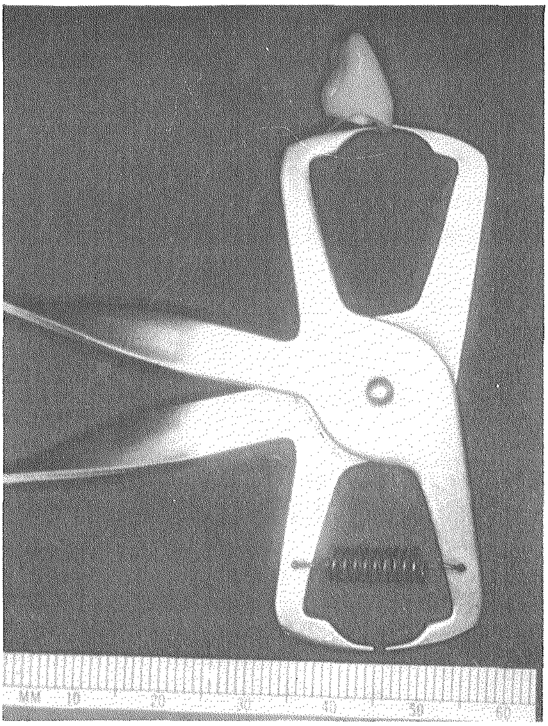


Figure 93. The thickness of the metal casting in the cervical border, plus the thickness of opaque and regular porcelain is more than 1 mm. This overall thickness of the restoration in this area is frequently not tolerated by the surrounding gingiva unless sufficient tooth structure is removed. Removal of too much tooth structure jeopardizes the pulp. If a shoulder cannot be prepared, then the metal collar must be visible.

under conditions in which this combined material is contraindicated also cause failures.

MAJOR SHORTCOMINGS OF PORCELAIN FUSED TO METAL

The major shortcomings are these: fracture of the porcelain; unsatisfactory color in many instances; overcontoured and bulky restorations; inaccurate fit of the casting; health of the pulp, jeopardized because of the necessity to remove much tooth structure; and difficulty in repairing fractures.

It is too much to expect porcelain to resist fracture, despite the claims of the manufacturers. Porcelain, by virtue of its chemical and physical composition, is subject to chipping or breaking, whether as a porcelain jacket crown or fused to metal. Clinical experience has proven that porcelain fused to a bridge frame is more apt to fracture than porcelain fused to a metal coping crown. Porcelain may separate from a metal cast veneer whereas it does not when fused to a cast coping. When the abutment preparations are not parallel, fracture of the porcelain is a foregone conclusion. The technician has to exert force in order to seat the bridge each time he places it back on the working cast. As a result of the undercut created by the unparallel prepared teeth, fracture lines are set up in the porcelain, to fracture completely at a later date. Many technicians sandblast the inside of the castings to overcome this problem of seating the bridge; however, they introduce another faulty condition by creating a loose-fitting restoration which contributes to failure of the bridge.

Color difficulties are often encountered because of the inability to fuse sufficient bulk of porcelain when not enough tooth structure has been removed in the preparation. *We must be mindful that a sturdy thickness of cast metal, at least 45 gauge, over a prepared live tooth, plus one layer of recommended bonding agent, plus one or, more often, two layers of opaque porcelain, limits the amount of thickness of regular porcelain.* As a result, color and contour become problematic in some instances. We know that a thin layer of fused porcelain is not exactly the same shade as a thick layer.[2] Furthermore, a shade guide tooth, from which most of the manufacturers make up their shades, has more bulk of porcelain than the usual amount of porcelain fused to the metal casting. When porcelain is fused to an opaque casting or metal frame, it is extremely difficult to obtain the exact likeness that one often gets with an individual porcelain jacket crown. *The metal struts and bridge frame affect the color of any type of porcelain crown or bridge whether the porcelain is cemented over the gold coping, over a gold core, or over a coping bridge frame, or is fused to metal.* The type of metal may also contribute to unsatisfactory color in the finished porcelain. A high-melting-range alloy, that possesses large amounts and many kinds of base metals that give off discoloring oxides, affects the color of the porcelain and weakens the metal. The Bureau of Standards of the American Dental Association should regulate the type and quality as well as the minimum requirements of today's metal alloys in the same manner as it regulates manufacture of other kinds of dental gold.

REQUIREMENTS OF PORCELAIN FUSED TO METAL FOR A SATISFACTORY RESTORATION

1. The porcelain must be an accepted dental porcelain with a sufficient amount of feldspar as a base, and must be fusible at a range in which a strong, condensed, and permanent ceramic glaze and texture can be obtained.
2. The porcelain must be manufactured so that the colors are satisfactory and capable of being matched with commonly used and accepted shade guides.
3. The color of the porcelain must be stable and not changed by fluids in the mouth.
4. The metal must not tarnish or be affected by alien oxides.
5. The metal casting must fit accurately on the prepared tooth.
6. The completed restoration must not undergo dimensional changes during stress or when porcelain is fused to it, so that fit and longevity of the restoration are assured.
7. The porcelain should not fuse above 1800° F., because repeated firings of the restoration at high temperatures will distort the metal.
8. The metal alloy must be capable of being invested so that it can be cast without involved and complicated techniques.
9. The metal should be as near a binary precious alloy as possible with a minimum amount of base metals.
10. The porcelain should not separate from the metal or fracture easily.
11. The porcelain and the metal should be available to all dentists, technicians, and dental colleges without franchises or special licenses.

PORCELAIN FUSED TO AN IRIDIOPLATINUM ALLOY

Platinum with about 10 per cent iridium added for stiffness has been used in dentistry for a long time, and fusing porcelain to it is not new. The fact that it has not met with continued favor over the years proves that it has shortcomings. Nevertheless, some operators seem to get the results they desire with this type of restoration. The alloy is a sluggish, slow-melting material, the management of which is particularly complicated. Few investments have been manufactured that are capable of withstanding the high temperatures necessary to melt it or of compensating for wax pattern shrinkage. Upon casting, the alloy shrinks. Skinner[5] writes, "Both platinum and palladium have a strong affinity for hydrogen as well as oxygen. Upon cooling, the absorbed gases are expelled and voids are formed." Iridioplatinum alloy oxidizes readily. When porcelain is baked to it, the oxides act as separating mediums which are contributing factors in the separation of the porcelain from the metal, or in its fracture. There is no direct union between the porcelain and the metal. The porcelain seems merely to have an attraction for the metal, and separation from the metal is apt to take place.

PORCELAIN FUSED TO A PALLADIUM ALLOY

An alloy based on palladium with varying amounts of ruthenium, gold, or platinum is also a slow-melting, sluggish material, with unfavorable characteristics that cannot be controlled. Upon solidifying from the molten condition, this alloy "spits" just like silver, yielding a hollow ingot.[3] Owing to the high temperature required to melt it, no suitable refractory material is available. The casting technique, as for iridioplatinum alloy, must be modified by new waxing procedures or matrices, which can be accomplished only with complicated and involved methods. Because palladium possesses the remarkable power of absorbing or occluding hydrogen, the tensile strength of the metal is reduced and the density during hydrogenation undergoes a change.[4]

Another disturbing factor is that a palladium alloy casting undergoes dimensional change when porcelain is baked to it. The casting does not fit accurately on the prepared tooth. The shrinkage of the high-fusing porcelain is so great that it usually cracks or checks. In order to overcome this checking, heavy layers of opaque porcelain must be applied to act as a cushion for the regular porcelain. One can understand, then, why the color in the completed restoration is not always satisfactory and why the restoration is bulky and exaggerated in contour.

When palladium alloy is heated to a melting redness, palladous oxide is formed. This oxide varies in color from a yellowish brown to a dark, almost black hue. Because of this oxide, there is no bond between the porcelain and the metal, and the porcelain is prone to peel off. Palladium alloy is affected by the fluids of the mouth and the color of the porcelain may change.

PORCELAIN FUSED TO A GOLD ALLOY

Several manufacturers make high-melting-range gold alloys and porcelain.

These alloys have a melting range between 2200 and 2600° F. When this type of gold is cast the marginal fit is accurate. The more gold in the alloy, the yellower the metal and the more platinum, the grayer. The alloys are sluggish but cast readily.

INDICATIONS AND CONTRAINDICATIONS FOR PORCELAIN FUSED TO METAL RESTORATIONS

Porcelain fused to gold is indicated only when sufficient tooth structure can be removed in the preparation to accommodate thickness of both materials without jeopardizing the health of the pulp. The porcelain fused to metal crown should be limited, if an individual porcelain jacket is not suitable. Three and four unit fixed bridges are recommended. Large span bridges, splints, and cantilever restorations, whole or in part, should rarely be used. Experience informs us that stresses and strains in such restorations contribute readily to fracture and gingival irritation. *Porcelain fused to metal restorations should never be used on teeth that participate in bruxism.* It is also contraindicated on short teeth and thin delicate ones. Furthermore, when no shoulder is possible because of exposed cementum, bell-shaped teeth, and the like, the gold collar must be visible to minimize overcontouring the restoration in an area where the deflecting contours of the crown must be in harmony with the deflecting contours of the gum.

Porcelain fused to metal has proved successful in abutment retainers to hold internal attachment removable partial dentures (Fig. 96). When orthodontic measures in young adults fail to bring a lingually positioned canine into alignment because of inherited positional patterns, a porcelain fused to gold casting can create an improved esthetic result (Fig. 97). Porcelain fused to metal is primarily indicated on the lower teeth when the patient objects to the display of metal. When the four

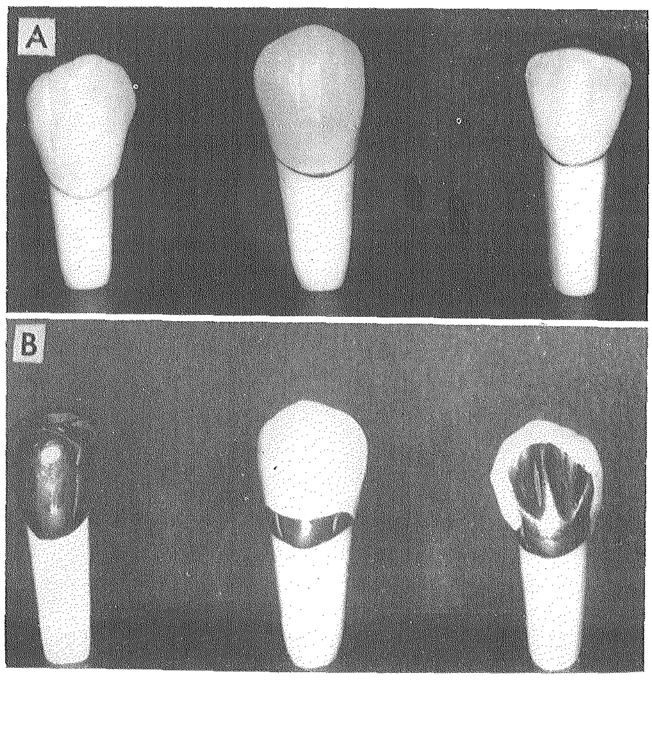


Figure 94. Three types of porcelain fused to metal crowns. *A*, Labial and buccal view. *B*, Lingual view.

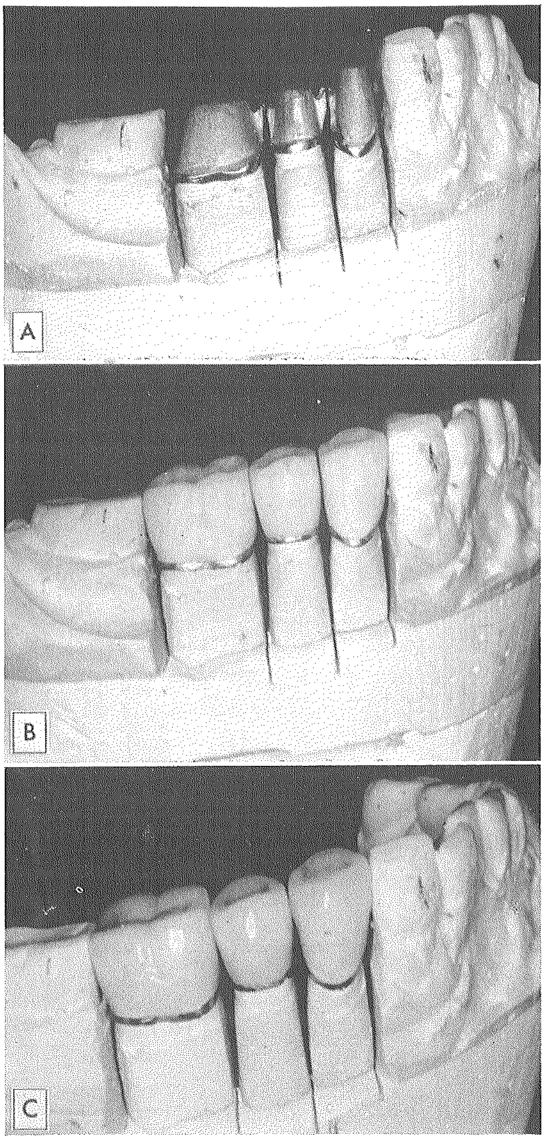


Figure 95. Three porcelain fused to gold crowns. *A*, Cast gold copings with metal collars in the shoulderless preparation. *B*, Biscuit bake porcelain to gold restorations should be tried on the teeth. *C*, Completed crowns with visible small metal collars. Thinning the gold collar and fusing porcelain over it to hide the gold will create distortion of the completed crown.

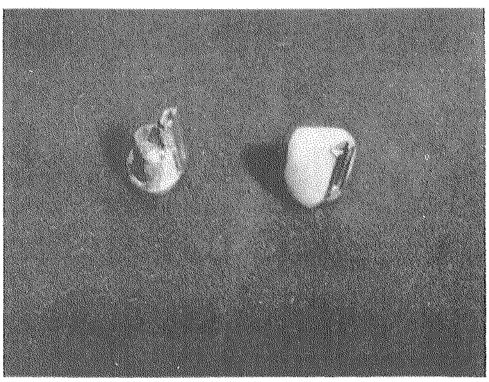


Figure 96. Porcelain fused to a metal coping having an internal female attachment.

incisors are missing in either jaw, and the occlusion permits, a fixed porcelain to metal bridge from canine to canine frequently proves more successful than any other esthetic restoration.

INACCURATE FIT OF THE CASTING

Many of us have had the experience of obtaining a snug, slightly frictional resistant fit of the cast gold coping or cast bridge frame on the prepared tooth or teeth, only to find the same casting fit extremely loosely after the porcelain has been fused to it. Before the common practice of sandblasting the inner surface of the cast coping, the technician was compelled to grind the distorted casting (because of repeated firings over 1800° F.) with burs. Rushing the firing of the porcelain and not allowing gradual slow cooling before removing the crown or bridge from the furnace are contributing factors to an inaccurate fit. We are dealing with two materials—metal and porcelain—and the firing and cooling cannot be rushed. The precious metal is the prime conductor; therefore sufficient time must be allowed for firing and cooling. High fusing porcelain is another reason for a distorted fit. Porcelain that fuses above 1800° F. is not recommended. Owing to the grain growth of crystallization that takes place during repeated firings and coolings, the metal casting is apt to undergo dimensional changes, particularly when the metal is thin.

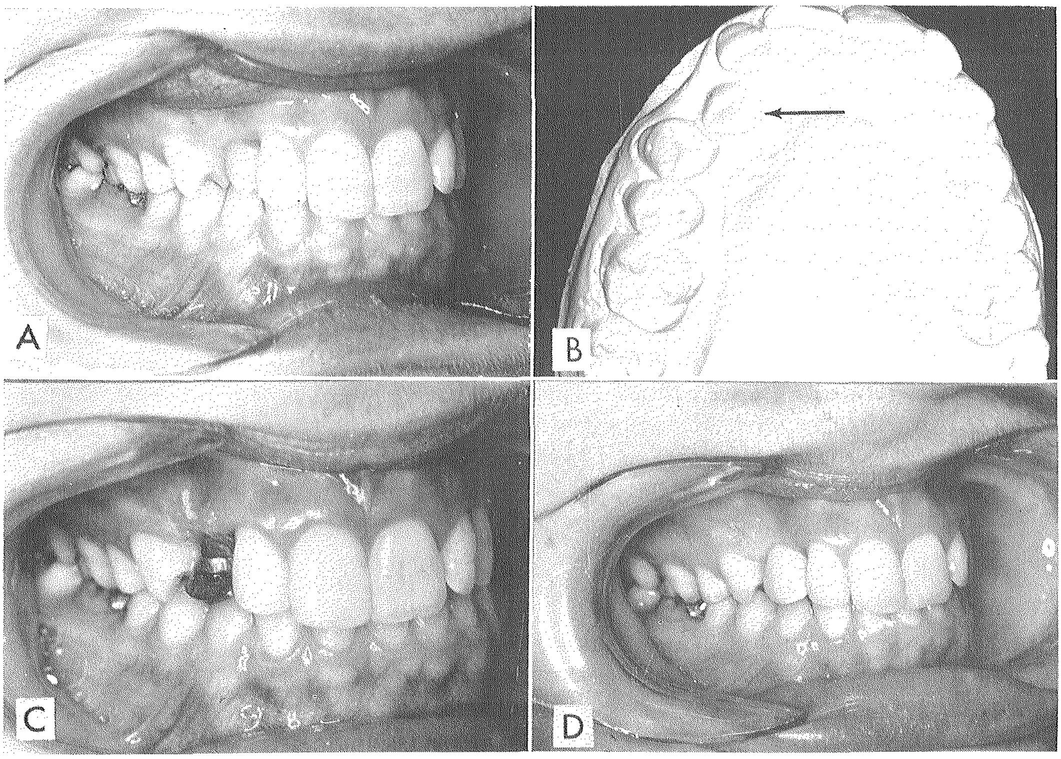


Figure 97. Porcelain fused to gold crown to improve the esthetics in a lingually positioned canine. *A*, Before treatment. *B*, Study cast; note the shortness and marked lingual position of the right canine that did not respond to orthodontic treatment. *C*, Gold casting over a preparation with proximal grooves. *D*, Completed porcelain fused to gold veneer crown.

WAXING TECHNIQUE FOR THE PORCELAIN FUSED TO METAL CROWN

The technique for fabricating the high-melting-range metal coping is as follows:

Wax the coping over the die, using a 30 gauge green wax strip cut to size. Warm the wax gently over the flame and wrap it carefully around the lubricated die, exerting a little pressure. Avoid stretching the wax, and be sure that the overlap is melted and sealed. Tighten the margin with a blue inlay wax bead. Create a heavy tapered shoulder lingually and allow an overlap of a little less than 0.5 mm. over the gingivocavosurface finishing line.

Another method is to cut a piece of 0.001 gauge platinum foil, fold into a tinner's joint, and swage this matrix as is done in the fabrication of a porcelain jacket crown. Melt some blue inlay wax and apply sufficient amounts to the swaged platinum matrix to be able to carve a coping with a shoulder of sufficient thickness. This method assures the operator of a casting without any bubbles or nodules inside the coping. The veneer crown is waxed the same way but without any undercuts in the boxing of the veneer casting.

WAXING TECHNIQUE FOR ONE PIECE CASTING OF A FIXED BRIDGE FRAME

Wax up the abutment retainer copings in the manner just described. Cut a piece of 0.001 gauge platinum foil and lay and burnish lightly over the saddle area of the master working cast alongside the waxed copings. Melt some blue wax over the saddle area to shape a wax pontic core, and seal the mesial and distal areas to the waxed abutment retainers. Remove the waxed frame carefully, trim away all excess platinum foil from the saddle, and try the waxed bridge frame in the mouth for fit. Waxing the retainers over swaged matrices makes for easy handling without fear of crushing the wax. Figure 98 illustrates a patient in whom a lower left premolar was missing. The patient was very concerned with the esthetics of a replacement of the missing tooth. The occlusion permitted the construction of a porcelain fused to metal bridge. The first molar and first premolar were prepared for copings. After impressions, dies, and master casts were constructed, the three unit waxed bridge frame was tried on the prepared teeth for fit. This accurately fitting waxed frame was invested and cast with a high melting range gold, and was tried on the teeth. Ceratex porcelain was then fused to the frame and after the biscuit bake restoration was tried on the teeth again, it was glazed and cemented.

DEFICIENCIES IN A SOLDERED BRIDGE TO WHICH PORCELAIN IS FUSED

Technical and clinical experience has proved that the one-piece casting bridge (three or four unit only) is superior to the soldered frame for porcelain to be fused to it. A casting is not dependable and may be considered a solid which is distinctly heterogeneous. The grain structure is coarse and inherently porous. Segre-

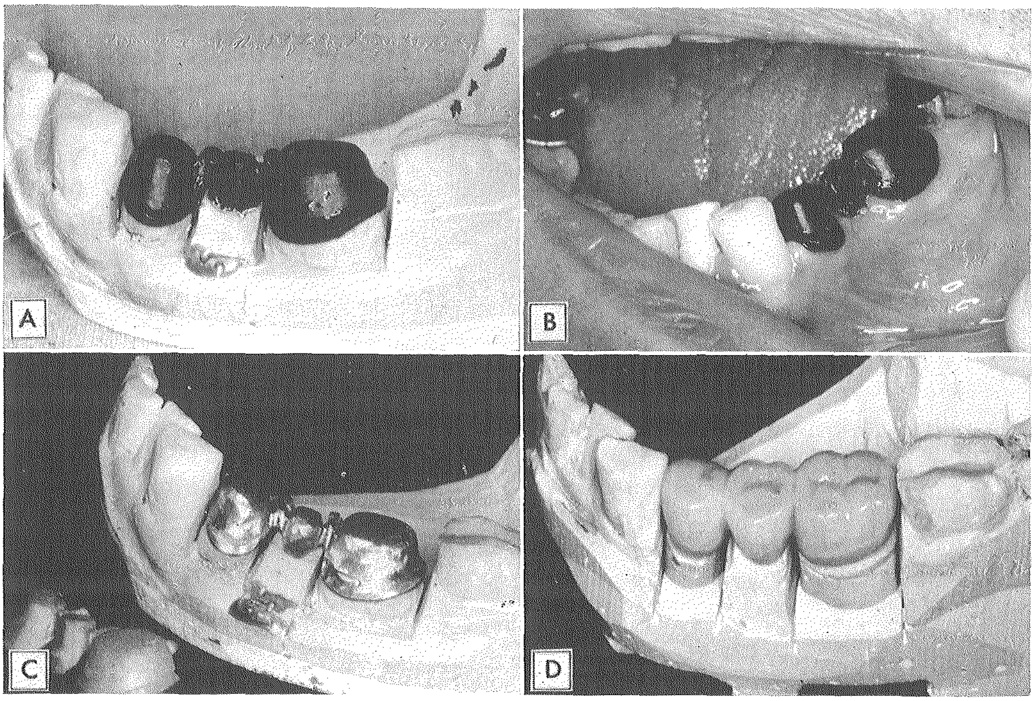


Figure 98. One piece casting, three unit bridge. *A*, Waxed bridge frame on working cast. *B*, The waxed frame is tried on the prepared teeth in the mouth. *C*, Completed casting on working cast. This should also be tried on the teeth in the mouth. *D*, After the biscuit bake, the restoration is again tried on the teeth and adjustments made before the porcelain is stained and glazed.

gation of the alloys takes place in a casting, due no doubt to the fact that the lower fusing and less dense metals liquefy first. There is no known method of determining the physical properties of the *completed* cast dental restoration, such as the proportional limit, Brinell hardness, elongation, and tensile strength. *Comparative data supplied by the manufacturers of dental alloys apply only to the alloys before casting and soldering.* No two castings are exactly alike in their physical properties, and no means are available to test the important characteristic of the completed restorations. Burnishing, grinding, and polishing the casting make the surface appear homogeneous, but the porosity exists under the ground and polished surface nevertheless.

Porosity is even greater in a soldered joint of the fixed bridge. A soldered connection between two metal castings, the abutment retainer and the cast pontic, is not sound and can be considered the weakest part of the bridge. When point pressure is applied to a cast abutment retainer the stress and strain are equalized around the marginal contour. When point pressure is applied to a soldered bridge, a cantilever effect causes deformation in the metal because of the porosity, inferior grain structure, and low proportional limit. Porcelain fused to a cast and soldered bridge frame is adversely affected by deformation of the metal so as to be unable to withstand the strain. Fracture lines and breakage of the porcelain are prone to occur. Furthermore, there is always the possibility of the bridge separating at the soldered joints

(Fig. 99). It is, therefore, beneficial to cast the bridge frame in one piece. However, when a four to six unit porcelain fused to metal bridge is desired, the shrinkage that takes place when casting a large span in one piece is great enough to cause the frame not to seat accurately, and the joints must be soldered. The areas to be soldered should be very small and small amounts of solder should be used (Fig. 100). The gold copings are cast with small cutouts on the surfaces approximating the pontics. The pontics are cast in such a manner with corresponding projections that they will fit loosely into the cutouts of the retainers. This procedure permits the use of small amounts of solder (Fig. 101).*

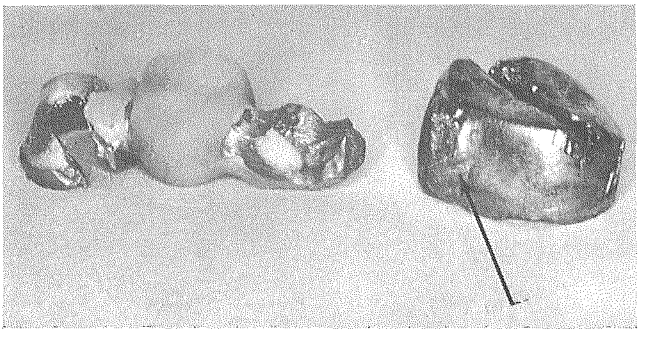


Figure 99. This porcelain fused to metal bridge broke at the soldered connection because of the porosity and voids in the solder joints of a large bridge. Correct solder technique minimizes fracture (see Figure 100).

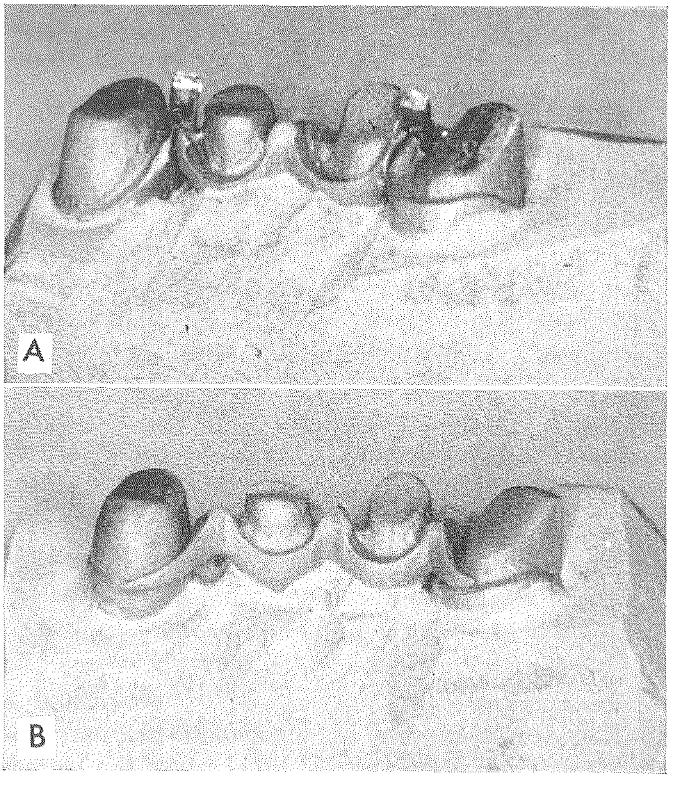


Figure 100. Solder technique (courtesy Nickie) for a porcelain fused to metal bridge frame. *A*, Solder connections confined in cutout receptacles in the abutment retainers. Plentiful yet minimal amount of solder is used which when melted does not flow over other parts of the gold. *B*, Soldered connections not confined but narrow gold arms abut the castings. Solder that flows uncontrolled affects the color of the porcelain and weakens the bridge frame.

* Nickie, Nu-Dent, N.Y.C.

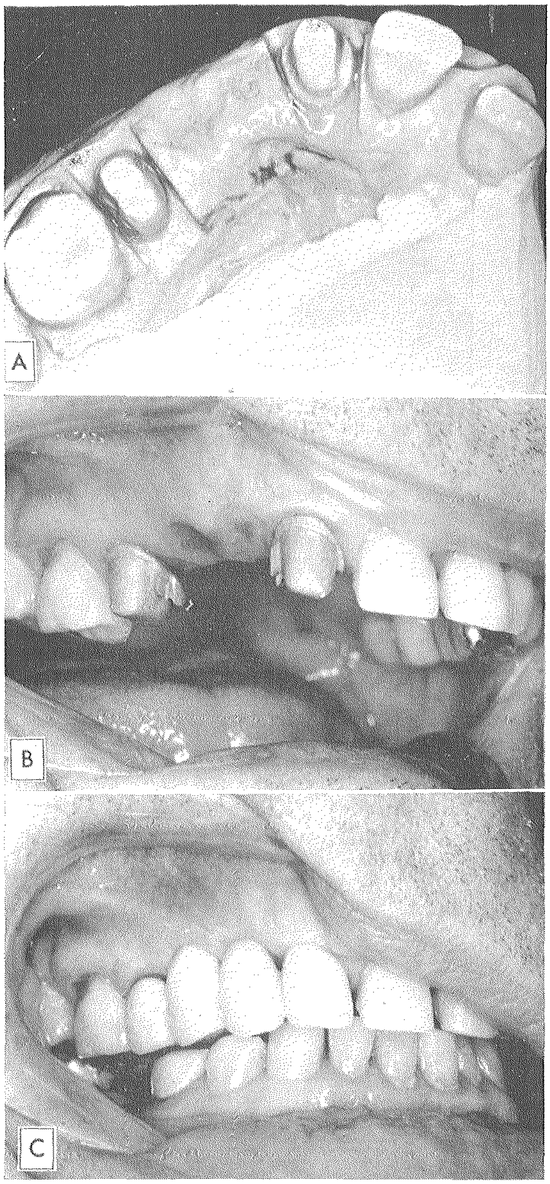


Figure 101. Soldered bridge completed. *A*, Abutment teeth prepared, impression taken, dies constructed, and master cast poured. *B*, The abutment retainer copings with proximal cutouts to receive cast pontic frame projections for better soldering. *C*, Completed four unit porcelain fused to metal bridge. It is not advisable to cast a four unit bridge frame in one piece because of shrinkage and possible distortion.

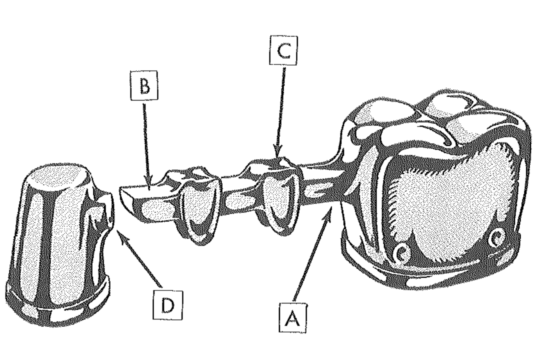


Figure 102. Wrought bar bridge frame for a stronger restoration. *A*, The abutment retainers may be cast to the wrought bar (see text). *B*, The wrought gold alloy bar. *C*, The pontic is cast to the bar. *D*, The receptacle in the free abutment retainer that receives the free end of the bar for soldering.

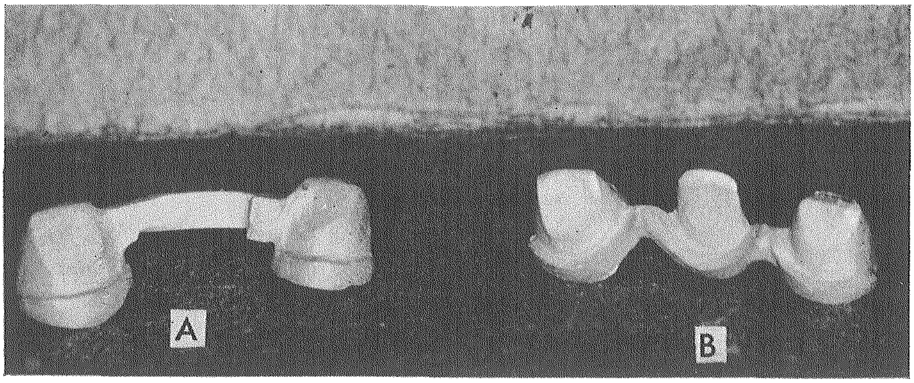


Figure 103. Types of anterior fixed bridge frames. *A*, The wrought bar bridge frame cast with one coping and fitted into a receptacle in the other coping to be soldered. *B*, A one piece three unit cast frame.

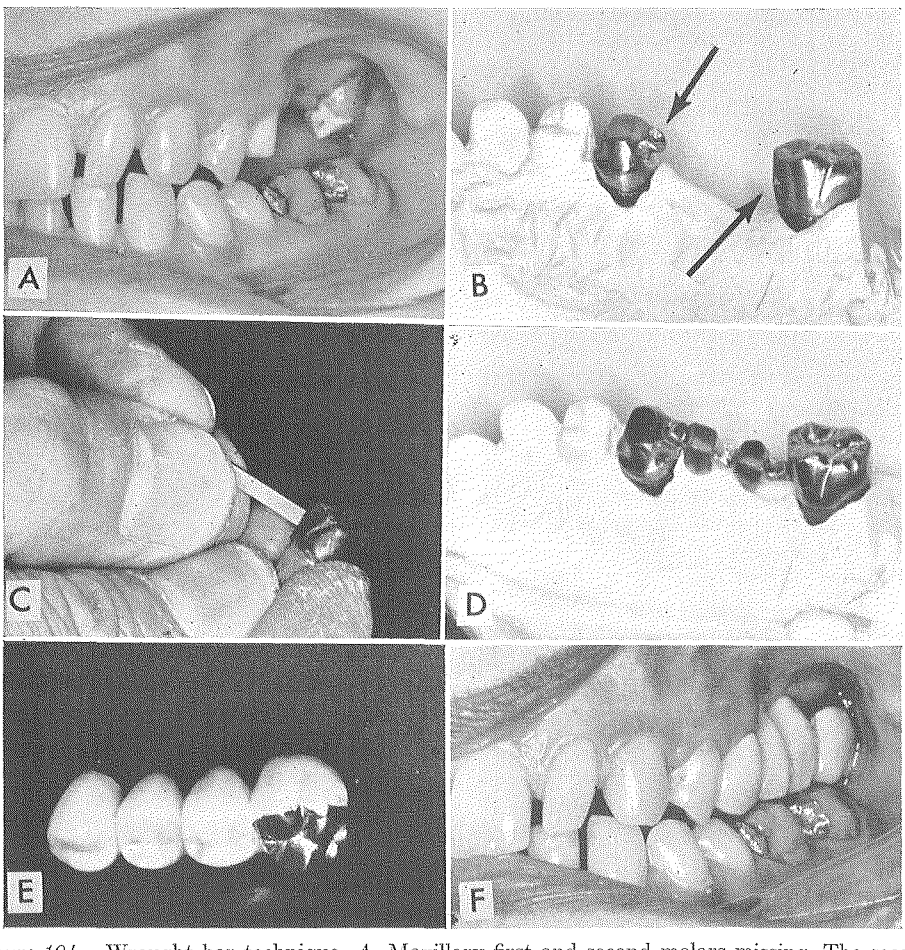


Figure 104. Wrought bar technique. *A*, Maxillary first and second molars missing. The second premolar is prepared for a coping and has a complete shoulder. The third molar is prepared for a veneer crown and has a finishing line except for a slight shoulder on the buccal surface. *B*, Each casting is constructed with receptacles ready to receive the bar cut to size. *C*, Another method of uniting the bar, fitting one end into the wax pattern retainer. *D*, The bar and attached pontic are fitted in the cutouts, then invested and soldered. *E*, Porcelain is fused to the bridge frame. *F*, The completed restoration.

WROUGHT BAR IN BRIDGE FRAME

A wrought metal bar is sound and continuous and not full of holes. Wrought gold alloys are strong and tough and tend to resist shock and fatigue.[4] They yield the maximum mechanical properties. Greater strength, hardness, and elasticity are obtained in the wrought than in the cast form.[6] Figure 102 illustrates a typical bridge frame with the wrought bar to be used in a large porcelain fused to metal bridge. The technique of constructing this type of wrought bar porcelain fused to metal bridge has been described.[1]

INVESTING AND CASTING THE COPING PORCELAIN FUSED TO METAL CROWN AND BRIDGE FRAME

The sprue (10 to 14 gauge) must be free of debris and should not be overheated when inserting it into the thickest part of the waxed coping or waxed bridge frame. Attach the heated sprue carefully to the wax pattern and allow it to cool before releasing your fingers from the sprue. Use a thick sprue or multiple sprues for the bridge frame. Create a small ball of wax on the sprue close to the pattern, to act as a reservoir for the molten gold. In addition, especially for the bridge frame, a dead-end ready made wax sprue is used as an offshoot to act as a vent for the collection of gases when the molten gold is cast. Invest the waxed frame or coping with cristobolite model investment, using the double mix technique. Be mindful, when the coping is waxed over a swaged platinum matrix, that no bubbles or nodules appear on the inside. When the investment has set completely, burn out the wax pattern between 1100 and 1300° F. An oxygen and gas blow torch or its equivalent must be used to melt present-day high-melting-range gold alloys. Because of the high specific gravity of the precious metal, the molten gold alloy will appear sluggish but will cast readily. After casting, allow it to cool thoroughly before opening the ring. Plunge and clean the casting in water or in one of the available ultrasonic cleaners. Trim and grind the metal casting with small stones and burs.

PREPARING THE CAST METAL COPING OR BRIDGE FRAME TO RECEIVE PORCELAIN

After the metal coping or bridge frame has been sandblasted on the outer surface for better retention of the porcelain, the casting is placed in a 5 or 10 per cent solution of ammonium hydroxide and brought to a boil. The operator now has a clean metal frame, free from oils, debris, and silica, that is ideally receptive to the recommended bonding agent or opaque porcelain. Manufacturers usually recommend their favorite bonding agent or gold color material to be fired to the casting. The bonding agents are wetting agents that overcome the adverse effect of the surface tension, provide a treated surface on the metal frame (coping) to which porcelain can adhere more tenaciously, and improve the color by masking the dark metal. The bonding agent is placed over all surfaces of the coping or bridge frame that will receive porcelain. The operator is advised to follow the directions recommended by the manufacturer regarding its application and firing temperature.

APPLYING THE OPAQUE PORCELAIN

Cleanliness is requisite in producing a satisfactory ceramic restoration. The baking should be accomplished in a room free from dust-producing laboratory procedures. A clean bench, clean hands, and clean instruments are necessary. Apply the opaque mix to firing temperatures recommended by the manufacturer of the porcelain being used. Make sure there is an even layer of opaque porcelain over all desired areas. For best results, allow the restoration to cool thoroughly before removing it from the furnace.

APPLYING THE REGULAR PORCELAIN

You are now ready to apply the porcelain to the opaqued bridge frame or coping. Clean the restoration in the ammonium hydroxide solution, rinse in clear water, and dry in air. Select the desired shade of gingival (body) color porcelain and make a slightly moist mix with *distilled water*. Apply this mix with a small brush and a spatula over the entire coping or metal bridge framework. Vibrate occasionally with the serrated instrument. Build up the mix to the full contours of the teeth, abutment retainers, and pontics. With a small fine sharp lancet, remove a layer of porcelain where the incisal or occlusal porcelain will be placed. Taper the body or gingival applied porcelain mix so that no sharp line of demarcation will exist between the gingival and incisal or occlusal porcelain on the buccal or labial or occlusal surface. On the bridge, separate each pontic and abutment retainer with a small carving blade by drawing the blade through each interproximal area to give the semblance of individual teeth. Place the bridge in a sagger stand and the

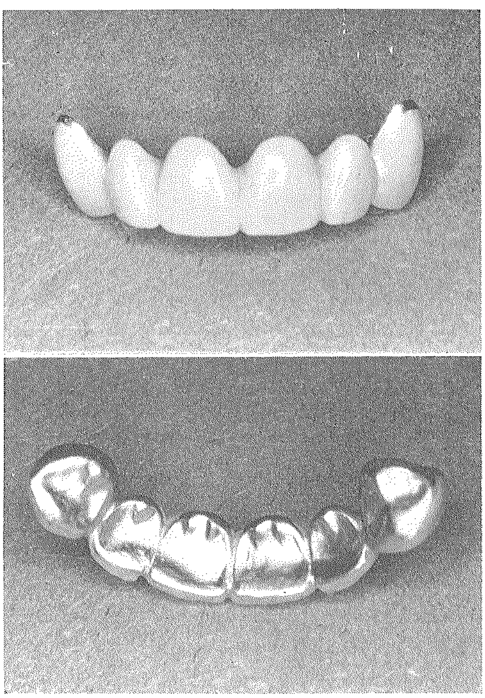


Figure 105. On anterior teeth, where the occlusion does not permit porcelain on the lingual surfaces, the abutment retainers and pontics are constructed with cast gold of a high melting range. Porcelain is then fused to this gold frame.

individual crown on a sagger cone and preheat in the open door furnace. Moisture elimination from the porcelain is best accomplished slowly by heat conduction in room atmosphere from the tray or stand to the metal, to the porcelain. Range from 0 to 500 ° F. in five minutes or longer, depending upon the size of the restoration.

When dry, close the furnace door and bring to a low biscuit bake, at the temperature recommended by the manufacturer of the porcelain used. *Allow the crown or bridge to cool slowly and completely, preferably in the furnace after the current has been turned off.* I am aware that this recommendation may not be feasible in large commercial laboratories. Nevertheless, it is better for the restoration because the length of time for cooling the two different materials must be prolonged. Make the required corrections in the biscuit bake and try the restoration in the mouth for fit and occlusal adjustments. Add additional incisal and body porcelain where needed and complete the restoration in the furnace. Glaze at temperatures recommended by the manufacturer, and cool thoroughly.

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6

REMOVABLE PARTIAL DENTURES WITH INTERNAL AND EXTERNAL PRECISION ATTACHMENTS

Removable partial dentures with clasps have been described by other authors and it is not the intention to include this phase of restorative dentistry in this text. The clinical management of the internal and external precision attachments will receive consideration because of the excellent role these retainers play in occlusal rehabilitation. *A direct retainer* is that unit of the partial denture which engages the abutment tooth in such a manner as to resist dislodgement.[2] Exclusive of the clasp, the direct retainers used in removable partial dentures are the internal and external precision attachments. The *indirect retainer* is that unit of the partial denture which rests upon suitable surfaces of the teeth which are located as far as possible from the free end of the base, so that movement of the base away from the surface of the supporting tissue is resisted (Fig. 106).[3]

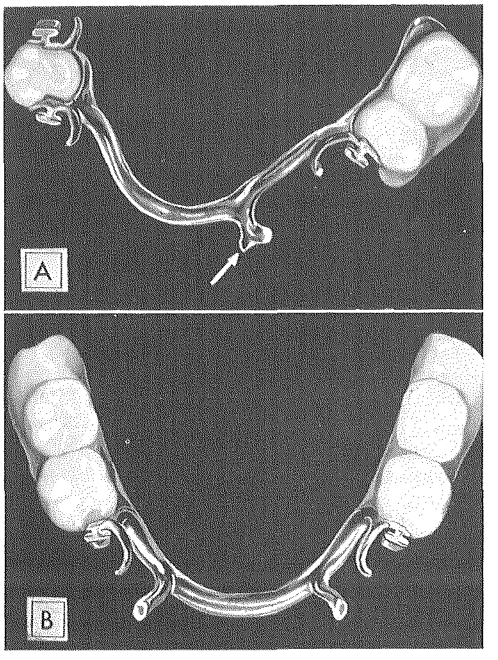


Figure 106. Indirect retainers. *A*, A single indirect retainer on the side of the distal extension base. *B*, Double indirect retainers in bilateral distal extension bases.

ADVANTAGES AND DISADVANTAGES OF THE INTERNAL ATTACHMENT

It has been proved clinically that there is less strain on the abutment teeth when inserting or removing a properly constructed removable partial denture with internal attachments. No doubt this is due to the fact that the attachments are parallel to each other and offer no resistance to the curvatures and contours of the abutment teeth, as do the clasps. Inasmuch as stress is distributed over the entire structure, the abutment teeth help support each other. The partial denture with internal attachments satisfies the esthetic requirements better than any other type. There is no buccal or labial clasp arm visible to make it obvious that the patient is wearing artificial teeth. In a mandibular removable partial denture, the cast occlusal surface of the retainer and its accommodating slot portion of the attachment are noticeable. The full coverage retainer, however, may be constructed of porcelain fused to metal. In this type of retainer, only the top of the metal face in the boxing of the attachment is visible (Fig. 107), and it appears as a small metal occlusal restoration on the tooth.

It is an accepted fact that tissues respond favorably to intermittent compression but not to continued pressure. In a precision attachment partial denture, the denture base offers slight yet sufficient movement tissue-ward. This movement creates enough compression to stimulate and benefit the mucosa. The technician is cautioned not to scrape the working cast in the construction of the denture bases and bars lest the tissues become red and inflamed owing to overcompression. The compressed tissues offer resistance and tend to create a movement of the partial denture. The patient requests that the attachments be tightened, and, as a result of such tighten-

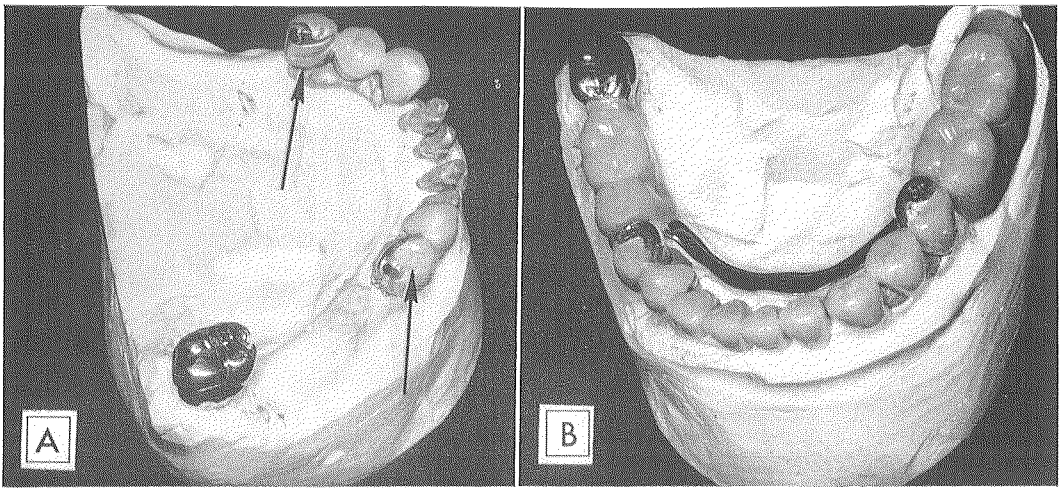


Figure 107. *A*, A lingual arm can be used on the porcelain fused to metal abutment retainer. *B*, When the removable partial denture with internal attachments slides into place, only the lingual surface of gold is visible.

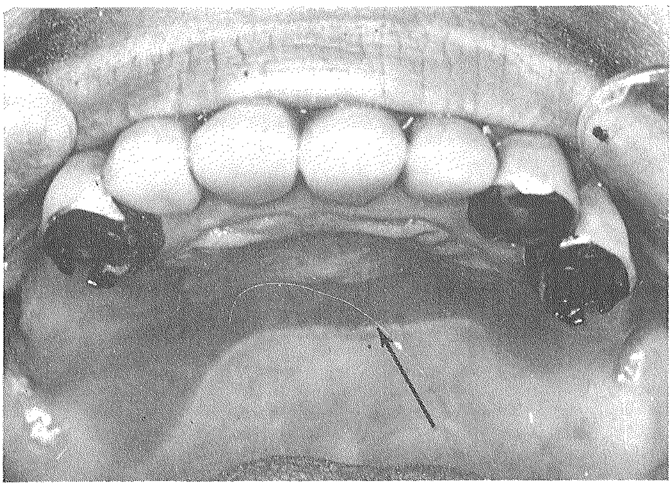


Figure 108. Inflamed tissue due to overcompression and lack of oral hygiene. The technician is cautioned not to scrape the working cast too much in the construction of the denture base. The compressed tissues offer resistance and tend to create movement of the denture. The patient requests that the attachments be tightened, and as a result of such tightening, the tissues remain under compression and become irritated and inflamed.

ing, the tissues can no longer move the partial denture but remain under compression to become irritated and inflamed (Fig. 108).

The force of mastication is tolerated with less damage to the abutment teeth because each male portion of the attachment rests upon the floor in the reinforced plate of the female boxing, at right angles to the long axis of the tooth. Another advantage is that the abutment teeth are in stress only when force is applied during function of mastication and deglutition. An abutment tooth may be considered as being under constant stress when circumscribed with a clasp.

There are a few disadvantages in an internal attachment removable partial denture. It is more often necessary to resort to a full coverage restoration such as the full cast gold or veneer crowns as the abutment retainers. The visible gold occlusal on a veneer retainer on a canine or a premolar in the lower jaw is esthetically objectionable. For some patients, this form of restoration is too expensive. The attachments wear and eventually become loose. Continual spreading of the male attachment to overcome looseness frequently results in breakage of that attachment. Many of these shortcomings, however, take place after years of use. The esthetic problem can be overcome by using porcelain fused to gold or acrylic resin cured to gold abutment retainers.

DECIDING UPON A PARTIAL DENTURE WITH INTERNAL ATTACHMENTS

Before the operator commits himself to recommending a partial denture with internal attachments he must be sure of the following:

1. The abutment teeth must be or can be made long enough to accommodate such attachments.
2. The abutment teeth must be strong and have sufficient supporting bone.
3. If the partial denture is to be an upper distal extension case, the operator must be sure there are no osseous undercuts around the tuberosities.
4. The patient must be prepared to accept a removable partial denture.
5. The patient must be able to finance this type of dental treatment.
6. The operator must determine whether it is necessary to insert a fixed bridge along with the removable partial denture to avoid saddles anterior and posterior to one or two abutment teeth.

TYPES OF INTERNAL ATTACHMENTS

An internal attachment can be a deep cast dovetail lug which fits into a counterpart receptacle in the abutment retainer. A frictional fit helps retain the removable partial denture. There are, however, factory-made internal attachments that are frequently used (Figs. 109 and 111). To better understand the internal attachment, it is advisable to familiarize oneself with its components. Basically, the direct retainer constructed by various manufacturers is the same. The difference for the most part is in the slot or slots, which are designed for tightening the male segment by spreading. The internal attachment consists of a male and a female portion and is manufactured for molar, bicuspid, and anterior teeth or large, medium, and small sizes. The female section is a high-fusing metal alloy boxing attached to a reinforced plate. This boxing and plate, when soldered to the abutment retainer, receives the male portion of the attachment. The floor of the boxing is almost at right angles to the long axis of the tooth and to any force applied in that direction. This arrangement, when the male segment is inserted, is kind to the health and stability of the abutment teeth. The male section consists of a metal alloy face with a slot or slots connected to a proximal contact plate or shank. The proximal contact shank is soldered to the metal frame of the removable partial denture.

The constant removal and insertion of the partial denture is bound to result eventually in a loose attachment fit. Each manufacturer makes provisions in the male section so that the operator can expand the slots. It is not advisable to spread the attachments until the patient has worn the partial denture for an extended period. The patient is then accustomed to the insertion, the removal, and the general

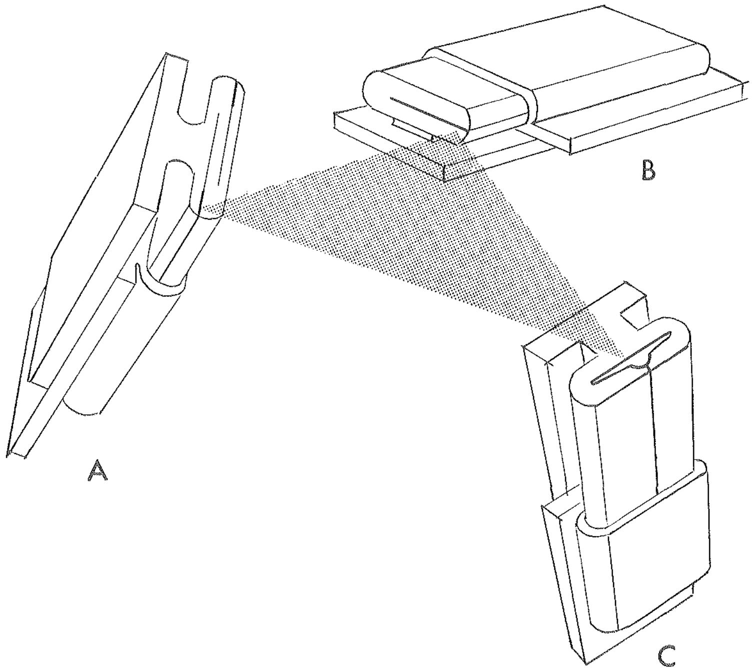


Figure 109. *A*, The Stern Type 7 attachment has two expansion slots on the face of the male attachment. *B*, The Baker attachment has the slot for spreading on one side only. *C*, The Ney-Chayes attachment has a single expansion slot with an angular opening.

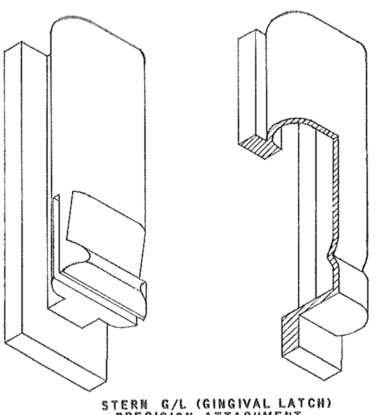


Figure 110. A special calibrated tool must be used in the Stern Latch Attachment. The tool has five numbered blades of different thicknesses.

management of the attachment restoration. Too tight a fit may eliminate some of the benefits of the internal attachment partial denture. Furthermore, continual spreading of the face of the male attachment may cause it to separate and snap off.

Spreading of the female attachment is brought about by the application of excessive force on the male attachment. This effect can be due to improper insertion of the removable partial denture or because the male attachment is not in correct occlusion. Biting down upon the partially seated denture to obtain complete insertion is a damaging habit. The sudden inaccurate pressure upon the male attachments by the opposing teeth tends to direct the male attachments in such a manner as to spring the female attachments. Check the occlusion carefully after the construction and insertion of the partial denture with internal attachments. If the male attachments meet the opposing teeth first, all of the force in closure will be directed primarily upon the male attachment that is "high" and will cause springing or spreading of the female attachments.

The Stern Type 7 attachment has two expansion slots on the face of the male attachment. To expand it, the operator must press a razor blade or similar instrument into a corner of each slot, then straighten it to full length. A newer type of attachment by the same manufacturer is the G. A. attachment (Fig. 112). This type has a beveled gingival edge which is supposed to make for easier insertion. The slot is on the gingival portion and retentive pressure within the female segment is confined to the area where that segment is the strongest and least subjected to distortion.

Stern G/L (Gingival Latch) attachment (Fig. 110) is recommended for short abutment teeth and for lingual areas of the pontic of a fixed partial denture. The adjustment slot is at the gingival border. The male consists of a tapered spring leaf, so designed as to produce efficient distribution of stresses during function. The gingival end of the spring leaf is formed into a retaining latch. The edge is beveled to permit easier insertion. The female attachment has a ridge which engages the spring-leaf latch when the male is seated fully.

The Ney-Chayes attachment has a single expansion slot in the male segment, so

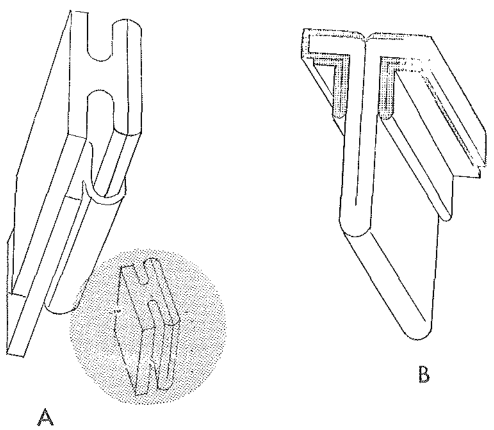


Figure 111. *A*, The Brown attachment has a single slot from above downward that does not extend all the way down and is solid at the base. *B*, The Williams attachment (designed by Dr. George M. Hollenback) has a wing thickness less than the other attachments. The male portion has the slot in the shank, resulting in control of the entire surface of the friction plate against the female slot.

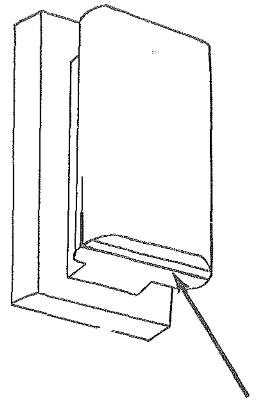


Figure 112. The Stern-Goldsmith G. A. attachment has a beveled gingival edge that is supposed to make for easy insertion.

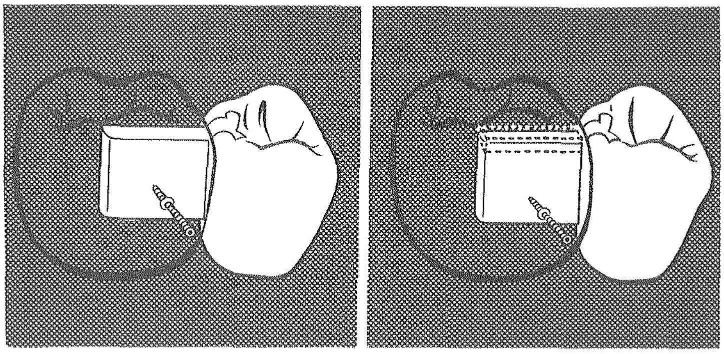


Figure 113. The Williams precision attachment. The extension arm is held within the pontic by a lock screw. When the restoration is completed, the operator makes two simple adjustments to provide for necessary vertical movement. The occlusal edge of the extension arm is reduced 0.2 to 0.7 mm., depending upon the type of tissue in the saddle area, thus allowing for vertical movement. The extent of movement is precisely controlled by the relief of the extension arm. The saddle simply rides up and down on the screw, while the extent of movement in all directions is controlled by the extension arm itself.

manufactured that an adjustment tool shaped like a needle can be inserted to open the slot a trifle. This angular opening is spread only on the occlusal end, which assures easy insertion.

Ney-Chayes split lingual attachment is a modified No. 9 Chayes attachment especially indicated where a combination of fixed and removable partial dentures is indicated. The split lingual attachment for the removable partial denture is inserted in the lingual area of the pontic of the fixed partial denture. The modification was made on the female portion of the attachment in the form of a wider reinforcing plate. This plate is soldered to the existing proximal plate. A shank type male is utilized, rather than the proximal contact male. The lingual arm, if desired, is close to the usual male attachment and prevents access to the slot for necessary adjustments. This split lingual attachment is placed so that the slot is accessible.

The Brown attachment has a single slit from above downward, in the male segment. This slit does not extend all the way down and is solid at the base. It may be spread without enlargement at the base.

The Baker attachment has the slot for spreading on one side only. The male section has a "skirt" or friction plate on both ends. This feature allows the technician to use the attachments in left, right, upper, and lower positions. The undesired part of the "skirt" is cut off during the construction of the partial denture.

The Williams attachment (designed by Dr. George M. Hollenback) has a wing thickness less than the other attachments. The male portion has the slot in the shank; this results in contact of the entire surface of the friction plate against the female slot and minimizes stress at any individual point. This attachment is held in place either by soldering or by the use of a set screw against an extension arm, inserted either from the lingual or through the base of the metal saddle of the denture (Fig. 114). When the shank is cut down a bit it is recommended for a distal extension case. This arm may be adjusted to either occlusal or ridge areas. By relieving the upper border of the extension arm very slightly, vertical motion of the denture is controlled. There is a Williams attachment with the *short arm*, primarily recommended for conventional tooth-bearing attachment cases. This type is only

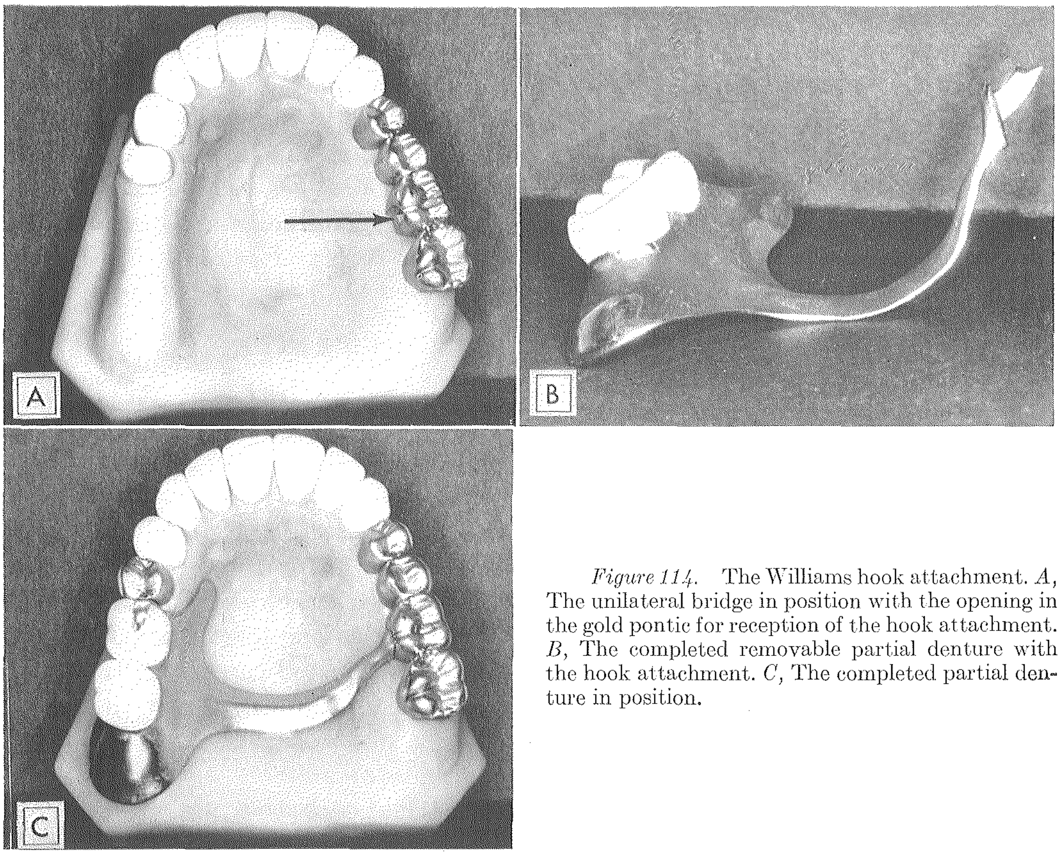


Figure 114. The Williams hook attachment. *A*, The unilateral bridge in position with the opening in the gold pontic for reception of the hook attachment. *B*, The completed removable partial denture with the hook attachment. *C*, The completed partial denture in position.

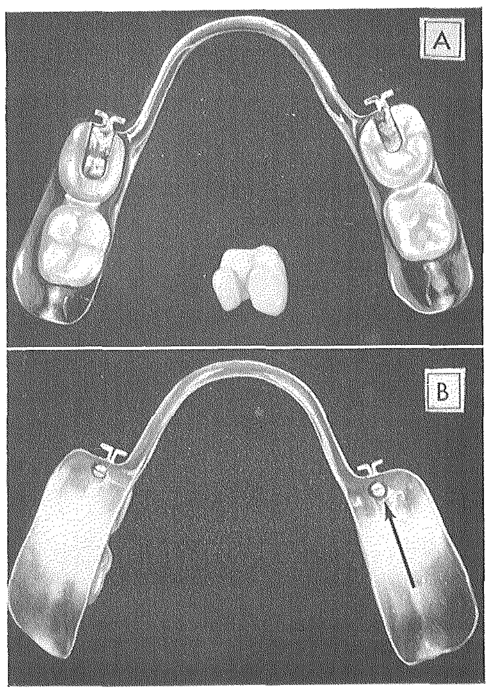


Figure 115. The Williams attachment (designed by Dr. George M. Hollenback). *A*, This attachment is held in place either by soldering or the use of a set screw against an extension arm, inserted from either the lingual or through the base of the metal saddle. *B*, The shank of the attachment is cut down a bit in a distal extension case. The set screw is on the base of the saddle.

two-thirds the thickness of conventional attachments, permitting practically complete incorporation within the normal contour of the abutment retainer. The Williams attachment with the long arm with a tube and screw is highly recommended in free-end saddle cases and provides proper load distribution through controlled, independent, vertical movement of the saddle, while avoiding any movement within the attachment itself. The entire saddle moves in the same plane, hence there is no hinge or lever action (Fig. 115). For unilateral cases, the Williams hook attachment can be used (Fig. 114).

CHOICE OF ABUTMENT RETAINER

The abutment tooth must have good bone support and the clinical crown should be of sufficient length to receive the full value of the attachment. If the tooth is short, exposing more of the clinical crown is recommended by cutting the gingival tissue away from the neck of the tooth. If the root is short, then double abutment retainers are indicated. The full coverage restoration is the retainer of choice to receive the internal attachment. A three-quarter crown or gold inlay is often separated from the cementing medium and marginal decay is apt to set in. However, some skilled operators have had excellent results in selected cases with the three-quarter crowns. The full coverage retainer has a cutout area to house the female boxing. This boxing is placed so as to be within the normal contour of the tooth. Sufficient tooth structure is removed from the abutment tooth so that the completed retainer and boxing can be constructed close to the normal form and anatomic contour of the natural tooth. The most common retainers are the full cast gold crown, the veneer gold crown with the acrylic resin facing, and the porcelain fused to metal restorations.

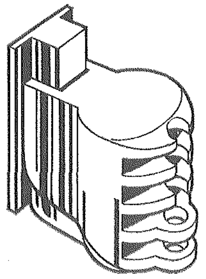


Figure 116. The Dalbo external attachment and distal extension stressbreaker.

PARTIAL DENTURE DESIGN

PLACEMENT OF THE INTERNAL ATTACHMENT

The internal attachment may be placed on the mesial surface, the distal surface, and on both mesial and distal surfaces of the crown retainer. Quite often it is housed in the pontic of a fixed partial denture. On rare occasions, the attachment may be placed on an artificial tooth cantilevered from a splint. When four to six anterior teeth are to assist in supporting a removable partial denture, it may be feasible to cantilever an extra tooth to house the internal attachment. It is necessary, however, to splint the anterior teeth together. In addition, it is advisable that there be a posterior tooth on each side to help absorb the stress. The procedure of cantilevering an extra tooth to house an attachment is not usually recommended on a distal extension case, because the denture base will have a "pump handle" effect on the anterior teeth which will sometimes cause pain and discomfort. Despite the fact that the abutment teeth are splinted together, damage to the underlying bone around the nearest abutment tooth supporting the cantilever tooth is apt to take place.

Depending upon the individual case, the dentist is compelled to compromise sound judgment to satisfy the esthetic demands. The maxillary canine and lateral incisor abutment teeth in a splint would have to be wider distally and unlike the anatomical forms of similar teeth in order to house the female attachments. When these teeth are pulpless, sufficient room can be made in the preparation. A fixed cantilever pontic, soldered or cast, on such teeth makes it possible to maintain the original anatomical forms (Fig. 118). Continued lever action of the partial denture on the free-end pontic has a tendency to cause the cementing medium in the splint to break away from the preparation. The patient who insists upon esthetics in such

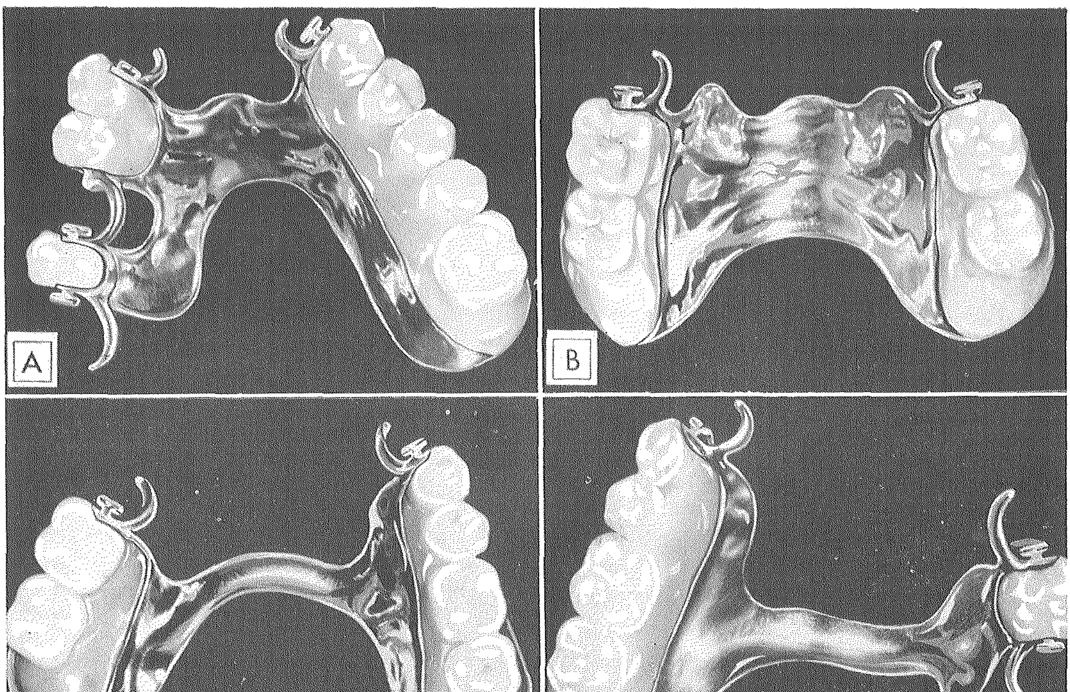


Figure 117. Partial denture design in the upper jaw (types of palatal bases for internal attachment removable partial dentures). *A,* The bar is closer to the anterior part of the jaw. *B,* A broad palatal bar toward the distal part of the maxillae. *C,* A narrow palatal bar situated in the center of the palate. *D,* A narrow palatal bar situated in the distal part of the palate.

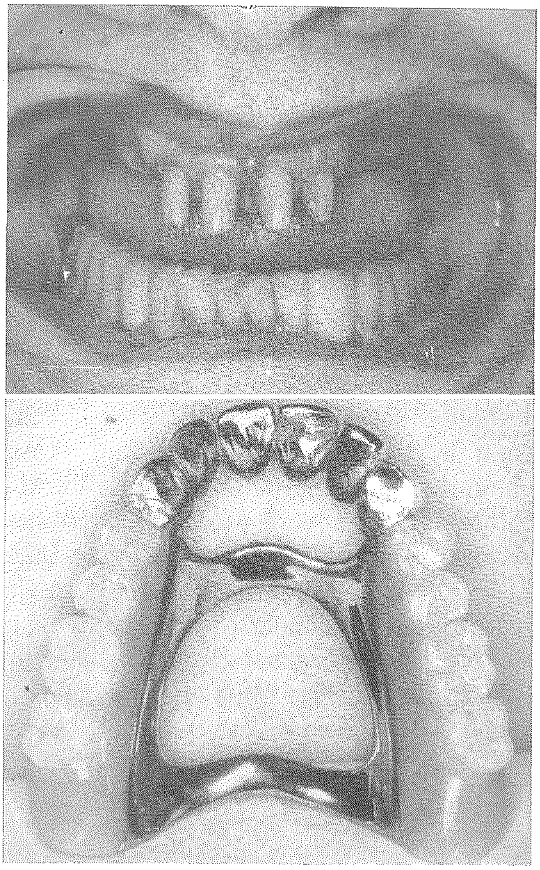


Figure 118. Four maxillary incisors splinted with veneer crowns and a canine pontic cantilevered off each lateral incisor of the splint. This procedure contributes to good esthetics; however, the stress on the cantilever canines creates a "pump handle effect" which frequently breaks the cementing medium and part of the splint loosens.

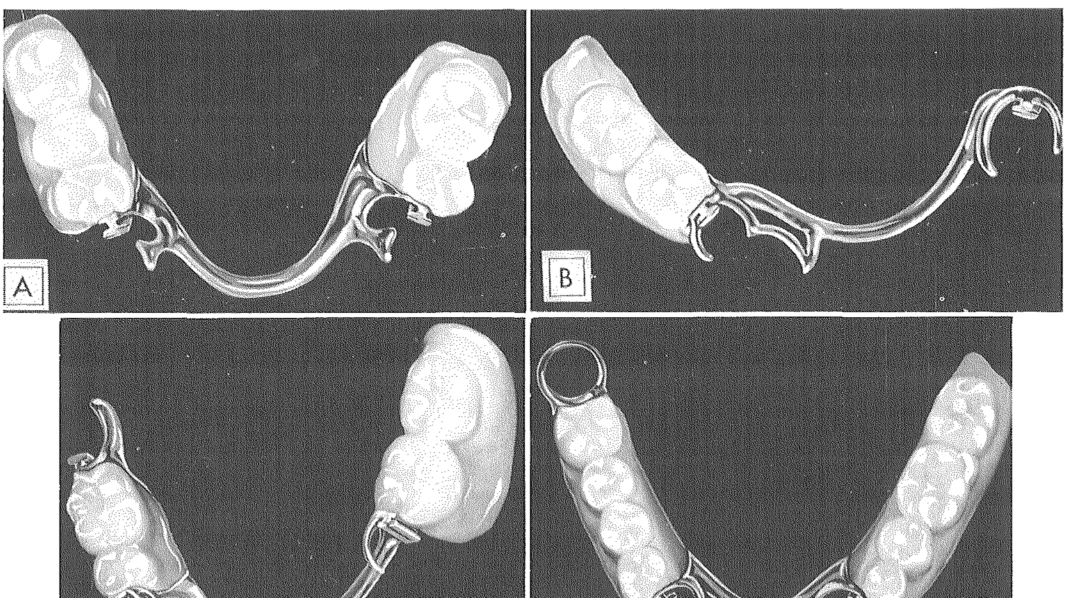


Figure 119. Partial denture design in the lower jaw. *A*, A bilateral distal extension case may have two indirect retainers. *B*, Design for a unilateral case for a patient without one side of the jaw. (Part of the ramus was removed because of carcinoma.) *C*, Unilateral distal extension case. *D*, Another unilateral distal extension case with a ring telescope clasp. (Courtesy Dr. Saklad and John Luft.)

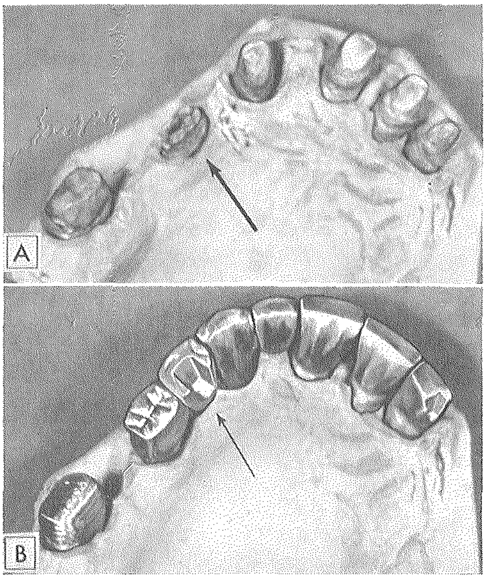


Figure 120. Long-range planning. *A,* The maxillary right second bicuspid is a pulpless tooth. There is always a possibility that it will react unfavorably. *B,* It is advisable to utilize the pontic casting of the fixed bridge to receive the female attachment. Should the pulpless tooth require removal it will not be necessary to remake any of the attachments. A tooth can be added to the denture.

a case must be advised of this possibility. Perhaps the thought of the splint becoming loose from the abutment teeth may convince that patient that function and retention of the remaining few teeth should receive preference over esthetics.

In Figure 120 one of the remaining teeth, the maxillary right second bicuspid, is a pulpless tooth. Although at the time of the construction of the removable partial denture this tooth was in a satisfactory condition, there is always the possibility of its reacting unfavorably. For this particular patient, it is advisable to utilize the pontic casting to receive the female boxing and corresponding male attachments. This pontic is a part of a fixed partial denture extending from the pulpless second bicuspid to the left lateral incisor. A partial denture is constructed with the internal attachments on the second molar, the first bicuspid pontic, and the lateral incisor on the left side. Should the pulpless tooth require removal it will not be necessary to remake or replace any of the attachments. A tooth can be added to the denture to replace the extracted second bicuspid. The location of the attachment on the pontic tooth of the fixed bridge is closer to the left edentulous area and affords better denture support. Figure 121 illustrates the completed partial denture.

When a single narrow pontic is to receive two male attachments the pontic becomes much narrower. One of the male attachments can be inserted slightly lingual into the abutment retainer (Fig. 122). This procedure makes insertion and removal less difficult and does not reduce the mesiodistal width of the occlusal surface of the pontic. The design for a removable partial denture on an upper jaw with a deep vault-like palate should not be a palatal bar, if possible. The horseshoe design should receive preference (Fig. 136B).

SPURS AND SPRING ARMS

Sometimes a little metal projection in the casting on the partial denture will make it possible for the patient to start the removal of the partial denture with ease

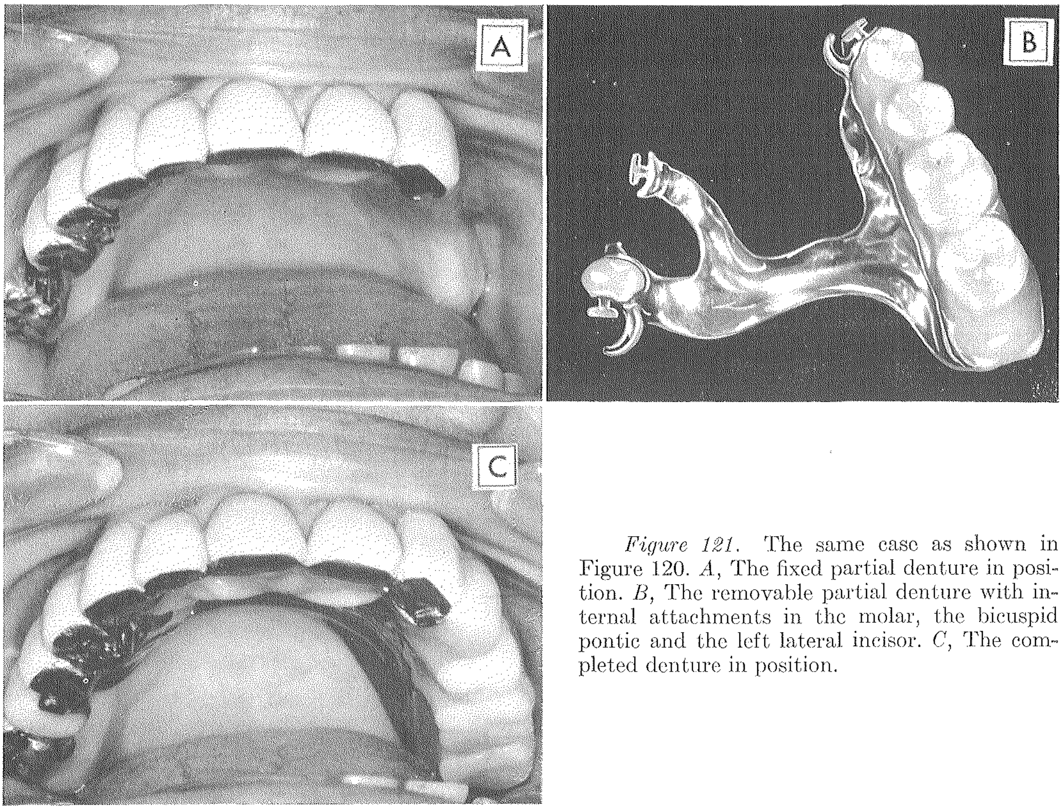
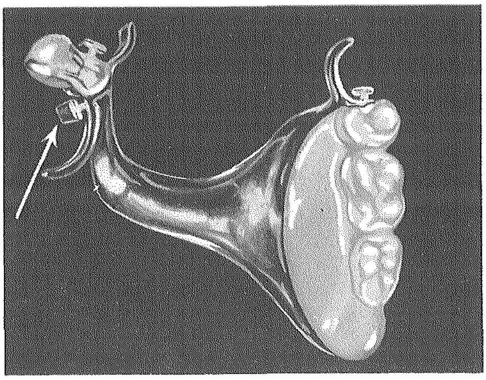


Figure 121. The same case as shown in Figure 120. *A*, The fixed partial denture in position. *B*, The removable partial denture with internal attachments in the molar, the bicuspid pontic and the left lateral incisor. *C*, The completed denture in position.

Figure 122. When a single narrow pontic is to receive two male attachments, the pontic tooth becomes much narrower. One of the male attachments can be inserted slightly lingual in the abutment retainer.



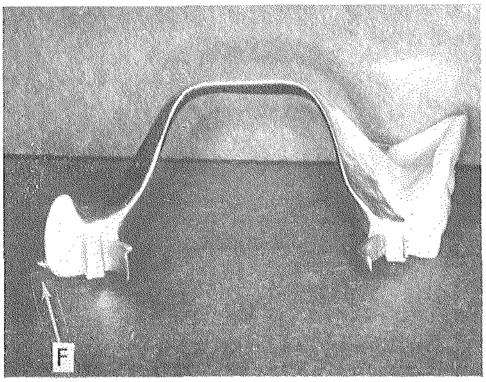


Figure 123. Finger spur on the removable partial denture. A single pontic tooth is practically wedged between two abutment retainers, making removal rather awkward and difficult. A little gold spur (*F*) attached to the casting makes it possible for the patient to start the removal of the partial denture.

(Fig. 123). In this case, a single pontic is practically wedged between two abutment retainers, making removal rather awkward and difficult. Figure 124 shows another example in which an additional device is used to facilitate removal. Provision is made in the occlusal surfaces of the castings to accommodate a spring arm with a small spur so that the patient can start the downward movement of the partial denture with the index finger.

A canine that has to be used to receive a retainer with an attachment must, because of the necessity of accommodation, have a casting that alters the occlusal anatomic form of the tooth. The canine is conical and it will have to be modified to appear almost like a bicuspid. This procedure enables the retainer to house and

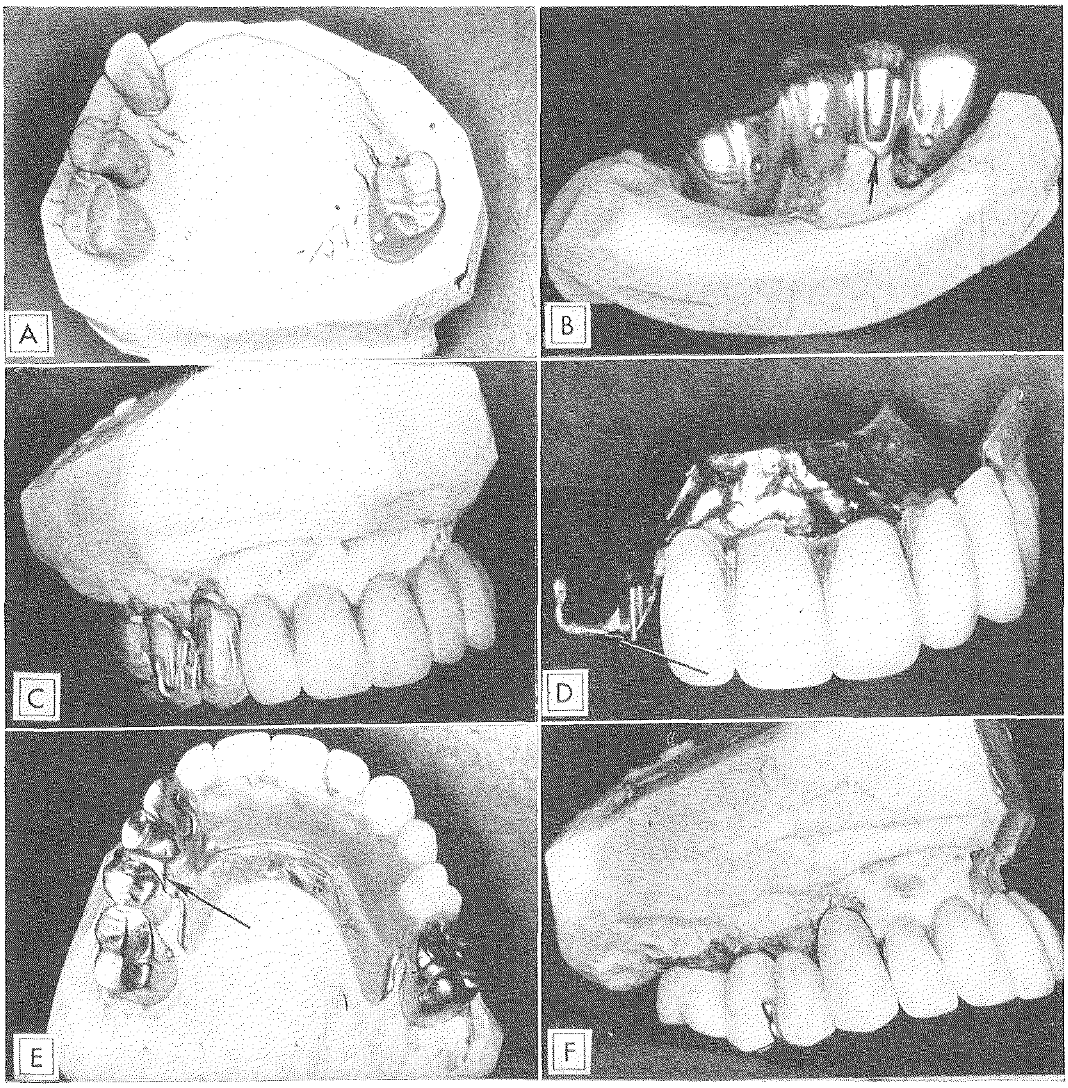
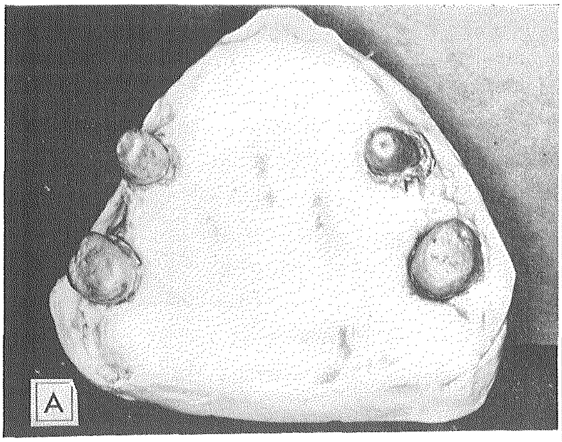


Figure 124. The spring arm for easy removal of the denture. *A*, The abutment retainers in position. *B*, Completed fixed partial denture with cutout in the pontic for the internal attachment. *C*, Incompleted fixed and removable partial dentures on the working cast. *D*, The partial denture with the spring arm for easy removal. *E*, Occlusal view of the spring arm set into a recess on the occlusal surface of the fixed bridge so that it does not interfere in the occlusion. *F*, The completed restorations.



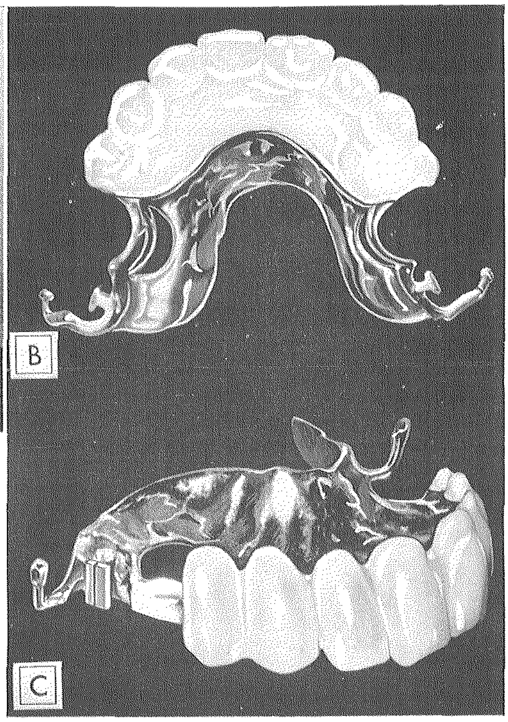


Figure 125. Bilateral spring arms. *A*, When fixed bridges are inserted on the right and left sides, the removable partial denture will be difficult to remove. *B*, *C*, The completed removable partial denture with right and left spring arms.

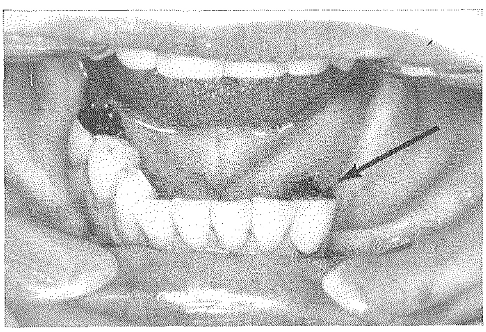


Figure 126. A mandibular canine receiving a precision attachment will have to be wider toward the lingual and will display the gold of the retainer. The change in anatomic form and the visibility of the gold are factors to contend with when the patient is fussy about esthetics.

receive the attachment. The patient should be forewarned regarding this condition. If the retainer is to be a veneer crown on a mandibular canine, then gold on the occlusal surface plus an additional occlusal or incisal width will be visible. An increase in bulk and the visibility of the metal are the two objectionable features that the patient must expect (Fig. 126).

AUXILIARY AIDS IN STABILIZING AND RETENTION OF A REMOVABLE PARTIAL DENTURE WITH INTERNAL ATTACHMENTS

Sometimes, additional means are necessary to assist in supporting and retaining a precision attachment removable partial denture such as these:

1. The cast lingual arm.
2. The continuous lingual arm with accessory lock-in devices.
3. The lingual arm with one or more accessory lock-in devices from the arm.
4. Two internal attachments in one retainer.
5. An additional internal attachment in the pontic of a fixed bridge.
6. An internal attachment rest or a lug rest.
7. The Baker split pin and tube external attachment.
8. Jelenko C and L spring attachment.
9. The Dalbo attachment and stressbreaker.

THE LINGUAL ARM

A cast lingual arm aids the internal attachment in equal distribution of the stress placed upon the denture and abutment teeth in function. The cast lingual arm is not intended to assist in retention. If the operator prefers a lingual arm, *it is imperative that sufficient tooth structure be removed from the lingual surface of the abutment tooth.* After adequate removal of tooth structure, the arm assumes the contour of the natural lingual surface of the abutment retainer casting and rests upon a slight shoulder in the gold (Fig. 127). The lingual arm resting upon such a shoulder helps absorb the stress in a vertical direction parallel to the long axis of the abutment tooth. A lingual arm without a recess to accommodate it interferes with the tongue, packs food, and defeats the main purpose of the arm because it does not absorb vertical stress.

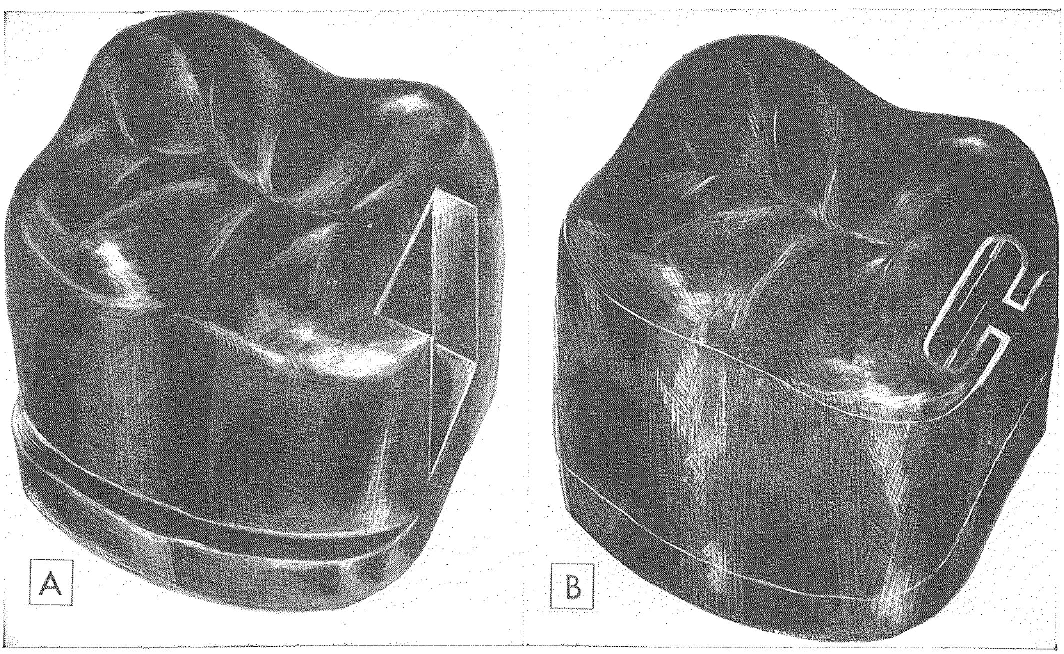


Figure 127. The cast lingual arm. *A,* It is imperative that sufficient tooth structure be removed from the lingual surface of the abutment tooth. A shoulder is created in the gold casting on the lingual surface to accommodate the lingual arm and still be within the confines of the original contour of the tooth. *B,* The arm assumes the contour of the natural lingual surface of the abutment casting.

A wrought clasp arm of any design that is supposed to assist in partial denture retention of an internal attachment case is a fallacy. The moment such a clasp arm is mechanically tightened for retention, the restoration ceases to be an internal attachment case. All the disadvantages of a clasp are now incorporated with the precision attachment partial denture restoration.

BAKER SPLIT PIN ATTACHMENT

This accessory device meets with favor with many operators when the abutment tooth is short or if it is the premolar or the canine. The abutment retainer to which the tube of the attachment is joined does not make the abutment tooth appear wider, as does the internal attachment. This external split pin attachment is precision made, and of the same metal as the other Baker internal attachments. Either the male (pin) or female (tube) section can be soldered to the abutment retainer or that part of the partial denture that abuts the retainer. In most cases, the section used is completely hidden under the occlusal surface of the first pontic tooth. This attachment does not offer as much resistance to dislodgement as the internal attachment. However, it is recommended as an auxiliary device along with internal attachments on the posterior teeth.

PLACING TEETH ANTERIOR TO THE ATTACHMENTS (A CONTRAINDICATION)

When teeth are placed anterior to the internal attachments as part of the removable partial denture, the abutment teeth in most instances are subjected to excessive strain. The partial denture pivots on the abutment teeth during incision and mastication of food. It seesaws, with the abutment teeth acting as fulcrums, and causes damage to the supporting structures, the abutment teeth, and the partial denture. A force applied to the mandibular incisor teeth on the denture in Figure 130

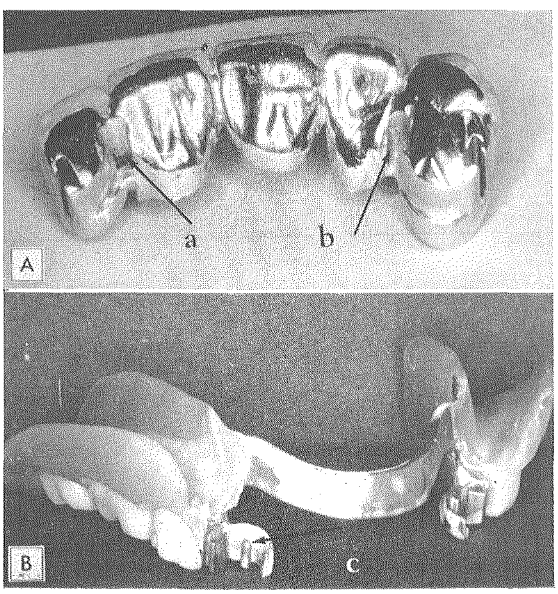


Figure 128. Accessory lock-in devices. *A*, Fixed splinted abutment retainers (a) (b). Cut-out lock-in receptacles. *B*, Accessory grooves in the lingual arm (c). These devices aid in retention, particularly in a distal extension removable partial denture.

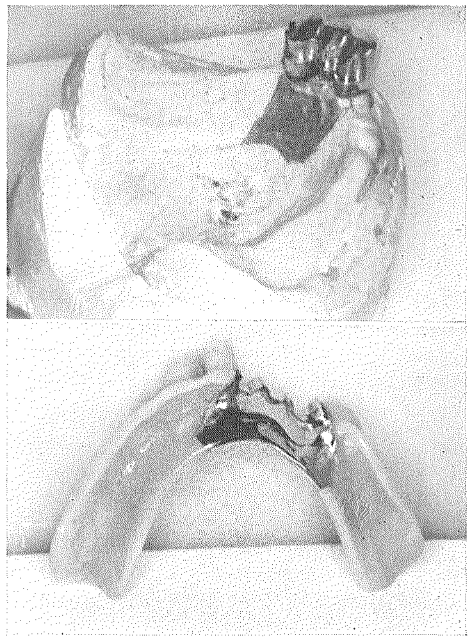


Figure 129. A continuous arm from the removable partial denture locks into corresponding receptacles of the anterior splint to aid in retention.

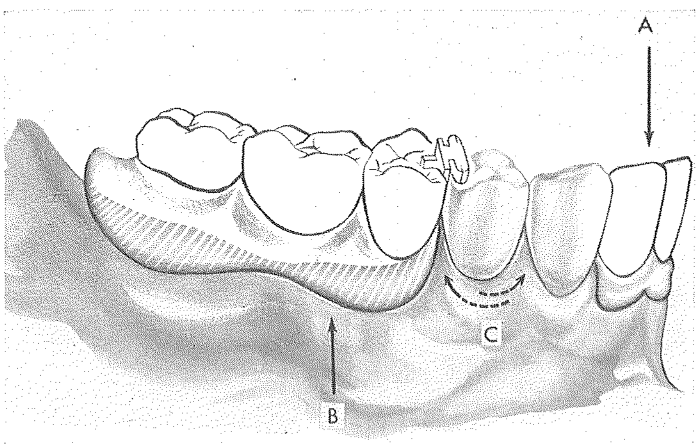


Figure 130. When teeth are placed anterior to the internal attachments as part of the removable partial denture, the abutment teeth in most instances are subjected to excessive strain. A force (*A*) applied to the anterior teeth on the denture raises the denture in the posterior (*B*). A force applied on the posterior teeth of the denture will raise the anterior part of the denture. The partial denture pivots on the abutment tooth because it seesaws in a rocking motion (*C*), which results in damage to the supporting structures and abutment teeth.

will raise the male attachments in the abutment biscupids. The chewing of the bolus on the posterior teeth will rock the posterior segment of the partial denture back upon the supporting tissues and ridges. Whenever possible, the operator should insert a fixed bridge for the edentulous area anterior to the abutment teeth. Figure 131 illustrates the management of such a case.

On occasion, the operator is called upon to decide whether two remaining teeth, particularly in the lower jaw, should remain and whether the partial denture should be constructed with these two teeth as abutments. Figure 132 illustrates an extreme but interesting case. When all efforts to save teeth have been exhausted, the patient becomes resigned to their extraction. It is natural for patients to fear a complete denture, particularly in the lower jaw. A partial denture with internal attachments can give satisfactory service in such an instance for several more years. The roentgenogram shows excellent bone support for the canine and first bicuspid. The second bicuspid must be removed. The two remaining teeth are splinted together with plastic veneer crowns and are prepared to accommodate a continuous lingual cast gold arm resting upon recessed shoulders in the casting. The female attachments are placed on the distal surface of the first bicuspid and the mesial surface of the

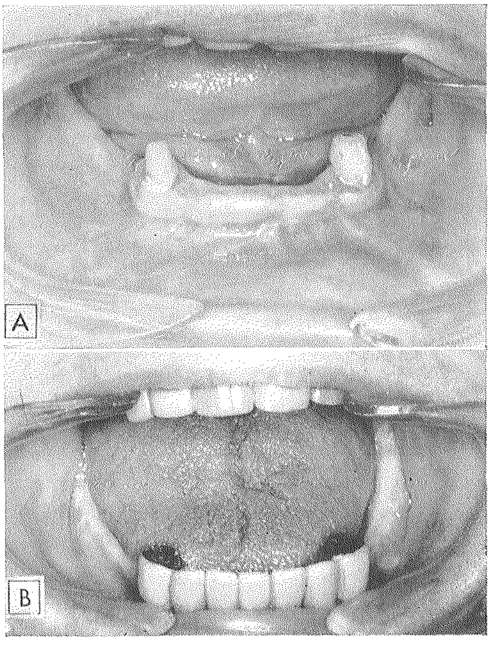


Figure 131. Whenever possible, the operator should insert a fixed bridge for the edentulous area anterior to the abutment teeth. *A*, The prepared abutment teeth. *B*, The fixed bridge in position ready to accommodate a removable partial denture with internal attachments.

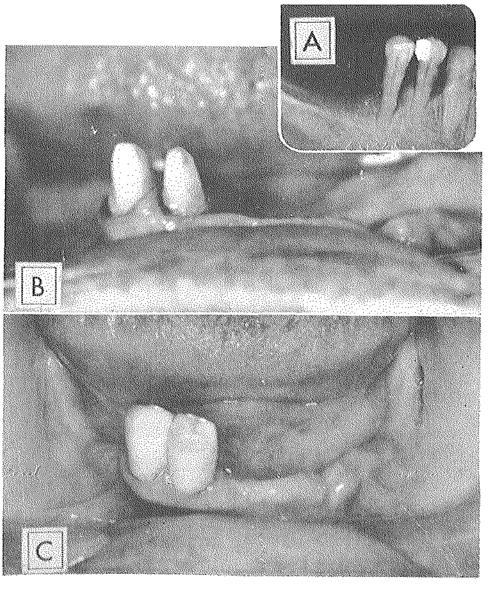


Figure 132. *A*, The lower right second bicuspid is mobile and is removed. *B*, Only the first bicuspid and the canine remain in the mandible. These two teeth are prepared to receive full coverage retainers. *C*, The two veneer crowns are splinted together and possess continuous lingual shoulders.

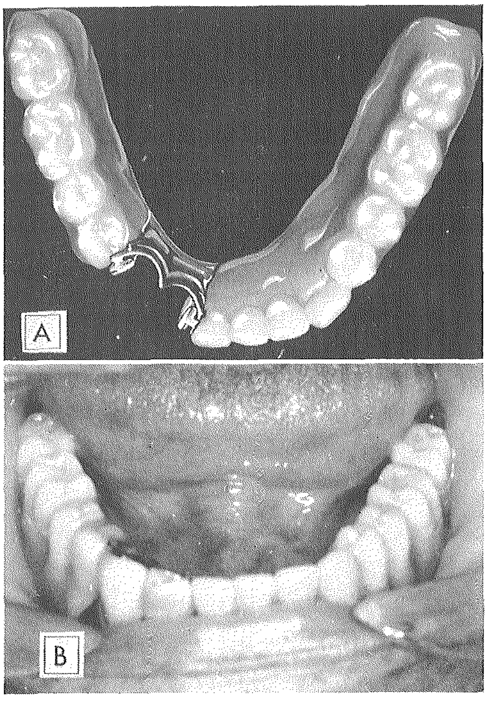


Figure 133. The same case as shown in Figure 132. *A*, The completed partial denture with internal attachments supported by only two teeth. *B*, the completed denture in the mouth.

canine. The acrylic resin bases of the removable partial denture extend well up on the retromolar pads and cover the ridge areas as much as, and just like, a complete mandibular denture (Fig. 133).

JELENKO C AND L SPRING ATTACHMENT

This attachment consists of counterpoise interlocking solid dovetail male and female sections plus an L-spring ball device. The male dovetail section is in the partial denture bar or lingual arm while the counterpart female recess is in the proximal surface of the abutment retainer. The male section has no slots to be spread as do the other internal attachments. The L-spring ball is attached to the pontic of the partial denture that approximates the abutment retainer directly opposite the interlock. When the partial denture is seated, the L-spring ball rides down the abutment retainer and rests passively in an undercut in the retainer. The male and female interlocks prevent lateral movement while the L-spring provides resistance to unseating. This attachment is indicated also on short abutment teeth. The L-spring is replaceable.

THE DALBO ATTACHMENT (FIG. 116)

A new practical attachment, imported from Europe, is this external type. It minimizes lateral movement and has a hinge action. It consists of a metal sleeve with a ball at one end which we can call the male section. This part can be soldered either to the abutment retainer or the pontic of the partial denture that abuts the retainer. The other section, the female, is a corresponding receptacle housing a small spring. This female section receives the male sleeve and snaps into place. The small spring gives vertical resilience. This device is manufactured by Cendres & Metaux Switzerland. It is also considered a stressbreaker, besides being an effective precision attachment.

DISTAL EXTENSION PARTIAL DENTURES

A distal extension partial denture is one in which the edentulous area is bounded on only the anterior end by the abutment teeth. To minimize lever action in such a restoration, the free-end acrylic resin base or bases should receive stable support from the ridges and tissues. In a mandibular removable distal extension partial denture, it is imperative that the bases extend well up on the retromolar pads. The longer the partial denture base, the greater the lingual arm of the denture base. Multiple abutment retainers and maximum tissue coverage will assist in overcoming some of the damage created by the lever. An indirect retainer is sometimes indicated to help resist the movement of the partial denture base from the supporting tissues.

An acrylic resin denture base is preferred by many prosthodontists. When bone resorption has occurred, the lever action on the abutment teeth is increased. The denture bases can be readily relined if they are made of acrylic resin. On the other hand, some operators feel that no resorption takes place if the denture is constructed properly.

When a limited number of teeth are present in the maxillae, the design of a distal extension partial denture with internal attachments must include the maximum support from tissues and teeth.

Lower distal extension cases are treated in the same manner as complete dentures. Swenson and Terkla[7] write, "The peripheral border of a lower partial denture free saddle should be identical to a comparable section of a full denture made for the lower arch. The saddle should cover the retromolar pads and extend buccally over as much bearing area as possible. Free saddles, which are narrow and not extended properly will cause resorption of the underlying tissues; the result will be soreness of the mouth and loosened abutment teeth.

"The best bearing area of a lower free saddle is the buccal flange. This flange, to be successful, depends on the strong cortical bone beyond the residual alveolar bone.

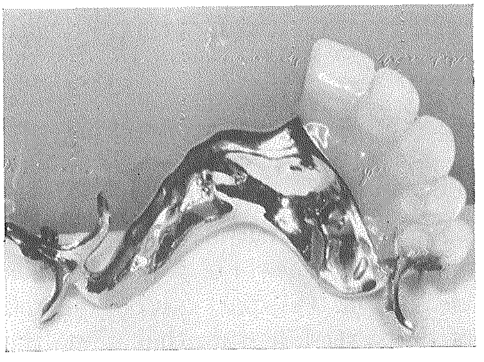


Figure 134. Design of a unilateral case when the remaining natural anterior teeth are strong, healthy, noncarious, and without old restorations. The contacting molars receive the crowns, to hold the precision attachments and lingual arms.

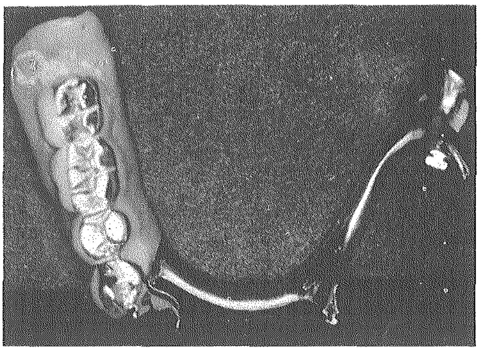


Figure 135. Removable partial denture with internal attachments and teeth containing cast gold occlusal surfaces.

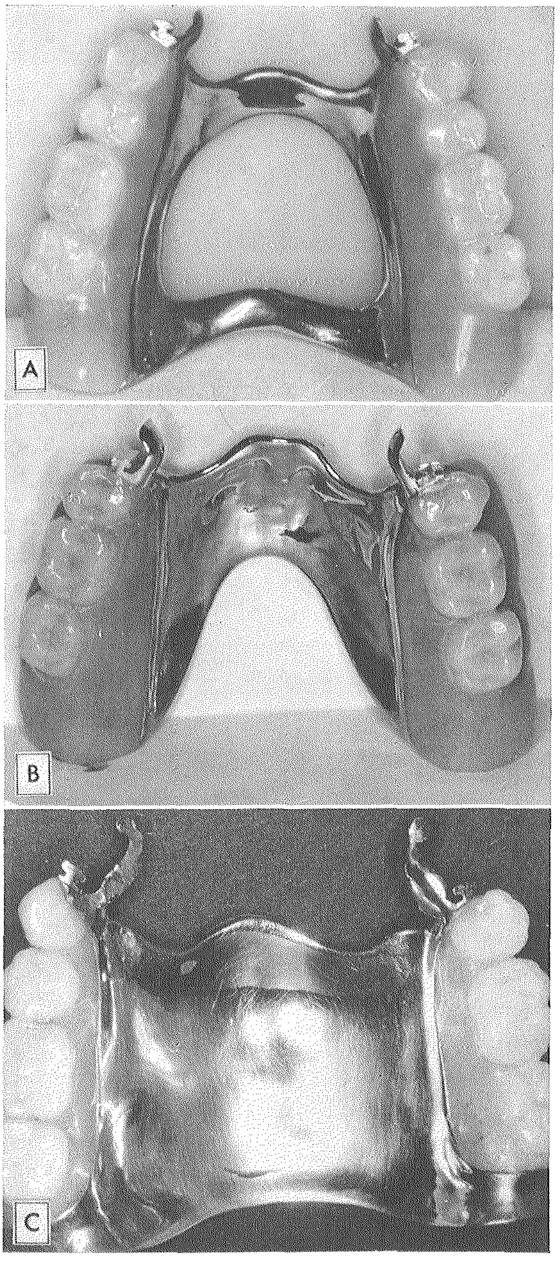


Figure 136. Some palatal designs of upper removable partial dentures with internal attachments. *A*, Open palate and double bar when the torus is large. *B*, Design for the patient who gags readily. *C*, Almost a full palate when the ridges are inadequate and the abutment teeth require tissue support.

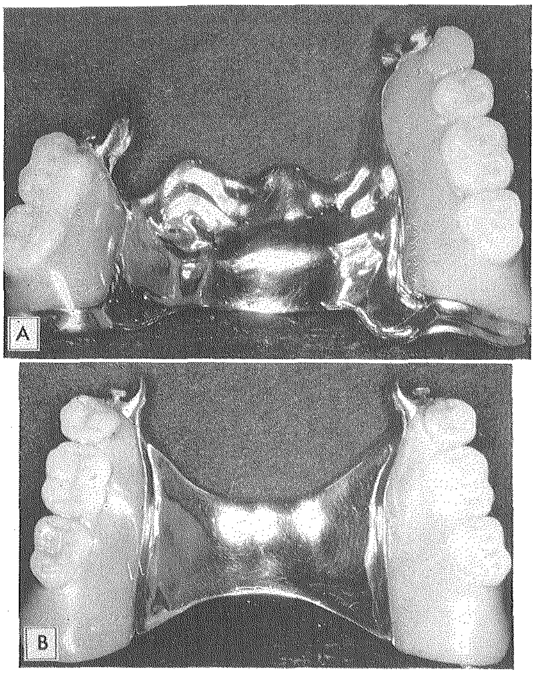


Figure 137. Additional palatal designs. *A,* When the rugae are large and prone to irritation, the casting must never touch that part of the tissue. *B,* A typical broad bar in the center of the palate.

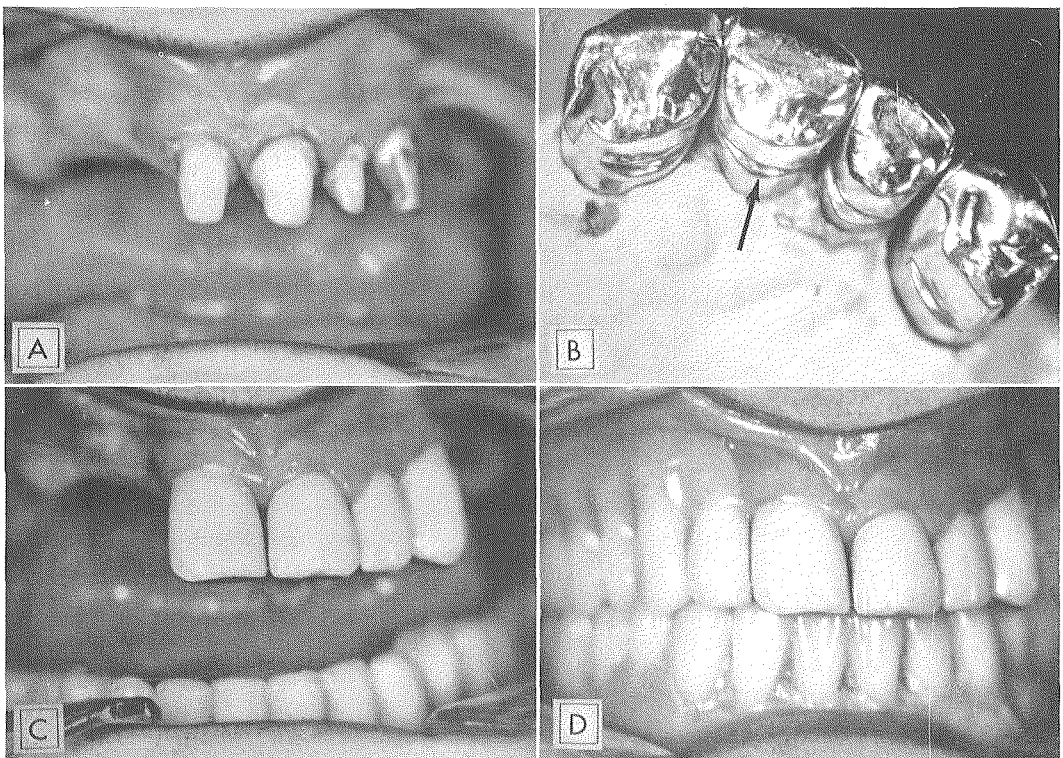


Figure 138. Maxillary distal extension case. When a limited number of teeth are present in the maxillae, the design of a distal extension partial denture with internal attachments must include the maximum support from tissues and teeth. *A,* Only four teeth remain in the upper jaw of this patient. *B,* Four veneer crowns are splinted together and each casting possesses a lingual shoulder for additional support. *C,* The completed abutment retainers in the mouth. *D,* The partial denture in the mouth.

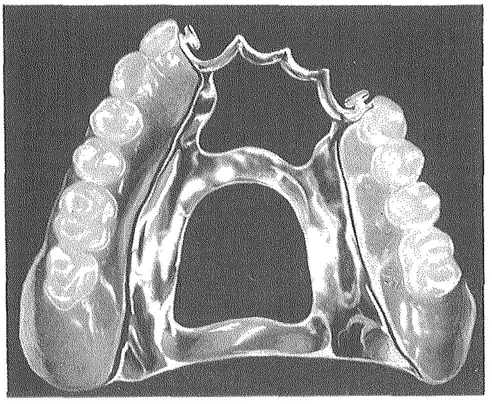


Figure 139. The completed partial denture for the patient in Figure 138. This design affords maximum support from the tissues and the teeth.

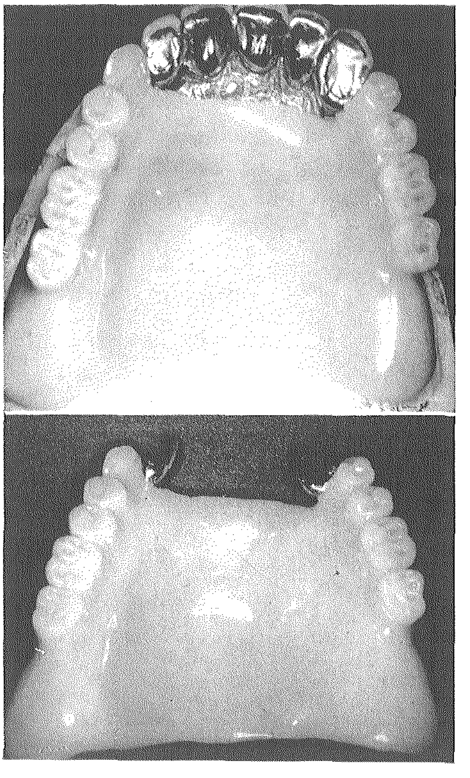


Figure 140. An upper removable partial denture with internal attachments and having a full acrylic resin palate is often recommended when few abutment teeth are present.

It should be noted that the buccal extension is nearly at right angles to the vertical biting force and therefore resists it very well. It is an invaluable aid in preventing rapid settling of this free saddle."

STRESSBREAKERS

A stressbreaker is a device which relieves the abutment teeth of all or part of the occlusal forces. McCracken[4] defines a stressbreaker as "a device that allows some movement between the denture base or its supporting framework and the direct retainers, whether they are intracoronal or extracoronal in design." The occlusal forces are more pronounced when the partial denture is a distal extension case.

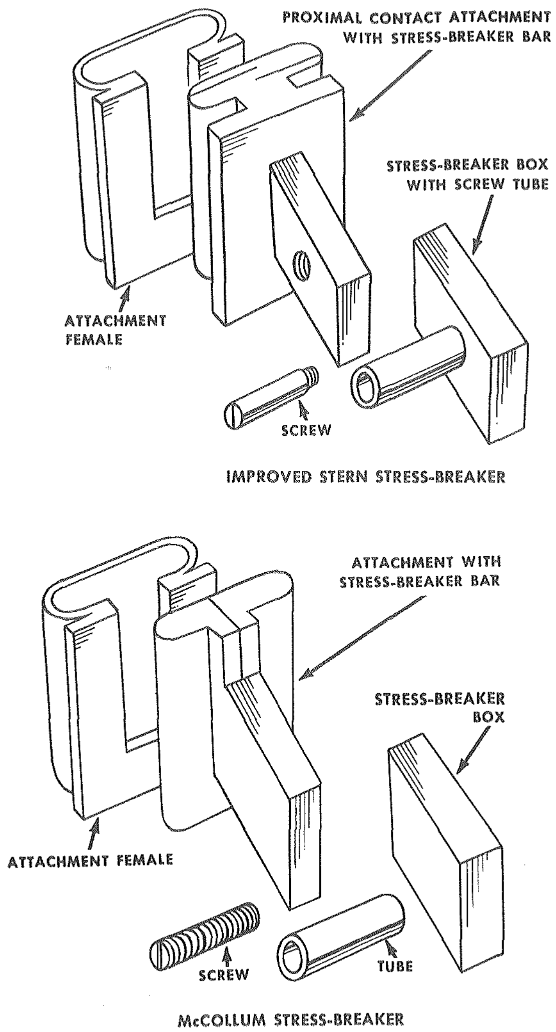


Figure 141. Stern and McCollum stress-breakers. (Courtesy Stern Dental Co., Inc., Mt. Vernon, N.Y.)

According to those who advocate it, the purpose of a stressbreaker is to make the removable partial denture completely static, except when in function, which primarily includes mastication and deglutition. The abutment teeth are preserved by the distribution of stresses between them and the mucosa. The stressbreaker allows for independent vertical movements of the free-end partial denture bases and restricts lateral movements. McCracken classifies stressbreakers in two groups.[5] "In the first group are those having a movable joint between the direct retainer and the denture base. Into this group fall the hinges, sleeves and cylinders, and ball and socket devices. . . . The second group includes those designs having a flexible connection between the direct retainer and the denture base. These include the use of wrought wire connectors, divided major connectors, and other flexible devices for permitting movement of the free-end base. Included in this group are those utilizing a moveable joint between two major connectors." There is a large group of operators who have little faith in stressbreakers.

A Stern stressbreaker bar extends from the proximal contact plate of the male attachment section in an internal attachment case and possesses a gauged hole. This hole receives the screw tube attached to the stressbreaker. It is designed for use in lower partial dentures only. The Ney stressbreaker consists of a rectangular shaft, a threaded screw, and a round tube welded to a rectangular tube. Stressbreakers come in one size, but are suitable for all teeth. The Williams attachment with the long arm and a screw and tube in the long arm is another type of stressbreaker.

PRECISION RESTS

A Stern precision rest or a small Williams internal attachment overcomes the deficiencies of improvised occlusal rests. The precision rest consists of a small wrought metal attachment and a recess former. The abutment retainer, or pontic, is cast with an oversize box to accommodate the recess former. This former is waxed into the box, invested, and soldered to the retainer or cast pontic. It is dissolved by boiling in nitric acid and leaves a clean, accurate box which accommodates the Stern precision rest. The rest is soldered to the metal strut of the fixed or removable partial denture. It is used as a stabilizer, in conjunction with internal attachments, n a fixed movable bridge and in fixed splinting of natural teeth.

THE BAKER SNAP-ON ATTACHMENT

The snap-on attachments made by several manufacturers are often called

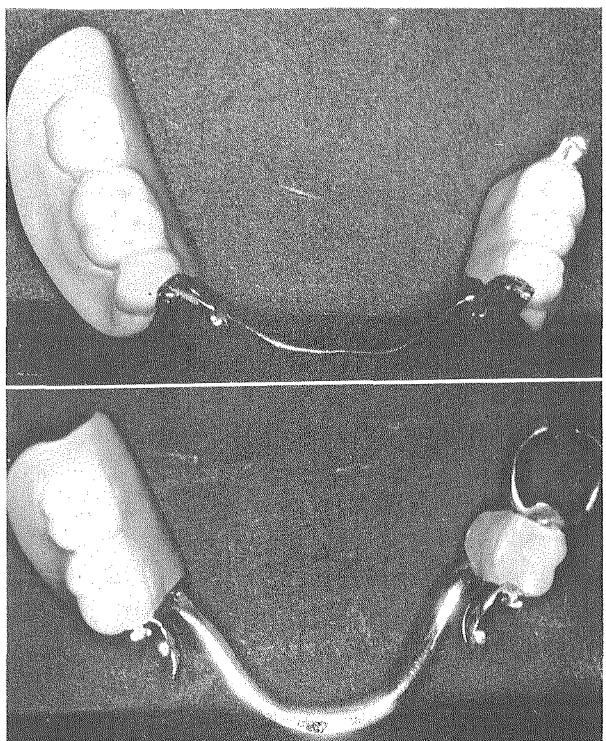


Figure 142. A lug rest should receive preference over a clasp, in an internal attachment case. As soon as the clasp is tightened, the restoration ceases to be a precision case.

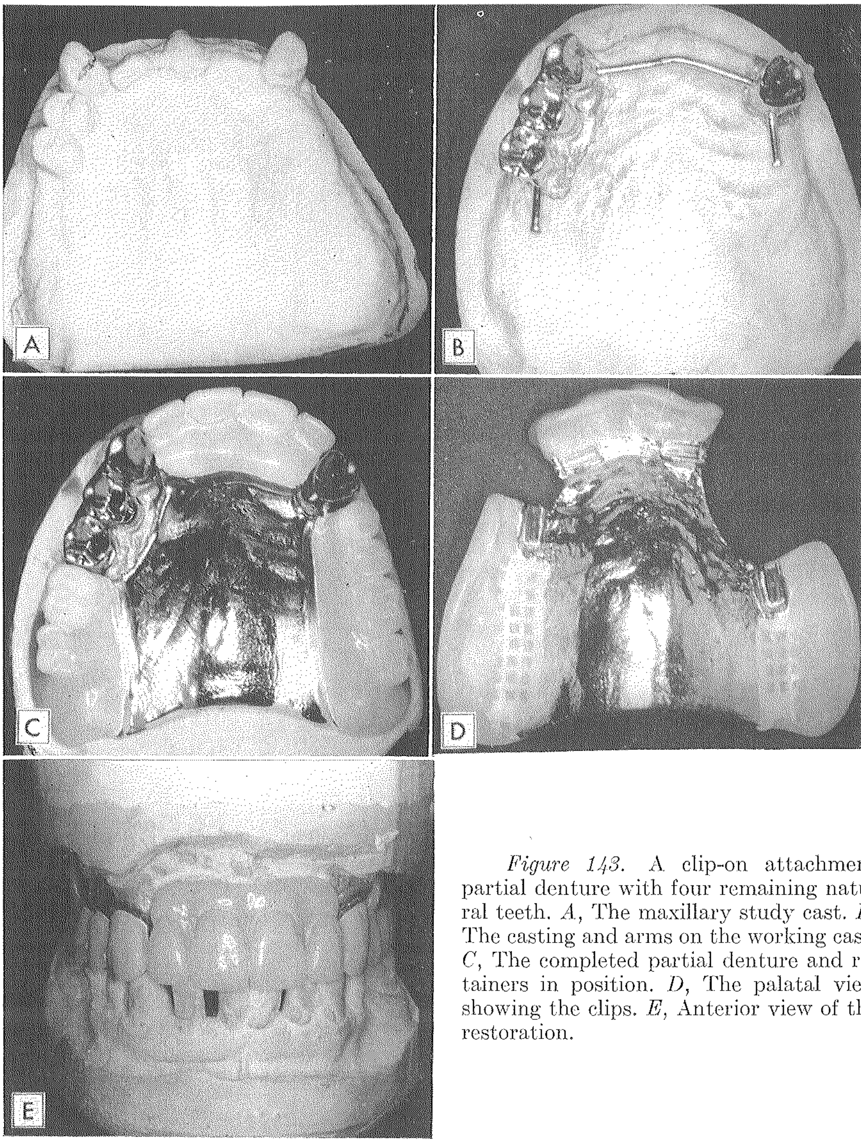


Figure 143. A clip-on attachment partial denture with four remaining natural teeth. *A*, The maxillary study cast. *B*, The casting and arms on the working cast. *C*, The completed partial denture and retainers in position. *D*, The palatal view showing the clips. *E*, Anterior view of the restoration.

internal attachments when in fact they are external. The Baker snap-on attachment is a semiprecision device consisting of a male section (bar) and a female section (clip) made of a gold-platinum alloy in either 11 or 14 gauge.[6] The clip female part snaps over the bar male part, hence the device should be called an external snap-on attachment. In use, the bar acts as a splint to connect the abutment retainers. The removable partial or complete denture contains the female (clip). The abutment teeth can be constructed to be full cast or veneer crowns which in turn receive clasps or lock-in rests. Roots of teeth, such as right and left canines in the lower jaw, can receive gold cores with small projections joined to the bar and over which the denture housing the female section is contained (Figs. 430 and 431).

Adisman[1] describes the clip attachment as "... a recommended retention device for retaining large and extensive appliances to remaining teeth. It is simple in concept, easy to construct, and adaptable to any variety of conditions and number of remaining teeth. It is particularly successful with loose or mobile teeth and very effective with roots of teeth. It has a distinct stress-breaker quality which is based on the movement of the clip around the bar. Its retentive action is direct and strong and it requires little or no adjustments. The external clip attachment can be used exclusively with or in conjunction with clasps or other types of direct retainers, depending upon the conditions present." (Fig. 143).

PREPARING THE PATIENT FOR A REMOVABLE PARTIAL DENTURE WITH INTERNAL ATTACHMENTS

Preparing the patient for the task of functioning with a removable partial denture is of utmost importance. The physician does not "hand" the amputee an artificial limb, for example, without first getting the patient ready psychologically. For the dental patient, the loss of all or many of the teeth is a severe shock, and unless the patient is familiar with the type of restoration, what to expect, and what to tolerate, he may never react favorably to the restoration. At the time of case presentation, the operator should explain the advantages and disadvantages of the restoration. The strangeness and fullness, and the difficulty in speaking and eating should be thoroughly explained. Never assure a patient that a removable appliance will be like his own teeth . . . because it won't. Occasionally there is a patient who cannot or will not get accustomed to a removable partial denture. The operator should try to sense this attitude, and if he is sure that the patient will not accept the partial denture it is best to dismiss him. The dentist must be kind, patient, informative, and truthful in his explanations regarding this type of restoration.

STEPS IN THE CONSTRUCTION OF A REMOVABLE PARTIAL DENTURE WITH INTERNAL ATTACHMENTS

It is recommended that the operator duplicate the study casts and survey and plan the design for the partial denture on the cast. The purpose of surveying the abutment teeth is to determine the insertion and removal paths of the denture. Surveying also discloses what surface and how much tooth structure should be removed to insure a casting that will make insertion and removal of the denture not too difficult a task. Outline the case design on the duplicated cast and consult with the technician. Keep a record of the size, type, and manufacturer of the internal attachment used. This will facilitate replacement if it should become necessary later on.

The two most important steps upon which the success of the partial denture depends are controlled by the operator and his technician. The doctor must obtain an excellent, accurate plaster impression of the entire jaw with the abutment retainers *properly and firmly positioned.* The technician must seat the abutment retainers accurately and firmly into the acceptable plaster impression before pouring the cast.

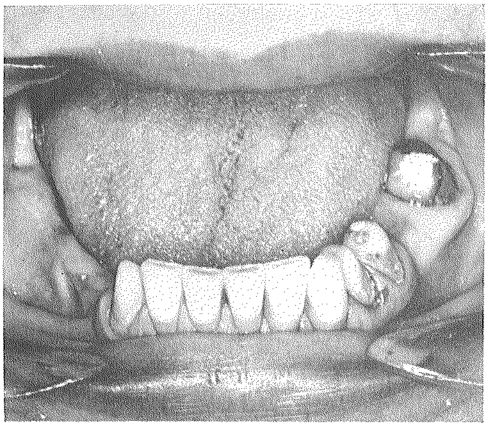


FIG. 144.

Step 1 (Fig. 144). Prepare the abutment teeth for full coverage retainers. Remove sufficient tooth structure from the surface receiving the attachment so that the female segment of the attachment will be within the confines of the original contour of the tooth. If a lingual arm is planned, remove enough tooth structure from the lingual surface to accommodate it. Take band impressions of the prepared teeth.

Step 2 (Fig. 145). Pack or plate the dies and cast transfer copings to fit them. Seat the transfer copings on the teeth.

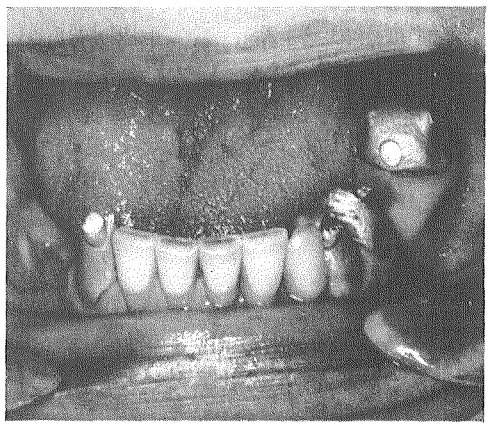
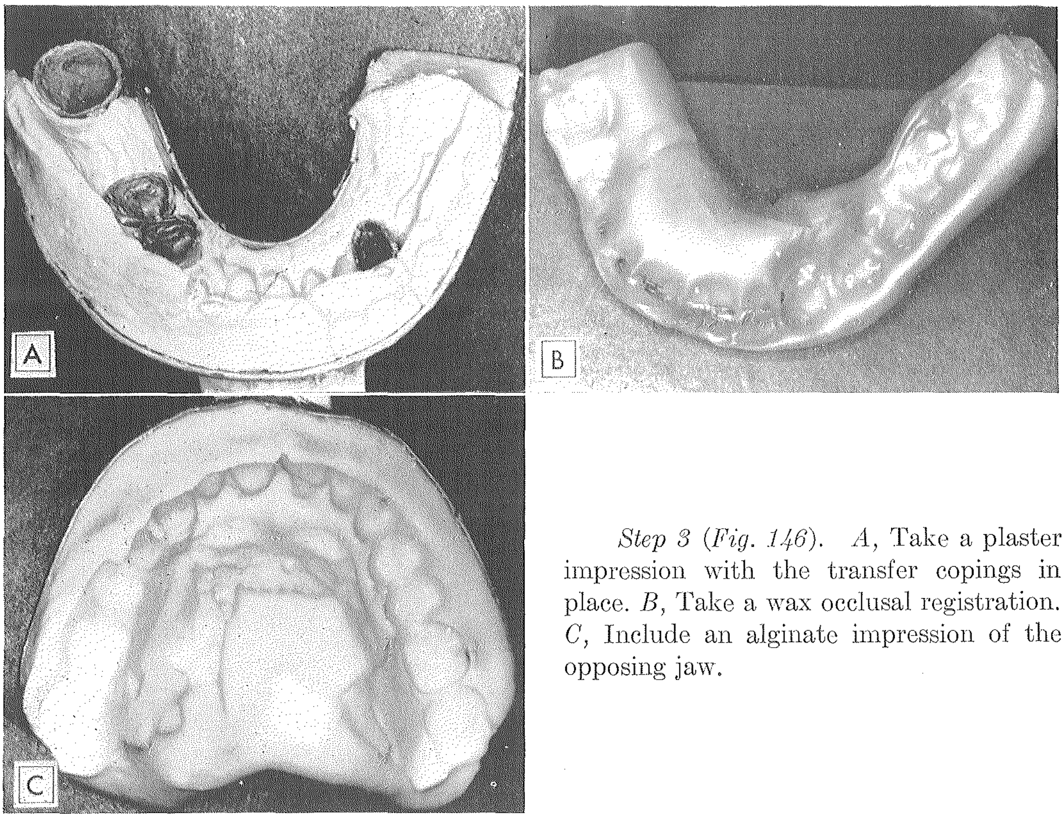


FIG. 145.

A tilted tooth to be used as an abutment is prepared in such a way that the full coverage restoration can be contoured to hold and receive the attachments without interference. It is not necessary that the abutment teeth be parallel to each other, but it is essential that the attachments in the restorations be parallel. The clinical procedures in the construction of a removable partial denture with internal attachments are the following (Figs. 144 through 156).

Instructions to the Patient on Temporary Insertion. Now that the removable partial denture is completed, it is necessary to set aside sufficient time for explanations regarding the restoration prior to insertion. The patient must be informed that the partial denture and abutment retainers will be inserted temporarily and will remain so for a few days, perhaps longer. The patient is advised to get accustomed to the strangeness of the partial denture first, speech second, and eating last. Any defect in speech is of a temporary nature. The patient is to expect some discomfort and perhaps some irritation from the denture bases. Instruct the patient to be meticulous in the use of a mouthwash, toothbrush, and toothpaste. Remind him that occlusal adjustments will be necessary and that some abutment teeth may experience sensitivity from thermal changes. Although the partial denture may seem to fit snugly at the time of insertion, it may loosen in a few days. Assure the patient that all inconveniences will be adjusted and eliminated as time goes on. Under no circumstances should the patient remove the partial denture. If he is most unhappy (an unusual occurrence), instruct him to come to the office. Preparing the patient for all these contingencies hastens the achievement of a successful result.

Temporary Insertion. Each male attachment should slide in its corresponding female attachment with slight pressure. If there is a binding or interference so that extraordinary force is required to seat the denture, it is advisable to remake the attachment that creates the disturbance. If the male section does not slip in readily, do not grind or polish



Step 3 (Fig. 146). *A*, Take a plaster impression with the transfer copings in place. *B*, Take a wax occlusal registration. *C*, Include an alginate impression of the opposing jaw.

FIG. 146.

Step 4 (Fig. 147). Pour the working cast.

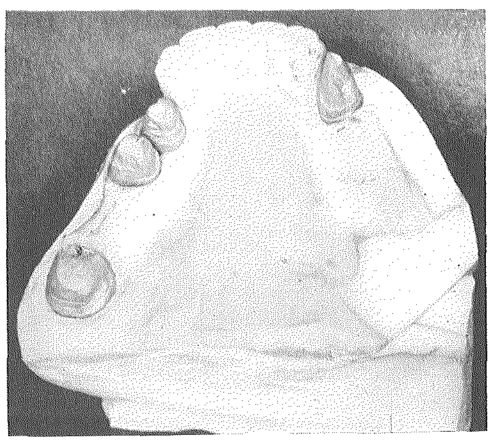


FIG. 147.

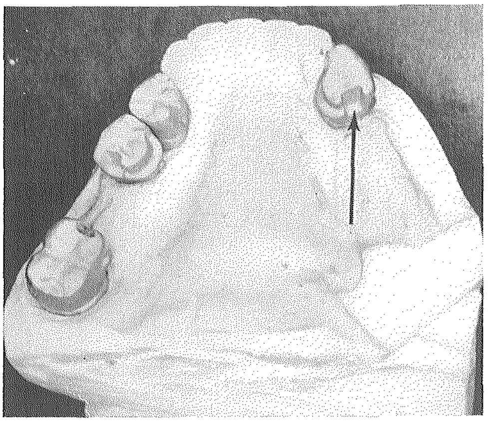


FIG. 148.

Step 5 (*Fig. 148*). Cast the abutment retainers.

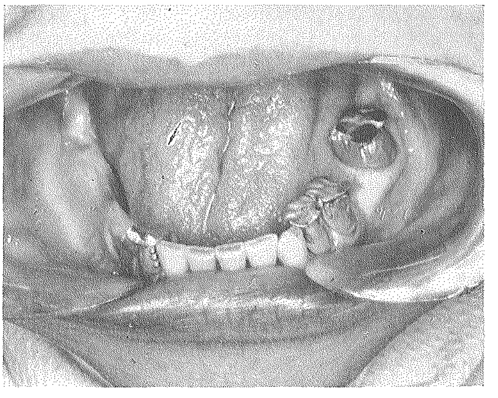


FIG. 149.

Step 6 (*Fig. 149*). Try in and fit the castings on the teeth.

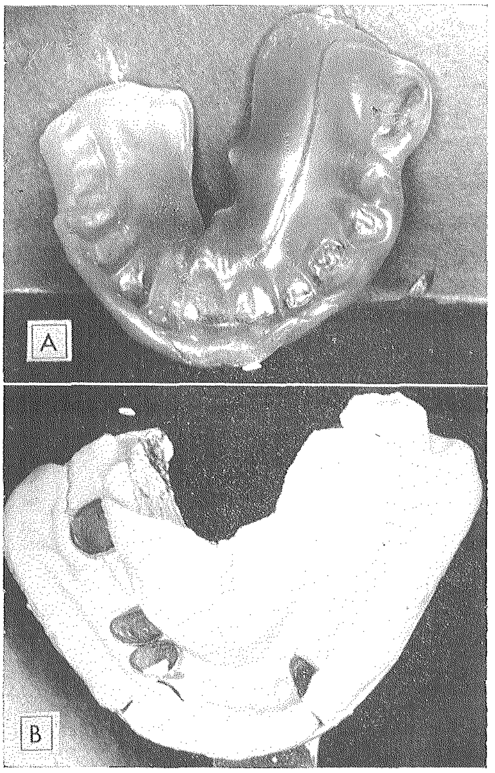


FIG. 150.

Step 7 (*Fig. 150*). *A*, Seat all the castings and take a wax occlusal registration. *B*, Take a full plaster impression with the abutment retainers in position. Pour the cast and rearticulate the casts.

it to make it fit. The cause of the difficulty is that parallelism of attachments has been lost, and the way to correct it is to separate the sections and reparallel and resolder them. Wash the abutment teeth with warm water and do not apply any irritating medicaments. The metal retainers are temporarily cemented with a temporary ointment. Be mindful that any zinc oxide and eugenol mixture is not a temporary medium and if the restorations are cemented with this mixture, difficulty will be experienced in removal. The cementing medium must have a petrolatum base with no setting or hardening properties. Instruct the patient to return the next day.

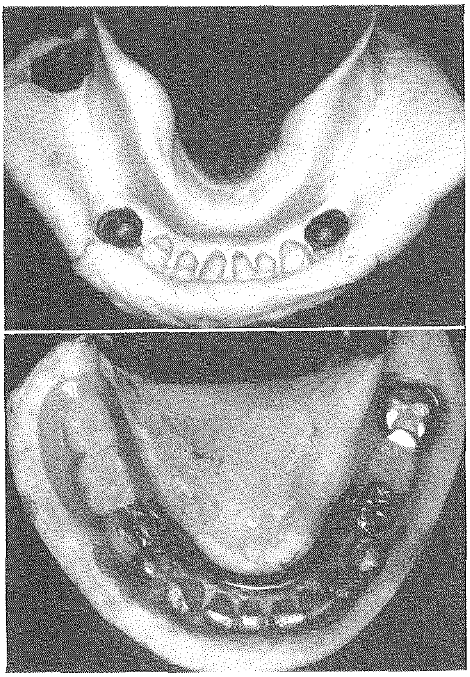
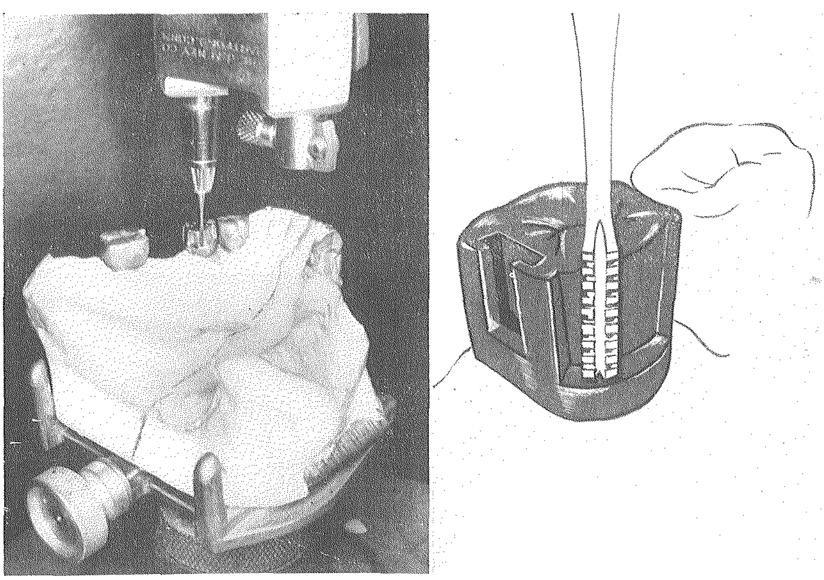
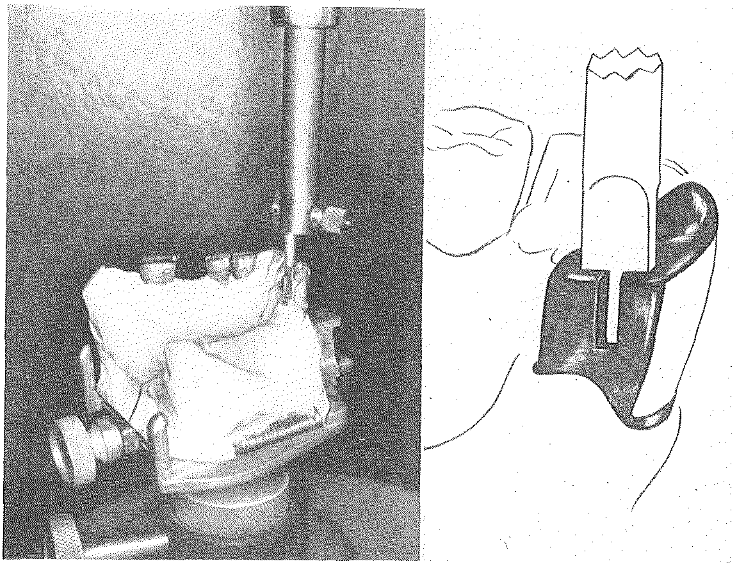


Figure 151. The master impression may be taken with a silicone material (Molloflex). The impression of the natural teeth can be poured in low fusing metal.



Step 8 (*Fig. 152*). Trim and parallel the shoulders in the castings on the surveyor. These shoulders are to support the lingual arms of the cast denture base.



Step 9 (*Fig. 153*). Solder the female attachments one at a time, using the mandrel as a guide with the surveyor to maintain parallelism.

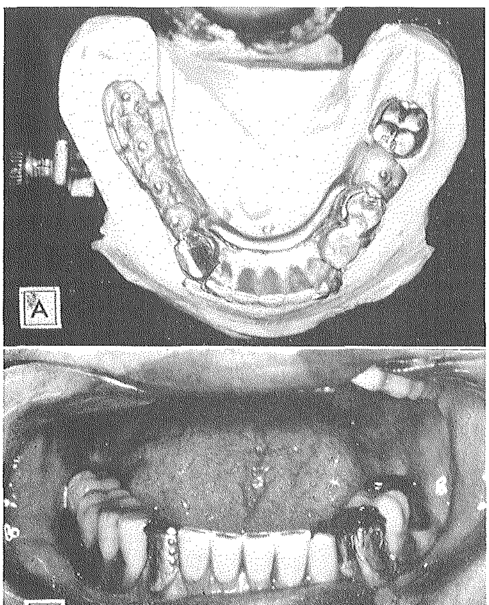


FIG. 154.

Step 10 (*Fig. 154*). *A*, Design and cast the partial denture base. *B*, Try the partial denture and abutment retainers in the mouth. The teeth are set up in wax.

At the time of this appointment, the doctor removes the partial denture and makes the necessary adjustments with regard to tissue impingement, overextension, occlusal interferences, etc. Insert the partial denture temporarily again. Repeat these procedures until the patient experiences comfort. Depending upon the patient, this may take from two to six sessions. The case is ready for permanent cementation and instructions for removal by the patient.

Cementation of Abutment Retainers. The abutment retainers must not be cemented separately and the cement permitted to set before inserting the partial denture. In most instances, the partial denture will not seat if this procedure is followed. If there are several abutment retainers, it is recommended to seat all but one and cement that one permanently. Repeat this procedure until the abutment retainers are permanently cemented. At each cementation, insert the partial denture. It may be advantageous to place a small amount of lubricant in the female receptable to prevent any cement which may enter from setting within the boxing. Make certain that all the abutment retainers are cemented securely before removing the partial denture to remove excess pieces of cement. It is a good policy not to instruct the patient on insertion and removal of the restoration until the next appointment for fear that freshly applied cement may lose some of its retentive properties as a result of the rocking and tilting of the denture.

Instructions to the Patient on Insertion and Removal of the Removable Partial Denture. The obstacle to overcome now is the removal and insertion of the exacting partial denture. At the beginning, the patient will have difficulty in executing these procedures. Instruct him to attempt removal while standing in front of a mirror. When he inserts the denture he is not to "bite" the restoration into place. Insertion is usually easier to accomplish than removal. Assure the patient that if the partial denture can be inserted, it can be removed. The trick is to find the most convenient and expedient manner of insertion. Some

Step 11 (*Fig. 155*). *A*, Complete the removable partial denture and try the case in the mouth again. *B*, Cure the acrylic resin into the veneer crowns and insert the entire case temporarily.

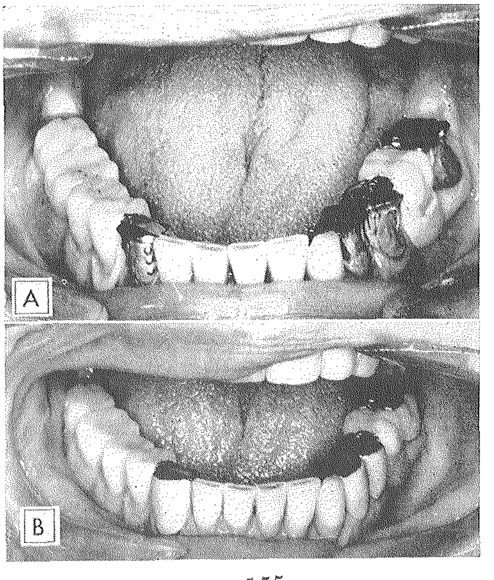


FIG. 155.

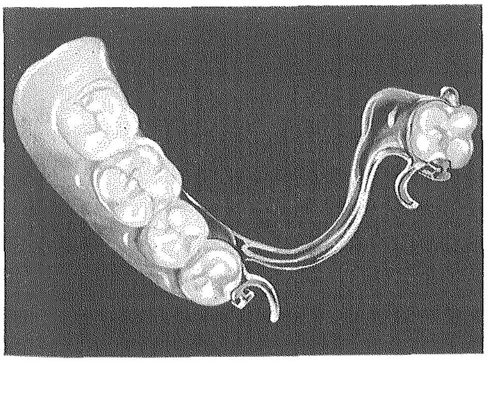


Figure 156. The completed removable partial denture with internal attachments.

persons require several days and sometimes weeks before they are able to insert and remove the restoration without becoming irritated and flustered. The operator should exercise patience and kindness in teaching these procedures. The patient must not make his own adjustments; instruct him to return to the office for any correction.

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7

COMPOUND, ELASTIC, AND PLASTER IMPRESSION TECHNIQUES

BAND AND TRAY IMPRESSIONS

An important phase in occlusal rehabilitation is the impression technique of the prepared teeth to receive full coverage restorations. Impressions may be taken with a band and impression compound, hydrocolloid procedures, silicone, or rubber base impression material. Kahn[4] and many others have presented a practical approach to the hydrocolloid method of taking impressions.

Figure 157. *A,* Use a wire and dentimeter measurement of the prepared tooth as a guide in selecting copper band of correct size. *B,* Place the wire loop on the closest fitting projection on the Moyco band box. This will denote the number of the band to use.

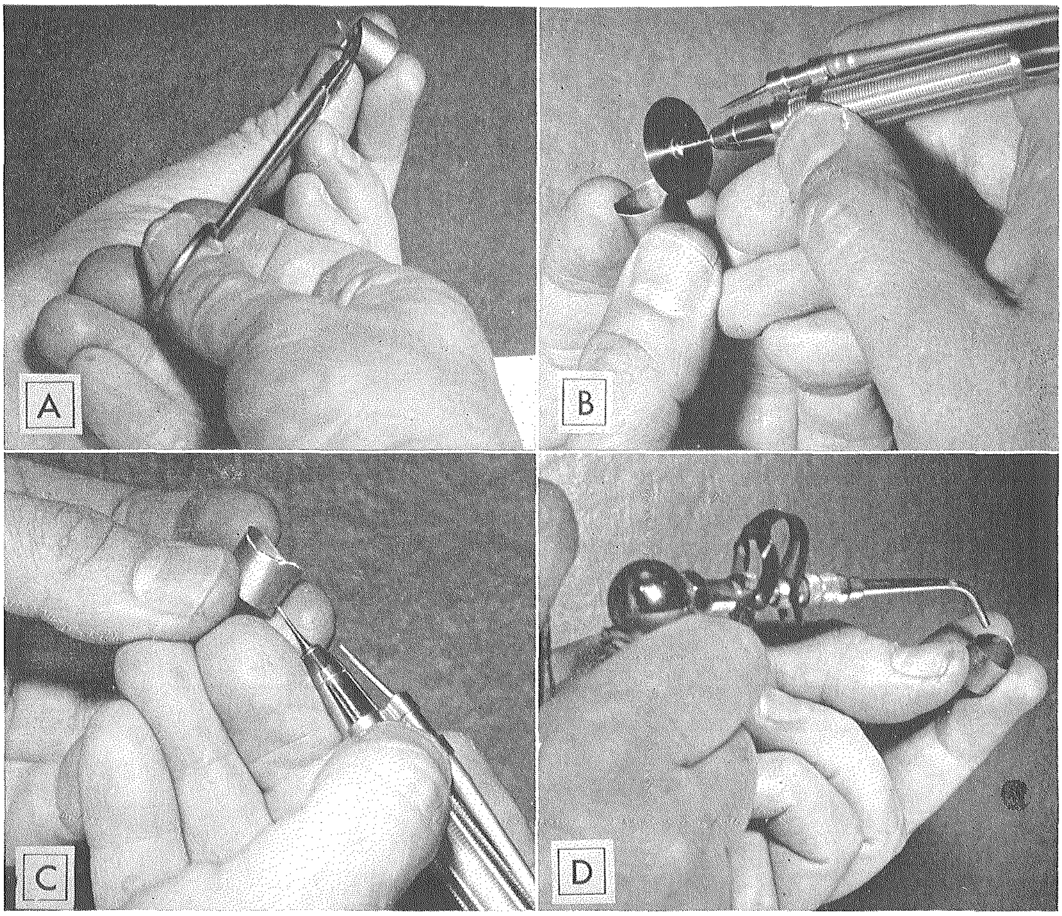

Figure 158. Steps in preparing the copper band for the impression. *A*, Anneal the band and festoon it with crown and bridge shears. *B*, Smooth the rough edges with a disk. *C*, Drill a hole in the buccal or labial surface. This designates the buccal or labial surface and permits the heated impression compound to escape, without undue pressure against the gingival tissues. *D*, Dry the inside of the band with several blasts of compressed air, so that the compound can adhere to the metal.

BAND AND IMPRESSION COMPOUND TECHNIQUE

Lubricate the prepared tooth with a thin oil before taking the impression. Experience will enable the operator to select a band of correct size by merely looking at the tooth. Until such experience has enabled the doctor to select the band in this manner, it is advisable to use a wire and dentimeter measurement of the prepared tooth (Fig. 157). An annealed band contributes to accuracy in the compound impression. The compound adheres to such a band, which has lost its springiness, and the impression will not be distorted (Figs. 158 and 159).

Step 1 (Fig. 158A). Festoon the annealed band with crown and bridge shears. Keep fitting the band over the prepared tooth and note where it may impinge upon the gingival tissues. Festoon it until no tissue is compressed.

Step 2 (Fig. 158B). Smooth the rough edges of the festooned band with a disk. Adapt and press the band around the prepared tooth with a flat burnisher. Sometimes it may be advisable to curl in the festooned part of the band with pliers so that it will hug the tooth more closely.

Step 3 (*Fig. 158C*). Drill a small hole in the buccal or labial surface of the band, close to the occlusal or incisal area, with a round or crosscut fissure bur. This hole not only designates the buccal or labial surface but also permits the heated impression compound to escape without undue pressure against the gingival tissues. It minimizes the possibility of the soft compound creeping up beyond the margins of the preparation and becoming locked in the depressions and undercuts of the roots.

Step 4 (*Fig. 158D*). Dry the inside of the band with several blasts of compressed air. This procedure permits melted compound from a stick to adhere to the inner periphery of the band and helps prevent it from pulling away from the metal.

Step 5 (*Fig. 159A*). Use Kerr's high-fusing impression compound stick and heat the end in the Bunsen flame. Melt some of the compound on the inner surface of the band and set it aside.

Step 6 (*Fig. 159B*). Keep part of an impression compound stick in the Hanau water heater. The first notch of the heater will warm the water to approximately 130° to 140° F. Soften the compound in the hot water because it will not be heated to the degree at which it

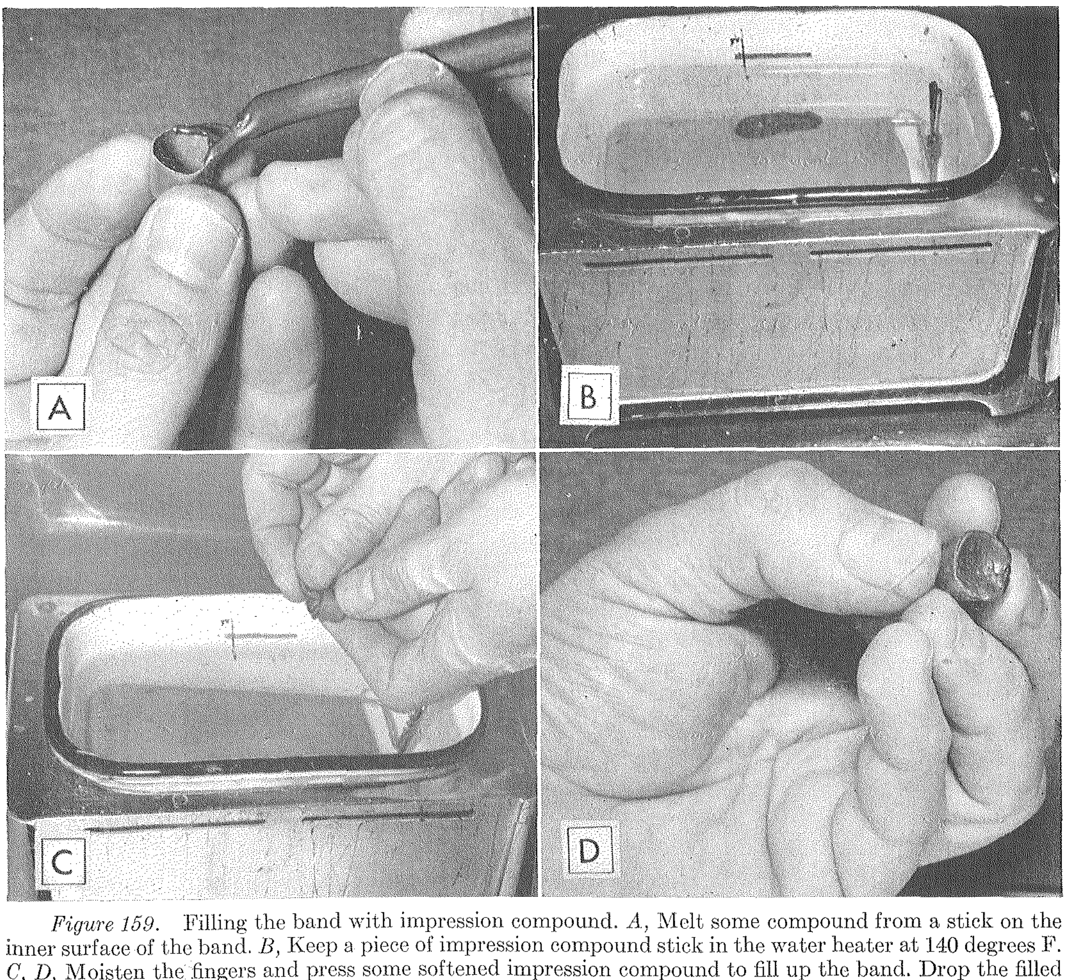

Figure 159. Filling the band with impression compound. *A*, Melt some compound from a stick on the inner surface of the band. *B*, Keep a piece of impression compound stick in the water heater at 140 degrees F. *C*, *D*, Moisten the fingers and press some softened impression compound to fill up the band. Drop the filled band back into the water for a minute or two before taking the impression.

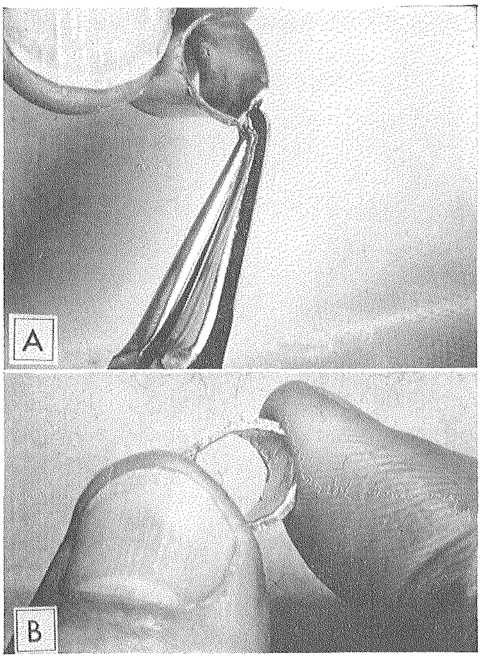

Figure 160. *A*, McKay recommends the outward bending of the band to permit the operator to use force in pressing the filled band over the prepared tooth. *B*, Such a band will not be squashed in the fingers during the taking of the impression or upon its removal.

will add injury to the partially hyperemic condition of the pulp which is created during the preparation.

Step 7 (Fig. 159C, D). There is no need to use petrolatum on the fingers to prevent the compound from sticking to them. Petrolatum is messy and slippery and may hinder the control of the band when seating it. Merely moisten the fingers in the warm water of the heater and press some softened impression compound to fill up the band. Drop the filled band back into the water and allow it to remain for a minute or so before taking the impression. The melted compound around the rim unites with the softened compound that is pressed into the band.

McKay[5] recommends the outward bending of the band with a pair of pliers (Fig. 160). This bend is opposite the end which is to slip over the preparation. Such a procedure permits the operator to use force in pressing the filled band over the tooth without danger of cutting his thumb. It also permits the operator to "stand" the prepared band on the bracket table. It will not squash in the fingers during the taking of the impression or upon its removal, but will remain sturdy.

Moisten the fingers and force the filled band into correct position, parallel to the long axis of the tooth, with the tips of the fingers. Rock the band a trifle, to prevent the trapping of air. When it is half way up the tooth, force it further with a moistened thumb until it slips slightly beneath the gingiva. Excess impression compound will ooze out of the hole in the band, making it easier to accomplish this procedure. There is no need to chill the impression with ice water, a procedure that contributes to pulpal irritation and also makes it difficult to remove the impression. Allow the compound to cool of its own accord. This high-fusing material will become hard after a few minutes and will not distort readily. Remove the impression with the towel clamp or a band remover.

BAND AND RUBBER BASE IMPRESSION TECHNIQUE

There is keen interest today in the rubber base impression material. The fact that an impression with this medium need not be poured immediately is an advantage the profession is seeking. Furthermore, the material lends itself readily to silver plating.

Seifman's technique for a band impression with a rubber base material is a practical procedure.[6] Hudson has contributed much to the profession in the handling of this material and the subsequent silver plating procedures.[3] Select a slightly larger copper band for the impression and a Sta-lite reinforcement ring. These rings come in

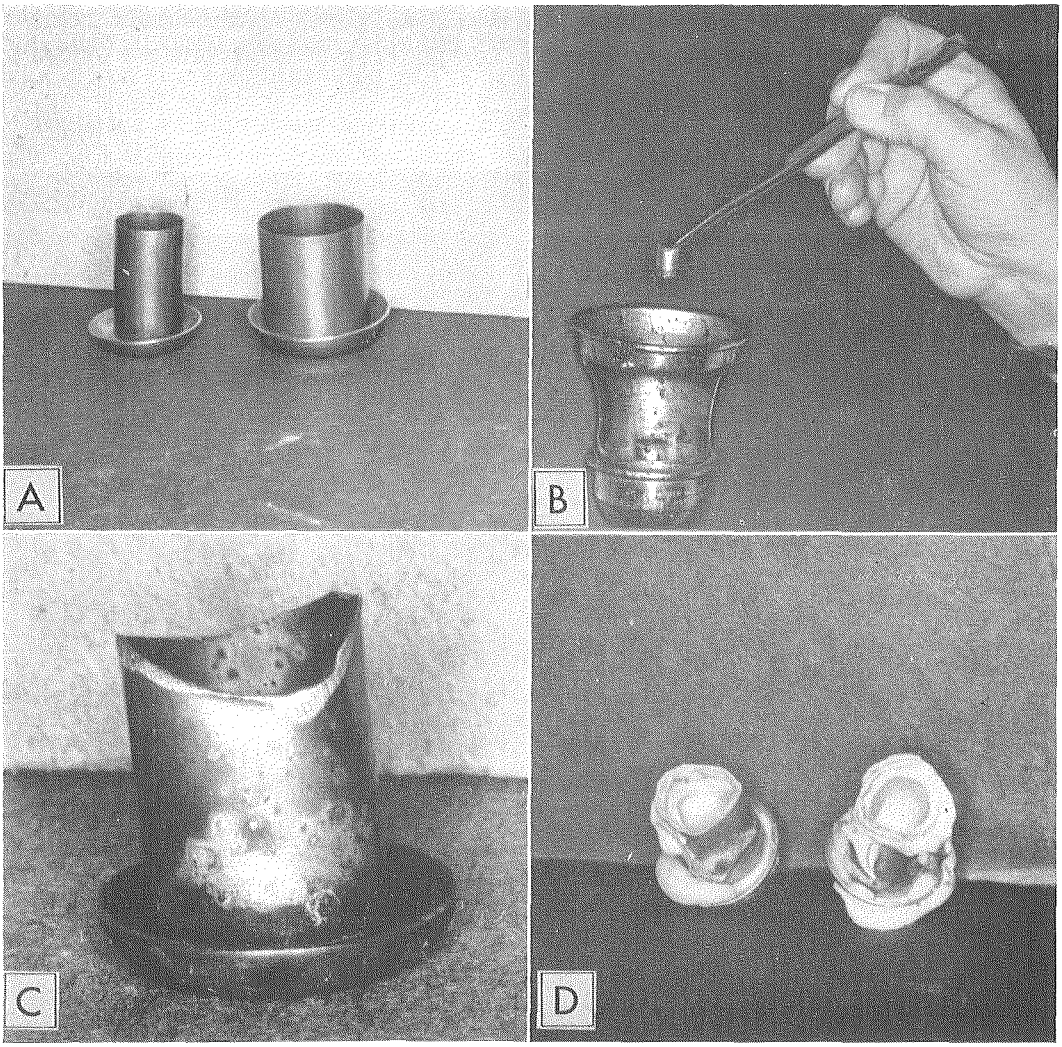

Figure 161. Band and rubber base impression technique. *A*, Select a slightly larger copper band than usual and a Sta-lite reinforcement ring. *B*, *C*, Anneal and festoon the band. Spread some Sta-rigid solder paste around the edge and into the groove of the ring. Pass it through the Bunsen flame until the paste flows. Add wax to cover the opening of the ring. *D*, Mix some rubber impression material on a paper pad and smear it into the band. Dry the tooth and tissues and seat the filled band over the prepared tooth. Hold it under pressure for one minute and then under light pressure for five minutes before removal.

two sizes (Fig. 161*A*). Anneal and festoon the band and then spread some Sta-rigid solder paste around the edge and into the groove of the ring. Pass it through the Bunsen flame at the bracket table until the paste flows (Fig. 161*B*, *C*). Only a little heat is necessary. Allow the band to cool and then wash off the excess solder paste. Adapt and fit the band slightly beneath the gingiva and then mold a firm piece of wax over the ring and the adjacent teeth. This attached wax will act as a stop when the impression is taken and will guide the operator so that he will not force the band too far beneath the gum. Add sufficient wax to cover the opening of the ring.

Mix some rubber impression material on a paper pad and smear it into the band. Dry the tooth and tissues and seat the filled band over the prepared tooth. Apply pressure against the band for one full minute when the extension wax arms touch the approximating teeth. Reduce the pressure but then hold the band in place for about five minutes, then remove it (Fig. 161*D*). The band impression is now ready to be silverplated or to receive a stone die.

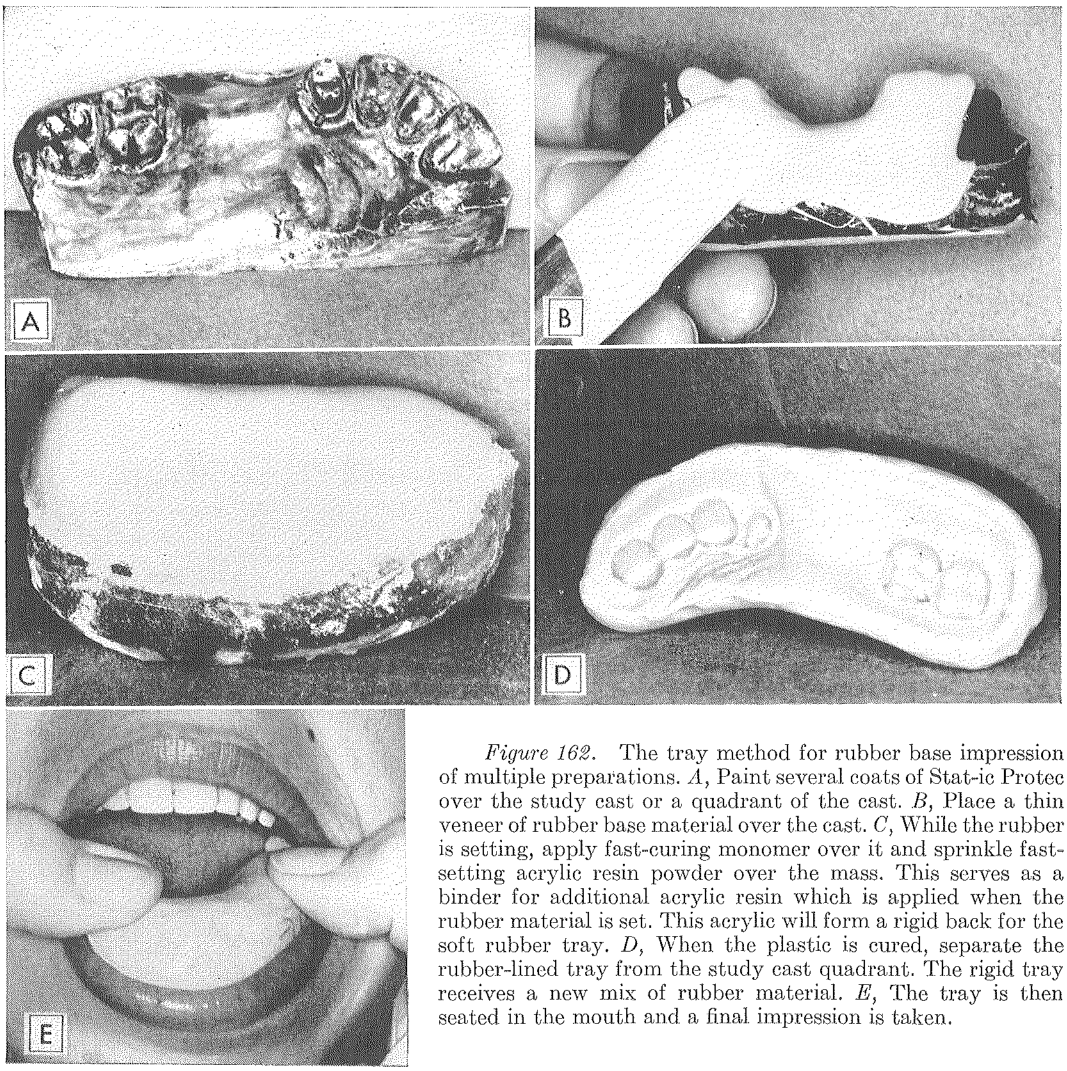

Figure 162. The tray method for rubber base impression of multiple preparations. *A*, Paint several coats of Stat-ic Protec over the study cast or a quadrant of the cast. *B*, Place a thin veneer of rubber base material over the cast. *C*, While the rubber is setting, apply fast-curing monomer over it and sprinkle fast-setting acrylic resin powder over the mass. This serves as a binder for additional acrylic resin which is applied when the rubber material is set. This acrylic will form a rigid back for the soft rubber tray. *D*, When the plastic is cured, separate the rubber-lined tray from the study cast quadrant. The rigid tray receives a new mix of rubber material. *E*, The tray is then seated in the mouth and a final impression is taken.

THE TRAY METHOD FOR RUBBER BASE MULTIPLE IMPRESSIONS

When multiple inlays and three-quarter and full crowns are indicated, the tray method of impression will facilitate the construction of accurate dies and working casts. Well defined imprints of the shoulders and cavity margins are obtained. There is no need to use escharotic medicaments to push away the gingival tissues.

Paint several coats of Stat-ic Protec, a quick-setting medium, over the study cast or a quadrant of the cast (Fig. 162*A*). This material adapts itself better than wax. Mix Stat-ic "X" rubber base material and place a thin veneer over the cast (Fig. 162*B*). While the rubber substance is setting, apply some fast-curing monomer over it. Then sprinkle acrylic resin powder over the mass. This procedure serves as a binder for additional acrylic resin to be applied when the rubber material is set. Mix rapid-setting acrylic resin and pack it over the back of the set impression mass, completing a rigid rubber-lined tray (Fig. 162*C*). When the plastic is cured, separate the rubber-lined tray from the study cast quadrant. The black Stat-ic Protec can be readily removed. The operator now has an ideal tray which fits accurately and closely over the working area of the teeth and possesses a rigid back. This tray has room for an even wash of rubber base material.

After the teeth are prepared, dry them with cotton pledgets and dry the surrounding tissues with cotton rolls. Make a new mix of rubber base material and place it in the tray and then take the impression. The rigid back of the tray will aid in compressing this new mix of material. When pressure is applied to the stiff outside of the tray for one full minute, the newly mixed material will be forced into the gingival crevices beyond the borders of the preparations. Hold the tray in position with light pressure for about five minutes before removal. The impression will produce clear-cut imprints of the shoulders (Fig. 162*D*).

SILVERPLATING

The Sta-lite Electroplating Unit is a compact unit for those who do their own

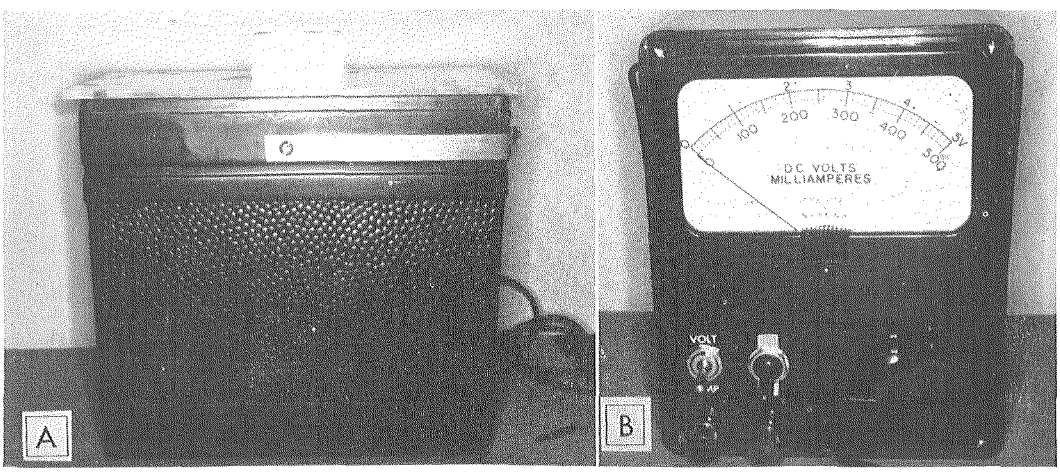

Figure 163. The Sta-lite Electroplating Unit. *A*, Hard rubber tank and cover. *B*, The voltmeter.

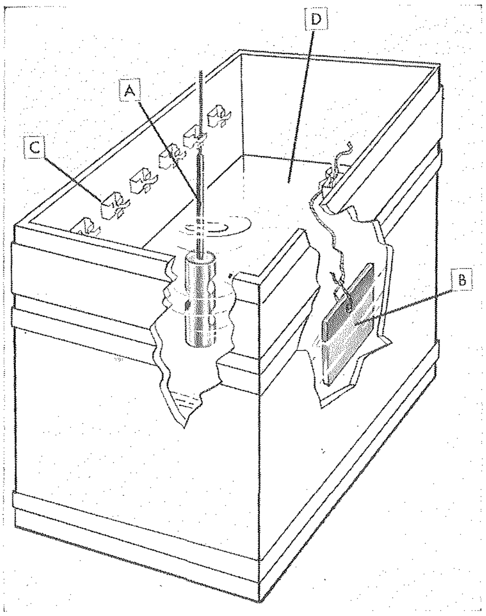

Figure 164. The silverplating tank. *A*, Multiple cathode rod. *B*, Two inch silver anode attached to a piece of bell wire. *C*, Attached clips to hold the cathode. *D*, The silverplating solution.

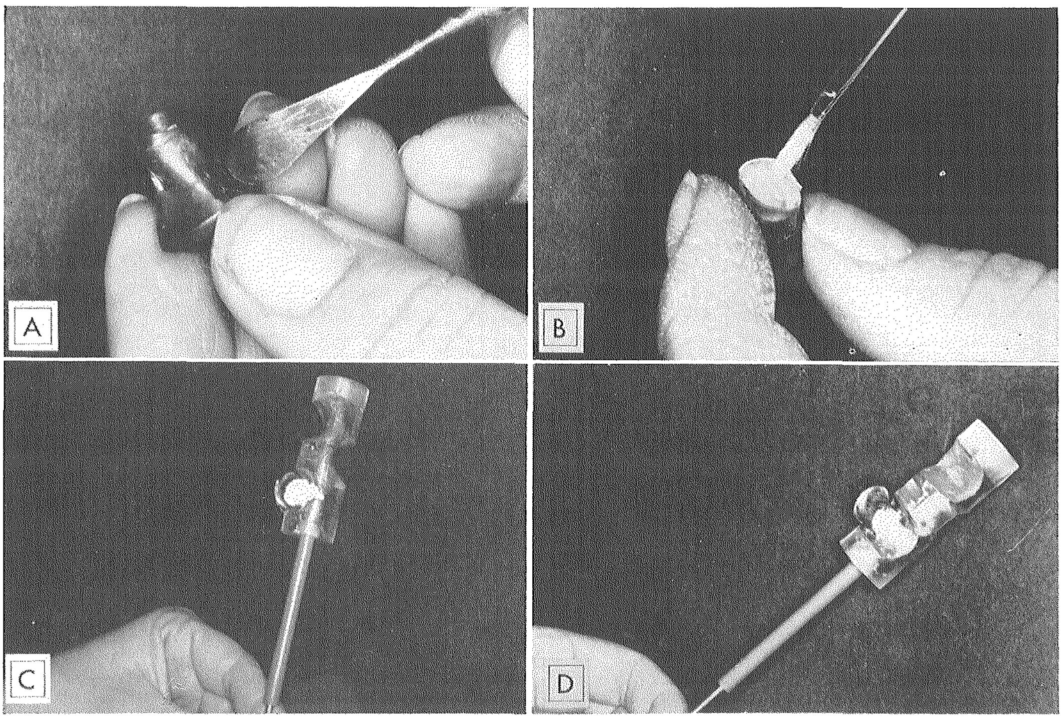

Figure 165. Silverplating the band impression. *A*, Apply wax to the band to hide the copper metal. *B*, Burnish silver powder into the band impression and blow out the excess. *C*, Attach the band to the cathode holder with some wax and paint contact from the band to the rod with Staco 101, a colloidal silver solution. Place the cathode with the attached band into the plating solution. Set the machine for no more than 10 milliamperes per tooth. Plate overnight. *D*, The plated band.

plating with silver, gold, or copper (Fig. 163). The solution for silverplating is composed of:

50 gr. Silver cyanide (C.P.)
150 gr. Potassium cyanide (C.P.)
1000 cc. Distilled water

Pure silver powder is used for coating. The machine consists of a hard rubber tank (half filled with the solution) with a top, a 2 inch square piece of silver anode, a multiple cathode rod, and a separate calibrated rectifier (Fig. 164). The operator is cautioned about placing impression compound or metal waxes in the solution. These materials contaminate the solution and render it worthless.

PLATING THE BAND IMPRESSION

Step 1 (*Fig. 165A*). Apply wax to the band to hide the copper metal.

Step 2 (*Fig. 165B*). Burnish silver powder into the band impression.

Step 3. Blow out the excess powder with the air syringe.

Step 4 (*Fig. 165C*). Attach the band to the cathode holder with wax.

Step 5. Paint contact from the band to the rod with Staco No. 101. This is a colloidal silver solution.

Step 6. Place the cathode and band into the solution. Set the machine for *no more than 10 milliamperes per tooth.*

Step 7. Plate for 15 minutes, then check any areas that are not flashed. Touch up these exposed areas with the colloidal solution.

Step 8 (*Fig. 166 C, D*). Overnight plating is recommended but a four to six hour plate is heavy enough to complete the die.

PLATING THE TRAY IMPRESSION

Step 1 (*Fig. 166*). Burnish silver powder into the teeth to be plated and blow out the excess.

Step 2. Block out areas not to be plated, with Stat-ic Protec.

Step 3. Hook a piece of insulated bell wire into any part of the impression. (Expose the ends.) One wire is sufficient no matter how many teeth are to be plated.

Step 4. Paint contact from the teeth to be plated to the wire with the silver colloidal solution.

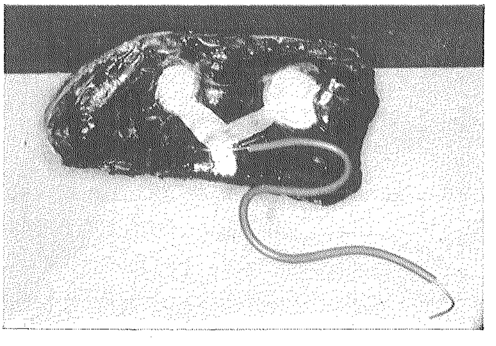

Figure 166. Plating the tray impression. Burnish silver powder into the teeth to be plated and blow out the excess. Block out areas not to be plated with wax or Stat-ic Protec. Hook a piece of insulated bell wire into any part of the impression. Paint contact from the teeth to be plated to the wire, with silver colloidal solution. Plate overnight.

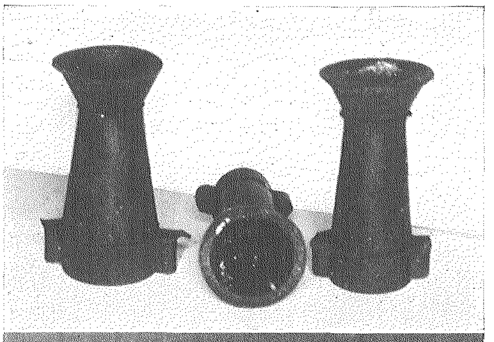

Figure 167. Ready-made rubber forms for tailpieces.

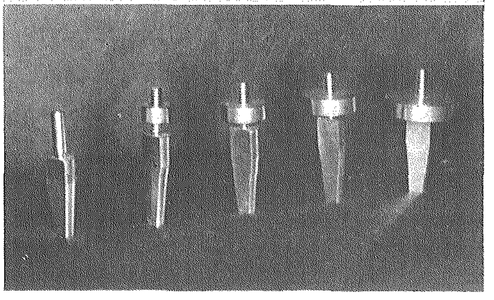

Figure 168. Ready-made brass tailpieces. (Courtesy Sta-lite Corp., New York.)

Step 5. Insert this into the solution and plate the same way as the band, using 10 milliamperes for each tooth. Remove after 15 to 30 minutes.

Step 6. Check for unplated areas and touch up with the silver colloidal solution.

Step 7. Insert in the tank and plate from four hours to overnight.

The operator is cautioned about the poisonous effect of potassium cyanide. Keep the tank covered at all times, preferably near a window that is slightly opened. Wash the hands thoroughly.

The plated teeth are ready for the tailpieces. These tailpieces may be packed with amalgam alloy, low-fusing metal, or acrylic resin (Fig. 167). Sometimes a ready-made tailpiece may be used (Fig. 168).

ELASTIC IMPRESSIONS FOR CROWNS AND BRIDGES

Rubber base and hydrocolloid impression materials in the fabrication of inlays, three-quarter crowns, full coverage restorations and fixed and removable partial dentures are receiving increasing attention by the dentist. The rubber materials have a mercaptan base or a silicone base. The earlier elastic impressions are poured, the more accurate will be the duplication of the prepared teeth and segment of the jaw; the longer any impression remains on the bench, the greater becomes the possibility of dimensional changes contributing to inaccuracies in the dies and master casts. The Thiokol (mercaptan) rubber impression can be silverplated but the silicone one cannot. All elastic impressions lend themselves to hard stone dies and casts. It is necessary to obtain some tissue retraction around the prepared teeth, and the teeth and surrounding areas should be as dry as possible. Care must be exercised not to trap air when taking the impression. The gingival tissue around prepared teeth may be retracted by mechanical pressure, surgical removal, or judicious use of chemicals.[1]

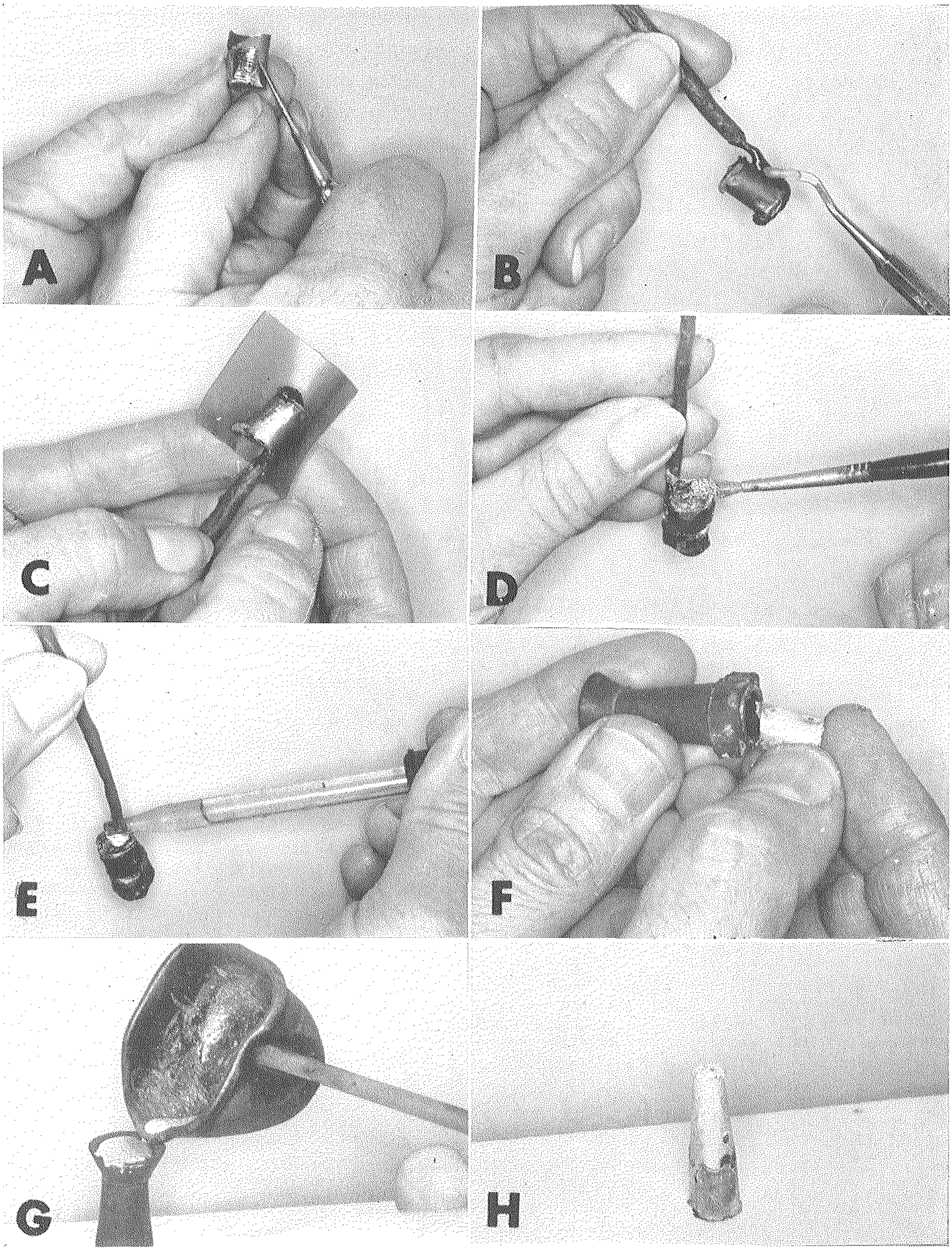

Figure 169. Steps in copper plating the compound band impression. *A*, Remove oxides from a portion of the annealed copper band with a bur. *B*, Attach the exposed wire electrode to the clean portion of the band with sticky wax. *C*, Wrap a cylinder of baseplate wax around the band and attached electrode. *D*, Dust in some bronzing powder. *E*, Add a few drops of copper sulfate liquid from the tank. *F*, After the impression is plated, remove the band from the wax and the electrode and fit it into one end of a prefabricated tailpiece former. *G*, Melt some low-fusing metal and pour it into the former. *H*, The completed tailpiece in the plated band.

The tray method of taking elastic impressions is the most popular. The type of tray is a matter of personal preference. Specially constructed and fitted trays confine the impression material and conserve on the quantity used. The mercaptan rubber base impression material is manufactured in thin-bodied and heavy-bodied mixtures. The thin mix is placed in a syringe and injected around the cervical border of the preparation, interproximally, and then over the entire preparation (Figs. 170, 171). The heavy-bodied rubber base material is then mixed, placed in a tray, and seated over the covered quadrant of teeth. This mixture, confined in the tray, exerts pressure on the previously injected mix, forcing it into all surfaces of the prepared and unprepared teeth. The two mixes coalesce. Observe the timing as

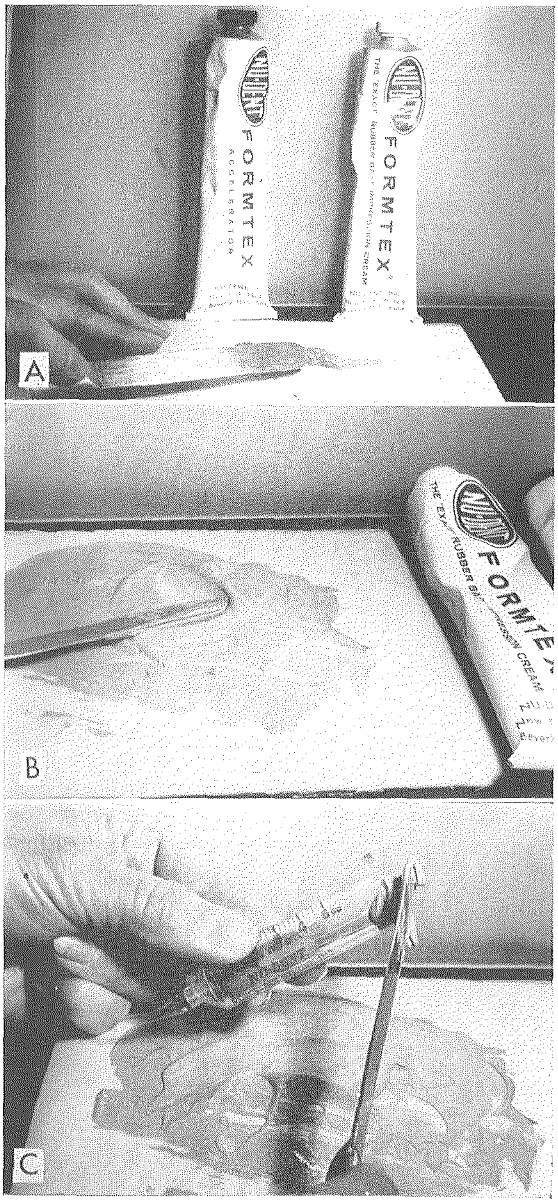

Figure 170. *A*, Equal parts of rubber base material and accelerator are squeezed from the tubes on a large waxpaper pad. *B*, Mix the brown and white strips until a solid color is obtained. *C*, Push a small amount into a disposable syringe.

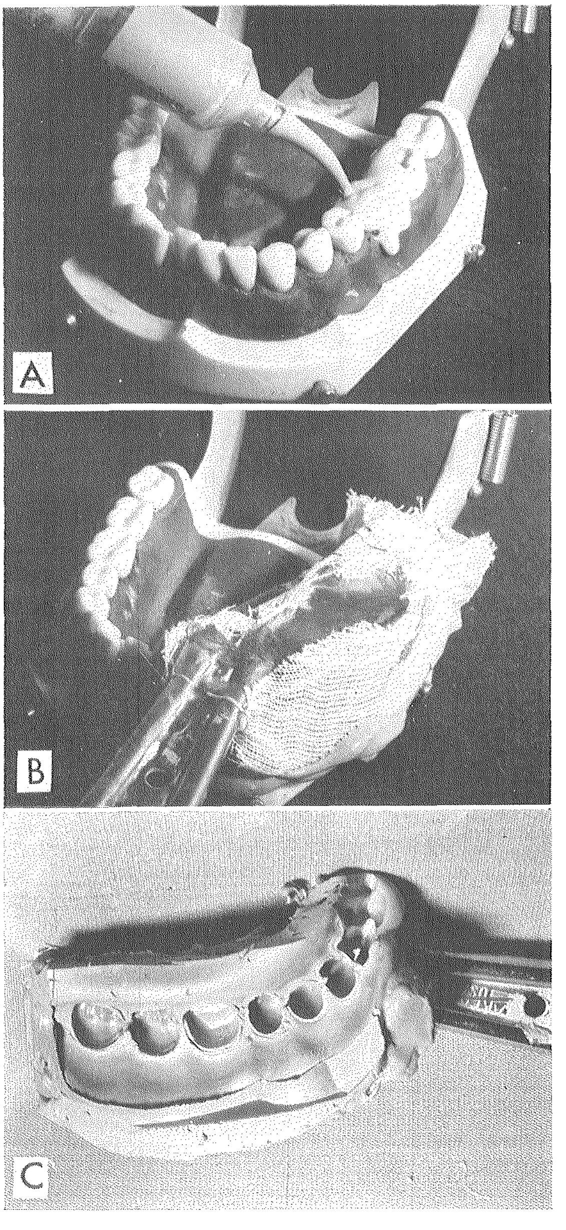

Figure 171. *A*, After the tissue is retracted and thoroughly dried, squeeze the rubber mix around the gingiva, the interproximal spaces, and finally the entire prepared tooth. *B*, Fill a prepared tray with the remaining rubber mix left on the pad and place the tray over the segment of the jaw. *C*, The portion of rubber squeezed from the syringe becomes part and parcel of the entire impression.

recommended by the manufacturer and when the rubber has set, forcibly remove the tray.

SILICONE BASE IMPRESSIONS

Silicone base impression material is manufactured in tubes or jars with an additional bottle of accelerator liquid that can be dispensed by the drop. Each manufacturer supplies instructions regarding the amount of accelerator to be applied to a specific amount of silicone material. Let me illustrate: Silicone* is squeezed from a tube onto a large wax paper. The amount depends upon the size of the tray and the area to be covered. Squeeze about 6 inches of this silicone on the pad if the tray is to cover a posterior quadrant of the jaw. Add about four drops of liquid accelerator for each inch of silicone, the number depending upon the humidity as well as the shelf life of the material. The operator must get the "feel" of the completed mix, and when it is almost setting, load the tray quickly and take the impression. Use a broad beveled spatula and mix the paste with the colored liquid until all streaks made by the colored accelerator have disappeared. The looser the mix, the greater the chance for bubbles in the impression, and too stiff a mix does not allow the material to creep into all crevices of the preparation. It is advisable that the operator practice taking impressions on a typodont at first.

* Molloflex, Köstner Co., Oberursel, Germany.

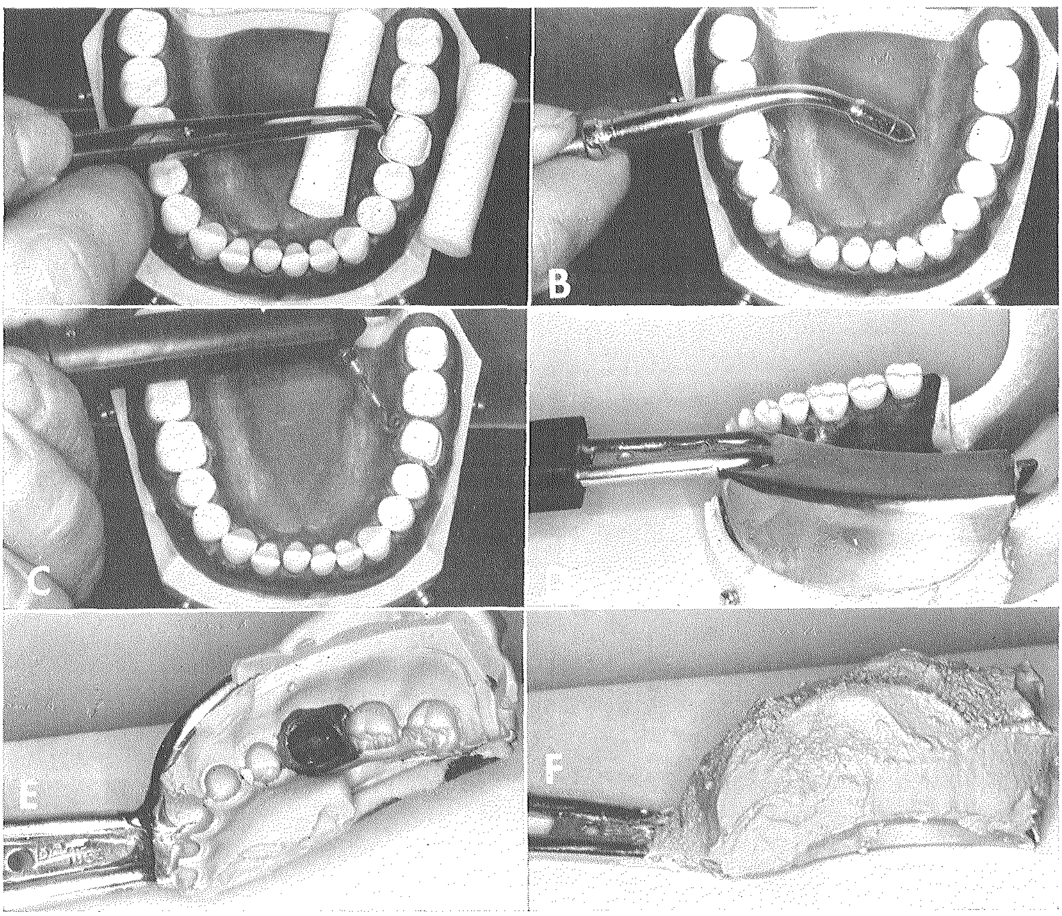

Figure 172. Taking the hydrocolloid impression (see text). *A*, Press Gingi-Pak thread into the gingival crevice for chemical retraction of the tissue. *B*, Remove the thread and dry with cotton and compressed air just before taking the impression. *C*, Squeeze some hydrocolloid interproximally, around the gingiva, and finally over the prepared tooth. *D*, Take the tray-filled hydrocolloid impression. *E*, Allow the cold water to flow through the tubes and when the hydrocolloid is set, remove the impression. *F*, Pour the impression immediately with hard stone.

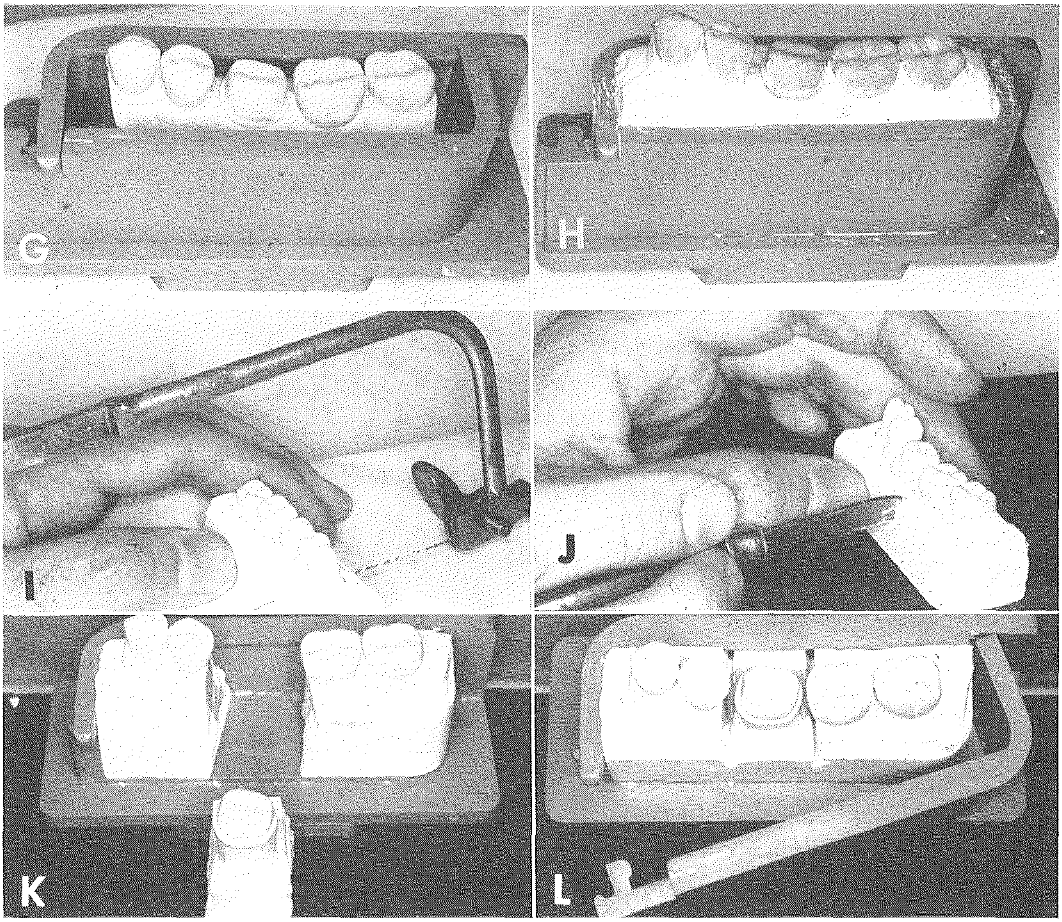

Figure 173. Constructing the die from the hydrocolloid impression in a Di-Lok tray (see text). *G*, Trim the master cast so that it clears the Di-Lok tray; score the back. *H*, Seat the cast in the tray with a new mix of different-color stone. *I*, Remove the cast from the tray and cut partway down each side of the prepared tooth with a fine saw. *J*, Insert the blade of the plaster knife and pry each segment apart. *K*, The separated prepared tooth in stone can be readily removed from the tray for waxing the crown. *L*, The stone die can be re-seated into its original position in the Di-Lok tray.

The operator dries the teeth and areas before mixing and instructs his assistant or the patient to maintain that dryness by holding cotton rolls or gauze pads over the teeth. Remove the filled tray in a vertical direction after the material has set.

TRANSFER COPINGS

It is necessary to obtain accurate places in the master impression for the correct seating of the metal dies. Although low-fusing metal transfer copings and even plastic caps are used, it is an accepted fact that a cast metal transfer coping assures more accurate seating of the dies. The metal can be gold, silver, or a technique metal. Bassman[1] advocates the "K" metal and recommends that it be used as a guide in creating and maintaining the established occlusal vertical dimension. The coping

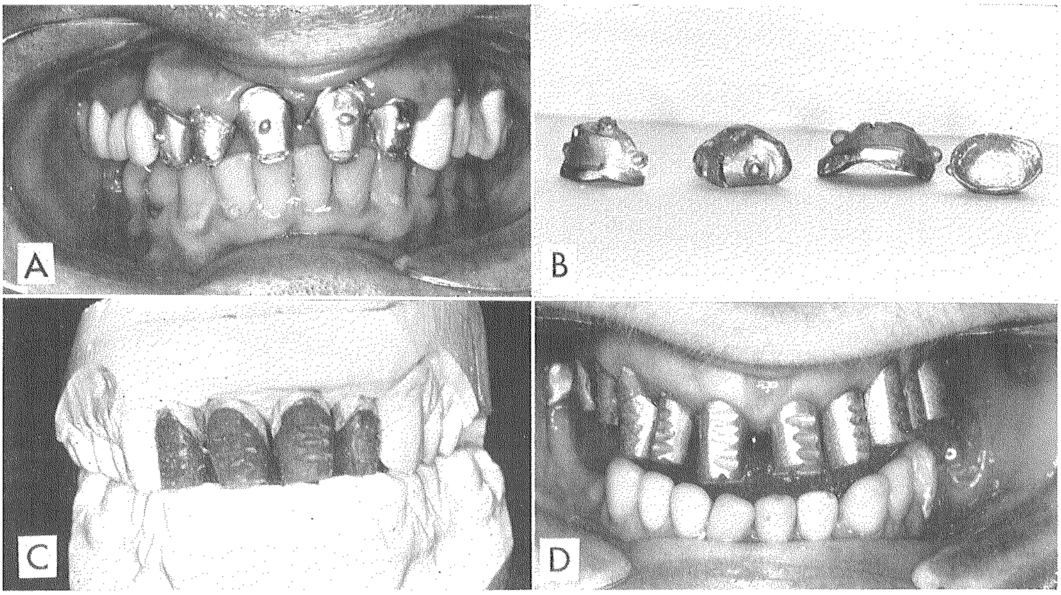

Figure 174. Types of transfer copings. *A*, Cast technique metal copings. *B*, Cast gold copings. *C*, Acrylic resin copings. *D*, Low-fusing metal copings.

is waxed carefully over the die. Small projections are created to facilitate removal in the plaster impression. A hole is made in the buccal or labial area so that proper seating can be recognized. The waxed coping is invested in crystobalite and cast. The "K" metal is sluggish but casts readily and the completed coping fits like a gold permanent restoration.

MASTER IMPRESSIONS

Master impressions in occlusal rehabilitation may be taken in plaster, hydrocolloid, or the elastic impression materials.

PLASTER IMPRESSION

Select a clean, smooth aluminum tray that is large enough to include the abutment retainers. It should cover the retromolar pads in the lower jaw. In the upper jaw, the tray must include the tuberosities. Lubricate the tray with petrolatum to facilitate separation from the plaster if the remaining teeth and abutment retainers or the alveolus presents undercuts. If the retainers are full coverage restorations it may not be necessary to lubricate the tray.

Depending upon the individual case, a tray filled with plaster can sometimes be removed from the mouth in one piece, with the abutment retainers in the impression. The operator is advised to examine the remaining teeth and alveolus for undercuts before attempting the impression. The patient experiences pain and discomfort if a plaster impression sets over these undercuts and force is applied to remove the tray. Fill in the undercuts by pressing some soft wax against the tissue and alveolus (Fig. 175). To prevent dislodgement of the wax, seal it to the necks of the teeth.

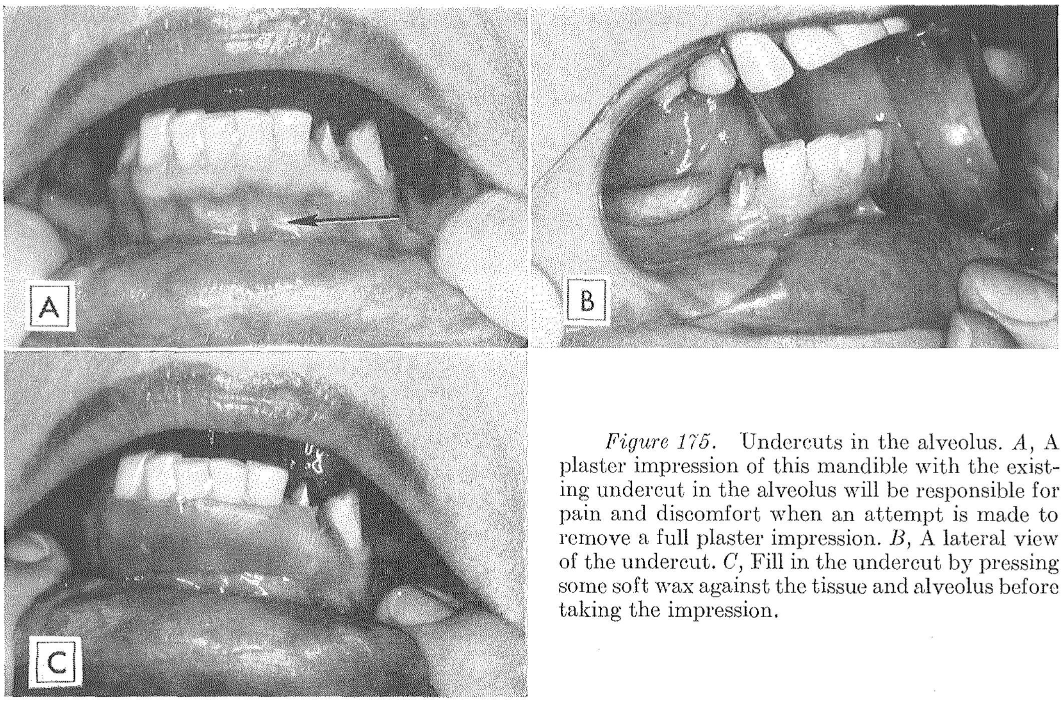

Figure 175. Undercuts in the alveolus. *A*, A plaster impression of this mandible with the existing undercut in the alveolus will be responsible for pain and discomfort when an attempt is made to remove a full plaster impression. *B*, A lateral view of the undercut. *C*, Fill in the undercut by pressing some soft wax against the tissue and alveolus before taking the impression.

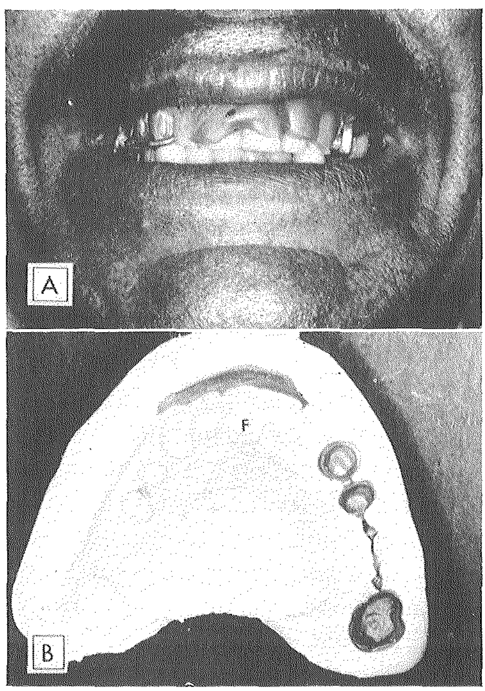

Figure 176. *A*, Undercuts in the interproximal spaces of some teeth can be covered with wax. *B*, The full plaster impression is removed usually in one piece. The wax remains in the plaster (*F*).

The plaster impression can then be removed in one piece (Fig. 176). If the undercuts are too pronounced, removing the impression in sections is recommended.

TAKING THE PLASTER IMPRESSION FOR THE REMOVABLE PARTIAL DENTURE

Seat the patient erect in the chair and request that the chin be held down to prevent gagging. Select the proper size full aluminum tray especially used for plaster. If there are no undercuts and if there are only abutment retainers, splints, or fixed bridges in position the inside of the tray need not be lubricated in some instances. There may be undercuts in the osseous structure and a downward pull may scratch or bruise the mucosa and hurt the patient. Therefore, it is necessary that the tray be lubricated with petrolatum before pouring the plaster mix into it. If the palate has a deep vault it is expedient to build up the tray before lubrication, with impression compound in the palatal area allowing sufficient room for thickness of plaster. Sift and mix impression plaster slowly and thoroughly in a large plaster bowl containing a sufficient amount of cold tap water. As soon as the mixed plaster has stiffened so as not to run, fill the tray and center it while seating it in the mouth. The assistant may retract one cheek to allow easy insertion. Hold the filled tray in position until the plaster is completely set. With small cotton pliers, remove the excess that tends to gag the patient. Tap the tray handle gently a few times and the lubricated tray will be separated from the plaster. With a special plaster knife, make an occlusal groove in the plaster from the posterior section on one side all around to the posterior section on the other side. Make this groove deep enough so that a broad instrument can be inserted for separation of the plaster. Make a vertical cut in the canine region on both sides with the pointed end of the plaster knife. Insert the long blade in the grooves, pry away the buccal posterior halves and the anterior section, leaving the complete lingual piece. The operator can force the palatal section away with the fingers. With practice, the operator can remove a plaster impression in three or four sections; however, with more than four sections, fracture of the plaster may develop. Rinse the sections in tap water and set them together in the original tray to be waxed together by the technician and poured in hard stone and low-fusing metal.

FULL MASTER SILICONE IMPRESSIONS

Sometimes a good result can be had with silicone, particularly a case with abutment retainers for the construction of an internal attachment removable partial denture. Depending upon the size of the tray, sufficient inches of silicone paste are spread onto the large wax paper pad in the form of a square to prevent the liquid accelerator from flowing off the pad. Place three or four drops to the inch (more or less, depending upon temperature and weather conditions) within the square. The accelerator and silicone are mixed with the large spatula until no white streaks of silicone are visible (the accelerator is reddish). The mucosa and abutments on the teeth, as well as any remaining teeth, are dried before mixing. Mix the materials and fill the tray. Seat it carefully without trapping air, and hold the tray in the mouth until the material sets. Remove the impression in a vertical direction. The abutment retainers usually are removed with the impression; however, if they fail to come with the impression, they can be seated. Low fusing metal can be poured into a Molloflex silicone impression.

References

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8

ARTICULATING THE WORKING CASTS

Now that the teeth in one or both jaws have been prepared, dies have been constructed, and the master casts have been poured from full mouth impressions, it is advisable to place the casts on an adjustable articulator. Seides stresses the importance of mounting the casts on such an instrument in order to recognize discrepancies in occlusion and in the correlation of centric relation to centric occlusion.[6] He writes, "Deep occlusal abrasion and uneven irregular tooth wear, together with elongation and drifting of teeth often induce faulty masticatory habits resulting in malrelation of the mandible to the maxillae. The discrepancy thus created between centric occlusion and centric relation is a diagnostic factor which is commonly encountered. However, this discrepancy may not be readily recognized clinically but it becomes strikingly obvious when the casts are mounted on an articulator." It is desirable that the casts relate to the hinge opening of the articulator as the mandible relates to the hinge opening of the jaw. Orientation of the casts facilitates the construction of the restorations.

The instrument used to transfer the working casts to the articulator is the face-bow. The operator is again reminded that the articulator is not the overriding factor in occlusal relation. According to Boucher,[1] "It should be pointed out that the instrument is not the key to successful treatment. It requires knowledge, skill, and integrity on the part of the dentist in order to render the best service to the patient, regardless of the instrument used."

OCCLUSAL RIMS

Occlusal rims are necessary to transfer the impression of the relationship of the jaws from the patient to a working device called the articulator. They are useful because they are used to establish and maintain the vertical dimension of occlusion. Occlusal rims are usually constructed of hard shellac pink baseplate, acrylic resin forms with wax mounds, or removable partial denture framework with wax mounds. Some operators utilize other means such as plaster or a combination of gauze and metallic oxide paste or mounds of silicone. The indication for any of these rims depends upon the individual operator and the individual case. The rims commonly used are these:

Base Plate and Wax Mounds (Fig. 177*A*). This type is usually used when all or most of the posterior teeth are missing in a patient with a collapsed or lost vertical dimension.

Vacuum Pressed Acrylic Base With Wax Mounds (Fig. 178). This method adapts the heated sheet of acrylic more closely to the working cast by a vacuum process after heating the material over a flame or a machine and moulding it with the fingers or with the machine. Omnivac is a precision vacuum adapter that heats, compresses, and adapts a strong, thin bite rim from a working cast. The advantage of this type of occlusal rim for a removable partial denture and a complete denture

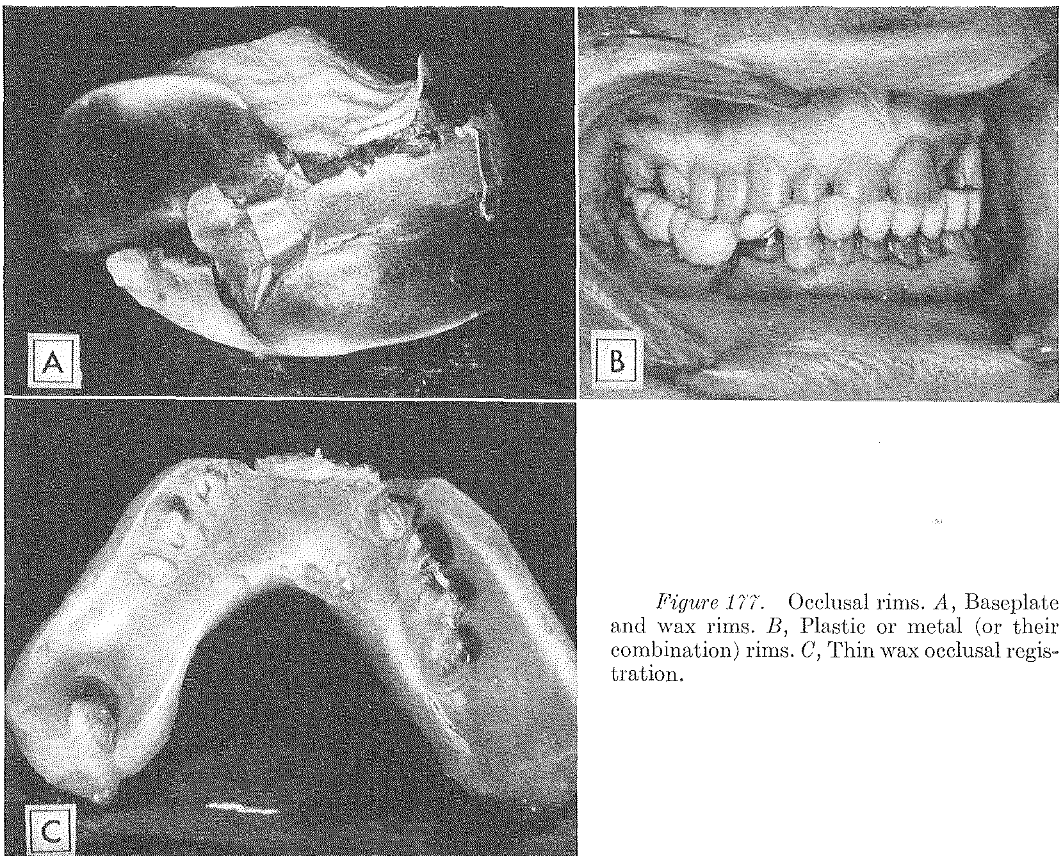


Figure 177. Occlusal rims. *A*, Baseplate and wax rims. *B*, Plastic or metal (or their combination) rims. *C*, Thin wax occlusal registration.

is that the rim does not slip or move readily. This form of rim fits the cast and edentulous areas in the mouth more closely. The existing teeth on the cast are blocked out with moldine. A sheet of omnident acrylic base plate 5 × 5 is heated in the vacuum adapter. At a predetermined time, the handles of the machine are pressed down, and the vacuum creates a well adapted occlusal rim. After trimming the rim, wax platforms are arranged on the edentulous areas. These vacuum constructed occlusal rims are also recommended for preliminary occlusal rims and for mouth guards.

Acrylic Resin or Metal Splint or Their Combination (Fig. 177*B*). This type is usually recommended when the occlusal vertical dimension is reduced by wear and when many occluding natural teeth are present. It is used to determine whether the patient can tolerate a prescribed vertical dimension of occlusion slightly greater than the one he has.

Thin Wax or Its Equivalent, Occlusal Registration (Fig. 177*C*). This type is indicated primarily when most of the natural occluding teeth are present and in a satisfactory occlusal relationship or as a check bite to reset the casts on the articulator. Schuyler's articulating wax is an ideal material to use.

Removable Partial Denture Metal Framework With Wax Mounds (Fig. 179). When a partial denture is planned for one or both jaws, the metal framework with wax mounds is the practical method of obtaining the occlusal registration.

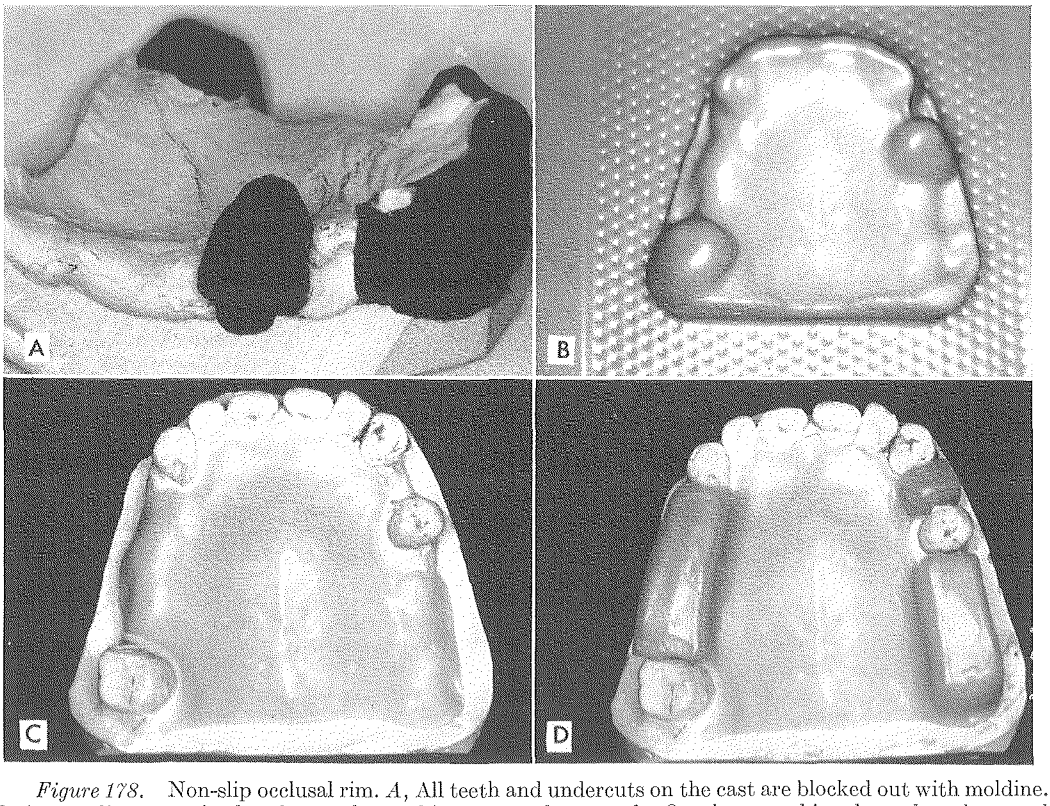


Figure 178. Non-slip occlusal rim. *A*, All teeth and undercuts on the cast are blocked out with moldine. *B*, An acrylic square is placed over the working cast and set on the Omnivac machine, heated, and pressed with the plunger. The vacuum draws the warmed acrylic over the cast. *C*, Cut and trim the acrylic form which fits snugly to the cast. *D*, Add wax mounds on the edentulous areas of the acrylic. This type of occlusal rim moves very little when registering the occlusion in the mouth.

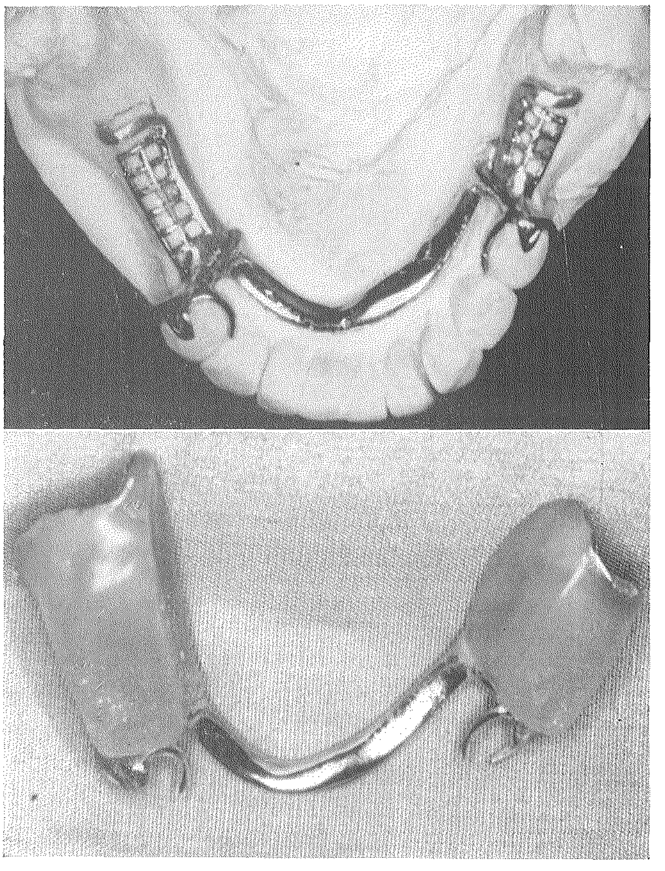


Figure 179. Occlusal wax rims on a metal framework of a removable partial denture.

ACRYLIC RESIN TRANSFER COPINGS FOR REGISTERING CENTRIC OCCLUSION

Another method of establishing or maintaining centric occlusion is the functional chew-in method with acrylic resin transfer copings. These copings are constructed to approximate heights. If one or two happen to be too short it is a simple procedure to add quick-cure acrylic at the chair. This method is ideal when a record of a satisfactory centric occlusion has been taken prior to the preparation of teeth. Sometimes acrylic is cured to cast gold copings, and the occlusal surfaces are carved like crowns and cemented on the prepared teeth. The patient chews and rubs with these restorations. Interferences are removed until comfort and function are acquired. Then centric occlusion is recorded and the record is used as a guide in establishing the vertical dimension of occlusion for permanent restorations.

THE FACE-BOW

Although many cases of occlusal rehabilitation have been successfully completed on articulators without the use of a face-bow, it is recommended, nevertheless. A face-bow enables the operator to orient the working cast more effectively. Orienta-

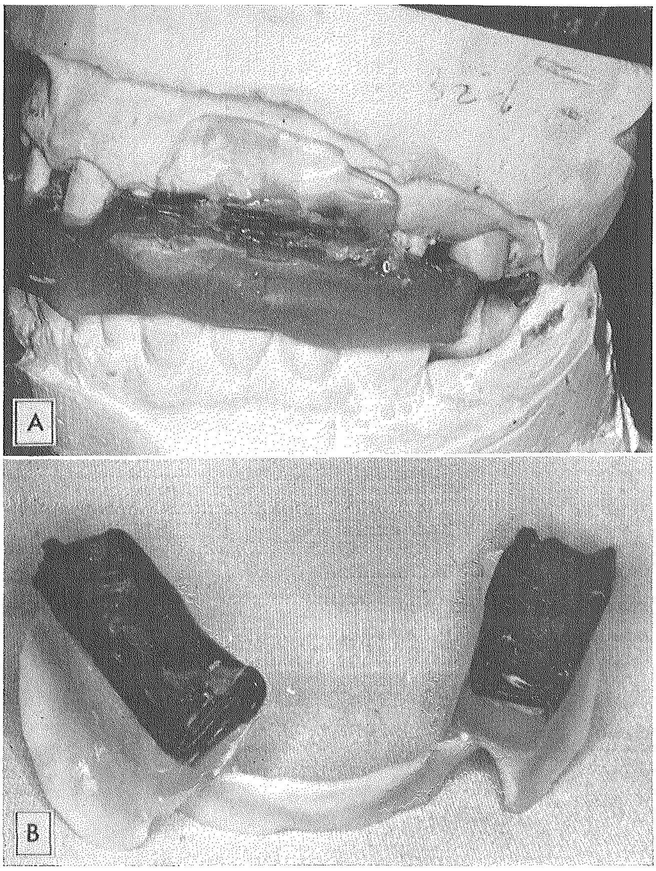


Figure 180. *A*, A wax "squash bite." *B*, Omnivac acrylic form with Schuyler articulating wax mounds.

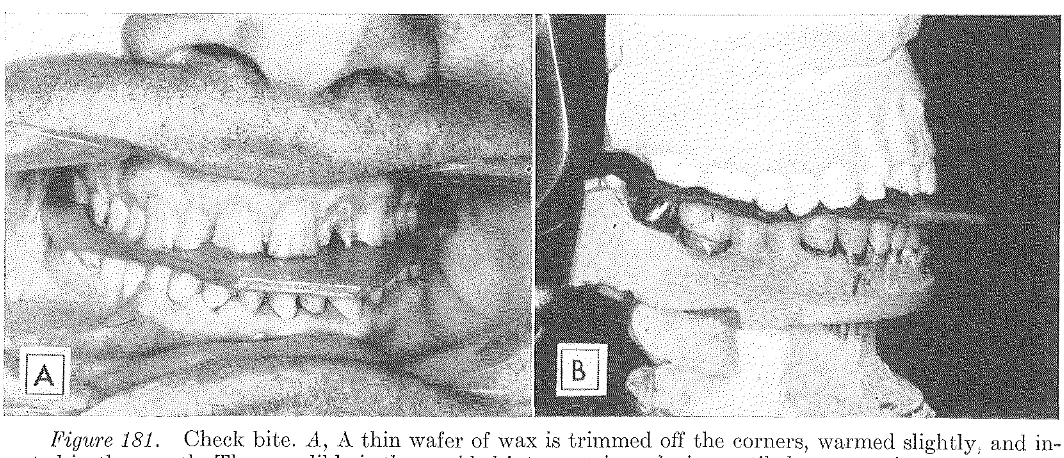


Figure 181. Check bite. *A*, A thin wafer of wax is trimmed off the corners, warmed slightly, and inserted in the mouth. The mandible is then guided into centric occlusion until the restorations on the teeth leave imprints in the wax. *B*, The cast is remounted on the articulator with the check bite wax as a guide. (Courtesy Dr. Ira Klein.)

tion of the maxillary cast to an articulating instrument offers the operator the position of that cast in close relation to the position of the patient's jaw (Fig. 182). Orientation obtained from anatomical landmarks on the patient's face or skull and transferred to a working instrument *decreases* the number of errors found at the bench in the laboratory. Obtaining the axial centers by means of anatomical markings is the operator's preference. The procedure depends upon the philosophy of occlusion he adopts. Some prosthodontists prefer markings around the temporomandibular joint areas, the bones of the face, the alae of the nose, etc. No matter which method and markings are used, orientation of the cast in near relation to the skull is the important objective. Each advocate of a procedure believes his method more accurate.

THE HINGE AXIS

The opening axis of the mandible is referred to as the hinge opening. Some operators believe that the plane on the face used in orienting the upper cast can be established *only* from one set of facial and skull markings. Furthermore, the followers of this gnathological philosophy believe that the locations of the ends of the hinge axis are so constant that they could be tattooed on the face as a permanent record, and that the movements of the mandible can be transferred exactly by pantographic tracings which "reproduce the patient" on the bench. To believe in a philosophy is man's prerogative. To insist that that philosophy is the only means of obtaining a successful result is absurd. From a clinical standpoint, to produce or restore an occlusion on the basis of the gnathological hinge axis for the patient who has been functioning in eccentric positions for years may be to invite trouble. Kurth and

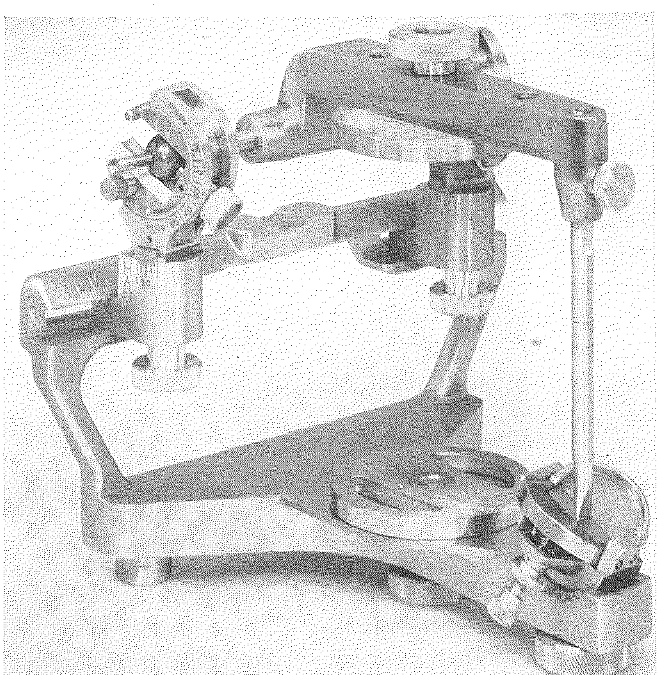


Figure 182. The Hanau University Articulator.

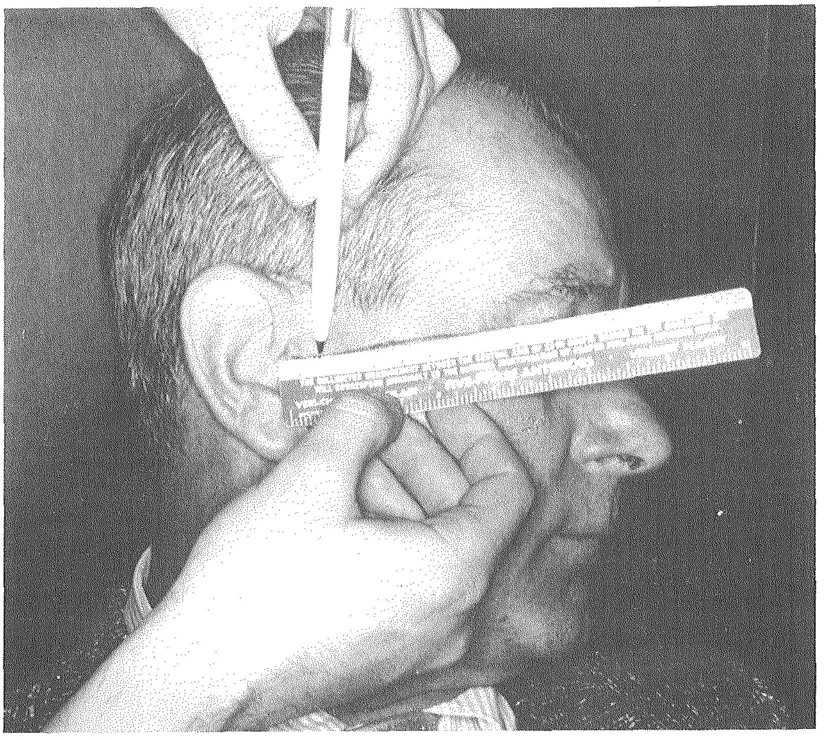


Figure 183. Locating the approximate opening axis. Draw a line from the top of the tragus of the ear to the corner of the eye.

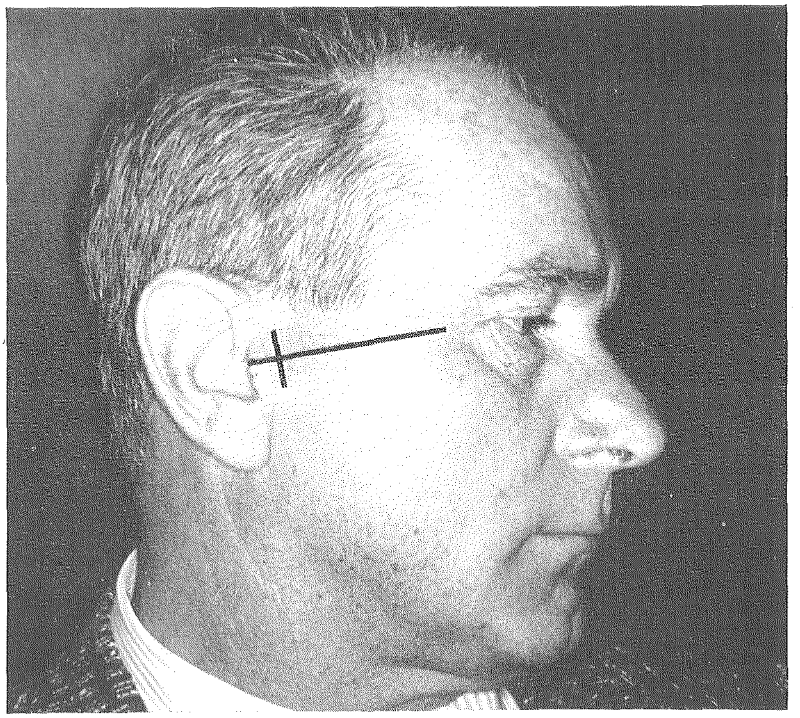


Figure 184. Draw another line at right angles to and bisecting the previously drawn one, at a point 11 mm. from the top of the tragus. The point where these two lines cross may be considered the landmark for the approximate opening axis.

Feinstein conclude from their experiments that *it is most unlikely that the hinge axis can be located with any degree of accuracy.*[4] "*Accurate location of the hinge axis is prevented by variations in anatomy, in physiology, in perception and in the ability of the patient to follow instructions and the preconceived prejudices of the operator.*" (Italics Brecker.)

Shanahan and Leff[7] concluded from their experiments and study that "the tracings of the natural opening, closing and masticating movements of the mandible does not show the presence of a mandibular axis in the reg'on o the condyles. An artificial mandibular axis can be produced during the opening and closing movements by forcing the chin backward. However, an artificially produced mandibular axis, jaw position, or jaw movement is not a normal physiologic movement." Trapozzano and Lazzari[9] came to these conclusions: "1. In 57.2 per cent of the subjects in this investigation, more than one condylar hinge axis point was located on either or both sides. 2. These findings indicate that since multiple condylar hinge axis points were located, the high degree of infallibility attributed to hinge axis points may be seriously questioned."

It has been stated that the human jaw mechanism is not precise and that exacting procedures done with so-called precision instruments that can record and transfer without errors or discrepancies are not possible. For those who wish to follow the gnathological concept of the hinge axis technique, the writings of Granger,[3] Lucia,[5] and Stuart,[8] to name a few, are excellent. The face-bow that possesses small needle-pointed metal rods applied to the opening axis markings and that utilizes more than one anatomical landmark affords closer orientation of the working cast to the skull. The face-bow minimizes time-consuming adjustments in restorations of all types. For the practitioner who has been trained with the Hanau articulator, the following method of orientation of the maxillary cast is recommended.

REGISTERING THE OPENING AXIS

The axial centers indicated by landmarks used in transferring the cast to the articulator are penciled on the skin. Location of the approximate opening axis of the mandible is the first step. Draw a line from the top of the tragus to the corner of the eye (Fig. 183). Then draw another line at a right angle to and bisecting the previously drawn one, at a point 11 to 13 mm. from the top of the tragus. The point where the two lines cross may be considered the landmark for the opening axis (Fig. 184).

ORIENTING THE WORKING CAST

If a previously worn splint is to be used as an occlusal rim, the procedure is as follows: Warm some wax and wrap it around the bite fork. Instruct the patient to close into the waxed fork and hold that position. The purpose of this procedure is to create imprints in the wax for seating of the maxillary cast in its orientation. Set the face-bow so that the bite fork can be fixed to it and the condyle rods can be firmly positioned at the marked axis points (Fig. 185). Remove the face-bow and attached bite fork carefully. Place and adjust them on the articulator and seat the

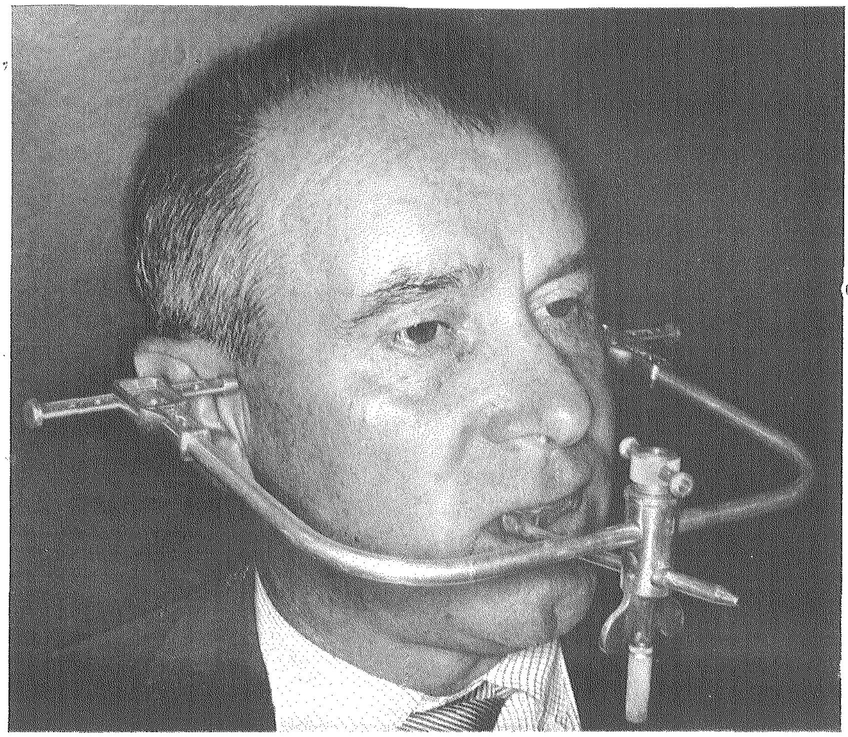


Figure 185. Setting the face-bow. If a previously worn splint is to be used as an occlusal rim then the procedure is as follows: Warm some wax and wrap it around the bite fork. Instruct the patient to "bite" into the waxed fork and hold that position. The purpose of this procedure is to create imprints in the wax, for seating of the maxillary cast in its oriented position. Set the face-bow so that the bite fork can be fixed to it and the condyle rods firmly positioned at the marked axis points.

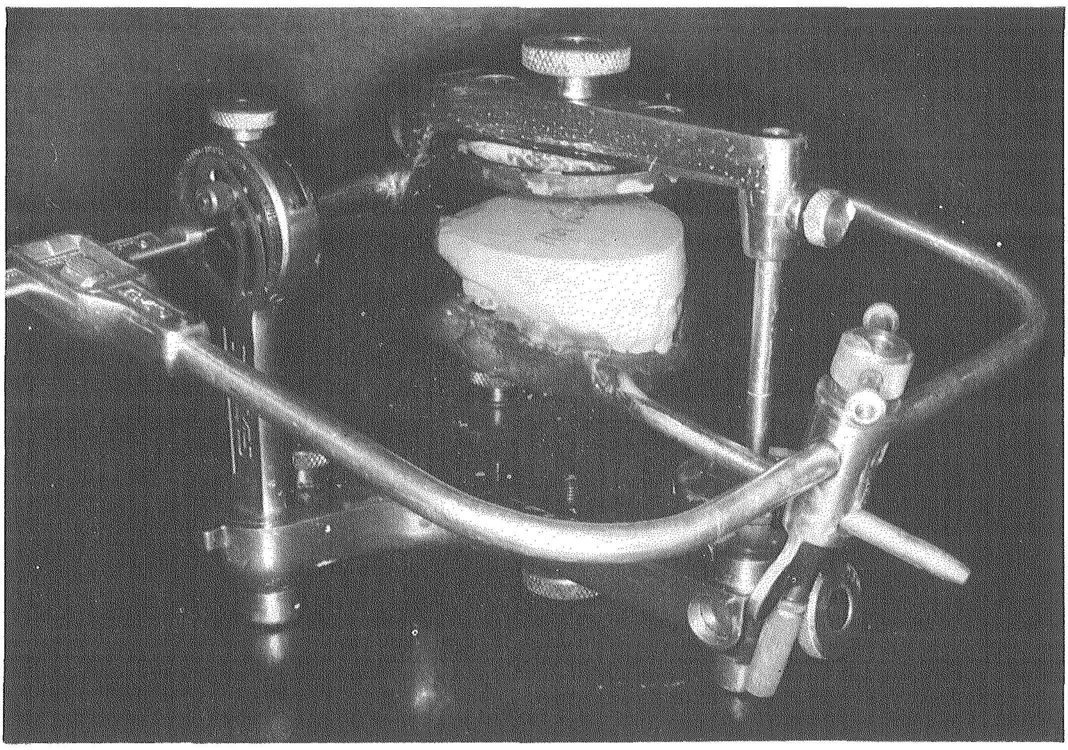


Figure 186. Mounting the upper cast on the articulator. Remove the face-bow and attached bite fork carefully. Place and adjust them on the articulator and seat the maxillary cast into the wax imprints on the bite fork.

maxillary cast into the wax imprints on the bite fork (Fig. 186). Mix some impression plaster and flow some over the top of the cast until it is attached to the upper mounting ring (Fig. 187). Adapt the metal-acrylic splint to the teeth on the upper cast. It is expedient to lute the splint to the cast with some sticky wax (Fig. 188). Close the articulator carefully after seating the mandibular cast into the corresponding part of the splint and attach the cast to the lower mounting ring (Fig. 189). After the plaster is set and the casts have been trimmed, remove the splint that has been used as an occlusal rim. The distance between the two casts is the space that will be occupied by the restorations in a satisfactory occlusal relation (Fig. 190).

FIG. 187.

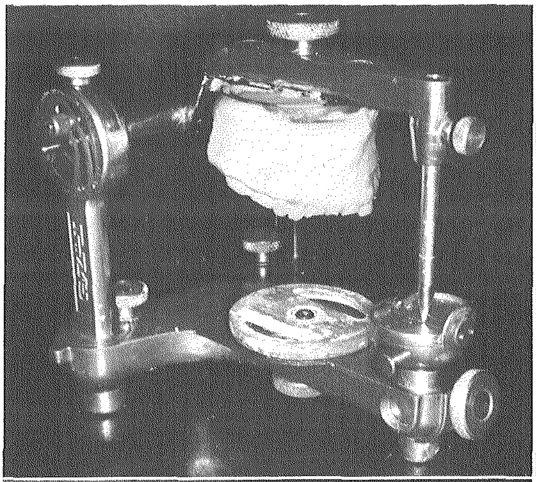
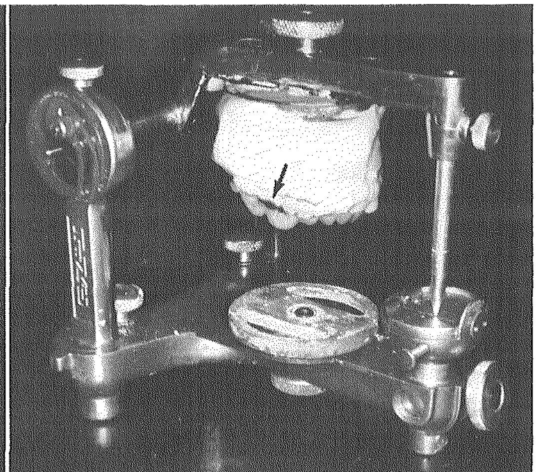


FIG. 188.



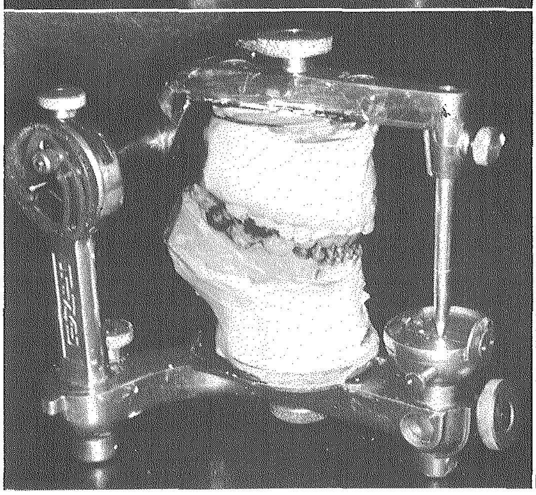


FIG. 189.

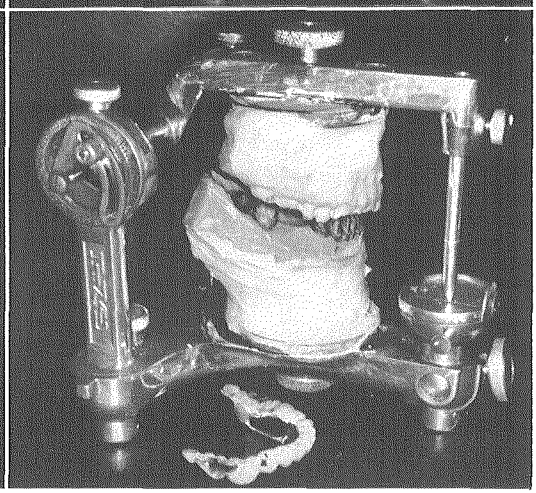


FIG. 190.

Figure 187. Mix some impression plaster and flow some over the top of cast until it is attached to the upper mounting ring.

Figure 188. Adapt the metal-acrylic splint to the teeth on the upper cast. Lute it to the cast with some sticky wax.

Figure 189. Close the articulator carefully and after seating the mandibular cast into the corresponding part of the splint, attach this cast to the lower mounting ring.

Figure 190. After the plaster is set, remove the splint occlusal rim.

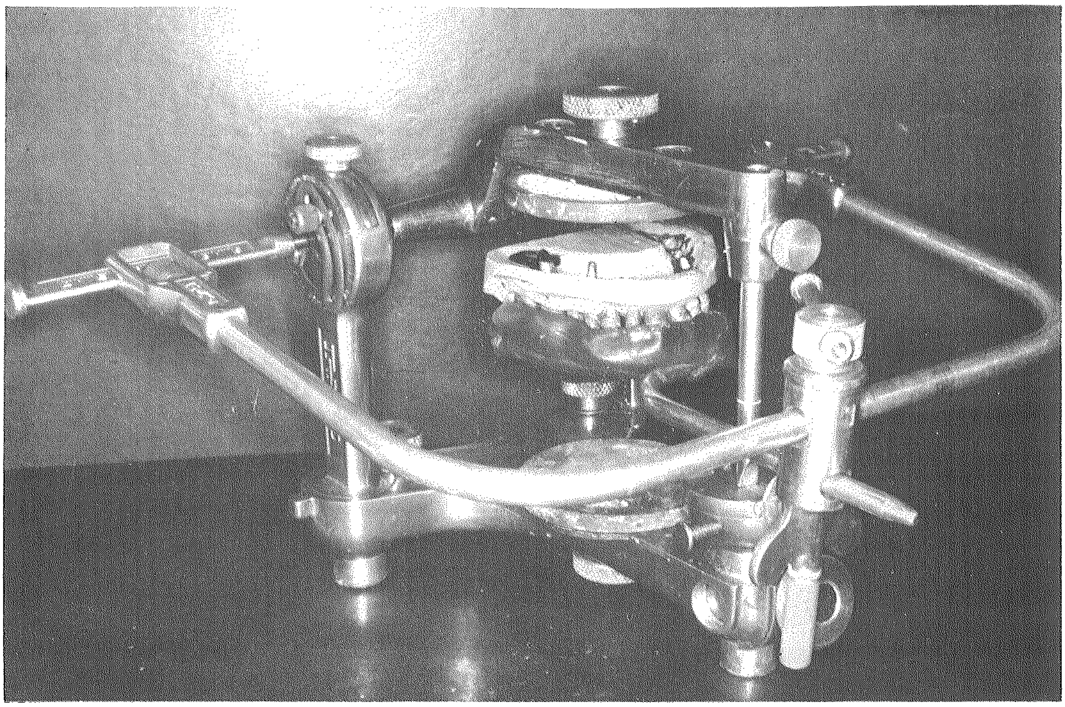


Figure 191. If a shellac baseplate and wax rim is used, it is mounted in a manner similar to that shown in Figure 185. Apply wax around the tailpieces of the metal dies in the upper cast so that the ends can be exposed for easy removal of the dies when the cast is mounted.

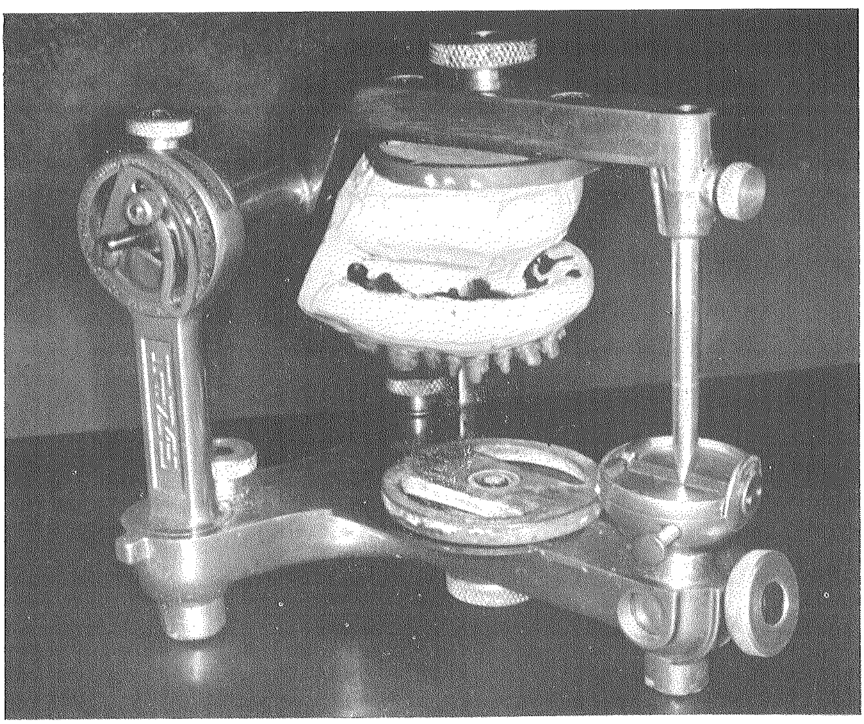


Figure 192. Attach the cast to the upper mounting ring. Expose the waxed ends of the dies.

If wax and shellac baseplate occlusal rims are used, these rims are used in the same way for orienting the working casts (Figs. 191–193). If the upper jaw is edentulous, a full maxillary occlusal rim is constructed and trimmed in the mouth so that the occlusal plane of the rim is parallel to a line drawn from the tragus to the ala of the nose (Fig. 194). If a partial denture framework with mounds of wax on the saddles is used, and most of the opposing teeth on the cast are present in acceptable relation, the patient is instructed to close into warmed softened wax mounds until the opposing natural teeth occlude in centric. It is frequently necessary that the operator guide the patient into this centric position. If the opposing jaw has an occlusal rim as well, then both rims are trimmed in the mouth so that the occlusal planes of these rims are parallel to the line drawn from the tragus to the ala of the nose.

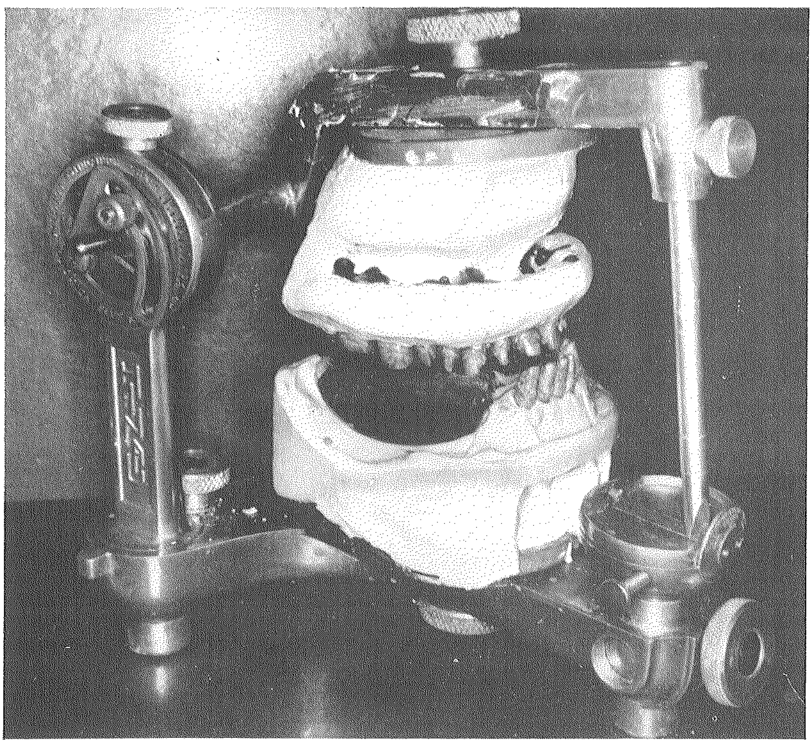


Figure 193. Lute the lower shellac baseplate and wax occlusal lower rim to the upper cast and attach the lower cast to the lower mounting ring with impression plaster. If the ridges of the mandibular edentulous areas are poorly formed and have some degree of displaceable tissue, this type of occlusal rim may produce inaccuracies. To control them, tin foil can be adapted to the remaining anterior segment and sealed to the occlusal rim with some wax entended over the incisal edges of the anterior teeth. This will prevent movement of the posterior segment of the rim. (After Dr. Louis Blatterfein.)

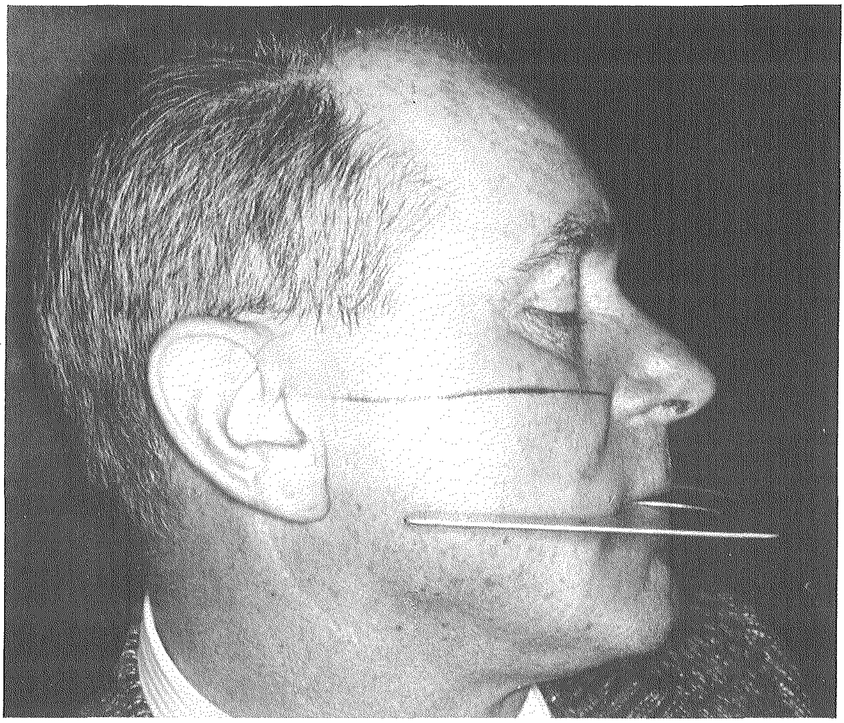


Figure 194. If the upper jaw is edentulous, a full maxillary occlusal rim is constructed and trimmed in the mouth so that the occlusal plane of the rim is parallel to a line drawn from the tragus of the ear to the ala of the nose. The Trubyte Occlusal Plane Plate is a useful guide in establishing this parallel. (Courtesy Dentist's Supply Co., York, Pa.)

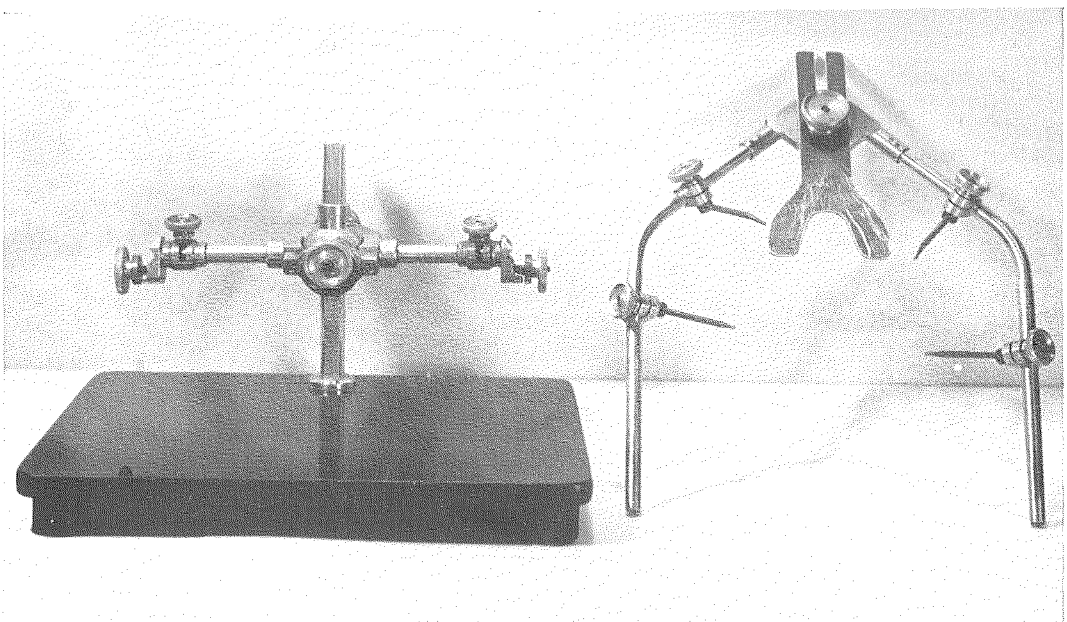


Figure 195. The Fischer Dentiphore. (Courtesy S. S. White Dental Mfg. Co., Philadelphia.)

THE FISCHER DENTIPHORE

Another basic instrument used in orienting the study casts and the working casts is the Fischer Dentiphore (Fig. 195). The advantage of this face-bow over the Hanau is the fact that extra landmarks of the skull are utilized. This affords a closer orientation of the working casts. Furthermore, the marks denoting the opening axis accommodate metal rods of small diameter that can be readily fixed to the bow stem. The bite fork can be replaced on the face-bow in the same position, no matter how many times it is removed. Measurements taken on the head are transferred to a platform superimposed on the Fischer platform, upon which the Dentiphore is mounted. This superimposed platform adapts itself snugly and accurately to the base. The operator can construct such a base of aluminum or a piece of Masonite. It is as thick as the Hanau mounting ring and it contains a cutout in the center to accommodate the mounting plate of the Hanau articulator (Fig. 196). The casts are oriented to the skull and attached to the mounting ring in one operation, and this facilitates the attachment of the Dentiphore to the articulator. It is ideal for the operator who does not have his own technician in his office.

A study or working cast with the Dentiphore is related to the four planes of the skull (Fig. 197). These are the preauricular plane, the orbital plane, the Frankfort plane, and the median line. Such a cast will disclose asymmetric influences and will provide the operator with an occlusal cant as it is related to these planes. A full upper impression is taken of the prepared teeth with the transfer copings in posi-

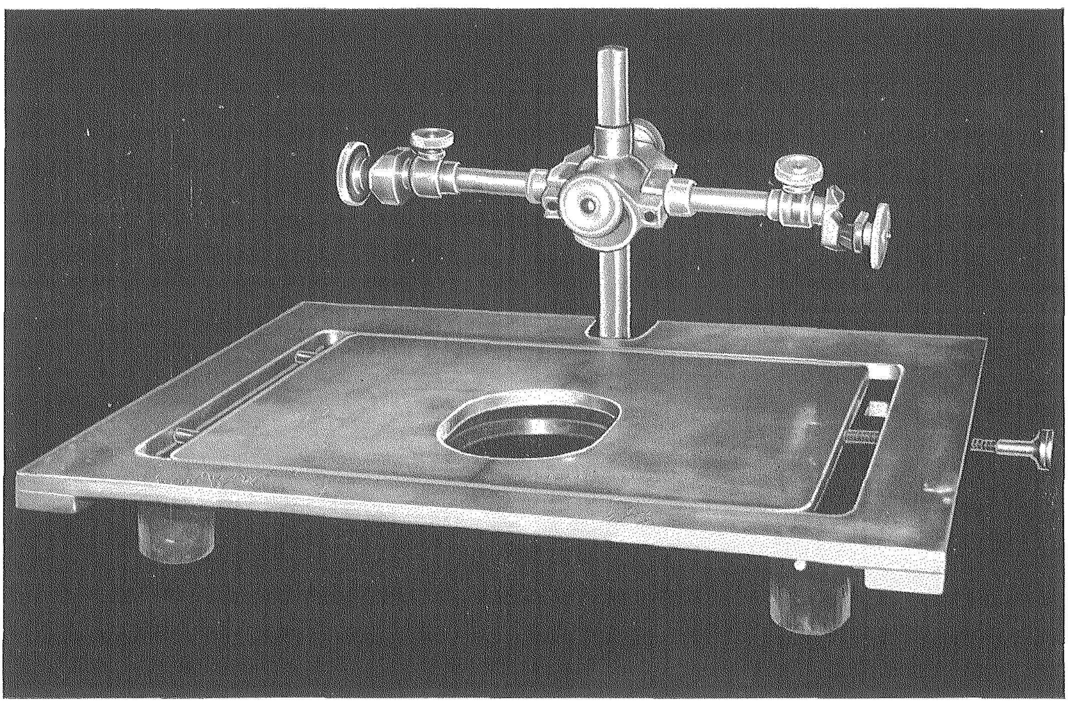


Figure 196. Superimposed plate on the Fischer platform of the Dentiphore has a cutout receptacle to seat the mounting plate or ring of the Hanau articulator.

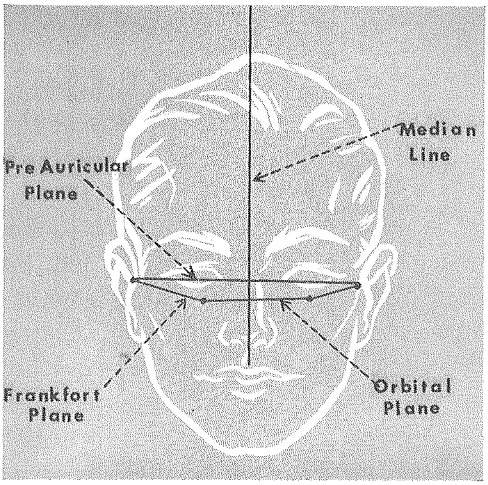


Figure 197. A study or working cast is related with the Dentiphore to the four planes of the skull and makes for more accurate orientation.

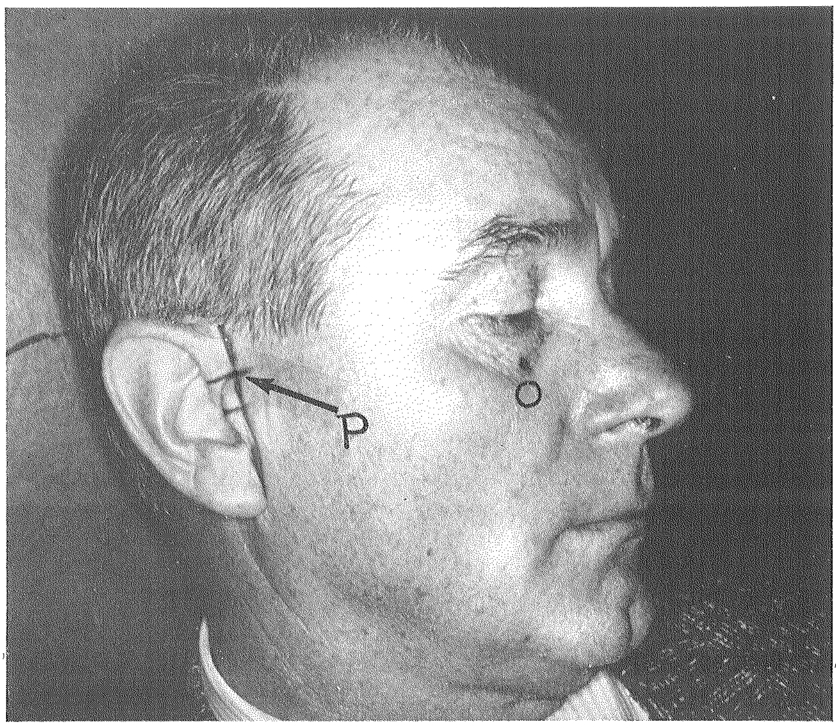


Figure 198. Locating the landmarks for the Fischer Dentiphore bow. With a skin pencil, draw a vertical line marking the base of the ear. This is the pre-auricular line. Another line, the tragal line, is drawn horizontally bisecting the tragus of the ear and intersecting the pre-auricular line. The point of intersection of the two lines is the tragal point. The pre-auricular point, *P*, marks the junction of the posterior root of the zygomatic arch and the pre-auricular line. The orbital points, *O*, are located by placing the mark on the lower rim of the orbit, directly in line with the pupil of the eye when the patient is looking ahead.

tion, and a stone cast is poured in the conventional manner. Facial markings are made to adapt the instrument.[2]

The Pre-auricular Points (Fig. 198). With a skin pencil, a vertical line is drawn marking the base of the ear. This is the pre-auricular line. Another line, the tragal line, is drawn horizontally bisecting the tragus and intersecting the pre-auricular line. The point of intersection of these two lines is the tragal point. With the tip of the index finger the zygomatic arch is palpated and the pre-auricular point marks the junction of the posterior root of the zygomatic arch and the pre-auricular line. The distance of the pre-auricular point from the tragal point is measured and this measurement is used to locate the pre-auricular point on the right side after locating the right tragal point.

The Orbital Points. These are located by placing the mark on the lower rim of the orbit directly in line with the pupil of the eye when the patient is looking straight ahead.

Softened baseplate wax is adapted over the bite fork. This is inserted in the mouth and the patient is instructed to clamp down suddenly upon the wax and to hold the closed position (Fig. 199). The wax is cooled with a stream of cold water and the patient is told to open the jaws. The bite fork is removed and the wax is trimmed so that the working cast can be seated without distorting the wax. This registration is done merely as an index for the maxillary cast during fixation to the Hanau mounting ring.

The fork with the wax indentations is replaced in the patient's mouth and held firmly by the teeth. The Fischer bow is fitted over the bite fork arm and the pointers are locked to the markings on the face. The arm of the bite fork assumes its correct position at all times because it is locked by a set screw at a given point (Fig. 200). The face-bow and fastened bite fork are removed. The previously poured maxillary working or study cast is luted to the bite fork with small paper clips (Fig. 201).

Figure 199. The patient is instructed to clamp down upon the waxed bite fork and to hold that position.

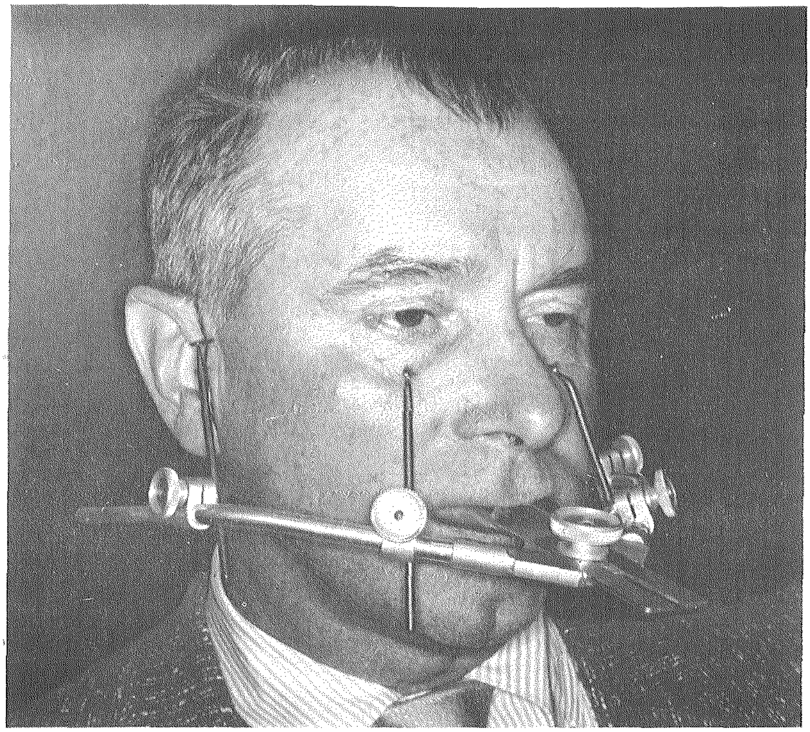


Figure 200. The Fischer bow is fitted over the bite fork arm and the pointers are locked to the markings on the face. The arm of the bite fork assumes its correct position at all times because it is locked by a set screw at a given point.

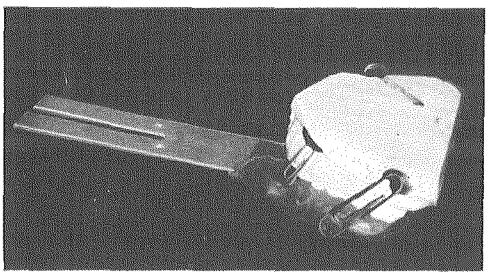


Figure 201. The previously poured upper cast is luted to the bite fork with small paper clips.

The luted cast is now immersed in a bowl of water for five or ten minutes to facilitate proper union with the new plaster base.

The four pointers of the Dentiphore are transferred to the platform so that the platform automatically becomes identical with the Frankfort plane. At least three of the pointers must touch the platform. These pointers are now fixed in that position. The bite fork and luted working cast are fastened to the face-bow, and the Hanau mounting ring is inserted in the accommodating slot in the platform (Fig. 202). Mix some impression plaster and pour some of it on the mounting ring until it is attached to the oriented maxillary cast (Fig. 203). When the plaster is set, remove the cast mounted on the ring (Fig. 204). This now can be placed on the Hanau articulator ready for articulation with the lower cast by means of the occlusal rims.

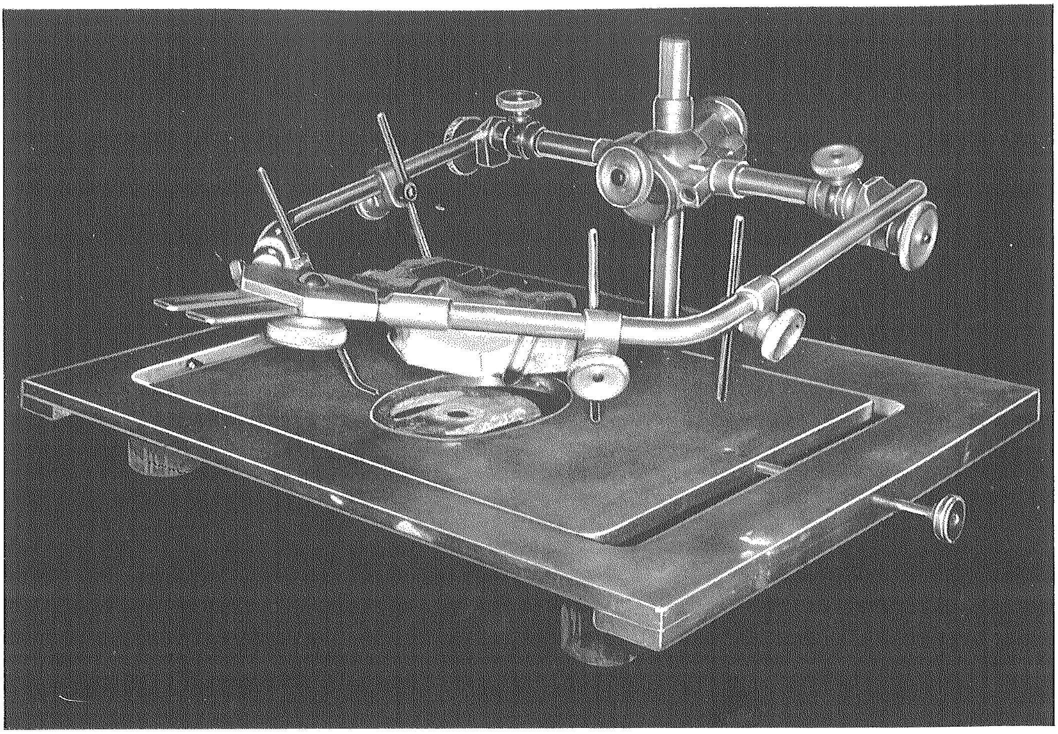


Figure 202. The four pointers of the bow are transferred to the platform so that the platform automatically becomes identical with the Frankfort plane. At least three points must touch the platform. These are now fixed in that position. The bite fork and luted cast are fastened to the bow. The Hanau mounting ring is inserted in the accommodating slot in the platform.

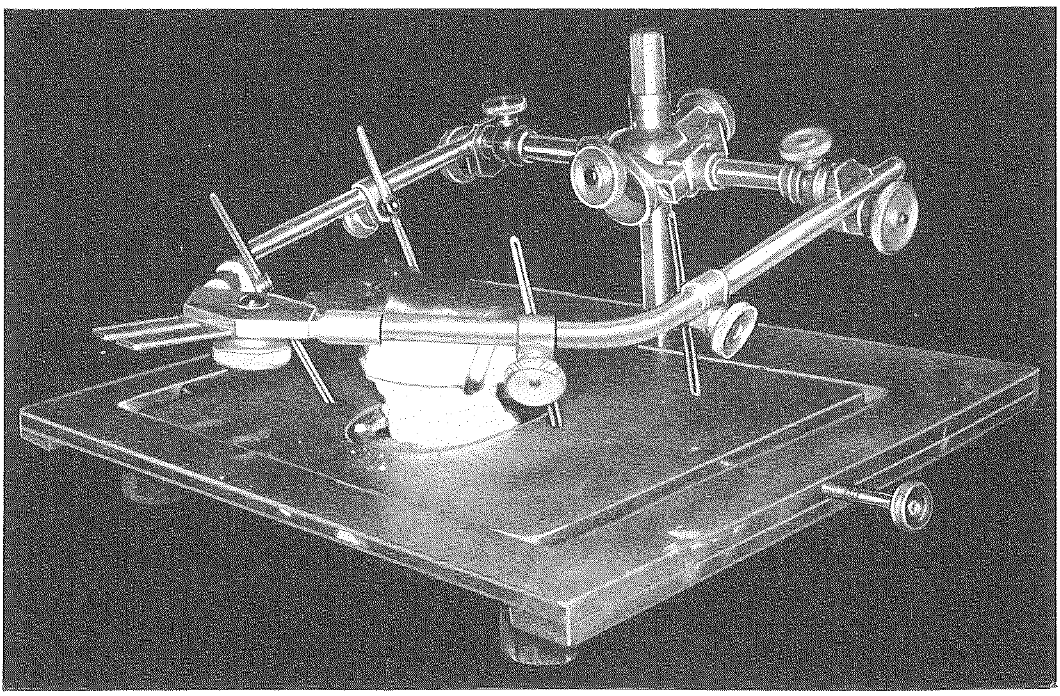


Figure 203. Mix some impression plaster and pour it onto the mounting ring until it is attached to the maxillary cast.

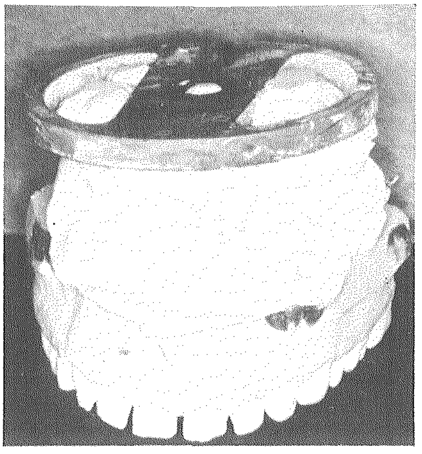


Figure 204. When the plaster is set, remove the cast mounted on the ring. This can now be placed on the Hanau articulator, ready for articulation with the lower cast by means of the occlusal rim or rims.

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9

MAXILLARY AND MANDIBULAR OCCLUSAL PLANES

The occlusal plane extends from the mesio-incisal angles of the incisors to the crests of the cusps of the posterior teeth, when viewed from the front or from the side. The *Glossary of Prosthodontic Terms* defines the occlusal plane as "an imaginary surface which is related anatomically to the cranium and which theoretically touches the incisal edges of the incisors and the tips of the occluding surfaces of the posterior teeth. It is not a plane in the true sense of the word, but represents the mean of the curvature of the surface."

The arrangement of the teeth which form the curve or cant is not exactly the same in every person or identical on both sides of the jaws of the individual (Fig. 212). There is a maxillary occlusal plane and a mandibular occlusal plane in the natural dentition. In complete dentures the occlusal plane of the lower dentition is frequently referred to as the compensating curve. Both maxillary and mandibular occlusal planes contribute to that part of the arrangement of the teeth which is physiologic. Wheeler states, "The occlusal surfaces of the teeth do not conform to any one curved plane exactly. *Nothing anatomic may be reduced to the mathematical exactness of geometric terms.*" Hanau expressed the opinion, "The indiscriminate setting up of the teeth to conform to an occlusal plane or some one other geometric surface is partly responsible for the many malarticulated dentures found." If this is true in complete dentures it is obviously true in rehabilitating a natural dentition. The degree of the maxillary occlusal plane and the degree of the mandibular occlusal plane are individual phenomena.

It is beneficial to the operator to be familiar with the types of occlusal planes generally found.

TYPES OF OCCLUSAL PLANES

1. Almost straight occlusal plane when viewed from the side (Fig. 205*A*).
2. Gradual occlusal arc to a steep occlusal arc when viewed from the side (Fig. 205*B*).
3. Developmental irregular occlusal curve when viewed from the side (Fig. 206A).

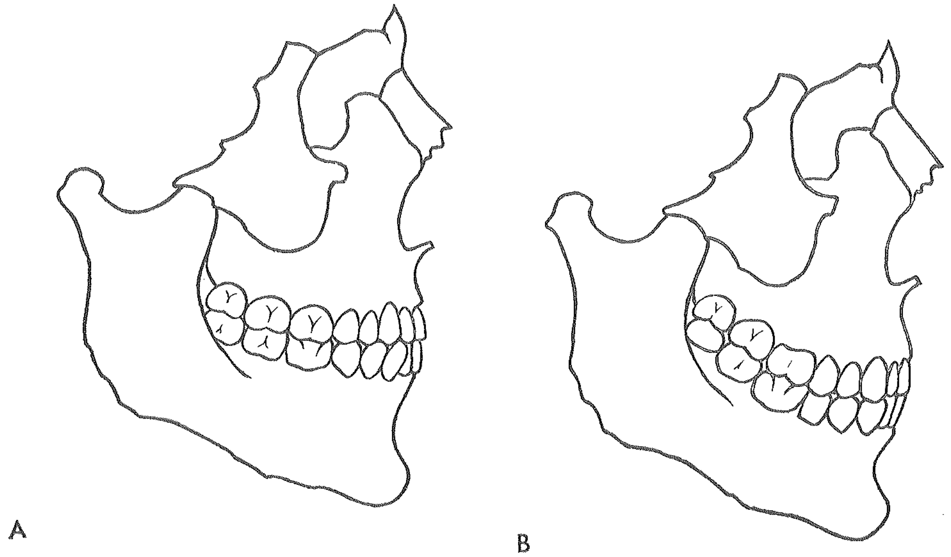


Figure 205. Occlusal curves may be almost straight or a slight arc (*A*), or a steep arc (*B*).

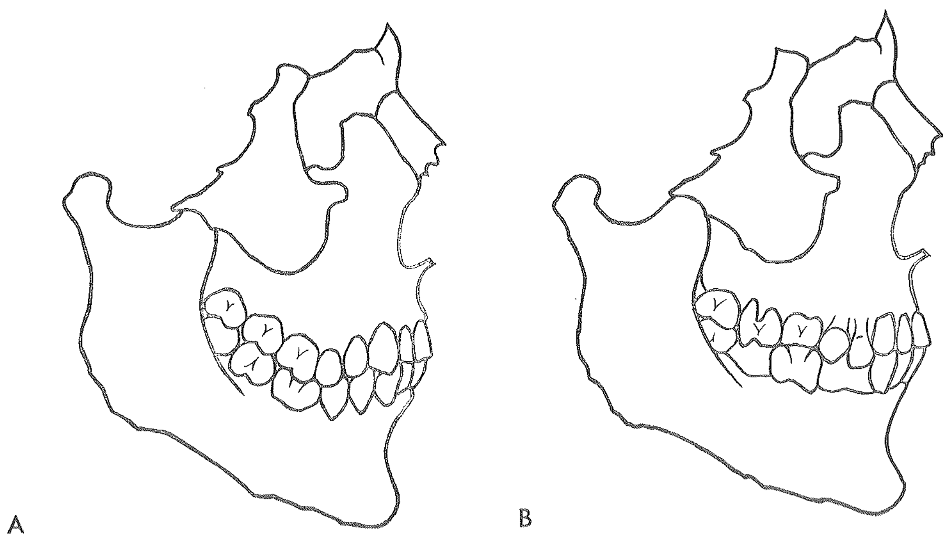


Figure 206. *A*, Developmental irregular occlusal curve. *B*, Abnormal irregular occlusal curve because of exfoliated teeth.

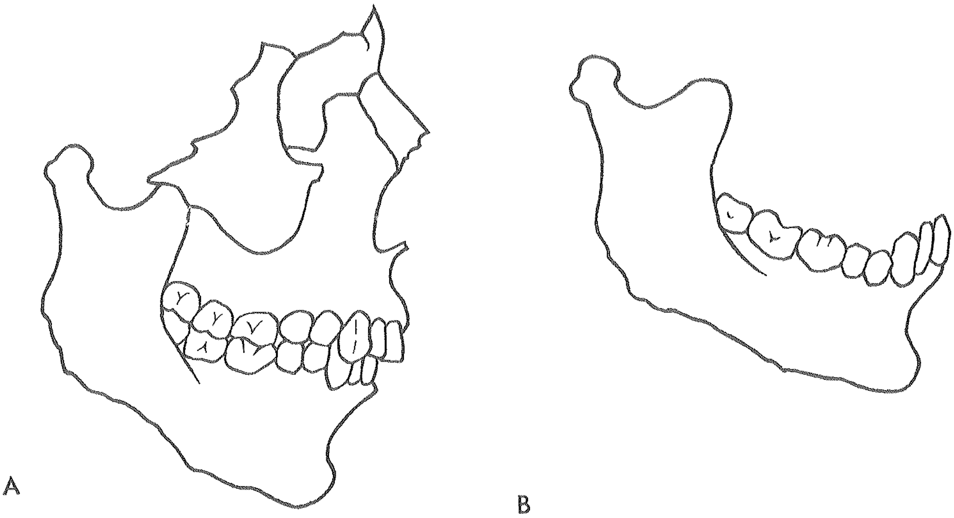


Figure 207. *A*, Step-up occlusal curve where the six maxillary anterior teeth are lower than the posterior teeth. *B*, Step-down mandibular occlusal curve where the six anterior teeth are higher than the posterior teeth in the lower jaw.

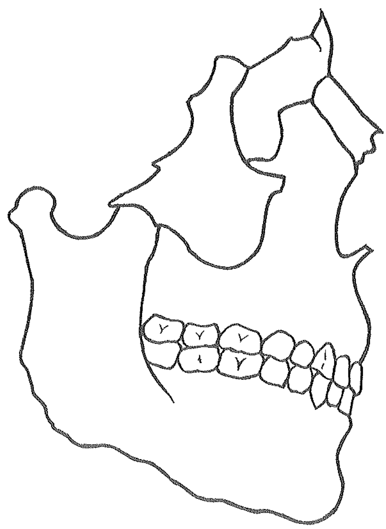


Figure 208. Reverse occlusal curves usually brought about by excessive bruxism.

4. Acquired abnormal irregular occlusal curve when viewed from the side or from the front (Fig. 206*B*).

5. Reverse or Pleasure curve when viewed from the side (Fig. 208).

6. Occlusal curve of different levels the maxillary "step-up" plane of occlusion when viewed from the side and from the front (Fig. 207*A*).

7. Occlusal curve of different levels, the mandibular "step-down" plane of occlusion when viewed from the side or from the front (Fig. 207*B*).

Every attempt should be made to duplicate as closely as possible the aforementioned planes in both jaws when rehabilitating an occlusion, except the irregular abnormal plane. Duplicating the normal planes of the individual's dentition is a contributing factor to the success of the reconstruction. The satisfactory occlusal plane is obtained from the oriented cast by the use of the face-bow in accordance with anatomical landmarks decided upon by the operator.

MANAGEMENT OF THE ABNORMAL PLANE AND THE ABSENCE OF A PLANE

The acquired abnormal irregular occlusal plane may exist in a collapsed or a reduced occlusion. It is also brought about by extruded, drifted, or improperly restored teeth (Figs. 209, 210). This abnormal manifestation must never be duplicated. When teeth have exfoliated because of failure to replace opposing missing ones, they affect optimum function. Such teeth must be radically reduced or even removed. The maxillary and mandibular occlusal planes can be created in the same manner as for complete dentures such as the bite rim parallel to a line drawn from the tragus to the ala of the nose (Figs. 211–216), the use of a template, and Pound's method. Pound[1] recommends using a mandibular landmark, such as the apex of the retromolar pad, to obtain a tolerant occlusal plane when the posterior teeth are missing. He writes, "A study of the mandibular models (casts) in which both the natural teeth and the pad exist will reveal the fact that the lower apex of the pad is level with the posterior aspect of the occlusal plane of the lower teeth. It is fortunate that this pad maintains its basic position after extraction of the mandibular

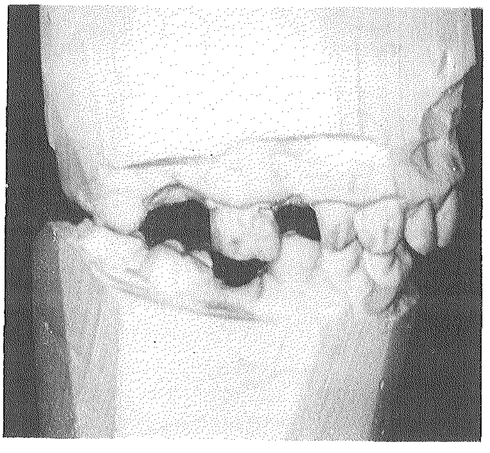


Figure 209. Extruded teeth. Different levels of occlusion created by extrusion of teeth are not to be considered in normal alignment and should be reduced to an acceptable level, or removed if they interfere with rehabilitation procedures.

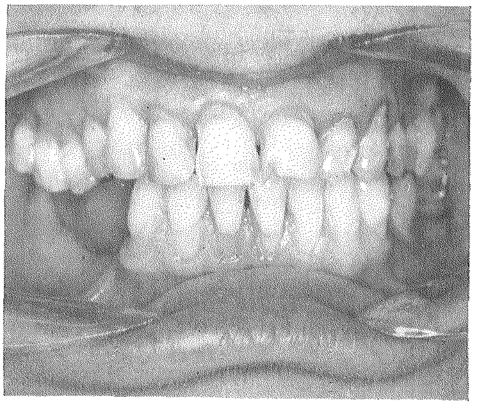


Figure 210. Failure to replace the missing posterior teeth on the right side is responsible for the extrusion of the upper posterior teeth, creating an abnormal irregular occlusal curve.

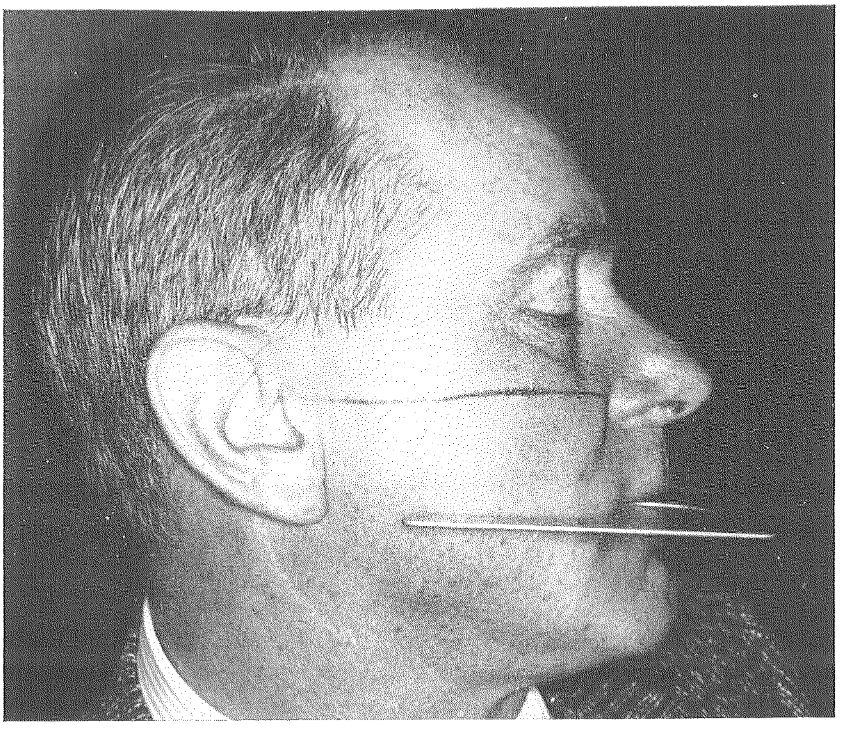


Figure 211. If the upper jaw is edentulous, a full maxillary occlusal rim is constructed and trimmed in the mouth so that the occlusal plane of the rim is parallel to a line drawn from the tragus of the ear to the ala of the nose. The Trubyte Occlusal Plane Plate is a useful guide in establishing this parallel. (Courtesy Dentist's Supply Co., York, Pa.)

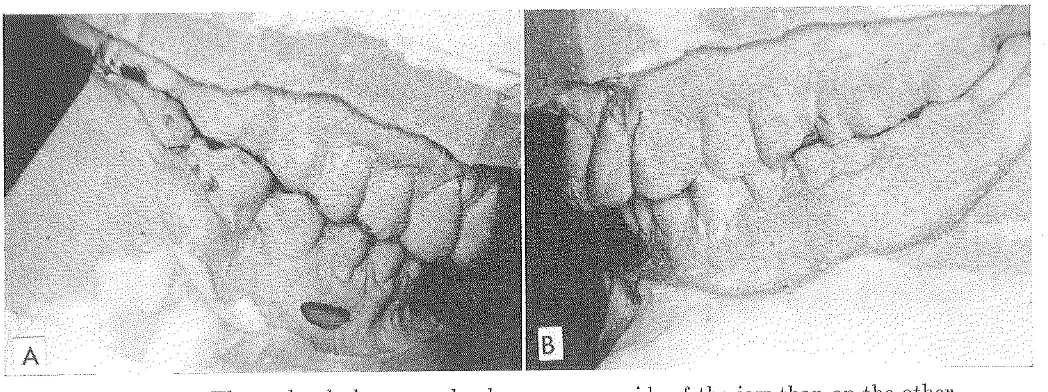


Figure 212. The occlusal plane may be deeper on one side of the jaw than on the other.

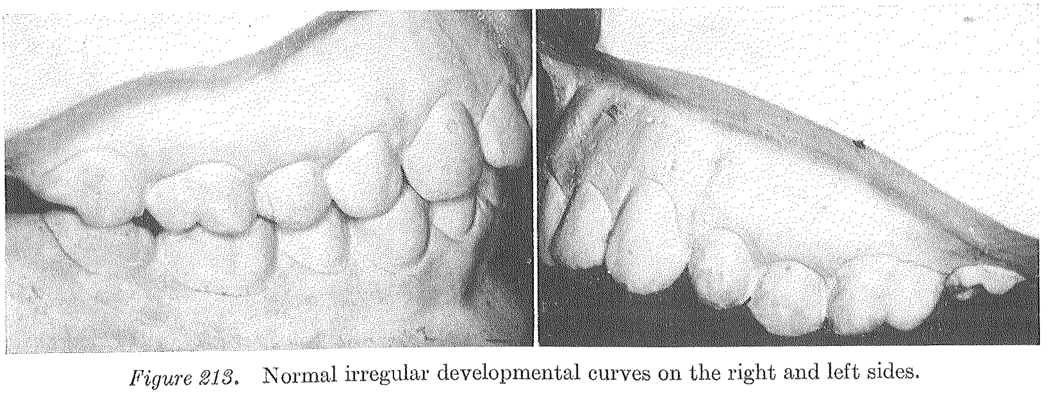
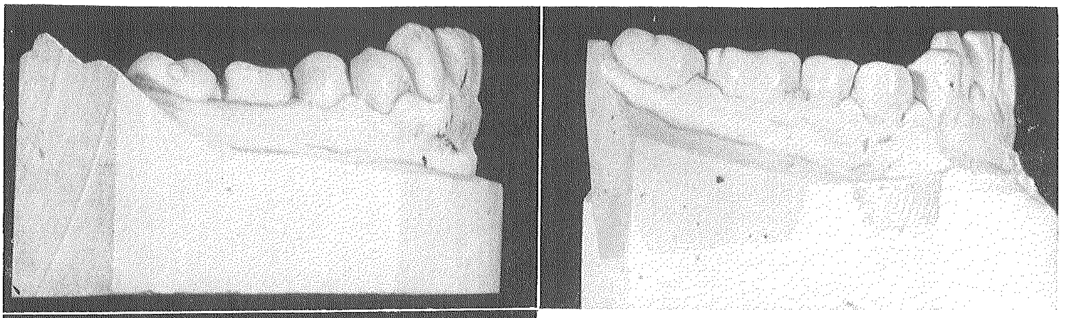


Figure 213. Normal irregular developmental curves on the right and left sides.



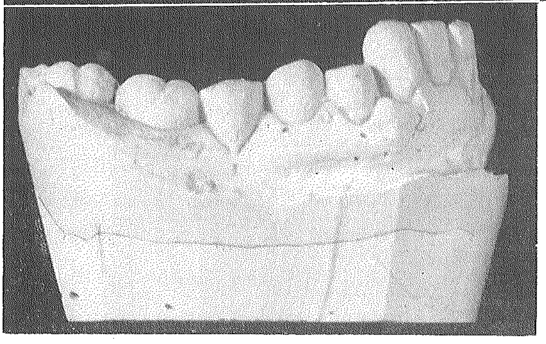


Figure 214. Differences in occlusal levels The occlusal levels of such teeth should not be altered in occlusal rehabilitation. Leveling off by grinding or with restorations so that the teeth "balance" in bilateral and protrusive excursions like complete dentures more often than not proves detrimental.

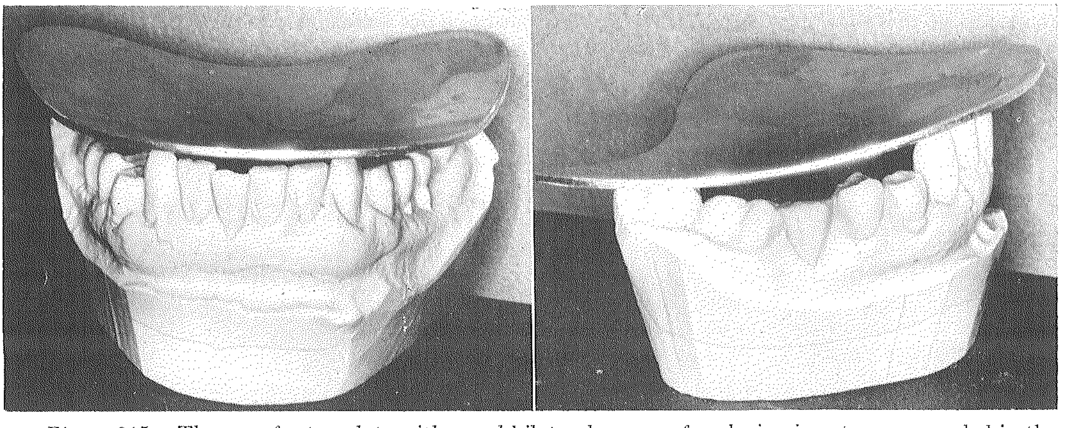


Figure 215. The use of a template with equal bilateral curves of occlusion is not recommended in the construction of restorations in occlusal rehabilitation.

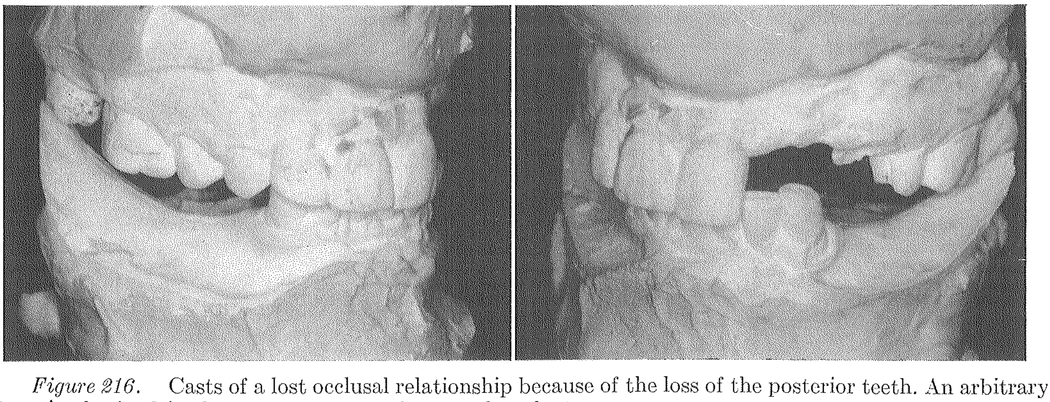


Figure 216. Casts of a lost occlusal relationship because of the loss of the posterior teeth. An arbitrary plane is obtained in the same manner as for complete dentures.

teeth. It is usually discernible in the mouth and should be registered in an undistorted manner of edentulous models (casts). When the pad is evident in the mouth, it automatically gives the height of the occlusal plane as its posterior position."

It must be recognized, however, that all occlusal planes, curves, or cants, arbitrarily selected, are used only as a starting point. Teeth replaced or restored to a theoretical plane will not always be tolerated and corrections will have to be made by reducing, reshaping, or even repositioning them until comfort and function are obtained. Attempts to correct an abnormal occlusal plane in the abnormal occlusion of convenience may not always be successful, even though the selected arrangement of the teeth is indicated. The neuromuscular system, which has adjusted to the abnormality over a long period of time, may not become compatible with the corrected new planes.

OCCLUSAL PLANES OF DIFFERENT LEVELS

It is a mistaken belief to assume that when the maxillary occlusal plane meets the mandibular occlusal plane in centric occlusion a single curved plane is formed. This arrangement is often seen in complete dentures in which the arrangement of the artificial teeth is controlled by the operator. This is not so in all natural dentitions, particularly when the plane of occlusion in the upper jaw is different from that of the lower jaw. Sometimes, a plane exists when there is a developmental difference in occlusal levels between the anterior teeth and the posterior ones. It has been stated that the occlusal plane extends from the mesio-incisal angles of the incisors to the crests of the cusps of the premolars and molars *when seen from the front or from the side*. When the difference in occlusal height exists in the upper jaw (Fig. 217) the incisors are lower in the alveolus than the remaining teeth. On occasion, the six anterior teeth are lower. This type of plane may be classified as a "step-up" maxillary occlusal plane which should be duplicated in rehabilitation

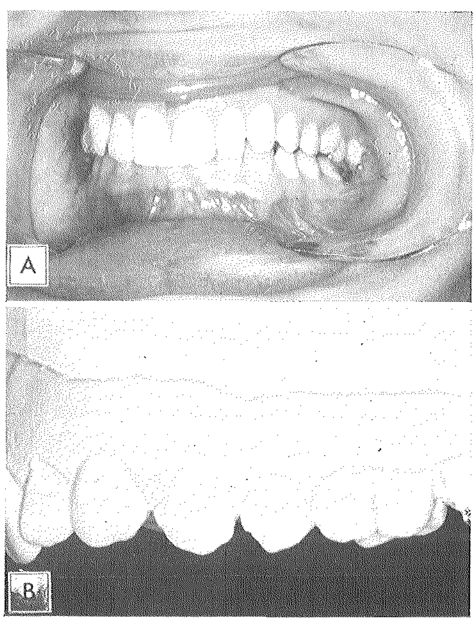


Figure 217. Occlusal planes. *A*, Maxillary incisors lower than the posterior teeth. *B*, Central incisors *only* lower than the rest of the teeth in the upper jaw.

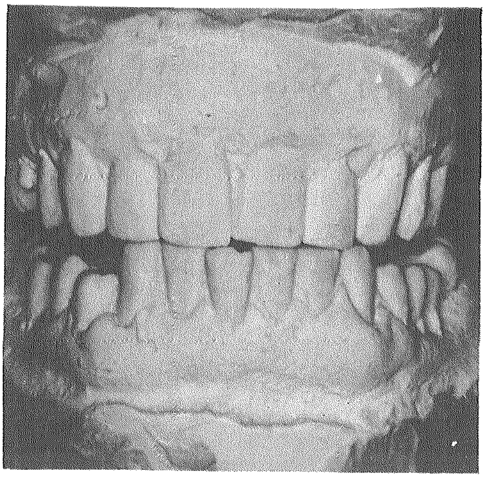


Figure 218. Lower incisors and canines are higher than the premolars and molars, creating a step-down occlusal plane. Notice that the posterior teeth do not contact in protrusive excursion.

procedures. When the mandibular incisors and sometimes the canines are higher in the alveolus than the posterior teeth, the plane thus formed may be classified as a "step-down" mandibular occlusal plane (Fig. 218). These planes of different levels exist primarily in excessive vertical and excessive horizontal overlap occlusions. The posterior teeth are not frequently subjected to the rocking lateral forces and, as a result, the bone and surrounding tissues rarely show any serious detrimental effect. "Step-up" and "step-down" occlusions are developmental in origin and do not impair function. The gingivae around the anterior teeth, however, are occasionally predisposed to abnormal periodontal syndromes. Why should an excessive vertical overlap occlusion with different levels of teeth be considered abnormal because the posterior teeth cannot make contact when the front teeth glide or incise into protrusive excursion?

Complete rehabilitation of an occlusion of different levels, done by leveling the curve, is usually not tolerated by the patient. *To level off the mandibular anterior teeth with the premolars and molars by means of a template would necessitate increasing the vertical dimension of occlusion beyond the limits of the physiologic rest position. This would place abnormal stress upon the muscles, nerves, and teeth. In order for this stress to be relieved, the soft alveolar bone would resorb and the teeth would be driven deeper and deeper in the bone until the occlusion was once again in its original position with different levels (Fig. 215).*

Sometimes, particularly in an excessive vertical overlap occlusion, the mandibular plane of occlusion assumes a deep saucer-shape arc, whereas the maxillary plane appears almost incongruent with this. Such a mandibular occlusal curve must be maintained when the dentition requires rehabilitation.

ACQUIRED OCCLUSAL PLANES CREATED BY UNCONTROLLABLE BRUXISM

Excessive attrition of the occlusal and incisal surfaces alters the original occlusal curvatures, in some instances. The planes in both jaws may assume a straight form due to the edge-to-edge occlusion or they may assume a reverse curve. Such

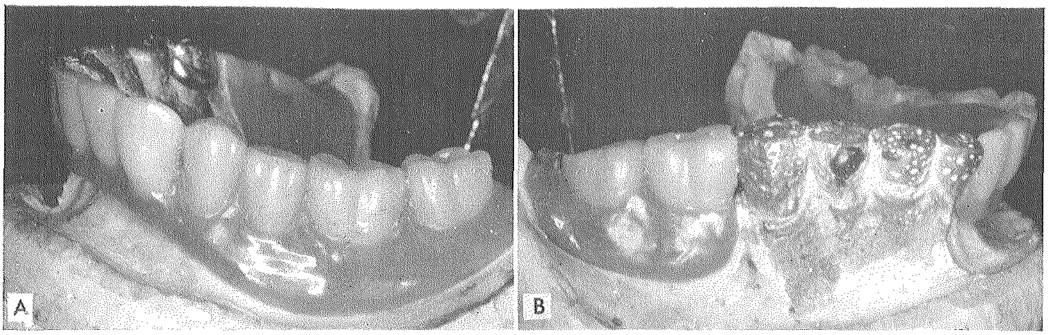


Figure 219. *A*, So-called normal lower occlusal plane on one side of the jaw, and *B*, a reverse occlusal plane on the other side which may be due to previous dentistry in the upper jaw.

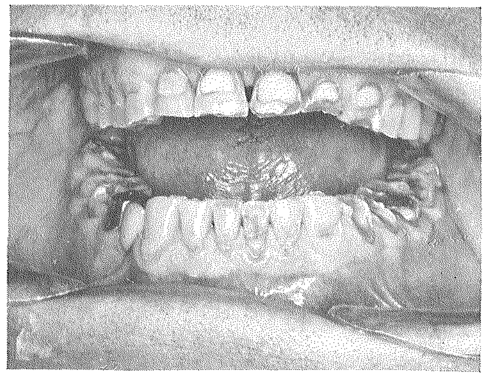


Figure 220. Reverse buccal curve of the mandibular teeth due to excessive attritional wear by bruxism.

occlusal manifestations should be duplicated when rehabilitating the dentition. Wear of the contacting surfaces is of long duration. The fact that the rubbing habit is often uncontrollable contraindicates occlusal carvings and a subsequent change in the acquired curve, because such inclines prevent the habit from being performed in comfort (see Chapter 23). Factors other than bruxism may be responsible for the reverse curve. It may have been brought about by previous dental treatment done to compensate for missing or extruded teeth, or to accommodate the patient over a long period of time (Fig. 219). Sometimes the wear takes place only on the buccal cusps, thus creating a reverse unilateral or bilateral occlusal plane (Fig. 220). Uncontrollable bruxism dictates the type of restorations and their occlusal designs.

Reference

1. Pound, E.: Recapturing esthetic tooth position in the edentulous patient. J.A.D.A., *55*:186, 1957.

10

EXAMINATION, DIAGNOSIS, CASE PRESENTATION, AND PREPARATORY PROCEDURES

In order to diagnose and recommend the treatment for persons requiring occlusal rehabilitation, the dentist must avail himself of his knowledge of all branches of dentistry including the basic as well as the clinical sciences. The first meeting with the patient is important. Patients become apprehensive of procedures and involved techniques in a thorough examination that they do not understand. The doctor should explain the reasons for study casts, roentgenograms, case history, and the like, in order to put the patient at ease. It is important that sufficient time be set aside for each professional visit.

DIAGNOSTIC PROCEDURES

MEDICAL AND DENTAL HISTORY

In the prolonged treatment for occlusal rehabilitation, it is necessary to have on record the physical health of the patient as well as the previous dental treatment and care. The patient's cardiac condition, diabetic disturbances, allergies, and all other systemic ailments must be noted. It will help in planning the restorative work to have on hand a dental history of unusual phenomena presented by the teeth and adjacent structures.

PSYCHOLOGICAL BEHAVIOR EVALUATION

Patients may be grouped as composed, precise, unintelligent, nervous, and neurotic types. The composed person is the ideal patient. The precise or difficult-to-please patient is more often unreasonable in his demands. The unintelligent or seemingly uninterested patient usually misinterprets what is said and what is done. The nervous patient should receive extra attention, and the operator must be patient and considerate throughout all operative and surgical procedures. The neurotic patient is difficult to treat, and it is advisable to consult with the patient's physician.

Throughout the first and second meetings with the patient, the operator should note facts which contribute to an evaluation of his psychological behavior. Will he expect and demand too much from the dentist and his ability? Will he be receptive to extensive dental treatment and will he be cooperative? The dentist can, in the course of conversation, determine whether the patient is emotionally disturbed, whether he will create unpleasantness, whether he will be aware of the limitations in the practice of dentistry. The operator should not suggest the esthetic correction of any "deformity" of the teeth, if such an abnormality is of no concern to the patient. Discuss the dental problems with the patient. It may be that he is upset regarding a wide diastema, he may fear the loss of teeth, or he may be in pain. It is better to anticipate disturbing psychological behavior patterns and avoid treating the psychoneurotic patient.

STUDY CASTS

The prosthodontist is advised to agree with Schuyler,[10] who expresses the opinion regarding examination and diagnosis, "Roentgenograms are essential in determining the presence of foci of infection, value of alveolar support, dental caries, etc. But without mounted study casts, it is impossible to determine factors of occlusal disharmony, abnormal position or inclination of teeth, undesirable tooth contours, and other factors which complicate oral rehabilitation." Impressions for study casts are taken in alginate, hydrocolloid, plaster, or one of the rubber base impression materials but never in wax or impression compound. The teeth are cleaned and polished prior to taking the impressions. Pour these impressions as soon as possible and trim them accurately and neatly. Whenever possible, study casts should be oriented to the patient's skull and transferred to an articulator, such as the Hanau, by means of the face-bow (Fig 221).

PHOTOGRAPHIC RECORD

It is a good policy to take color transparencies of the teeth with the cheeks retracted. A record in color of the teeth and gingivae is sometimes necessary to recall

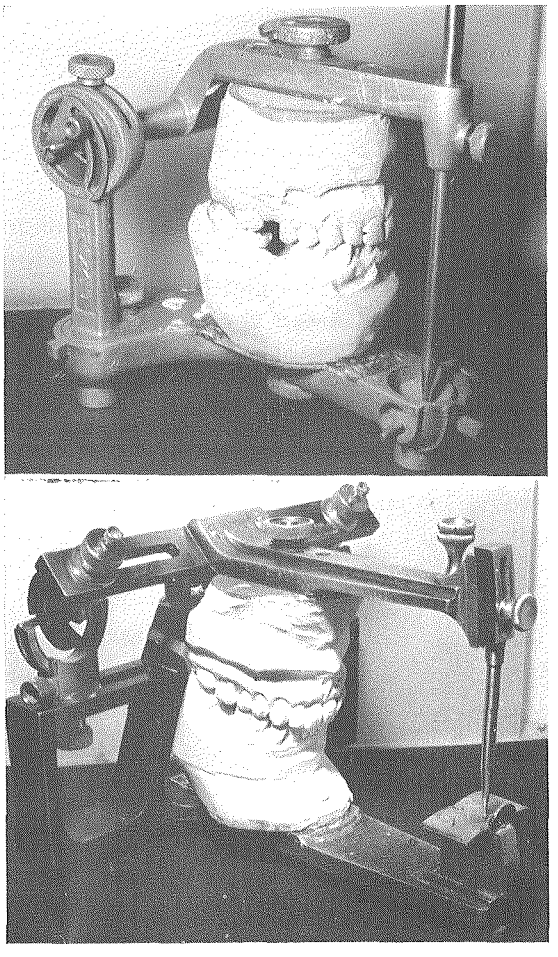


Figure 221. It is necessary to have full mouth study casts mounted on an anatomic and adjustable articulator to help determine the type of crown.

to the patient's mind what state the mouth was in prior to completion of the restorative dentistry. Patients quite often seem to forget abnormalities that existed.

ROENTGENOGRAMS

A complete series of roentgenograms of all the teeth as well as the edentulous areas is the next phase of the examination. After they are developed, the size and length of the roots of the teeth and the condition of the bone are recorded.

CLINICAL EXAMINATION OF THE TEETH

Scrutinize all the teeth carefully, without comment regarding the previous restorations. Pulp test all doubtful teeth. The Vitalitron (Fig. 222) is an ideal pulp tester because no electricity shocks the patient. This instrument will detect degenerating pulps and determine the condition of the pulp following an injury or after tooth reduction for preparations. It will indicate any changes in the pulp tissue and determine whether these changes indicate tendencies to return to normal or to progressive degeneration.

If teeth are missing, examine the position of the remaining ones and record those which have drifted. Displaced teeth and badly decayed, inadequately restored, abraded, and eroded teeth all contribute to a disorganized occlusion and should be noted and charted.

CLINICAL EXAMINATION OF THE GINGIVA

Check the color and condition of the gingiva. Note any abnormal condition of the tongue, inside of the cheek, or lip. Have the patient swallow and observe whether he has any abnormal swallowing habit or tongue movement.

Early recognition of precancerous manifestations is the duty of the dentist. Any leukoplakia should be referred to a physician for further study without alarming the patient. Record the level of the lip line as well as the level of the gingiva over each anterior tooth. If periodontal pockets are present, measure and record them. Chart the mobility of any tooth and determine the prognosis of its retention. Decide whether the gingiva requires surgical reduction.

SO-CALLED ABNORMAL CONDITIONS

Have the patient smile and notice whether he or she shows a lot of gum tissue. Chart any abnormal spaces such as wide diastemas or those brought about by the drifting of teeth. These conditions will impede the esthetic end result in rehabilitation. A record of these manifestations, to be explained to the patient at the time of case presentation, will prevent misunderstandings later. Asymmetries, if obvious, are called to the patient's attention, to prepare him for the limitations in the treatment plan. The result in the occlusal rehabilitation may fall short of the patient's expectations because of such asymmetries. The dentist must impress upon the patient that all he can accomplish is an improvement over the existing conditions.

Pay particular attention to any occlusal or incisal wear of the remaining teeth

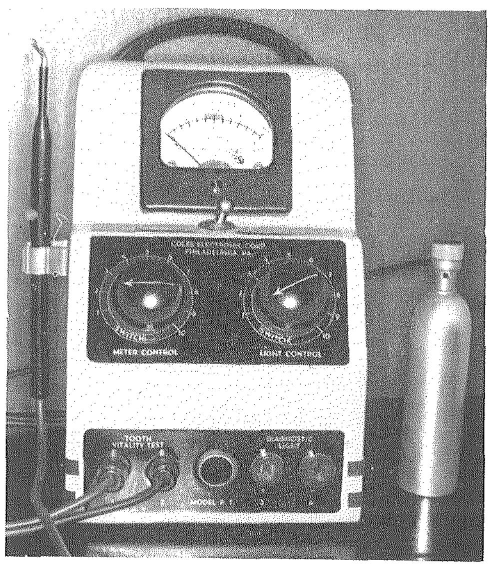


Figure 222. The Vitalitron pulp tester. This pulp tester is ideal because no electricity shocks the patient. (Courtesy Coles Electronic Corp., Philadelphia.)

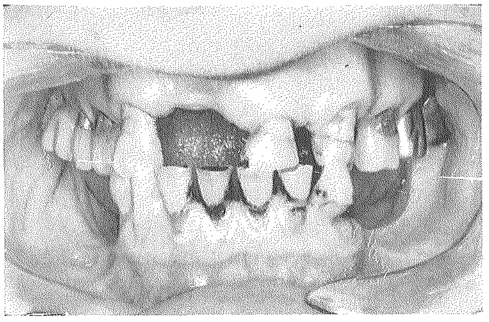


Figure 223. Pay particular attention in the examination of the patient to any occlusal or incisal wear that will indicate the habit of bruxism.

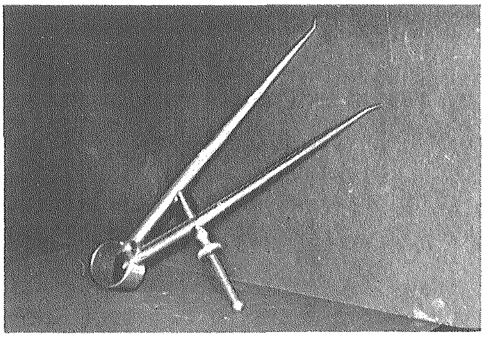


Figure 224. Calipers are recommended for measuring the distances in recording the physiologic rest position.

and determine whether the facets are brought about by habit, such as bruxism (Fig. 223). Inquire as to possible clenching habits, fingernail biting, bobby pin retention between teeth, and any other possible habit that may interfere with the plan of treatment.

OCCLUSION

Examine the occlusion and determine and record whether it is a marked overlap occlusion with limited lateral excursions, or an edge-to-edge occlusion with a wide range of lateral or protrusive movements. The interocclusal clearance varies with the type of occlusion. Measure the interocclusal distance and chart this distance for future reference. Be aware that the mandible assumes three positions, eccentric position, strained position and the postural position with the musculature at rest.

Recording the Physiologic Rest or Postural Position

There are several methods of recording the physiologic rest position. The use of the calipers is most common (Fig. 224). According to Pleasure,[7] the patient must be seated erect and at a height convenient for the operator. Cut two triangular pieces of adhesive or black Scotch tape and attach both to the patient's face as in Figure 225*A*. These triangles should be approximately in the midline and with the apexes pointing toward each other. Place one above the lip and the other on the chin. Explain to the patient that he is to sit in the chair without any back or head rest support and be relaxed. If the purpose is outlined to the patient, complete relaxation of the muscles will be obtained in a short period of time. The lips will part slightly, the teeth will not be in contact, and the eyelids will close partially. This is the physiologic rest or postural position of the jaw (Fig. 225*B*). When the patient closes the jaw the muscles are not in rest (Fig. 226*A*). Repeat the procedure several times, rest and relax with the muscles at ease and then with the jaws closed. When the patient thoroughly understands what the doctor wants, adjust a pair of calipers. approximately to the distance between the apexes of the two triangles (Fig. 226*B*). This measured distance is *the vertical dimension of the face,* considered by most authorities to be constant in the individual at a given time.

The patient is then instructed to close the mandible until the teeth contact in cuspation, and to hold that position. The distance between the apexes of the triangles is measured. *The position of the teeth in contact is called centric occlusion* and the measured distance at this point is *the occlusal vertical dimension.* The difference between physiologic rest position (vertical dimension of the face) and centric occlusion (occlusal vertical dimension) is the interocclusal clearance.

If all the posterior teeth are missing, occlusal rims are constructed and trimmed so as to be within the limits of the interocclusal clearance, thus taking the place of contacting teeth. Recording the interocclusal distance will aid the operator in determining whether the occlusal vertical dimension should be restored or maintained.

Shanahan Method for Obtaining Vertical Dimension. Shanahan[11] recommends the following technique for determining the physiologic vertical dimension

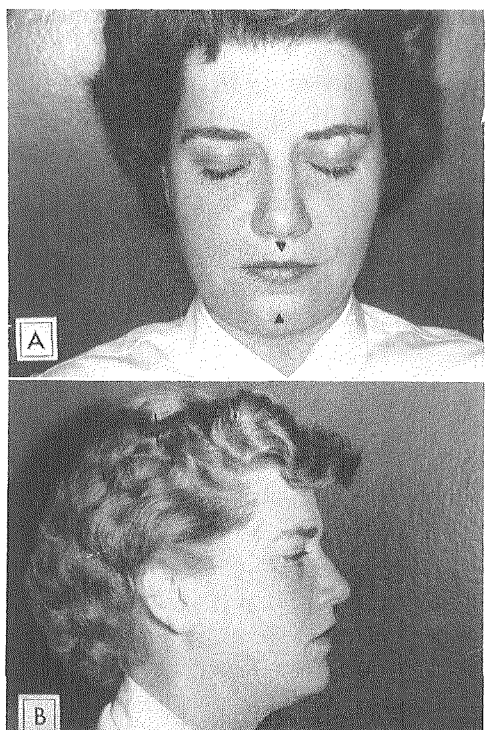


Figure 225. Obtaining the physiologic rest position. *A,* Cut and place two triangles of black Scotch tape on the patient's face, approximately in the midline and with the apexes pointing toward each other. Place one above the lip and the other on the chin. *B,* The patient sits in the chair without any back or headrest support and is instructed to relax. The lips will part slightly, the mandible drops a bit, and the teeth do not touch. The eyelids will close partially. In a short period, complete relaxation of the muscles will take place. This is the physiologic rest or postural position of the jaw. Measure this distance with the calipers.

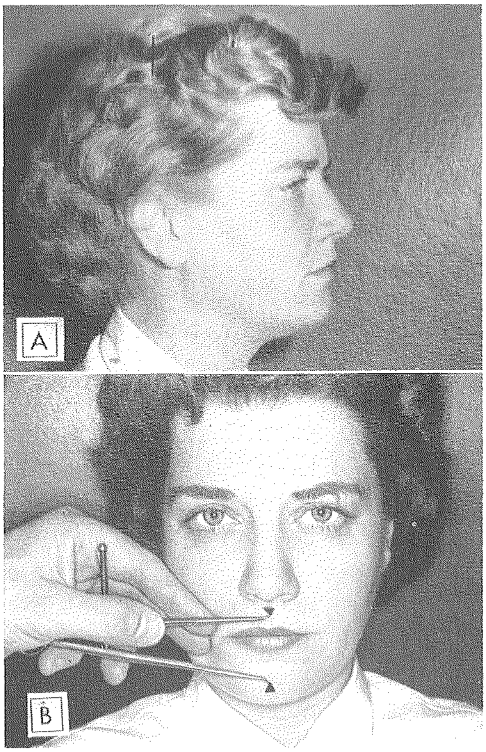


Figure 226. Obtaining the occlusal vertical dimension. *A*, Instruct the patient to close the jaw with the muscles not at rest, and the occluding teeth in cuspation. (If no teeth are present then occlusal rim or rims correctly trimmed.) *B*, Measure the distance between the apexes of the triangles. The difference between the physiologic rest position in Figure 225 and centric occlusion, or the occlusal vertical dimension, is the interocclusal clearance of freeway space.

and centric relation in a fixed dentition. The premature contacts that may cause the mandible to be deflected from a normal path of closure are removed first. The method for testing the natural or physiologic vertical dimension and centric relation is virtually the same for all occlusal restorations and replacements at all ages. Procedures may vary somewhat, depending upon whether the patient is dentulous, partially edentulous, or completely edentulous.

To test the complete natural dentition, drape a small ball of very soft (Trubyte Equalizing) wax, 8 to 10 mm. in diameter, over the occlusal surface of the lower first bicuspid on each side. With the patient relaxed and in a comfortable position, have him swallow several times. Upon examining the wax, if there is evidence that the lower teeth made contact with the upper teeth, then the operator can be certain that the natural vertical dimension has been retained, and no need exists for measuring it. On the other hand, if it is obvious that the teeth did not occlude during the swallowing function, this fact indicates that the teeth did not occlude at the physiologic vertical dimension and that the vertical dimension may be increased regardless of the extent of the interocclusal distance. However, several tests should be made before the final decision is reached.

To test the physiologic vertical dimension in a partially edentulous mouth, drape a small amount of very soft wax over the occluding surfaces of the lower first bicuspids. Cause the patient to relax in a normal sitting posture. Give the patient a small piece of candy to suck on, and instruct him to swallow the saliva as it accumulates.

SILVERMAN METHOD FOR OBTAINING VERTICAL DIMENSION

Another excellent method of obtaining the vertical dimension is the speaking method, introduced by Silverman.[13] He recommends that the patient sit erect without using the headrest, that the eyes look forward, and that the occlusal surfaces of the upper posterior teeth be parallel to the floor. The measurements must be taken under identical conditions of posture and vigor of speech. The patient must speak rapidly in a calm, relaxed, and normal manner, without consciously controlling the muscular movement of the jaw. Tipping of the head, variations in the vigor of speech, or any muscular control of the jaw may alter the reading of the vertical dimension. The patient closes into centric occlusion with the upper and lower teeth held together in maximal occlusal contact. The centric occlusal line is drawn with a pencil on a lower anterior tooth at the horizontal level of the incisal edge of the opposing upper anterior tooth. The patient is then asked to pronounce the phonetic sound S, as in "yes." While the S sound is made and held, the closest speaking line is drawn on the same lower anterior tooth on which the centric occlusion line was drawn. The distance between the lower line, the centric occlusal line and the upper line, the closest speaking line, is called the speaking space. The measurement of this closest speaking space is the measurement for vertical dimension.

Note whether the mandible contributes to a chopping "up and down" motion. Record the levels of occlusion, paying particular attention to whether it is a satisfactory functional level occlusion or one created by extruded teeth.

The patient is dismissed and the second appointment is made.

PLANNING THE TREATMENT

With all the information on hand, the operator should plan just how the completed restorations will look. The location of the abutment teeth will influence the diagnosis regarding fixed or removable partial dentures. Wherever possible, fixed partial dentures should receive preference. Determine what teeth are to be removed, what temporary replacements will be required, and what teeth need endodontic therapy. Will periodontic treatment have to be included in the treatment plan or will electronic surgery be indicated? Decide upon the type of full coverage restorations and how much success you expect in the improvement of esthetics. Estimate the length of time it will take to complete the rehabilitation, with plenty of leeway for contingencies. Classify the patient in accordance with the treatment plan classification described in Chapter 11.

CASE PRESENTATION TO THE PATIENT

Presenting the treatment plan to the patient is the next important procedure. The dentist should allow himself sufficient time for this meeting, without interruptions.

Seat the patient in a comfortable chair opposite you at your desk. Have the study casts on a clean towel along with all other pertinent material. An x-ray viewer is helpful. Point out the salient factors on the roentgenograms to the patient. Explain, with the aid of the study casts, the disturbances in the occlusion, and the reasons for using fixed and removable partial dentures. If necessary, present the patient with a hand mirror and let him see the abnormal manifestations which may limit the correction or treatment. Every word and reason in explanation of the patient's problem should manifest an attitude of confidence. Do not make any rash predictions as to the end results, but discuss the importance of treating the mouth as a unit. Point out the detrimental manifestations in the oral cavity.

Explain the shortcomings of the materials used in dental restorations as well as the limitations in and around the mouth. Make it clear that as a result of these shortcomings it may be necessary to alter the procedure in the course of treatment. The operator should express his prerogative to alter his diagnosis and plan of treatment should the occasion arise. Some teeth may not respond to treatment, and their removal undoubtedly will change the plan. Discussion of the fee and the manner in which it should be paid should be presented to the patient before treatment is introduced. Explain that some inconveniences and perhaps some discomfort may have to be experienced in the course of rehabilitation. The importance of keeping appointments should be emphasized.

The average patient is primarily concerned with how long the dental treatment will take, how much it will cost, whether there will be any pain, how long the restorations will last, and the esthetics. *The dental profession cannot assure the permanency of good health, sound teeth and everlasting restorations.* It is imperative that the patient not be left with the impression that all dental restorations are "guaranteed." Remind the patient that nothing of a material nature lasts indefinitely, and that the doctor cannot determine beforehand what can be tolerated. The dentist should not intimate that the rehabilitation result will remove wrinkles or make the patient look younger, or that the restorations will always look like perfect, natural teeth. Sometimes the patient sets up in his mind the kind of beautiful teeth he would like to have regardless of the conditions and limitations involved. The patient must agree to some responsibility for the degree of success of the restorations for a condition the dentist did not create.

A frank and honest discussion before dental treatment is begun will prevent unpleasantness later on. Tell the patient that porcelain is fragile and may break, and that acrylic will discolor. Servicing of broken porcelain restorations, remaking discolored acrylic crowns and veneers, spot grinding high and unworn interferences should always be considered a part of the treatment plan. It is the practitioner's prerogative whether he wishes to charge a fee for this maintenance as soon as the rehabilitation is completed or after the first year of completion. Be sure to record on the patient's chart or on a special form all the things you have explained. It is surprising how patients forget, and the written record of what you found and what you said as well as what to expect in the treatment and in the materials recalls their memory.

PREPARATORY PROCEDURES

The patient has accepted the treatment plan and is willing to undergo treatment. Before actual procedures are introduced in occlusal rehabilitation it is necessary to place the teeth and surrounding tissues in a sound, healthy state. All condemned teeth and roots are removed by the operator or the oral surgeon, and necessary temporary removable or fixed replacements are inserted.

Some problematical and questionable teeth with deep-seated caries can be saved from pulp exposure or extraction if immediate attention is given their preservation. The operator is cautioned not to wait until his schedule calls for treating some teeth. Occlusal rehabilitation procedures are time consuming. Therefore, it is a good policy to excavate the decay of all affected teeth, give them pulp protection, and insert cement or Temrex restorations until such time as the operator can prepare them. On occasion an amalgam restoration may be necessary to "build up" a broken-down tooth. Pulp protection with calcium hydroxide is a good procedure to follow. Teeth that require endodontic treatment are cared for either by the operator or the endodontist. If, however, a pulpless tooth with incomplete root fillings has existed for many years without pain, discomfort, or detriment, it can remain in the jaw if it is an important cog in the treatment plan. This policy should be explained to the patient.

SELECTIVE GRINDING, EQUILIBRATION, AND "BALANCING"

Before rehabilitation procedures are instituted, occlusal disharmonies in the dentition must be corrected. The word, equilibration, has been associated with cross-tooth contacts in three prescribed cross-jaw movements. This philosophy has been responsible for unnecessary reduction of tooth structure in order to obtain such contacts. The term, selective grinding, should be substituted for equilibration because it means the reduction of only those areas that are responsible for damage to the periodontium and teeth. Occlusal adjustments prior to operative procedures have long been considered an accepted aspect of dental therapy. We must be mindful that one plane of occlusion or the same end result in occlusal contacts, for all patients, does not dictate the form of an individual's occlusion. The use of mathematics, engineering principles, and sameness of procedures frequently disorganize a satisfactory articulation. It is important to know when and how to reduce teeth judiciously—it is easy to grind but difficult to know when to stop.

A PRACTICAL DEFINITION OF A BALANCED OCCLUSION

The late Samuel Charles Miller[6] stated, "*A balanced occlusion is the natural closing and fitting together of upper and lower teeth, the relationship of the mandibular and maxillary teeth when closed or during excursive movements of the mandible whereby maximum masticatory efficiency and periodontal preservation is obtained.*" This definition should be added to Part 1 of the definition of a balanced occlusion as expressed in the *Glossary of Prosthodontic Terms* (p. 29).

WHEN IS SELECTIVE GRINDING (EQUILIBRATION) INDICATED? PREMATURITIES AND INTERFERENCES

We often hear the phrase, "Before beginning the operative procedures in constructing a fixed appliance, occlusal balance of the natural dentition should be obtained." The recommendation to reduce perfectly healthy, normal teeth that create no disturbance or damage is unreasonable, and its practice should be condemned. Healthy teeth are reduced *only* because they do not contact in right and left lateral and protrusive mandibular movements. The areas that prevent the movements desired by the operator (but not by the patient) are labeled prematurities, a word that has taken on the connotation of reduction. It is important that we distinguish between a prematurity and an interference. A *prematurity* is the physiologic contact of an area of a tooth or teeth that touches the antagonist before the surfaces of the other teeth. An *interference* is a prematurity that causes damage. Interferences are occlusal disharmonies that harm the teeth, the underlying bone, the neuromuscular mechanism, and the temporomandibular joint areas, and reduce function. All interferences must be reduced judiciously. *It is illogical to assume that all interferences can be accurately located on an articulating instrument, because the interference may be brought about by a particular mandibular movement which the mechanical instrument cannot duplicate.* Clinical and roentgenographic examinations plus the patient's history help the operator recognize interferences. The symptoms are readily recognized. There may be soreness or pain in a tooth or teeth, and inflamed gingivae and pericementum. The interference may be responsible for loss of bone, pocket formation, drifting of teeth, or pain and discomfort in the temporomandibular joint areas. Interferences may be responsible for impaired function, and the patient usually informs the dentist of this. *Unless any one or a combination of such symptoms exists, the tooth or teeth should never be reduced.*

TESTS FOR HARMONIZING AN OCCLUSION BY SELECTIVE GRINDING

There are several recommended procedures for reducing interferences, including those of Brecker, Ramfjord, Schuyler, and Shore, to name a few.[3, 8, 10, 12] The usual method is the rule of BU-LL. Reduce the buccal cusps of the upper tooth and the lingual cusps of the lower. All authorities agree that the vertical of occlusion should not be reduced. The movements tested are right and left lateral and protrusive, with as many teeth making contact as possible. But suppose that the interference is not detected in these common movements; then the operator has to determine whether the chewing movement or the rubbing movement is responsible. Teeth with broad, worn occlusal areas are reshaped to create narrower widths. Deep plunging, damaging cusps are reduced and extruded teeth which reduce optimum function are either removed or radically shortened, even if root canal therapy has to be instituted.

TESTS FOR REMOVING INTERFERENCES AND HIGH SPOTS IN RESTORATIONS (FIGS. 227 AND 228)

The primary contacting movements to be tested are: (1) centric tooth contact, by tapping the teeth together in centric occlusion; (2) occlusal contact at the termination of the normal swallowing act; (3) chewing contact, an individual movement; (4) rubbing or bruxism, with the teeth making contact which may be lateral, side lateral, circular, protrusive, side protrusive, and scissors-like. If the tests are on restorations the procedure is as follows:

All porcelain restorations should be tested in their biscuit bakes (without the glaze) and gold restorations should not be polished. Articulating paper registers more accurately on unglazed and unpolished surfaces. It is advisable that the patient practice each contacting movement before testing. Cut a strip of Stalite or

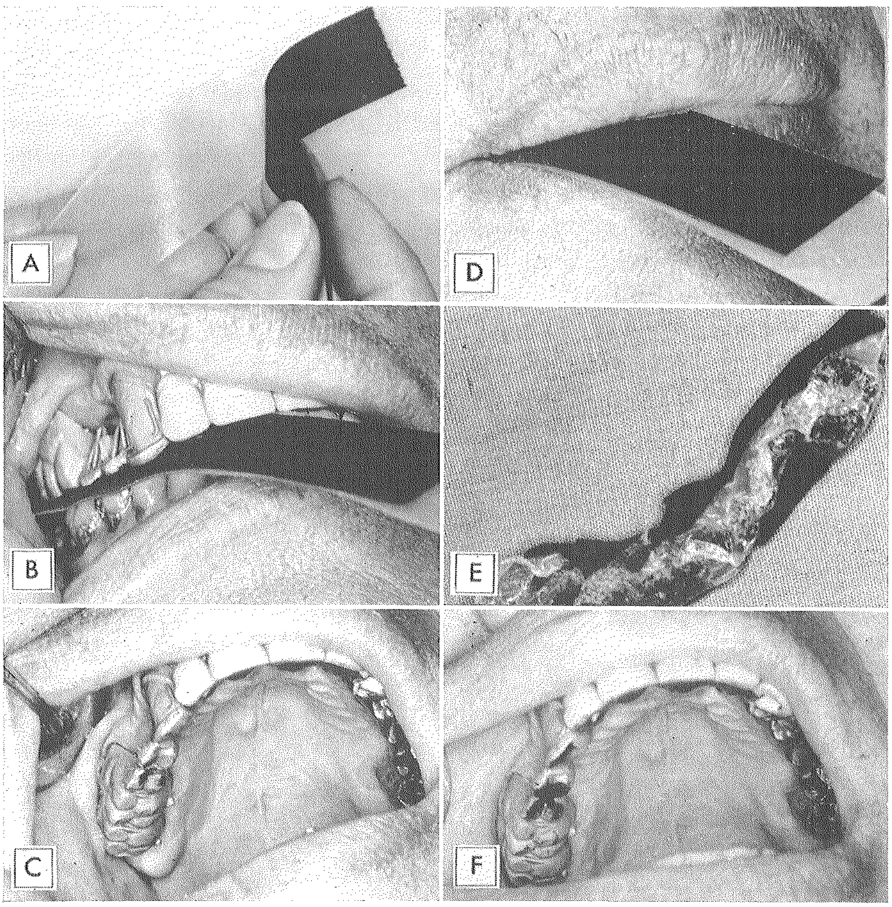
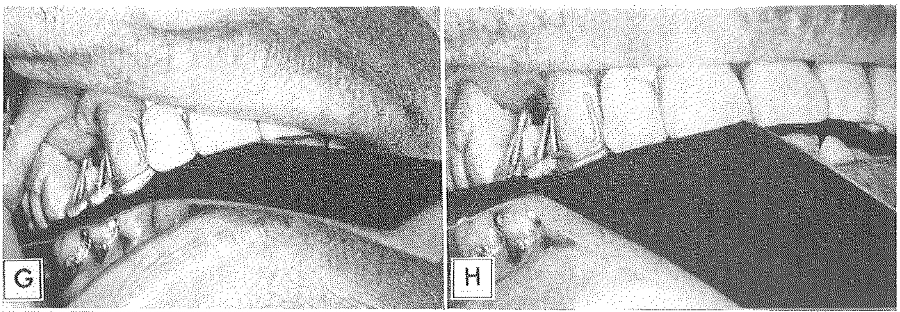


Figure 227. Reducing high spots or interferences. *A*, Cut a strip of Sta-lite 30 gauge adhesive sensitive wax to approximate size of a thin strip of articulating paper. *B*, Place the wax paper between the unpolished crowns or bridge and request the patient to tap, tap his teeth together in centric occlusion. *C*, Remove the covered strip and reduce the heavily marked high spots on the restoration. *D*, With a fresh piece of wax-covered articulating paper, have the patient go through his chewing movements. The wax facilitates the chewing maneuvers which are peculiar to the individual. *E*, The chewed, wax-covered articulating paper which made the markings on the high spots of the restorations. *F*, The high spots in the chewing movement. The same disclosure can be obtained in locating an interference of a natural tooth.



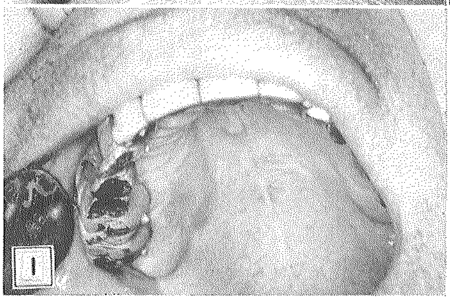


Figure 228. Testing the high spots or interferences in the rubbing movement. *G*, Place a fresh piece of wax-covered articulating paper between the teeth in centric. *H*, Instruct the patient to rub his teeth in his habitual rubbing movement, usually identified on the study casts by the patterns of wear. *I*, This will disclose a high spot or interference which did not become evident in the previous tests.

similar 30 gauge sensitive adhesive wax to the approximate size of a thin strip of articulating paper or ribbon. This procedure prevents smudging and smearing of the teeth and restorations which cause inaccuracies. Insert the unpolished restoration on the prepared tooth. Seat the patient in the chair, preferably without the support of the headrest, but with the head tilted slightly backward. Place the wax-covered strip of articulating paper between the restoration and the opposing teeth in centric contact. Request the patient to tap, tap, tap the teeth gently together. It may be necessary to guide the patient's chin in these tapping movements by holding your fingers under his chin. Remove the waxed articulating paper and examine the heavy markings on the unpolished metal. The interfering high spots may appear in one area at first. Reduce these spots with small stones and repeat the procedure until the articulating paper makes nearly uniform markings on all the teeth, including the restorations.

Insert a fresh piece of waxed articulating paper and instruct the patient to tap, tap, tap and swallow. Do this several times. Markings may appear in some dentitions depending upon the degree of backward movement of the mandible during the swallowing act. Reduce any such markings on the restorations.

Take time rehearsing the chewing cycle with the teeth and restorations making contact. The chewing and rubbing movements are the most damaging movements. The patient is advised to chew the wax-covered articulating paper like a piece of food, making no more than three or four chewing movements. The wax facilitates the chewing maneuvers, while the articulating paper makes its markings on the high spots in the gold. *These chewing movements simulate the shearing, rolling, and mashing motions made by the tongue pressing a bolus against the lingual surfaces of the teeth intermittently.* Insert a fresh piece of wax-covered articulating paper between the restorations and the opposing teeth and instruct the patient to perform his motions of chewing. Remove the waxed articulating paper strip, which now looks partially chewed, and examine the restorations for heavily marked areas. Reduce these high spots until uniform markings are made throughout. Sometimes the markings will appear on surfaces already reduced, but will not become evident in the tapping centric and swallowing contacts. The grinding may result in deep or shallow grooves or facets in the metal. It is often necessary to insert two strips of waxed articulating paper, one on each side of the jaw, because patients have a preferred side to chew on and the restoration to be tested may be on the opposite side. Be careful not to reduce the acceptable and tolerant centric occlusion.

To test the rubbing movements it is advisable to examine the study casts and note the surface of the teeth that show distinct patterns of wear (Ch. 23). Insert the fresh piece of waxed articulating paper between the teeth and the restoration and advise the patient to close in centric and hold that position. Now instruct him to perform his convenient and habitual rubbing movement. Even though that movement is habitually made on the side opposite the side with the restoration, the wax paper is still inserted on the side with the restoration. A rubbing lateral movement or side lateral rubbing on the left side, for example, may disclose a high spot on the restoration on the right side or in the anterior restoration. Remove the wax paper and examine for heavy markings. Reduce these markings a little at a time, creating or duplicating the original pattern of wear in the restorations. *The grinding of the metal surfaces necessitates the removal of beautiful carvings that the technician has made in the crown or bridge. When all high spots have been reduced, it is necessary to carve sluiceways in the reduced areas before polishing the restoration* (Fig. 229).

When making the tests on biscuit bake porcelain restorations of any type, it is advisable to press your finger on the buccal or labial surface of the ceramic crown or bridge. This will stabilize the restoration to some degree so that fracture of the

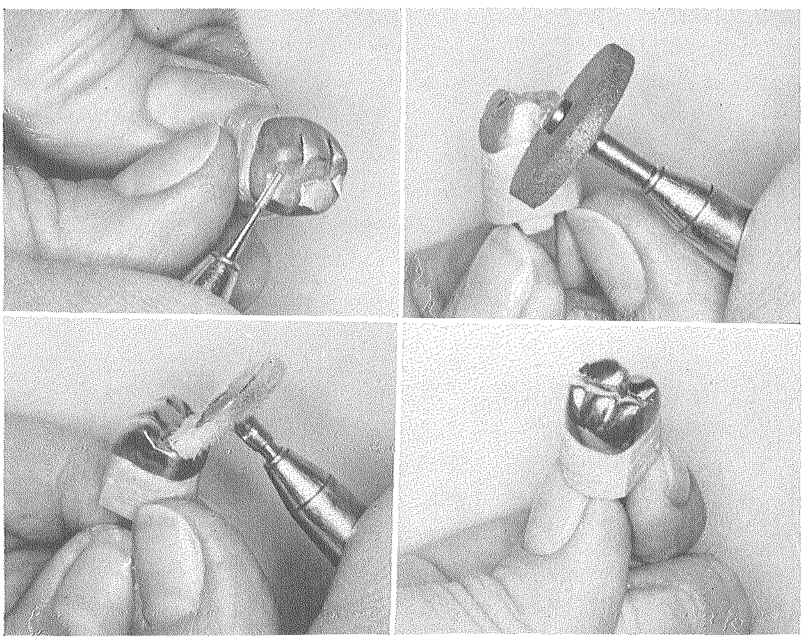


Figure 229. After reduction of the high spots on the restoration, the operator is advised to carve sluiceways in the gold before polishing the restoration with rubber wheels, fine pumice, and rouge with a soft Robinson bristle brush.

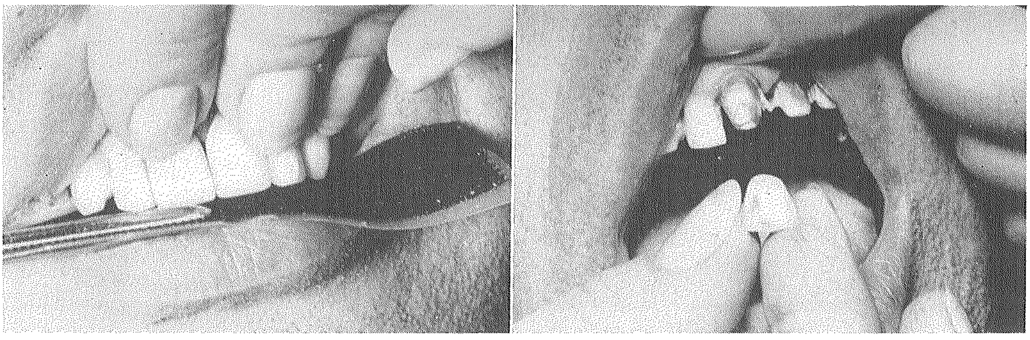


Figure 230. When making tests on ceramic restorations in their biscuit bakes, the operator is advised to press and hold his left forefinger firmly on the buccal or labial surfaces of the restoration. This will stabilize the porcelain crown or bridge to a great degree so that fracture is minimized.

porcelain is minimized when the tests are made (Fig. 230). Caution the patient not to be too vigorous in the testing of ceramic restorations. Use a Busch silent wheel stone No. 12 or 15 to reduce the porcelain. It does not chip the porcelain and does not roughen the surface.

PRELIMINARY GINGIVAL CARE

The problems of the middle-aged patient have imposed many responsibilities upon the prosthodontist. The care and treatment of the gingiva prior to restorative dentistry is one of the responsibilities that the operator must accept. He may refer the periodontal treatment to a periodontist. The practitioner, however, should be qualified to place periodontal tissues in a satisfactory and healthy condition. A thorough prophylaxis of the teeth is recommended, and this procedure should include the removal of deposits from unexposed as well as exposed surfaces. All rough areas of the teeth should be smoothed and polished. The gingiva in general is placed in a satisfactory, healthy condition. It is not the aim of this chapter to classify and present the treatment plan of the various gingival disturbances. Surgical intervention, either by the scalpel or by electronic surgery, sometimes "gets the gingiva in shape" in a comparatively short time so that the operator can proceed with his urgent task of restorative work.

Electronic Surgery As an Aid in Occlusal Rehabilitation

Electronic surgery is a practical adjunct in occlusal rehabilitation. The electronic surgical instrument employs a controlled and non-shocking current. There is no need to fear this form of procedure because it involves electricity. It is not necessary that dental practitioners become physicists and thoroughly understand the complex mechanism of every electrical apparatus. It is sufficient that we know what a high frequency wire electrode can do and what it cannot do, what precautions the operator should take when using it, and where he can apply it in his practice, and that we have a general understanding of the working of the machine.

It is not my intention to discuss the attributes of surgery, scalpel or electronic, in periodontics. I am primarily interested in presenting improvements in restorative dentistry through the medium of the three-tube, full rectified and filtered electronic instrument. The operator should not consider the wire electrode as a substitute for the scalpel but rather an adjunct that contributes to successful reconstruction.

Electronic surgery is contraindicated on hard structures, therefore the operator must stay away from bone. If he will permit this type of surgery to do what it is meant to do, there will be no sequestra and no ill effects. Strock[14] writes, "A third erroneous concept is that the electrosurgical scalpel can cause necrosis of bone. This idea is an outgrowth of earlier days when machines were used without adequate instruction. These units were not vacuum tube machines, but were of the spark gap variety in which it is difficult to control accurately the amount of current delivered. Far more current was used than was required to perform the task at hand and sequestration of bone followed."

It is misleading to refer to an electronic instrument as a cautery because each of these instruments, or their techniques of use, differs completely in function and end results. The cautery is nothing but a hot wire. Briefly, the 110 volt commercial office current is made to pass through a transformer and then directly connected to a handle. On the end of this handle is a platinum wire which is heated to a cherry red when current is passed through it. When applied to tissue it makes an incision by incandescence. The tissue is severed by direct heat conduction, and this form of surgery is usually followed by massive tissue destruction and heavy coagulation at the line of cleavage. Postoperatively, the cooked and necrotic tissue sloughs and healing is delayed. When healing does take place, hard scar tissue is formed.

The three tube, fully rectified generator is an ideal instrument because the rectified and filtered true radio current does not scar tissue. The commercial current

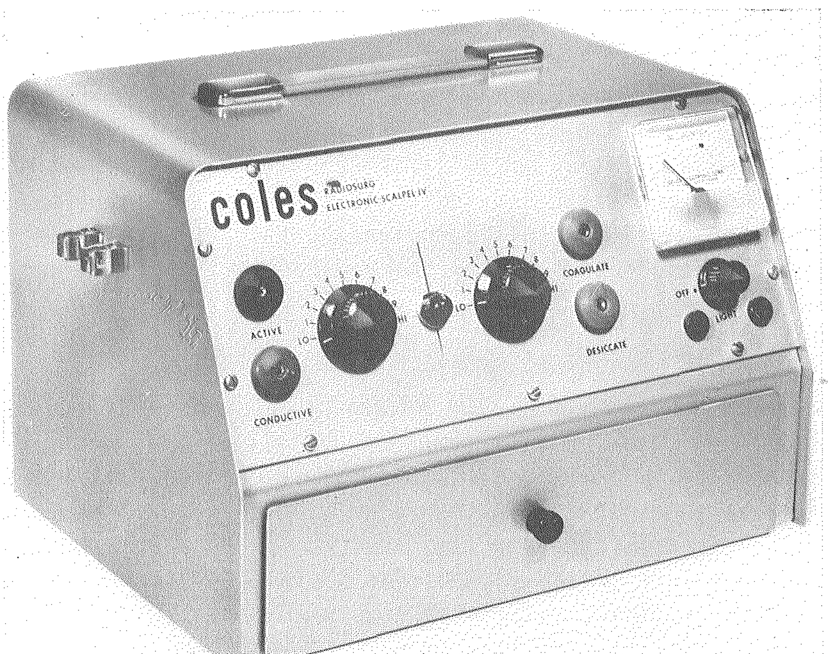


Figure 231. The Radiodent machine for electronic surgery. (Courtesy Coles Electronic Corp., Philadelphia, Pa.)

passes through a transformer and then through two half-wave rectifying tubes. These tubes change the current from alternating to direct current, and it is then converted to a very high frequency electronic (not electric) current by means of an oscillating tube. *A controlled and uninterrupted arc is formed which does the cutting.*

The current is now further refined through chokes and condensers and finally goes to an output through a power tube and then to a handle. The physical and surgical advantages of this type of generator are:

1. Elimination of current surges and lapses which makes for even and smooth cutting.
2. Elimination of heat, which causes tissue destruction and sloughing.
3. Prevention of the formation of scar tissue.
4. The field of operation is practically bloodless and dry.
5. The operator with the wire electrode can approach with ease any part of the tissue in the mouth.

The electronic surgical current is stable and easy to control. The tissue is severed by cellular explosion, without trauma, and the cut heals without pain. Cutting is accomplished with little bleeding, inasmuch as the capillaries become sealed by coagulation. The types of current on the three tube generator are: scalpel or cutting current; coagulating or dehydrating current; and fulgurating current, the current that destroys living tissue and organisms. The wire loop electrode is the most effective and efficient medium. These loops are of assorted sizes and shapes. The loop can be used to cut, to plane, to carve, and to festoon the gum tissue. Straight wire electrodes, some in angle holders, are ideal for incisions in the interproximal areas. Saghirian[9] writes, "Electronic surgery serves as a sterile, deliberately controlled sharp knife, cutting without pressure. Unlike the cold knife which meets resistance of the tissues, the wire loop parts the tissue ahead of itself so that it meets no resistance and feels as if it is floating through the tissues."

Procedure of Cutting. It is advantageous to inject a few drops of local anesthetic into the tissue to be severed, *but no profound anesthesia is necessary.* Dry the tissue with a piece of gauze before cutting, because moisture dissipates the current used. It is not necessary for the patient to sit on the indifferent plate. (A patient may become apprehensive when asked to sit on the plate.) This plate may be draped over the back of the dental chair and it will concentrate the current just the same. Because the alveolar bone is not at the same level even on the same tooth, it is advisable to cut the tissue toward and over the tooth. Cutting the tissue in a horizontal manner with a straight wire electrode may encroach upon the alveolar bone and can be considered a factor in the formation of sequestra. Cut in a shaving motion. The cutting stroke must be rapid and light; slowness is responsible for too much coagulation and may cause sloughing. The wire electrode must be employed with ease, having in mind beforehand just what and how much tissue is to be cut.

Permit the electronic current within the tissue itself to form the tiny arc just ahead of the progressing electrode. *Remember, the electronic arc does the cutting, not the wire loop; therefore, do not use pressure.* It is not necessary to move the electrode so rapidly that the electronic arc does not have sufficient time to form. By the same token, do not hold the electrode still. Any electrode or tip not in motion will produce heat and may act as a cautery. If sloughing occurs, the wire loop has been moved too slowly, the operator has stayed in the area too long, or he has stepped up the current too much. Inasmuch as there is no heat generated while the electrode is in motion, plastic restorations are not affected. There is no damage to the pulp as one works around the neck of a tooth. In function, the cutting loop should cut freely, that is, without undue flashing of the electrode on the tissue. The rule to follow in regulating the strength of the current is that *one should use the lowest current that cuts freely to the desired depth, without pulling or dragging.* The current in the office is not of the same strength every minute of the day, and the doctor should follow this rule every time he uses the machine.

The structure of the tissues as well as the rapidity of motion influences the amount of coagulation and the ease of cutting. The more fibrotic the tissue, the more resistance does the electrode meet. On such tissue, there is a tendency to use pressure on the wire loop which may cause it to break. If too much resistance is met, step up the current gradually. The more vascular the tissue, the greater the bleeding. Sometimes it is advantageous to cut such tissue with the coagulating current to minimize bleeding. Dry the tissue often, and be mindful that it is always better to cut too little than too much. The Hyfrecator (Fig. 232) is another electronic device that is useful in occlusal rehabilitation. It is a spark-gap instrument which generates a damped current with a frequency of approximately 2.5 million cycles. The action of this type of current will not cut tissue. It is ideal for performing electrodesiccation of tissue. The inherent resistance of the tissue causes a temperature rise in that tissue and its ultimate desiccation. The instrument is recommended for exposure of the gingival margins in the indirect impression technique for all types of restorations.

Figure 232. The Hyfrecator. (Courtesy The Birtcher Corp., Los Angeles.)

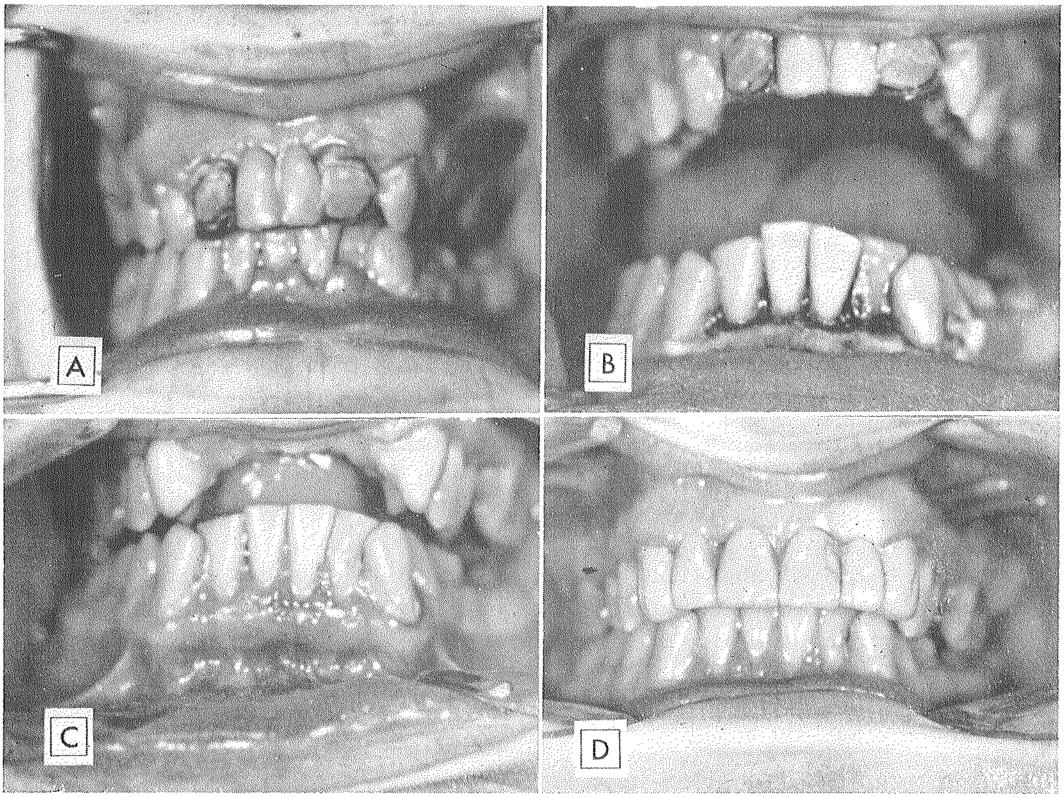


Figure 233. *A*, The gingival tissues are inflamed and the esthetics of the maxillary anterior fixed bridge are extremely unsatisfactory. *B*, The wire electrode denudes the teeth of this inflamed tissue. *C*, Five weeks later; notice the fine healthy tissue. *D*, The completed restoration. Electronic surgery contributes to the success of many bridge restorations.

It is useful as an adjunct in the treatment of periodontal conditions, denuding gum tissue that has grown into a cavity, and coagulating bleeding tissues.

Postoperative Care. Carrel[4] demonstrated that an aseptic wound, when it is cleansed of all debris and when it is protected from outside irritation, will show no evidence of healing even after two weeks. If the wound is covered with a slightly irritating dressing, healing begins in a few days. Therefore, a zinc oxide and eugenol paste such as Ward's Surgical Cement should always be applied to the cut surfaces in the form of a pack. It not only allays pain and discomfort but promotes healing by stimulating the activity of the tissue cells by slight irritation. Ward's Cement (rapid setting) is mixed on a wax paper pad to a loose consistency and applied to the wound with a cement carrier instrument. Work the dressing well into the interproximal areas and then cover all cut surfaces. Sometimes a piece of tin foil pressed over a wound, covered with a thin mix of surgical cement and burnished well over the occlusal or incisal surfaces of the teeth for retention makes a satisfactory dressing in an area in which it is difficult to retain a pack. Such areas are the pericoronal second and third molar regions and the gingivae in the lingual areas of the upper and lower teeth. When the pack has become hard, usually in about five minutes, trim and festoon it close to the cut gum with a curved chisel for neatness and esthetics.

The patient is always instructed not to use the toothbrush on the treated areas but to use any antiseptic (not astringent) mouthwash. It is imperative that the oral cavity be kept clean. Should any part of the dressing fall away, exposing the cut area, the patient must return for a new pack. The wound is not painful or sore when covered with the dressing. In about five days the pack is removed and the cut

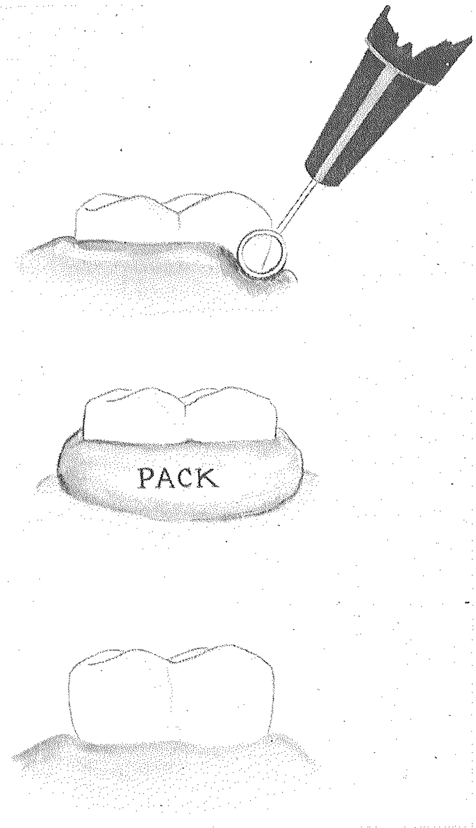


Figure 234. More of the clinical crown of a short tooth can be exposed by the wire electrodes.

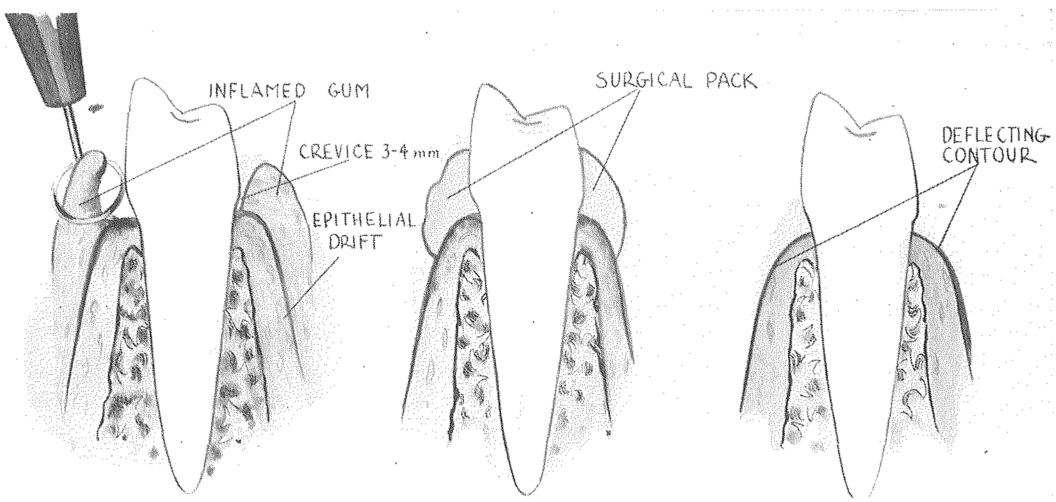


Figure 235. Periodontal pockets are reduced and even eliminated with the wire electrodes. These loops reach areas where a scalpel cannot. (Drawing after Saghirian.)

gum tissue is carefully swabbed with a pledget of cotton saturated with hydrogen peroxide. If some shreds of loose tissue are present, they should be carefully removed with sterile tweezers.

At this time one observes that the entire wound is covered by fairly well developed stratified squamous epithelium and that granulation tissue has become joined to the underlying connective tissue. Bernier and Kaplan[1] are of the opinion that the process of repair seems to be the outcome of cellular proliferation resulting from stimulation which is probably chemical in nature, substances liberated by the degenerating cells acting as exciting agents. The repair of the gingival tissue is the same as that which occurs in all tissues of the body. In an exposed surface, such as that which is produced by the removal of gum tissue, the wound is filled in by granulation tissue and healing takes place by this granulation. The dressings are replaced until healing is complete. Such healing may require from two to six weeks.

On occasion, one notices that the interproximal tissue does not heal as rapidly as elsewhere. The epithelium grows into the interproximal spaces from the labial and lingual areas, thus traversing a greater distance. Another reason, according to Bernier and Kaplan,[2] may be the fact that the operator did not push the surgical pack snugly between the teeth and as a result there is much less irritation than on the labial surface. The question arises whether cut gingival tissue regenerates and grows back.

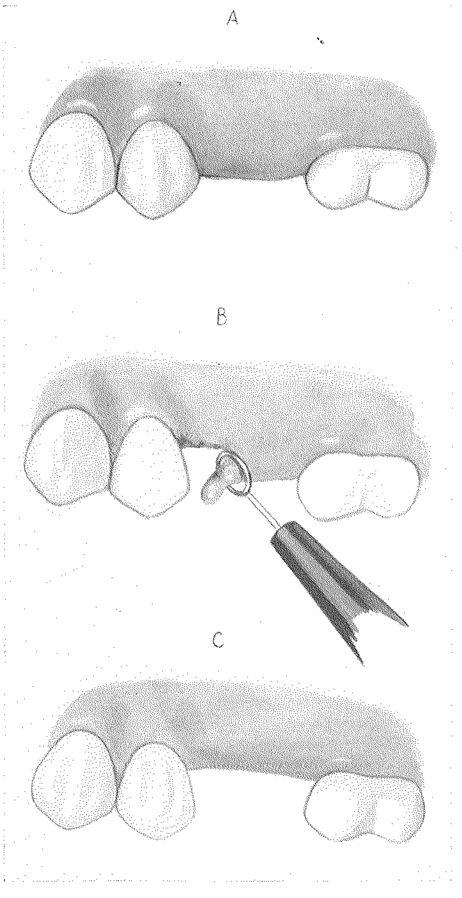


Figure 236. When more space is needed for the reception of a porcelain pontic on a fixed or removable partial denture, the tissue in the edentulous area is removed by the wire electrodes.

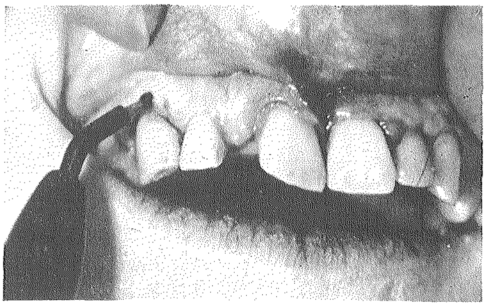


Figure 237. Healthy tissue may grow back. To prevent cut tissue from regenerating to its original level, make the tissue pathologic by creating a slough and a small inflammation, the day before the tissue is denuded. Pathologic tissue will not regenerate when it is entirely removed. The growth processes of the germinal layer of the gingiva are destroyed by the inflammatory condition.

Healthy Tissue May Grow Back. There is always the possibility that denuded healthy tissue will return close to its previous level. We do know, however, that inflamed or pathologic tissue, when completely denuded, will not regenerate. The growth processes of the germinal layer of such inflamed tissue are no doubt destroyed by the pathosis. When the attachment is severed, the gingival tissue has little chance of returning to its exact previous level. Therefore, in removing tissue for hydrocolloid impressions be sure not to cut too much tissue.

Electronic surgery is indicated in minor periodontal disturbances, as in the reduction of swollen tissues around the necks of teeth to be used as abutments for bridge retainers (Fig. 233). The removal of tissue extending into a cavity is best accomplished by the wire electrode. The loop not only removes the interfering tissue but does so in such a manner that there is little bleeding and the cavity can be filled immediately. There are occasions when the gingival margin is so placed that it is traumatized frequently during mastication and thereby becomes inflamed. Goldman[5] believes that because of this incorrect contour, food is deflected toward, instead of away from, the gum margin. This tissue can be reshaped and recarved with the loop electrodes so that food does not irritate the gingiva. Sometimes, short anterior teeth can be denuded of some gingival tissue so that the operator can construct esthetic crowns of sufficient length without increasing the occlusal vertical dimension.

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11

TREATMENT PROCEDURES FOLLOWING THE INDIVIDUAL PHYSIOLOGIC OCCLUSION CONCEPT IN OCCLUSAL REHABILITATION

THE INDIVIDUAL PHYSIOLOGIC OCCLUSION CONCEPT IN REHABILITATION

The gnathological approach recommends restorations on teeth to interdigitate when the mandible is in centric and bilateral and so-called protrusive balancing contacts. In some respects it can be considered the denture type of occlusion. The variation of the gnathological philosophy stresses cusp-to-fossa mutually protected occlusion. The Pankey-Mann concept is primarily one of spherical congruency and the generated path. The transographic philosophy is a concept dependent upon the type of articulator. Each philosophy stresses a different procedure and treatment plan, *the same for all patients.*

It must be recognized that no single individual reacts to dental treatment exactly like another. Occlusions are like fingerprints—no two are identical. Because of this, a precise rule or pattern of procedure cannot be formulated for the management of all patients requiring occlusal rehabilitation. Nevertheless, some plan is necessary to assist the operator in starting his case with explicit steps in mind. He will then have to be guided by many factors that may make it necessary to deviate from a set procedure. With few exceptions, the more closely the operator duplicates the patient's occlusion, the greater the chances for success.

PROCEDURES CONDUCIVE TO SUCCESSFUL OCCLUSAL REHABILITATION

The individual functional occlusion concept takes into consideration the patient's osseous and neuromuscular asymmetries, chewing habits, and limiting factors which are peculiar to him and success in treatment depends upon compatibility of these factors. For the operator who undertakes rehabilitating an occlusion, I recommend the following steps:

1. Maintain or duplicate the patient's existing satisfactory interocclusal (freeway) space whenever possible. If unable to do so, then use the 2.5 to 3 mm. average space measurement, but only as a guide. Rely upon function, comfort, tolerance, speech, swallowing, and esthetics.
2. Maintain or duplicate the patient's incisal guide, provided the anterior teeth have not drifted abnormally to interfere with function.
3. Maintain or duplicate the patient's satisfactory occlusal and compensating planes on each side and in both jaws, provided these planes are not distorted by exfoliation or drifting of teeth or by old incorrect restorations.
4. Maintain or duplicate the patient's existing, tolerant, comfortable, and functional vertical dimension of occlusion whenever possible. Do not raise the bite to make room for esthetic restorations.
5. Maintain the patient's vertical and horizontal overlaps, no matter how excessive they are, unless the overlaps have been increased by the loss or the drifting of teeth.
6. Maintain or create a healthy periodontium.
7. Remove all occlusal disharmonies (interferences).
8. Create restorations that will be tolerated without damage by abnormal uncontrollable bruxism or rubbing movements.

The operator can use any articulator he desires, any facial recordings he wishes, just as long as the existing limitations are considered.

OBJECTIVES IN OCCLUSAL REHABILITATION

The most important objectives in this phase of dental treatment are *function, comfort, speech, esthetics, retention of remaining teeth and restorations, and a healthy periodontium.* The restorations should be so constructed that the direction of the force of mastication and contacts of the restored teeth are parallel to the long axis of the teeth. Stress should be distributed as equally as possible by accommodating occlusal designs in the restorations. It is beneficial and imperative that the restored teeth in the opposing jaws make contact without interferences and that the occlusion does not encroach upon the interocclusal space and physiologic rest position.

CLASSIFICATION AND TREATMENT PLANS FOR PATIENTS REQUIRING REHABILITATION

Patients in need of occlusal reconstruction may be classified into these categories:

GROUP I

Class 1. Includes patients in whom there is a *collapse in the vertical dimension of occlusion* because of the shifting and movement of existing teeth brought about by failure to replace missing ones, because of a systemic disease, or because of a periodontal disease.

Class 2. Includes patients in whom *the vertical dimension of occlusion is lost* because all the posterior teeth in one or both jaws are absent and those remaining are in an unsatisfactory occlusal relationship.

Class 3. Includes patients in whom there is a *decrease in the vertical dimension of occlusion* because of abnormal excessive occlusal and incisal wear.

GROUP II

Class 1. Includes patients with all or sufficient natural teeth in each jaw and possessing a satisfactory occlusal relationship.

Class 2. Includes patients possessing a limited number of occluding teeth in a satisfactory occlusal relationship but requiring aid in maintaining that relationship in the form of a preliminary occlusal rim.

GROUP III

Includes patients who require maxillofacial surgery or orthodontic treatment as an aid in restoring the vertical dimension of occlusion.

GROUP IV

Includes patients for whom sectional treatment is recommended over extended periods for reasons of health, age, or the economic factor.

There are persons who are included in any combination of these four groups and classes.

GROUP V. PROBLEM OCCLUSIONS WHICH ARE NOT TYPICAL

Occlusion with prognathic jaw.
Occlusion with an anterior or posterior crossbite.
Occlusion with abnormal tongue and swallowing habits.
Abnormal functional occlusion of convenience.
Occlusion affected by accident or disease.
Occlusion with an excessive vertical overlap.
Occlusion with an excessive horizontal overlap.
Occlusion previously treated.
Terminal occlusion.
Occlusion with excessive attrition.

ESTABLISHMENT OF THE VERTICAL DIMENSION OF OCCLUSION

Of prime importance in the execution of the treatment of patients in these five groups is the manner in which the vertical dimension of occlusion is established.

VERTICAL DIMENSION OF OCCLUSION IN GROUP I

The vertical dimension of occlusion in all group I classes is established in the same manner as for complete dentures. The physiologic rest position is the starting point for obtaining the interocclusal clearance. This interocclusal space is established arbitrarily no matter what method is used. The patient's tolerance and comfort and the esthetics and speech will govern, in the last analysis, just how much interocclusal space is necessary. Wax records placed between occlusal rims are used to register the relation between both jaws. The rim consists of a thickness or two of softened baseplate material, adapted to the cast and relieved of all undercuts. Several layers of baseplate wax are warmed and formed over these rims. These are then trimmed so as to be within the confines of the patient's interocclusal clearance and then are transferred to an articulator by means of the face-bow.

On occasion, a metal or plastic splint is constructed. The patient wears this splint to determine whether he can tolerate the selected vertical dimension of occlusion. The construction of this splint is the same as for a complete denture. When comfort and function are obtained, this splint is used as an occlusal rim to aid in mounting the working casts in their proper relationships.

VERTICAL DIMENSION OF OCCLUSION IN GROUP II, CLASS I

Despite the fact that cuspal interdigitation is variable, centric occlusion between some opposing natural teeth can be used as reference positions when these teeth contribute to a stable, comfortable, and satisfactory functional occlusion.

These teeth must be in harmony with non-damaging movements of the mandible and must possess sufficient bone support and a healthy gingiva or one that can be restored to a healthy state. When no appreciable change in cuspal interdigitation has occurred, some occluding teeth can act as "guides" or "stops" in maintaining the satisfactory occlusal relationship while the other remaining teeth are receiving occluding restorations. These so-called guide teeth may exist in a mouth with a full complement of natural teeth. *It should not be necessary to prepare all the teeth in one jaw first, thus destroying the comfortable, satisfactory occlusion, and then seek to re-establish that occlusal relationship by guesswork.* "Guide" teeth may also be utilized in a mouth in which natural teeth exist only on one side or anterior teeth are present in opposing jaws in correct occlusal contact.

VERTICAL DIMENSION OF OCCLUSION IN GROUP II, CLASS 2

In group II, class 2, when occluding natural teeth are few in number and not strategically situated, their preparation invalidates their usefulness as "guides." A preliminary occlusal rim (rims) is constructed on a cast duplicated from the study cast, before the teeth are prepared. The "guide" teeth plus the preliminary occlusal rim help maintain the existent satisfactory occlusal relationship. Sometimes a duplicate preliminary rim is fabricated as a reserve, to be used in the progressing and succeeding procedures of occlusal rehabilitation.

VERTICAL DIMENSION OF OCCLUSION IN GROUPS III AND IV

After the maxillofacial surgery or orthodontic treatment has been successfully accomplished, the patient's vertical dimension of occlusion is established in the same manner as for group I. The occlusal vertical dimension for patients treated sectionally depends upon the individual case and will be influenced by the teeth present.

GENERAL CONSIDERATIONS IN TREATMENT

In subsequent chapters we shall follow the management of patients in each group and in each class. For each patient, case histories, study casts, roentgenograms, and all the pertinent information as explained and recommended in Chapter 10 are studied by the operator. The treatment plan is decided upon and presented to the patient for acceptance. The operator should plan his procedures in such a manner that the occlusal rehabilitation will be completed in as short a time as possible. Prepared teeth may suffer in vitality and the treatment plan may have to be altered because of the movement of teeth or the loss of a tooth, when the restorative work is extended over many, many months. It is not advisable to carry too many cases at one time. The dentist and the technicians are frequently under pressure, and the mental attitude and physical health of the operator suffer.

The doctor should allow sufficient time to prepare the teeth for the many restorations. It is not advisable to subject the patient to prolonged preparations of many teeth in one session except in emergencies. Too long an appointment may put a strain upon the operator as well as the patient. The first appointment for the preparation of teeth is very important because of the anxiety of the patient. Discomfort is due primarily to apprehension and pain and it sometimes becomes necessary to prescribe sedation before grinding the tooth. For the hypersensitive and nervous patient, 1½ grains of Nembutal, Seconal, or some other fast- or immediate-acting barbiturate will moderate discomfort and fear. We must be aware of the fact that older people do not tolerate depressive drugs as well as younger ones. Therefore, it is recommended that the dentist consult with the patient's physician for any possible unfavorable reactions to any prescribed sedative in the treatment of elderly people.

12

GROUP I CLASS 1

Procedures in Restoring a Terminal Collapsed Occlusion Brought About by Failure to Replace Missing Teeth

Examination

The patient, a woman of 51 years, is a physically healthy individual in the post-menopausal stage. An improvement in esthetics seems to be her primary concern in dental treatment. In general, she appears composed and pleasant, without apparent abnormal psychologic behavior patterns. Clinical examination discloses that all the mandibular molar teeth on the left side and the first and second molars and the second bicuspid on the right side are missing. Owing to failure to replace these missing teeth, the maxillary molars have elongated beyond repair (Fig. 238). The mandibular left canine and two bicuspids have drifted distally and created an objectionable space between the left mandibular lateral incisor and the cuspid tooth. Because of the shifting and spreading of the teeth, they have positioned themselves in a "head-on occlusion" which interferes with the free gliding movements, to the detriment of the masticatory organ. The maxillary incisors have spread in movement and present an objectionable space. Several dentists have advised complete dentures. I consider her teeth as a terminal case. She is willing to undergo rehabilitation even though satisfactory occlusion may last only a few years.

The gingivae appear healthy but because of the occlusal disharmonies and bone resorption, the bicuspids are slightly mobile (Fig. 239). Function in mastication is impaired and the patient has developed lip habits in an attempt to conceal the unattractive dentition. The interocclusal clearance measures 4 mm. and is recorded. The patient's occlusion functions abnormally in a chopping up and down motion with all the force of mastication exerting upon the anterior teeth.

Treament Plan

The maxillary molars on the right and left sides will be removed. It will be

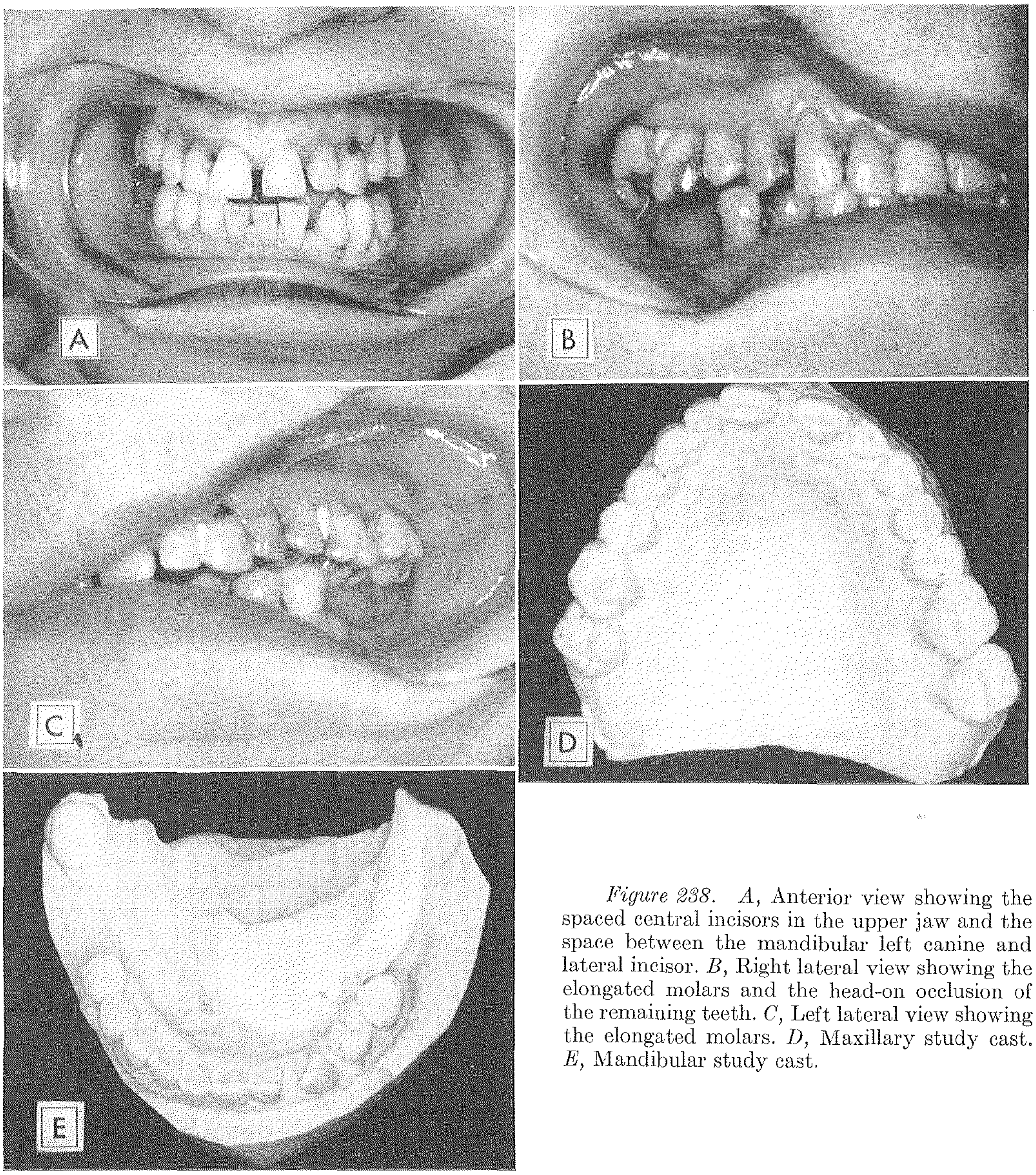


Figure 238. *A*, Anterior view showing the spaced central incisors in the upper jaw and the space between the mandibular left canine and lateral incisor. *B*, Right lateral view showing the elongated molars and the head-on occlusion of the remaining teeth. *C*, Left lateral view showing the elongated molars. *D*, Maxillary study cast. *E*, Mandibular study cast.

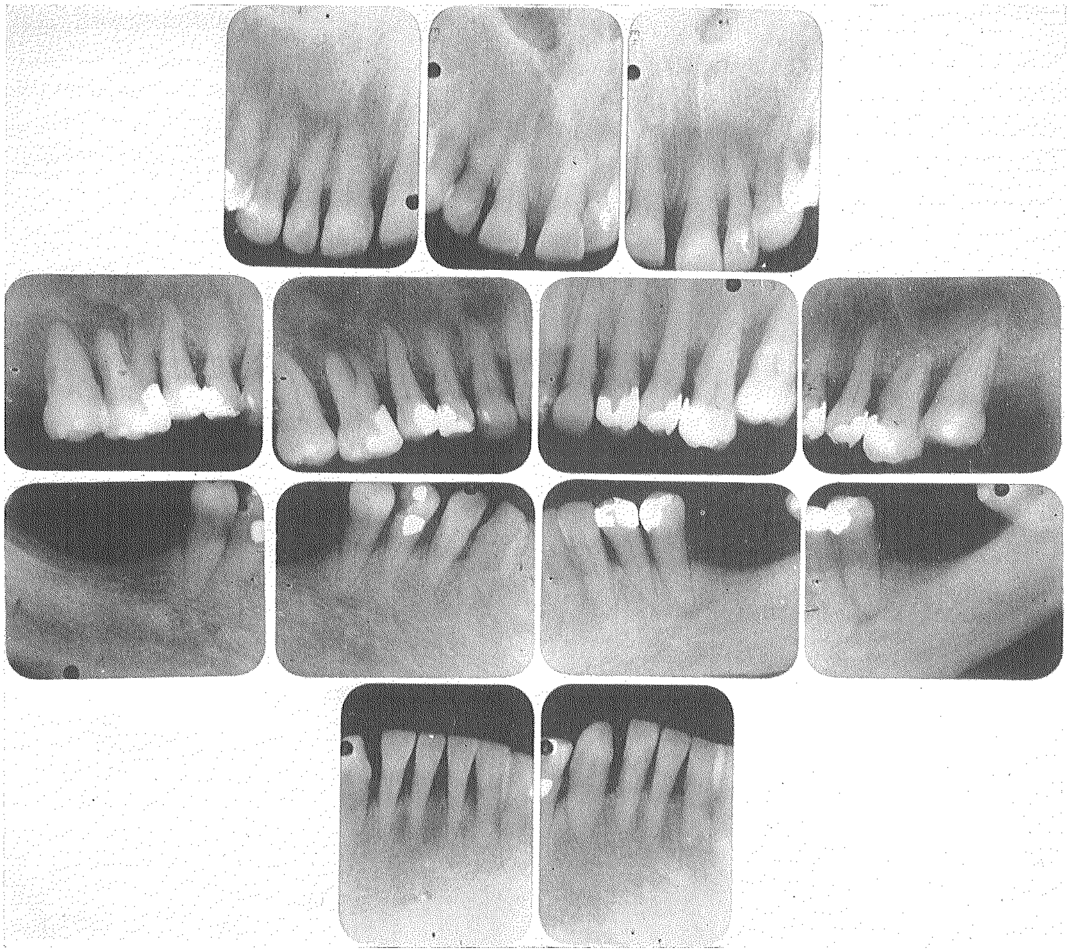


Figure 239. Roentgenograms of the patient before treatment.

necessary to expose more of the clinical crowns of the maxillary anterior teeth to assist in obtaining acceptable anterior restorations for improved esthetics. Furthermore, the small periodontal crevices will be reduced, to assure a healthy gingiva. The maxillary right premolars and canine will be splinted together as will those on the left side. These multiple abutment retainers will accommodate a distal extension removable partial denture with internal attachments. The splinted retainers will be plastic veneer crowns. The central and lateral incisors will be treated with individual porcelain jacket crowns to improve upon the esthetics.

The mandibular right first bicuspid and canine will be splinted together and the left first and second bicuspid and canine will be joined. As multiple abutment retainers, these teeth will support a removable partial denture with internal attachments. The mandibular right third molar will receive a cast gold crown to assist in supporting the partial denture. Should this third molar react unfavorably at any time, it can be removed readily and a new artificial tooth added to the denture without necessitating the construction of a completely new removable restoration. To satisfy the patient's wishes for esthetic improvement, the retainers on the teeth in the mandible will be porcelain fused to gold restorations. Of course, the operator can use veneer crowns with cast gold occlusal surfaces and acrylic resin veneer restorations. The mandibular incisors will be covered with porcelain jacket crowns to aid in closing the objectionable space.

Step 1 (*Fig. 240*). Expose more of the clinical crowns by removing some of the gingival tissue from the necks of the maxillary anterior teeth with the wire electrodes of the Electrosurg machine. Include the bicuspids on both sides in this procedure in order to reduce the periodontal pockets as much as possible. Cover the cut areas with Ward's Surgical Cement or its equivalent, and dismiss the patient. Change the dressings every four or five days until healing takes place. Do not prepare the teeth until complete healing is evident and the gingiva is firmly attached to its new level without bleeding. While the granulation tissue is forming around these teeth, remove the elongated condemned maxillary molars at different intervals.

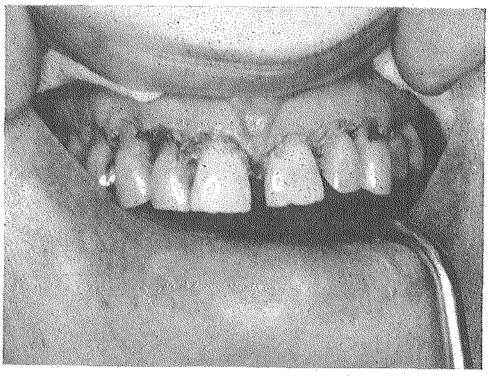


FIG. 240.

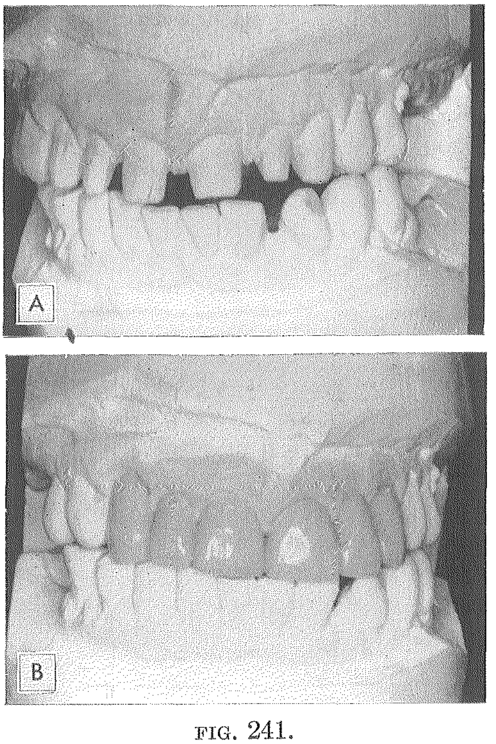


FIG. 241.

Step 2 (*Fig. 241*). During these procedures, duplicate the maxillary study cast and prepare the six plaster teeth for an acrylic resin splint. Construct the temporary restoration to be inserted when the maxillary anterior teeth are prepared. Temporary restorations may also be fabricated for the remaining teeth. Figure 241*A* shows the plaster teeth on the cast prepared. In Figure 241*B* is shown the temporary bridge on the cast.

Step 3 (*Fig. 242*). Prepare the maxillary incisors and canines for full coverage restorations. Take individual band impressions of these prepared teeth and pack the amalgam dies. Fabricate transfer copings on the dies. Insert the previously constructed anterior temporary plastic splint with a temporary cement.

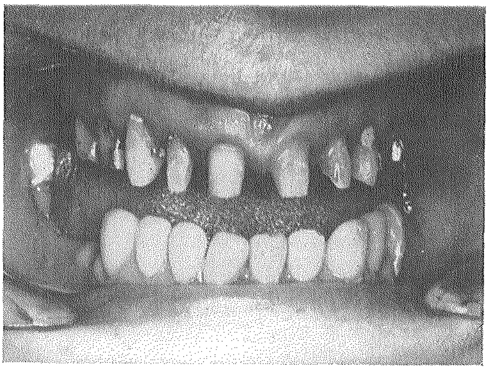


FIG. 242.

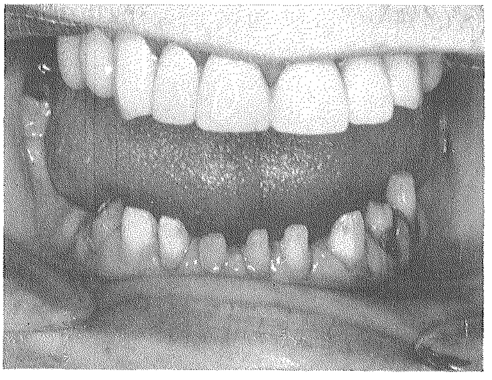


FIG. 243.

Step 4 (*Fig. 243*). During the next few appointments with the patient prepare all the remaining teeth for full coverage restorations. Inasmuch as the mandibular bicuspids and canines will receive porcelain fused to gold copings, these teeth are prepared with complete shoulders and with sufficient occlusal and incisal reduction to accommodate both porcelain and gold. The mandibular incisors are prepared to receive porcelain jacket crowns. The mandibular right molar is prepared to accommodate a full cast gold crown to house a male attachment on the removable partial denture.

Step 5 (*Fig. 244*). Construct metal dies from the band impressions of all the prepared teeth in both jaws. After the dies are trimmed and smoothed, fabricate transfer copings for the teeth. Insert these copings on the teeth.

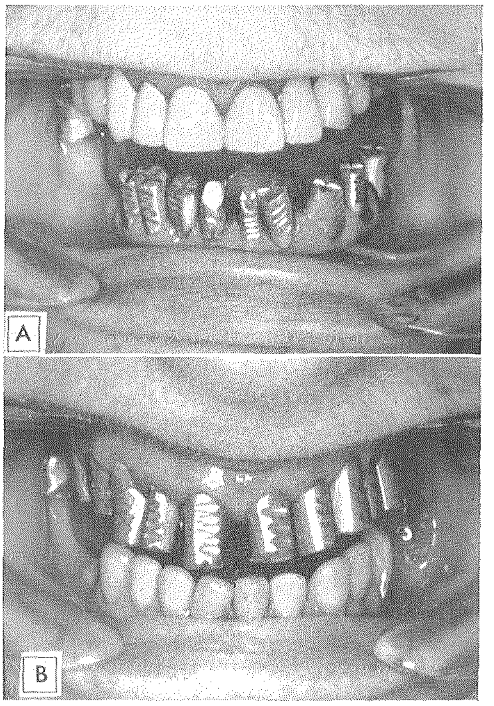


FIG. 244.

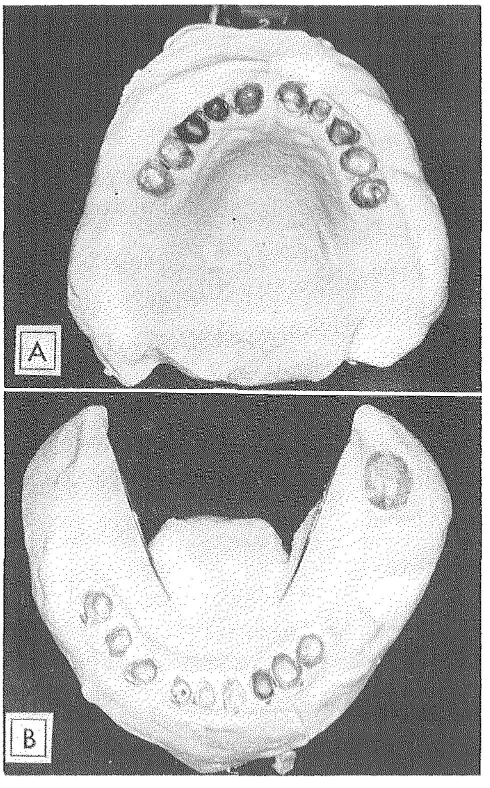


FIG. 245.

Step 6 (*Fig. 245*). Select a suitable aluminum tray for each jaw and take plaster impressions with the copings in position. The upper impression is shown in Figure 245*A*, the lower impression in Figure 245*B*.

Step 7 (*Fig. 246*). Pour the master casts in stone. Construct shellac baseplate and wax occlusal rims for each jaw, with sufficient wax on the rims to allow for trimming. Reduce the baseplate so that it does not impinge upon the soft tissues and scratch them during the many try-in sessions. Figure 246*A* shows the maxillary occlusal rim, Figure 246*B*, the mandibular occlusal rim.

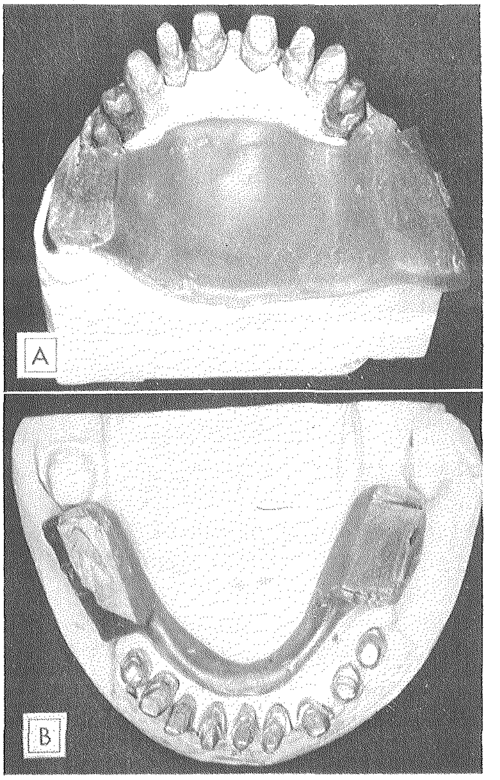
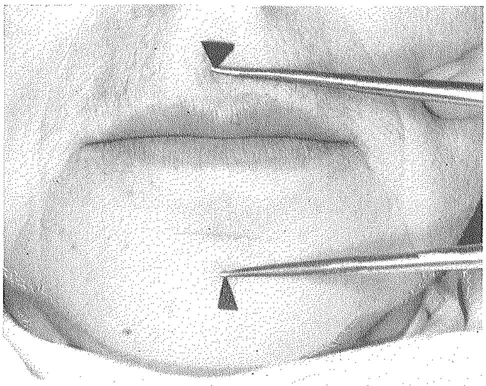


FIG. 246.

FIG. 247.



Step 8 (Fig. 247). Seat the prepared occlusal rims in the mouth and add or reduce the wax until the rims come within the measured interocclusal clearance. The operator must be cognizant of the fact that this contact is analogous to the measured space, so allowance must be made for the contact of the restored teeth.

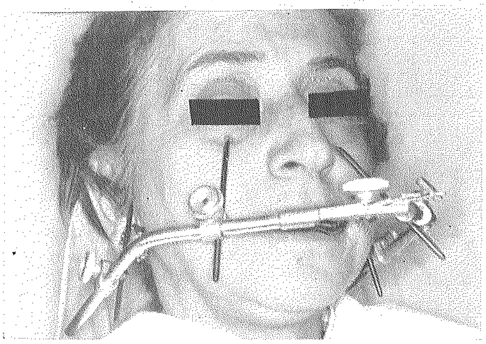


FIG. 248.

Step 9 (Fig. 248). Take a face-bow registration with the wax occlusal rims in place and mount the master working casts on the Hanau articulator, or on the one of your choice.

Step 10 (Fig. 249). Wax and cast acrylic resin veneer crowns with recesses for the internal attachments, for the upper jaw. Cast the copings to which porcelain will be baked, for the lower jaw. Carry the retainer castings in the upper jaw slightly toward the median line so that the canine distance is reduced. By so doing, the diastema can be closed with four porcelain jacket crowns possessing normal widths. The esthetics are thereby improved. Fit the castings on the teeth and take individual bridge tray impressions of each segment. Pour these impressions in a suitable soldering investment and solder the multiple abutment retainers together. Figure 249*A* illustrates the maxillary multiple retainers with a cutout on the bicuspids to house the internal attachments. Figure 249*B* shows the mandibular high melting range multiple retainers and the third molar crown.

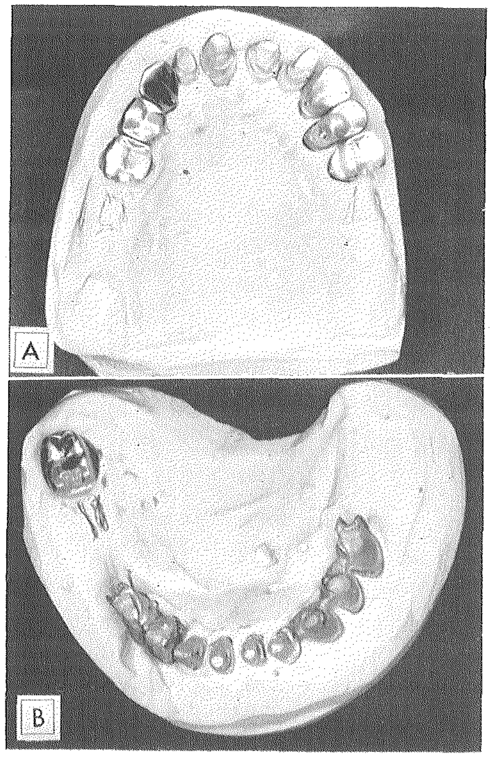


FIG. 249.

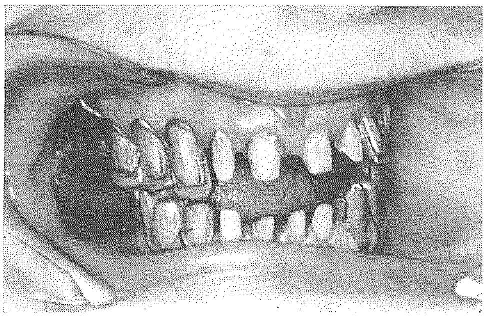


FIG. 250.

Step 11 (Fig. 250). Try the cast gold crown and multiple retainers in the mouth and check for fit (the splinted retainers must not rock), for occlusion, and for freedom from interferences during the gliding movements. Grind any interferences and spend sufficient time adjusting the occlusion to the patient's tolerance and comfort. Be sure that the gold copings have sufficient occlusal clearance to accommodate the porcelain.

Step 12 (Fig. 251). Make certain that the interdental papillae between the splinted retainers are not pinched and that there is no overhang on the castings to create blanching of the tissues. Take a wax occlusal registration as a check in remounting the working casts. Select a suitable tray for each jaw and take a plaster impression with the castings on the teeth. Record the color and shade of the teeth for the porcelain restorations, for the acrylic resin veneer crowns, and for the artificial teeth on the removable partial dentures. The maxillary impression is shown in Figure 251*A*, the mandibular impression in Figure 251*B*.

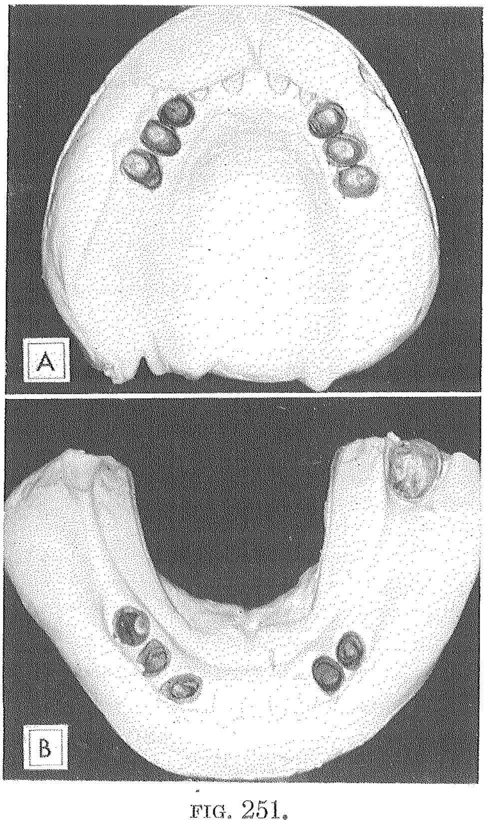


FIG. 251.

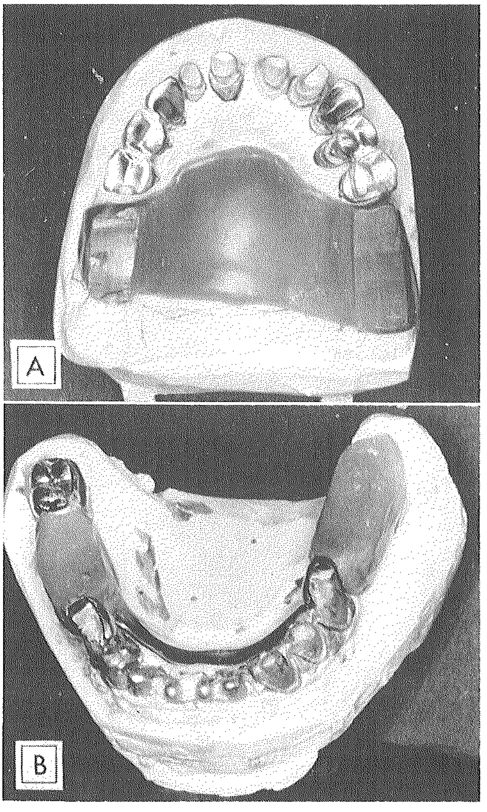


FIG. 252.

Step 13 (Fig. 252). Pour the casts and remount them on the articulator. Wax and cast the mandibular lingual bar partial denture framework with the lingual arms. Solder the female boxings of the internal attachments to the bicuspid high melting range gold copings with a special high fusing solder (Noble Metals, Inc.). Attach wax rims to the metal base. Try this in the mouth, and, if necessary, take a new check bite. Consult with the technician and design and outline the removable maxillary partial denture. Wax and cast the denture with lingual arms fitting snugly in the recesses of the abutment retainers. Figure 252*A* shows the maxillary occlusal rim, Figure 252*B*, the mandibular cast gold lingual bar with the lingual arms resting on the lingual shoulders of the gold.

Step 14 (Fig. 253). Fuse porcelain to the mandibular splinted abutment retainers after the female attachments are soldered to the boxings. Then fire biscuit bake porcelain jacket crowns for the maxillary and mandibular anterior teeth.

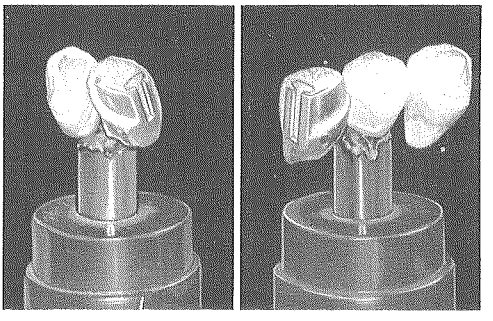


FIG. 253.

Step 15 (Fig. 254). Fill the splinted maxillary veneer castings with white wax and try these in the patient's mouth. Check for the alignment, the occlusion, and the contour. Figure 254*A* illustrates the veneer retainers filled with white wax, and Figure 254*B* illustrates the biscuit bake porcelain fused to gold retainers.

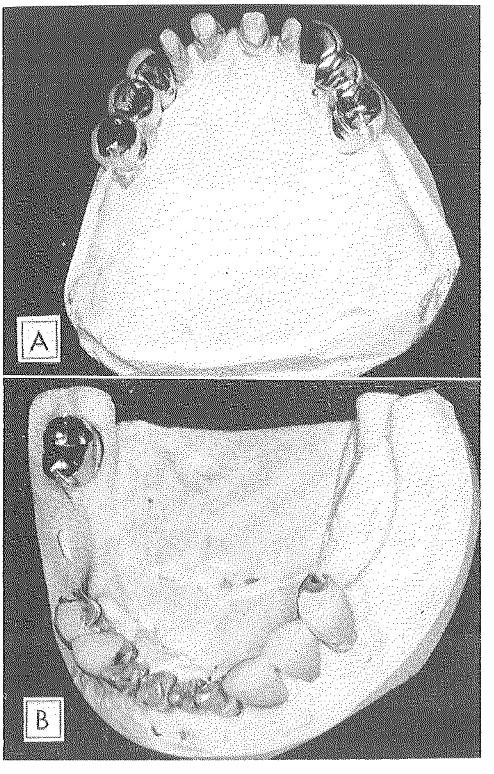


FIG. 254.

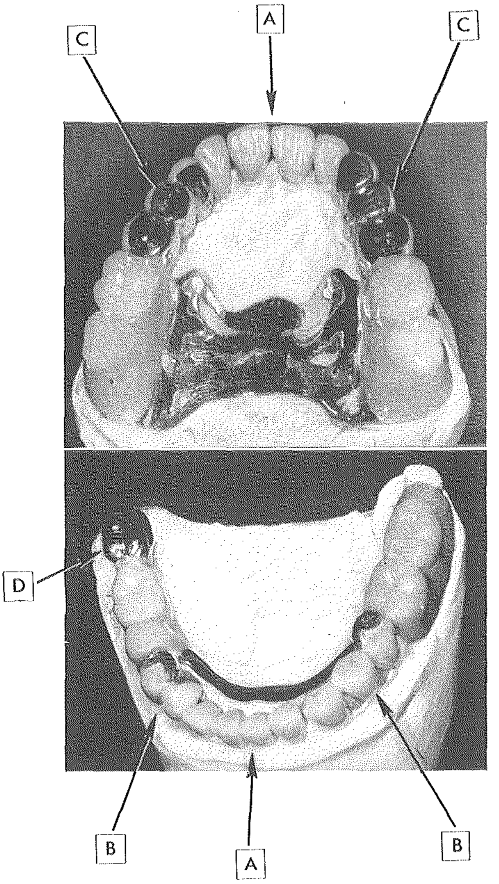


FIG. 255.

Step 16 (Fig. 255). Complete the removable partial dentures and glaze and stain the porcelain restorations. Cure acrylic resin to the cast veneer crowns. Examine all the restorations critically for possible perforations in the occlusal surfaces of the gold. In Figure 255*A*, porcelain jacket crowns; *B*, porcelain fused to gold; *C*, acrylic resin veneer multiple retainers; and *D*, cast gold crown.

Step 17 (Fig. 256). Insert all the restorations in the mouth temporarily with the exception of the porcelain jacket crowns. Cement these crowns with Caulk's Di-Cem No. 2 cement. The occlusal view of the completed restorations in the upper jaw is shown in Figure 256*A*, and the occlusal view of the completed restorations in the lower jaw appears in Figure 256*B*.

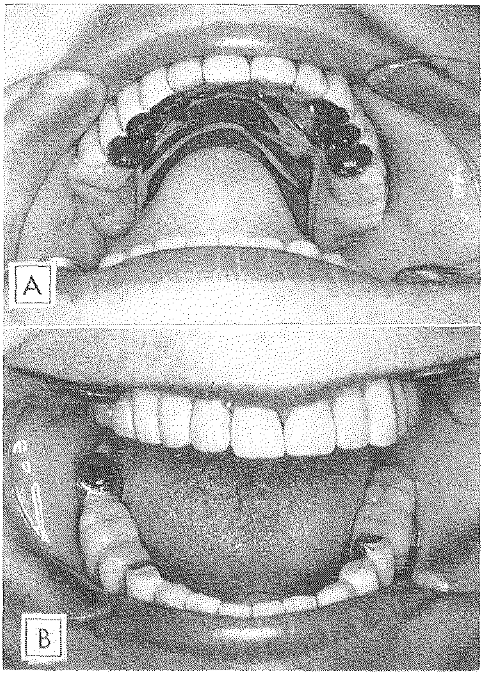


FIG. 256.

Step 18 (Fig. 257). When all adjustments have been made and the patient is comfortable, cement the retainers permanently with oxyphosphate of zinc cement. Figure 257*A* shows the patient before treatment, and Figure 257*B* shows the patient after occlusal rehabilitation.

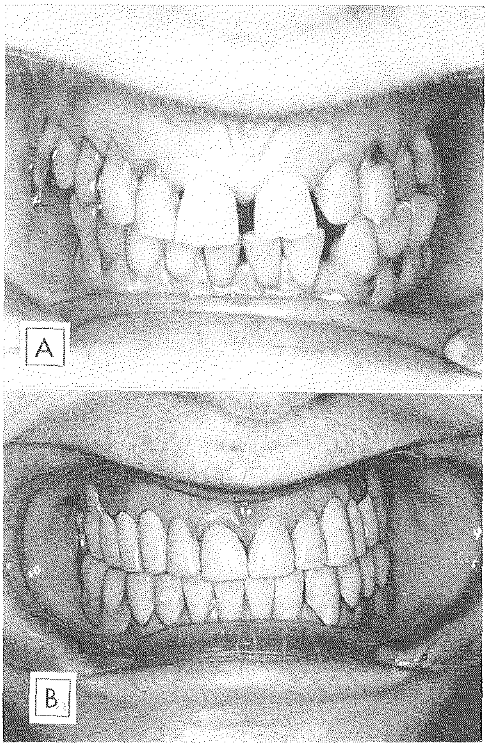
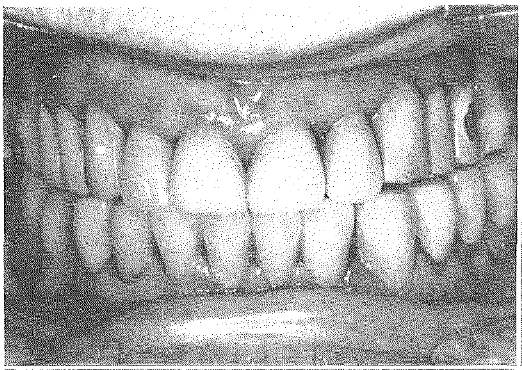
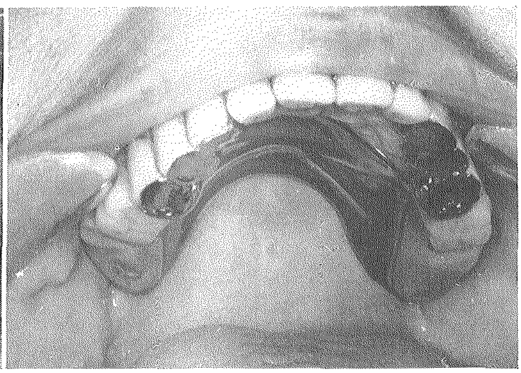


FIG. 257.

Figure 258. Roentgenograms of the completed case.





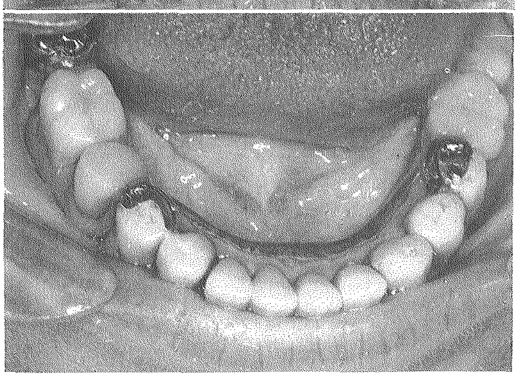


Figure 259. Same patient, nine years after completion of treatment. Good oral hygiene has not been strictly followed and the periodontal condition has worsened in this terminal case. The acrylic resin on the left second premolar veneer crown is worn away and the gold is exposed. Complete dentures were recommended but the patient is willing to retain her present dentition.

13

GROUP I CLASS 2

Procedures in Restoring a Lost Terminal Occlusion Brought About by Loss of All Posterior Mandibular Teeth, with Remaining Teeth Not in Satisfactory Occlusal Relationship

Examination

The patient is a businesswoman of about 54 years. Preservation of the few remaining teeth and improvement in the esthetics are her main wishes. In the maxillae, the left canine, first bicuspid, first and third molars, the right first and second bicuspids, and the first and third molars are missing (Fig. 260*A* and *B*). The root of the upper right second bicuspid is retained. In the mandible the first, second, and third molars are periodontally involved, mobile, and beyond repair. The right mandibular canine and first bicuspid have drifted and are mobile. These two teeth have been forced labially by a powerful tongue habit during swallowing. This habit contributes to the prognathous articulation of the anterior teeth on the right side (Fig. 260*C*).

The roentgenograms disclose that the mandibular right canine and first bicuspid are beyond repair (Fig. 261). The study casts show asymmetric jaws, the mandible longer and wider than the maxillae. The right side of the maxillae is wider than the left (Fig. 262).

The interocclusal clearance measures 4 mm. and the patient functions in an abnormal occlusion of convenience. She thrusts her mandible forward and to the right whenever she chews and swallows her food. The mandibular incisors all slant labially because of the abnormal habits. The teeth are small and the esthetics are

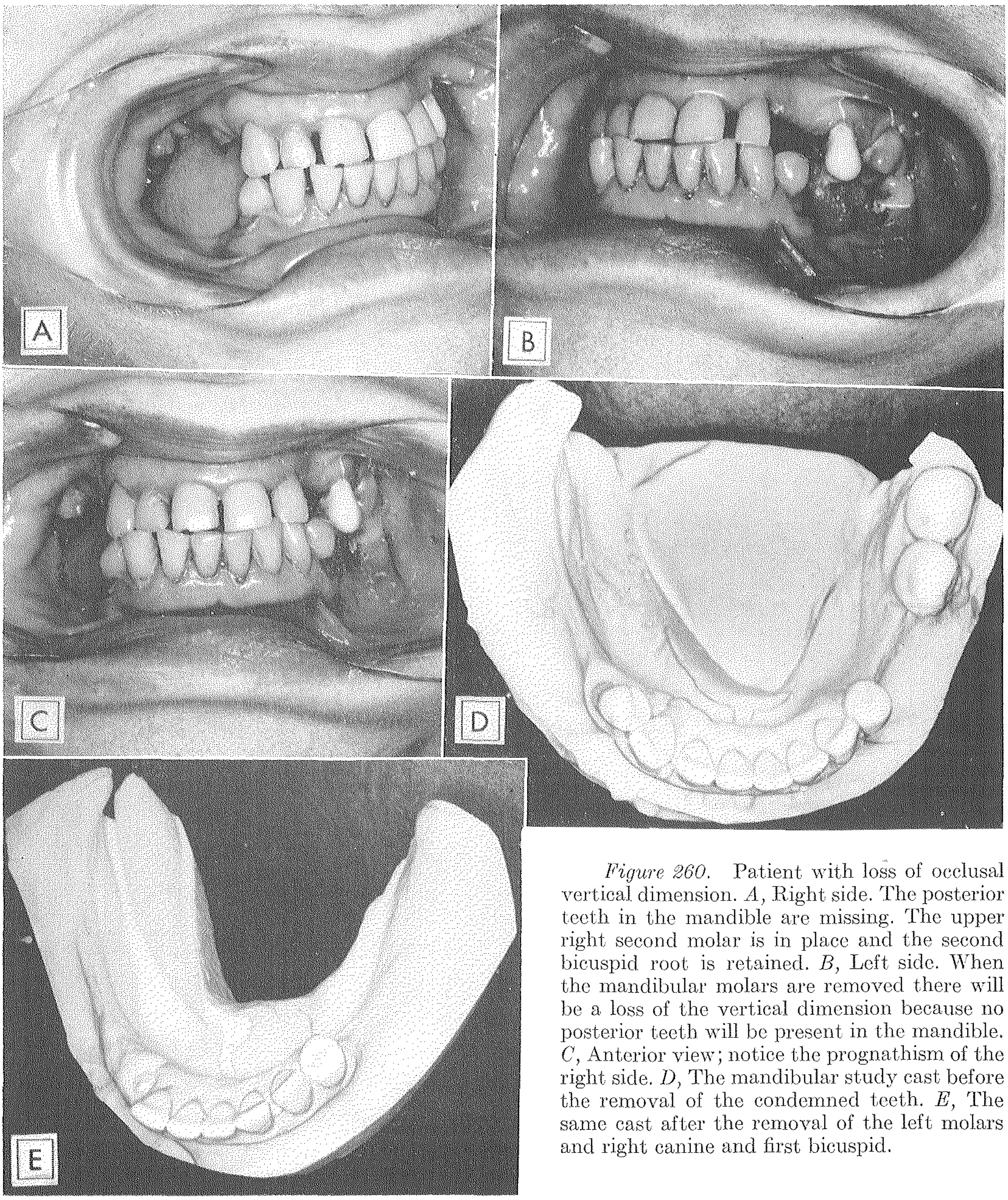


Figure 260. Patient with loss of occlusal vertical dimension. *A,* Right side. The posterior teeth in the mandible are missing. The upper right second molar is in place and the second bicuspid root is retained. *B,* Left side. When the mandibular molars are removed there will be a loss of the vertical dimension because no posterior teeth will be present in the mandible. *C,* Anterior view; notice the prognathism of the right side. *D,* The mandibular study cast before the removal of the condemned teeth. *E,* The same cast after the removal of the left molars and right canine and first bicuspid.

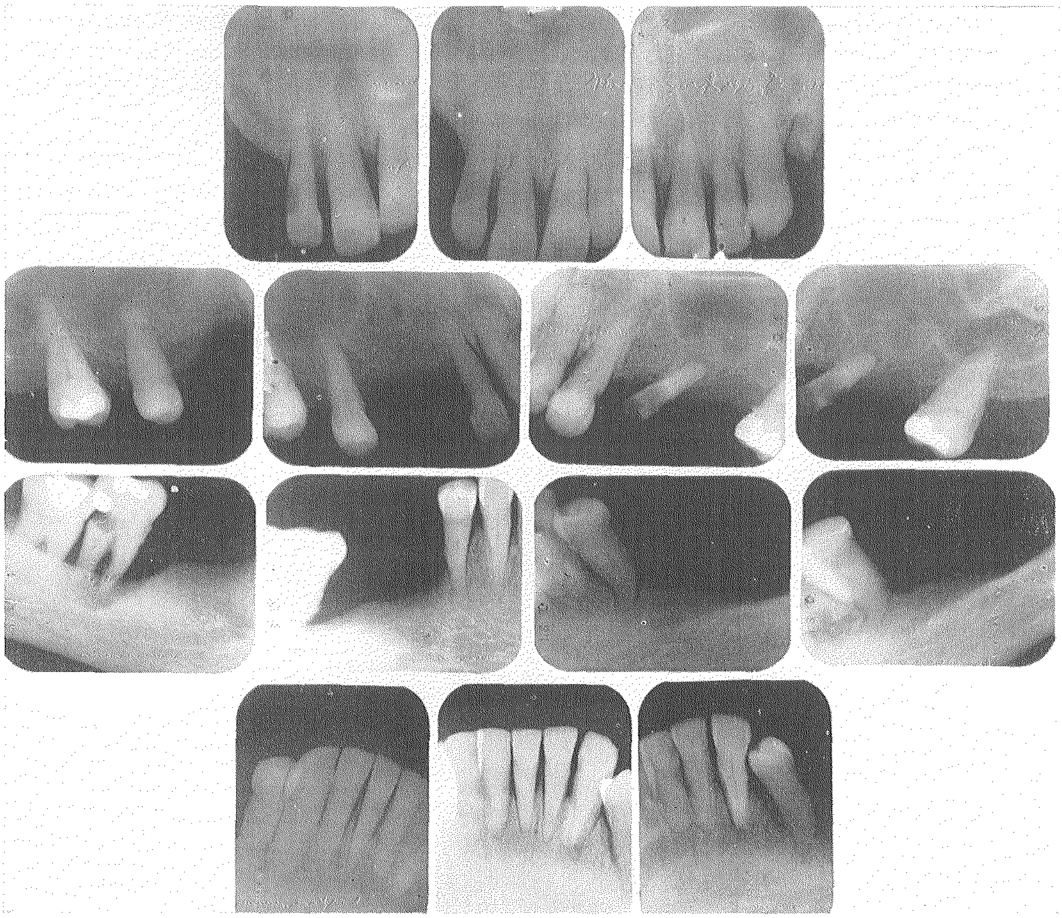


Figure 261. Roentgenograms of the patient.

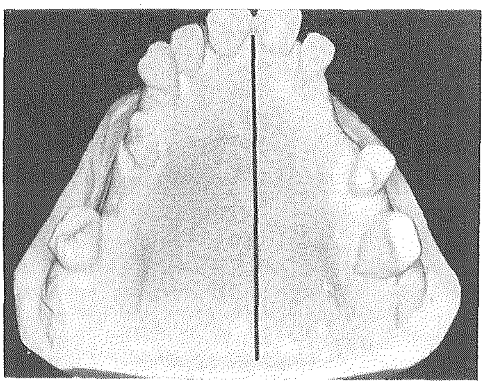


Figure 262. The maxillary study cast showing the asymmetry between the right and left sides.

unsatisfactory. The gingivae surrounding the teeth have deep crevices but with sufficient bone to warrant their retention. This patient was advised to have complete dentures. I consider her teeth a terminal case. The patient refuses to have complete dentures made, and is willing to try rehabilitation.

Treatment Plan

The maxillary right bicuspid retained root and the right mandibular canine and first bicuspid as well as the left second and third molars will be removed. After these extractions, the patient will have a loss of occlusal vertical dimension because all of the posterior teeth in the mandible will be absent and those remaining will be in an unsatisfactory occlusal relationship. The maxillary left molar and drifted bicuspid will be treated with a cast gold crown and a plastic veneer crown, joined to act as a multiple abutment retainer. The right molar and canine will receive a gold crown and a modified veneer restoration. These castings will house internal attachments for a removable partial denture. The remaining anterior teeth will hold acrylic resin crowns fused to porcelain copings.

The mandibular incisors will be splinted together to help support a removable partial denture with internal attachments. In order to obtain a satisfactory esthetic result, these multiple abutment castings will be cast gold copings with acrylic resin crowns in apposition to the maxillary resin restorations. A pontic canine casting with a boxing for the attachment will be soldered to the mandibular splint to aid in esthetics. Besides, a mandibular lateral incisor is not ideal to house an internal attachment, and the additional canine, soldered to the splint, can be so constructed that the reception of the attachment will be more favorable. The mandibular left bicuspid of the splint will house the internal attachment on that side. The occlusal surfaces of all the posterior teeth will be cast gold and the denture teeth will be porcelain, to maintain the established occlusal dimension. An attempt will be made to correct the acquired abnormal occlusion of convenience. The neuromuscular influences established over the years to accommodate the convenient habits of function will be obstacles in the correction. Because of the long distal extension on the lower right side plus the fact that the partial denture will be supported by the pontic canine, a stressbreaking device may be considered in the long denture base to minimize the strain on the canine.

Treatment

The steps in the treatment of this patient are illustrated on the next few pages.

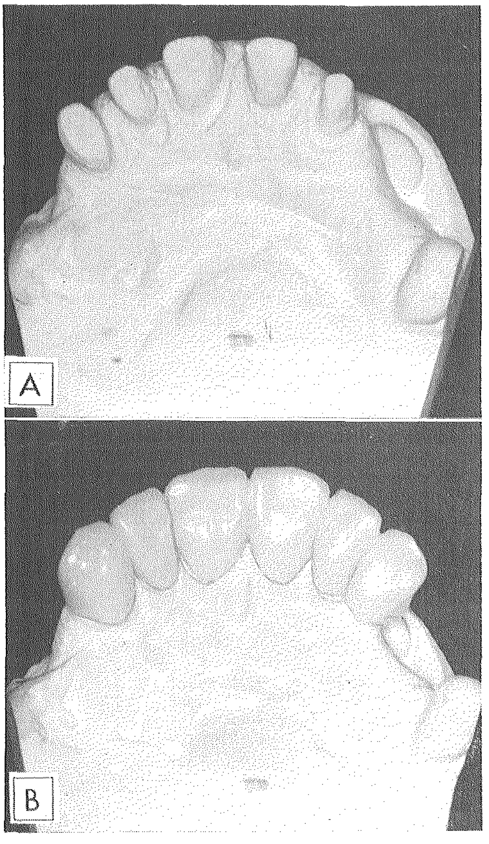


FIG. 263.

Step 1 (*Fig. 263*). At different interval appointments, remove the condemned teeth and retained root. Duplicate the study casts and prepare the plaster teeth (*A*) for the reception of a temporary acrylic resin splint (*B*). Reduce the gingival crevices of the anterior teeth in both jaws with the wire electrodes on the Electrosurg machine.

Step 2 (*Fig. 264*). When the gingival tissues are completely healed, prepare the maxillary and mandibular teeth to receive full coverage restorations. Do these preparations at different appointments. When the anterior segment is prepared (*A*), insert the temporary splint. Be careful in the preparation of the mandibular incisors not to taper them (*B*). Sufficient tooth structure must be removed interproximally on each tooth near the gingiva to accommodate the thickness of the soldering connections of the gold coping splint. Take individual band impressions and fabricate the metal dies.

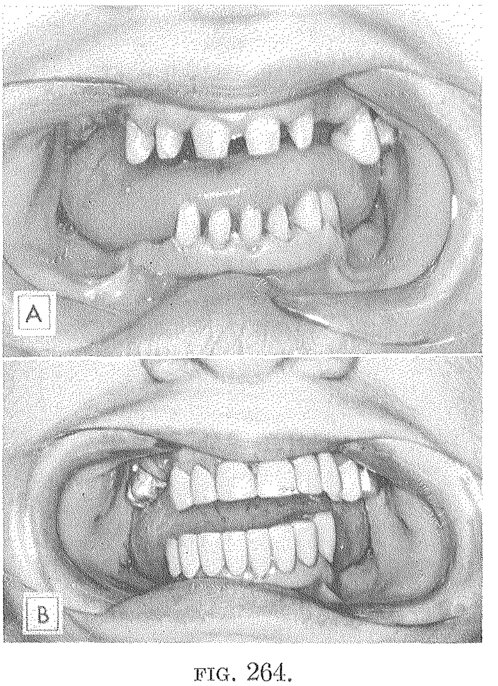


FIG. 264.

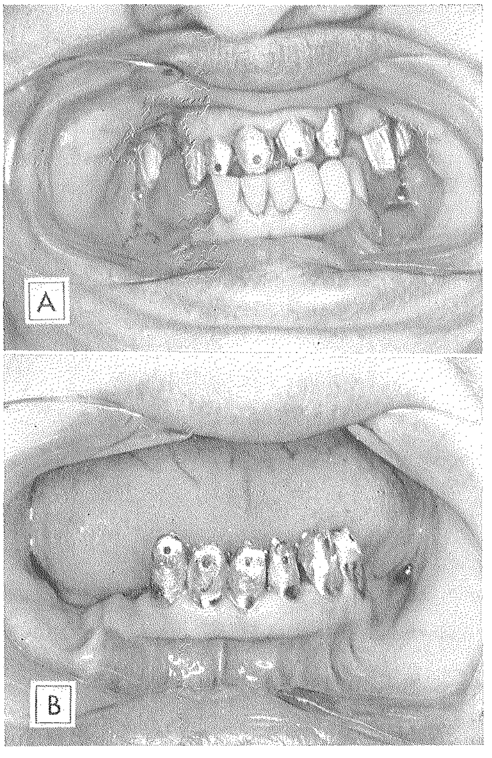


FIG. 265.

Step 3 (*Fig. 265*). Construct cast "K" metal or gold transfer copings for all the teeth prepared in the upper jaw (*A*). Seat the copings on the teeth and test for accurate adaptation. Do the same for the lower jaw (*B*). The holes in the labial or buccal surfaces will enable the operator to determine whether the cast transfer copings are properly seated.

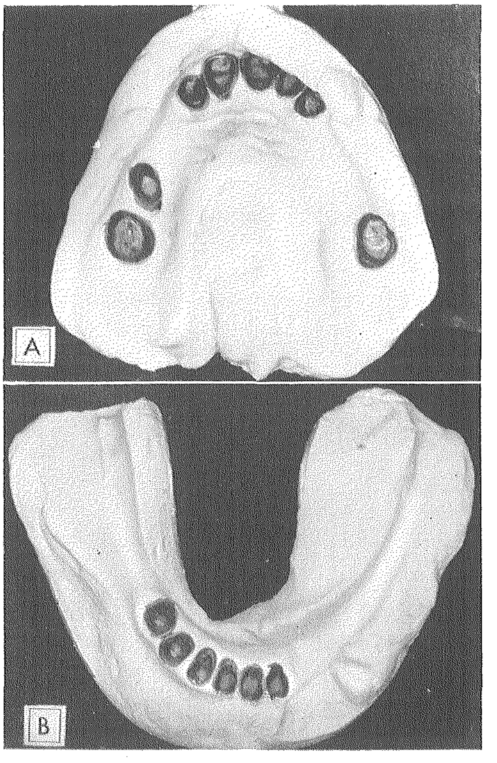


FIG. 266.

Step 4 (*Fig. 266*). Select an aluminum tray for each jaw that will include the tuberosities of the maxillae and the retromolar pads of the mandible. Take a full plaster impression of each jaw with the transfer copings in position (*A* and *B*). Seat the trimmed metal dies in their respective copings and pour each master impression in stone.

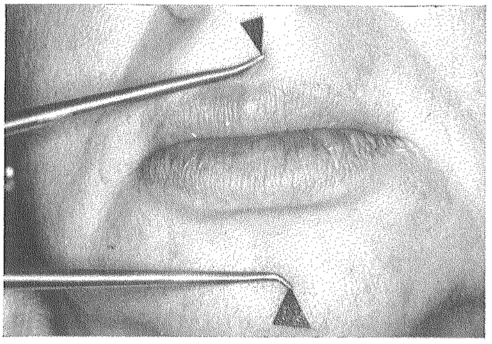


FIG. 267.

Step 5 (Fig. 267). Determine the physiologic rest position with the calipers and note its measurement.

Step 6 (Fig. 268). Construct baseplate and wax occlusal rims on the study casts.

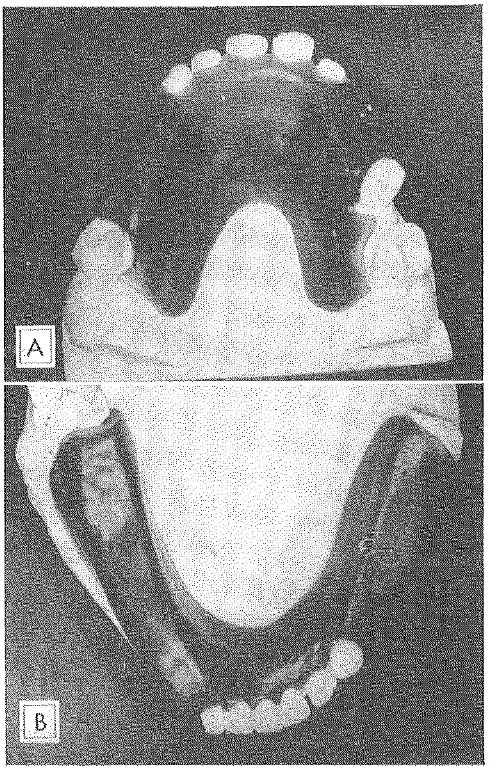


FIG. 268.

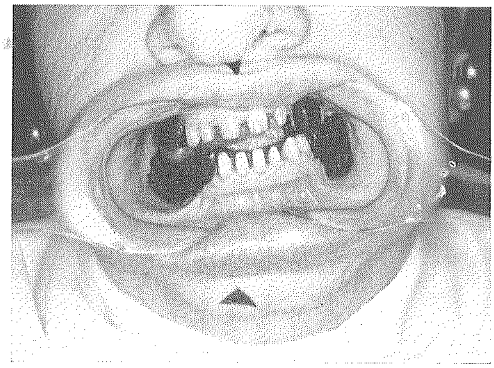


FIG. 269.

Step 7 (Fig. 269). Remove the temporary restorations and insert the occlusal rims. Reduce or add wax on the rims until they come within the tolerance of the physiologic rest position. The distance between the measurement when the jaw is closed with the occlusal rims in contact and the measured physiologic rest position should be between 2½ and 3 mm., just as in full dentures. The amount is arbitrarily chosen from the average. Seal the occlusal rims and remove them carefully from the mouth until they are ready to use with the face-bow.

Step 8 (Fig. 270). Warm the bite fork and attach it to the sealed occlusal rims in the mouth. Make the anatomic markings on the patient's face and secure the Hanau face-bow to the bite fork while the condyle rods of the bow are tightened to the marks designating the opening axis.

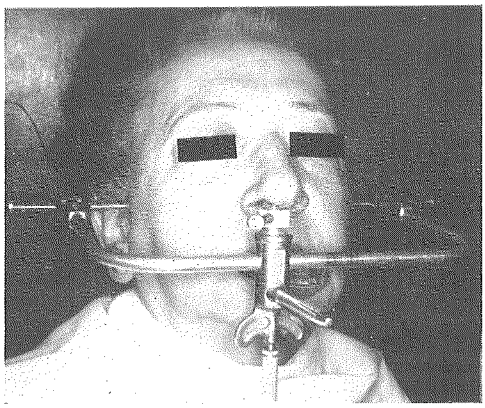


FIG. 270.

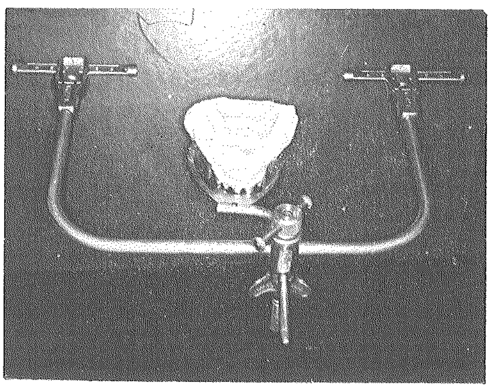


FIG. 271.

Step 9 (Fig. 271). Remove the face-bow and attached bite fork with the occlusal rims from the mouth. Seat the previously poured maxillary working cast into the upper occlusal rim.

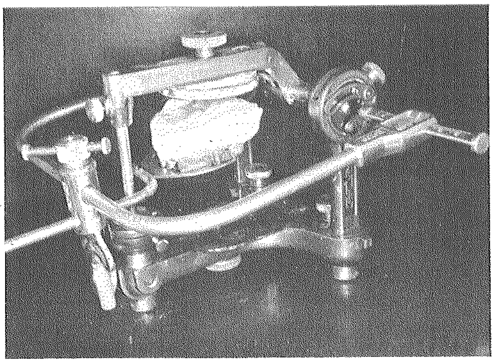
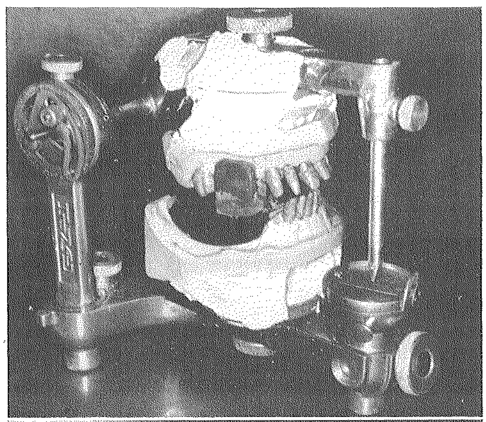


FIG. 272.

Step 10 (Fig. 272). Set the articulator for mounting and adjust the face-bow to it. Pour impression plaster on the top of the cast until it becomes attached to the upper ring of the articulator. Remove the bite fork and face-bow.

FIG. 273.



Step 11 (Fig. 273). Place the occlusal rims on the attached upper cast and seal it with some sticky wax. Adapt the lower previously poured working cast to the occlusal rim and seal that with some sticky wax. Attach the mandibular cast to the lower ring with some plaster.

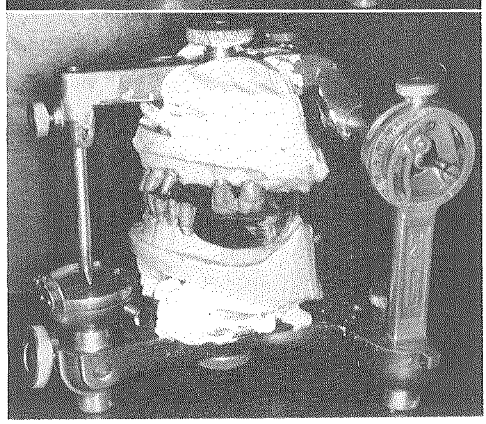


FIG. 274.

Step 12 (Fig. 274). Wax and cast the maxillary full cast crowns and the acrylic resin veneer. The bicuspid and right molar will have cut-outs to receive the boxings for the internal attachments. Wax and cast special gold copings for all the remaining mandibular teeth.

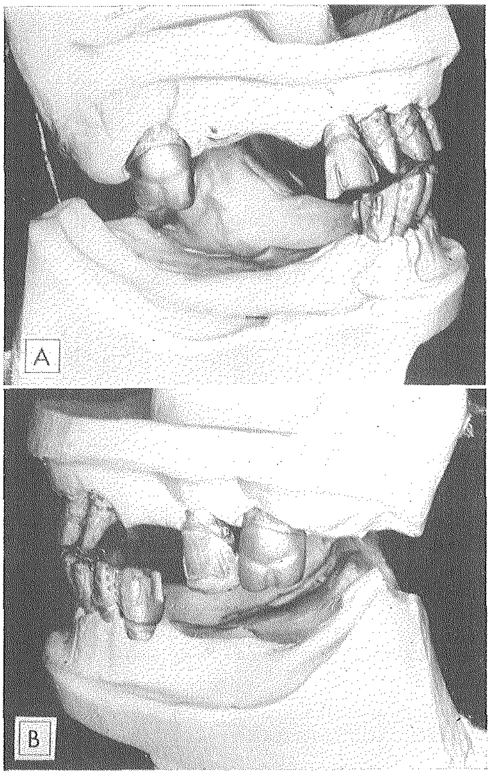


FIG. 275.

Step 13 (Fig. 275). The gold coping on the right canine is constructed with a distal boxing (in occlusion with the lower rim) to house the boxing for the female attachment (*A*). The bicuspid coping on the left side has a definite receptacle for the reception of the attachment (*B*).

Step 14 (Fig. 276). Try the mandibular coping castings on the teeth and after the necessary adjustments, take a full plaster impression with the copings in position. Pour a new stone cast for soldering. The maxillary left molar and bicuspid castings are soldered together to serve as a multiple abutment.

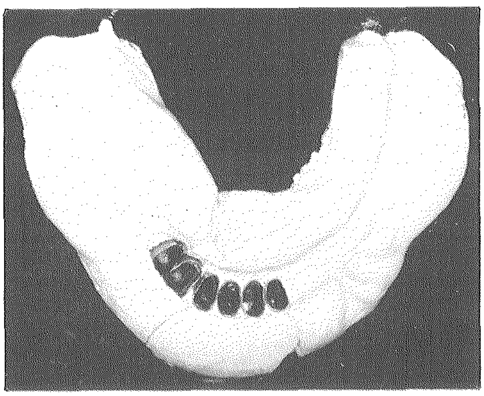


FIG. 276.

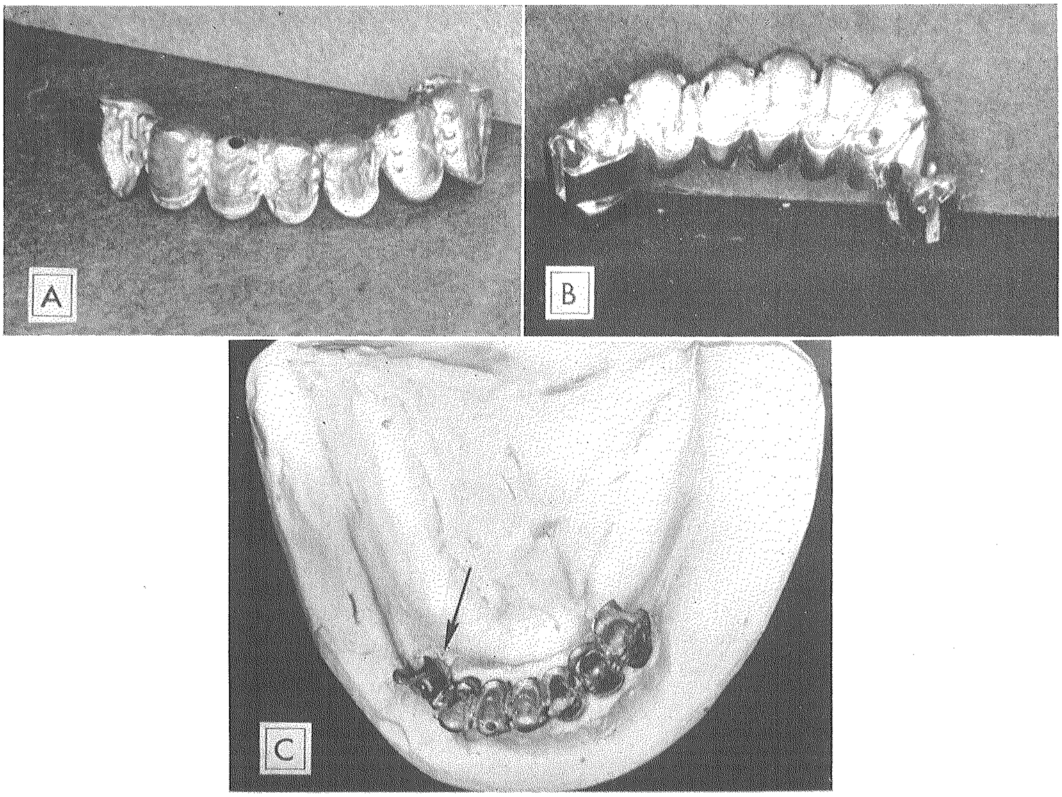


FIG. 277.

Step 15 (*Fig. 277*). Solder the mandibular coping castings in a splint. Cast a right canine coping pontic with provisions to house an internal attachment and lingual arm, and solder this to the splint (*A* and *B*). This should fit accurately on the master cast (*C*).

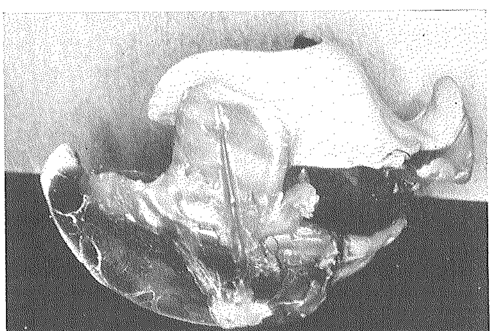


FIG. 278.

Step 16 (*Fig. 278*). It may be necessary to construct another occlusal rim for each jaw. Fit the mandibular coping splint on the teeth and make the required adjustments. Extend the lingual shoulders of this splint as far down toward the gingiva as possible. Adjust the occlusion and trim and seal together the occlusal rims, in harmony with the inter-occlusal clearance.

Step 17 (*Fig. 279*). Take a plaster impression of each jaw with the castings and splint in position (*A* and *B*). Pour the impressions and remount on the articulator.

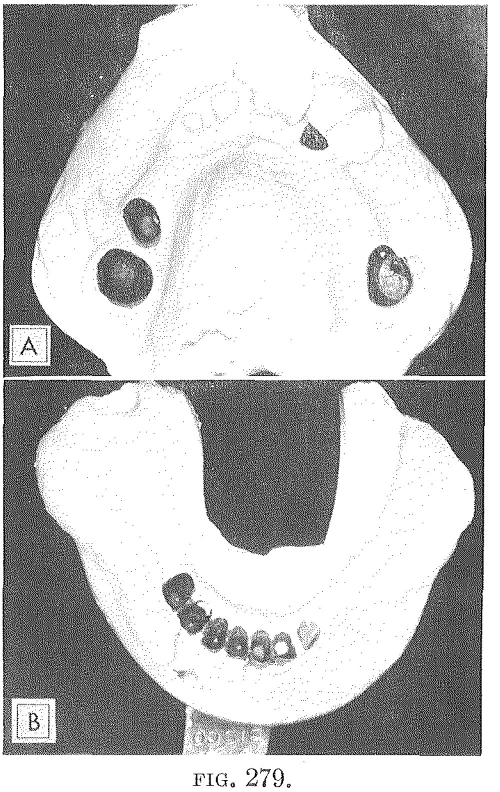


FIG. 279.

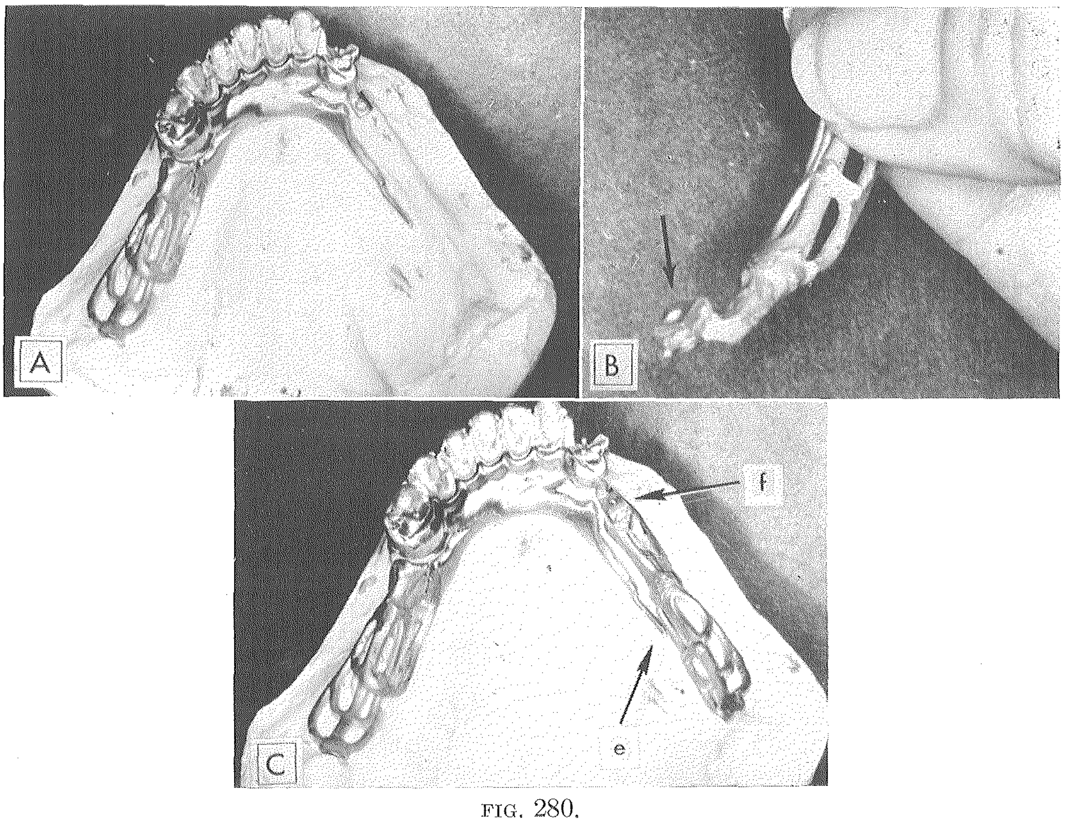


FIG. 280.

Step 18 (*Fig. 280*). Plan and design the removable partial dentures and consult with the technician. Construct a wide lingual bar resting and fitting accurately against the lingual shoulders of the splint. The bases are cast separately. The longer right metal base will accommodate a stressbreaker (*A* and *B*). The lingual bar segment is soldered closer to the end of the base (*e* in part *C*). The stressbreaker (*f*) is attached to the front end of the denture base with a set screw. The acrylic for the denture base will secure the extension, while the stressbreaker, fitting into its accommodating slot, will relieve the stress of the distal extension case in mastication.

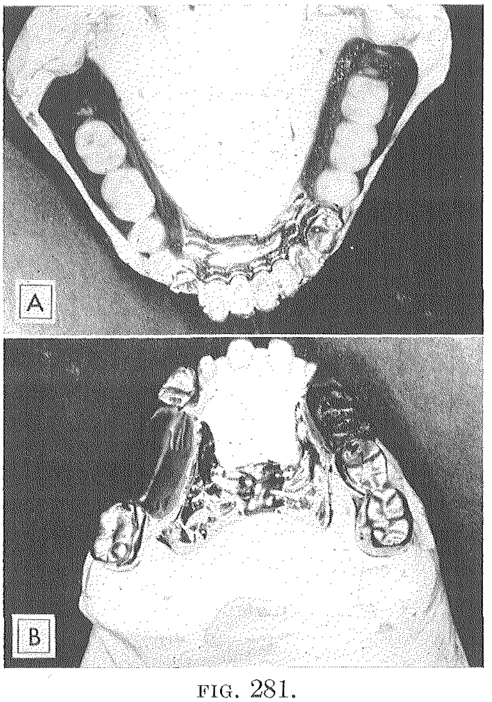


FIG. 281.

Step 19 (*Fig. 281*). Wax artificial teeth to the lower denture after the internal attachments are soldered (*A*). Attach wax rims to the maxillary denture for further occlusal check (*B*).

Step 20 (*Fig. 282*). Try all the abutment retainers and both partial dentures in the mouth and make all adjustments, particularly in occlusion. Seal the dentures together in their proper relationship.

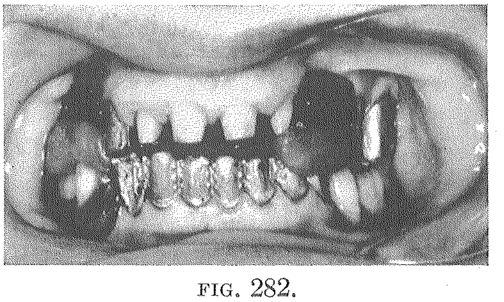


FIG. 282.

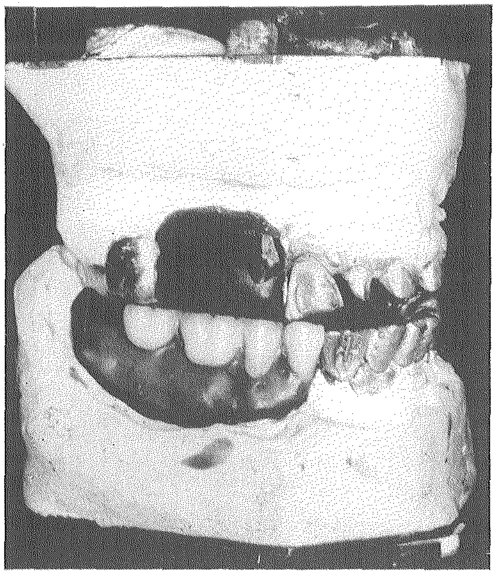


FIG. 283.

Step 21 (*Fig. 283*). Remount the working casts with the guidance of the sealed dentures, on the articulator if necessary.

Step 22 (*Fig. 284*). Complete both removable partial dentures (*A* and *B*).

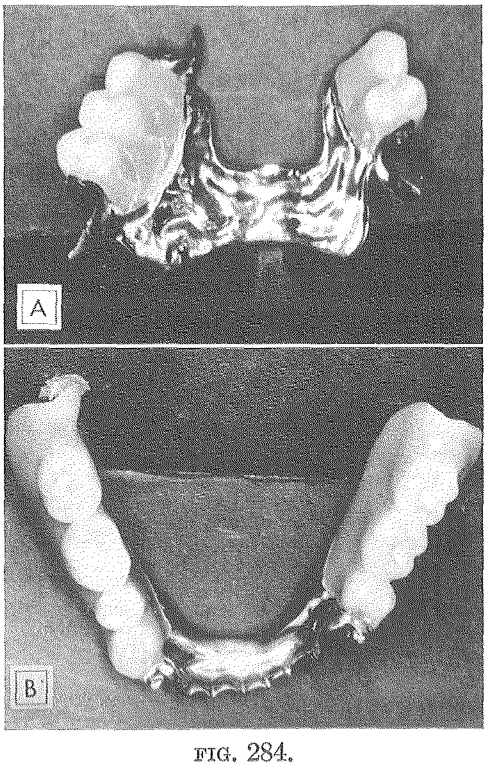


FIG. 284.

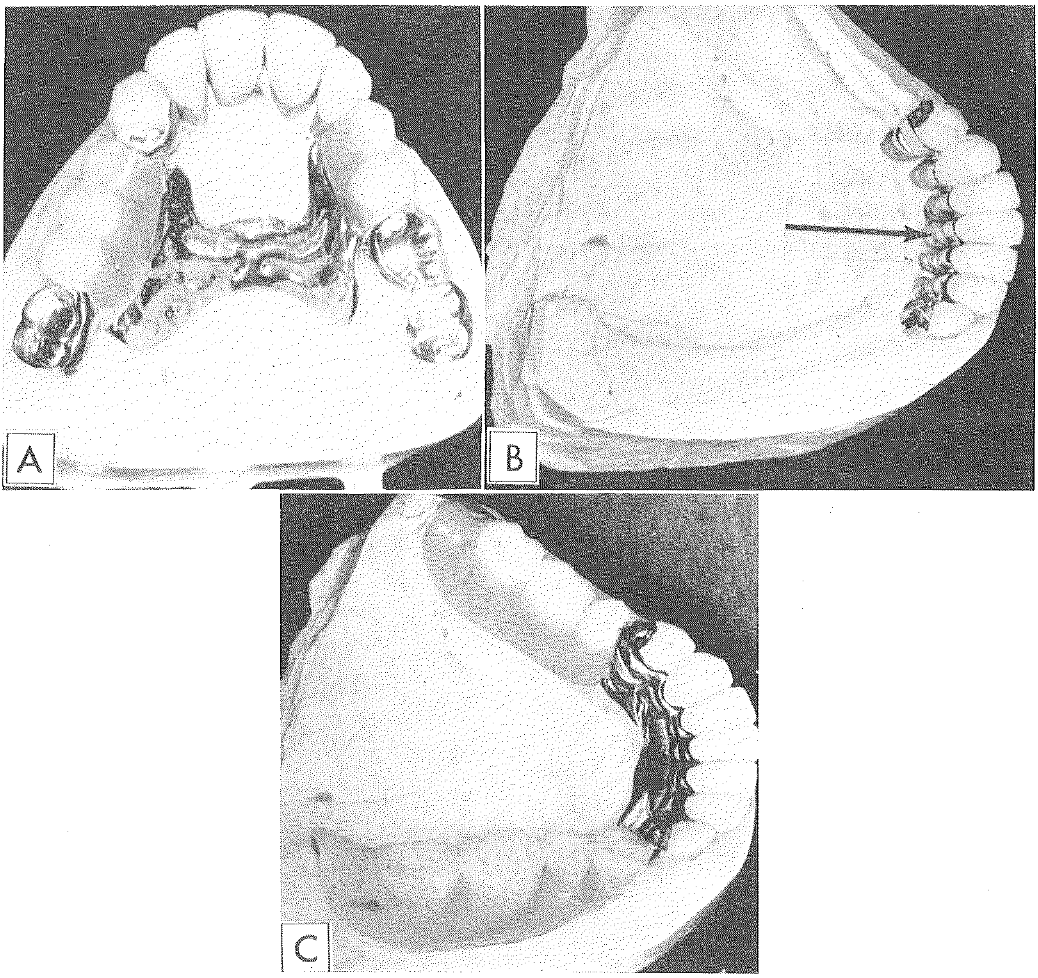


FIG. 285.

Step 23 (*Fig. 285*). Wax up the maxillary four incisors to fused porcelain copings. Carve the wax over the mandibular anterior splint retainer.

A, The waxed restorations, abutment retainers, and maxillary removable partial denture on the cast.

B, The mandibular cast with the waxed splint retainer. The arrow points to the gold shoulders accommodating the continuous gold bar.

C, The waxed restorations, splint, and partial denture on the cast of the lower jaw.

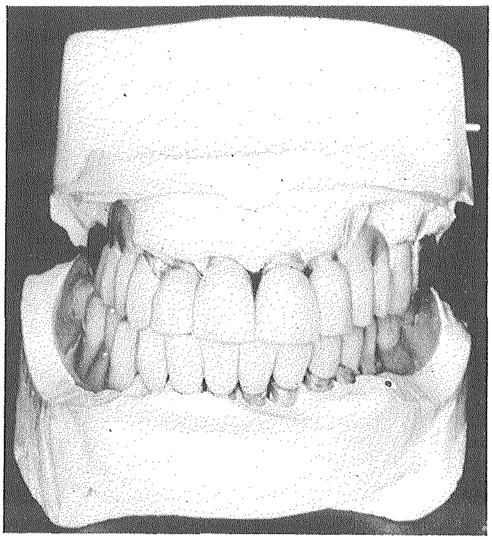


FIG. 286.

Step 24 (*Fig. 286*). Wax the anterior crowns in occlusal relationship on the articulated casts. Then try all the restorations in the mouth and make the necessary adjustments for esthetics.

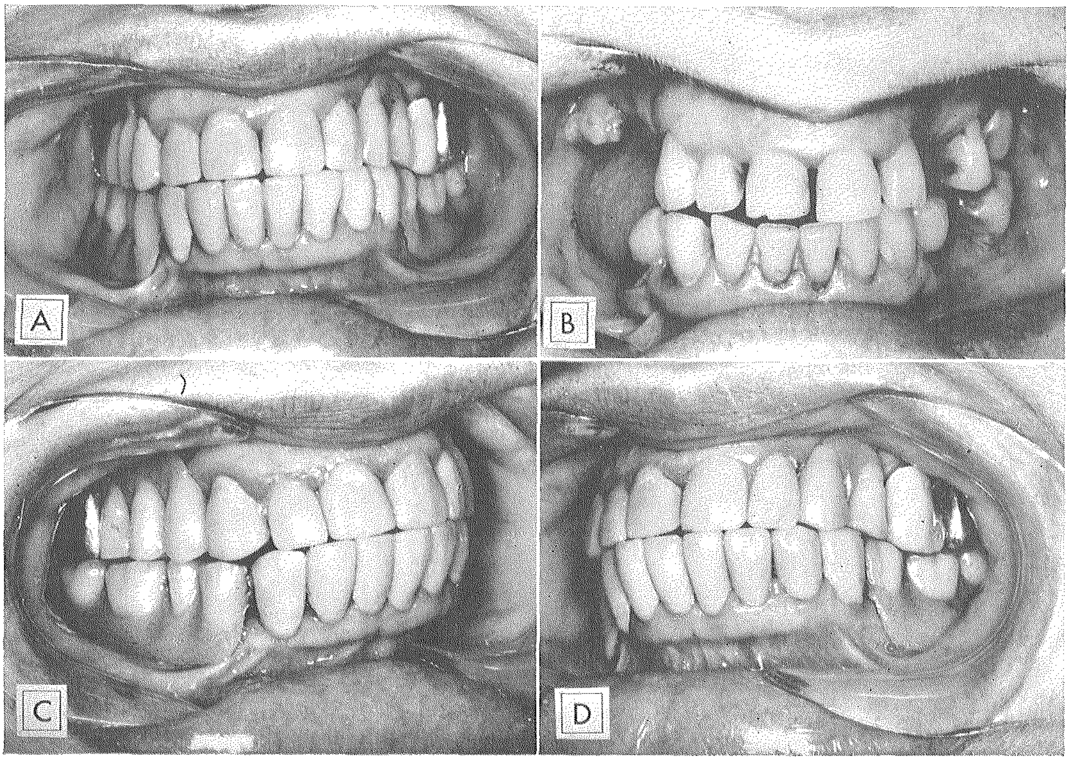


FIG. 287.

Step 25 (Fig. 287). Complete all the restorations and insert them in the mouth temporarily. Cement the four maxillary crowns permanently. After all adjustments have been made and the patient is comfortable, the restorations are cemented permanently.

A, Anterior view of the completed case.

B, The anterior view of the case before occlusal rehabilitation.

C, *D*, Right and left lateral views of the completed case.

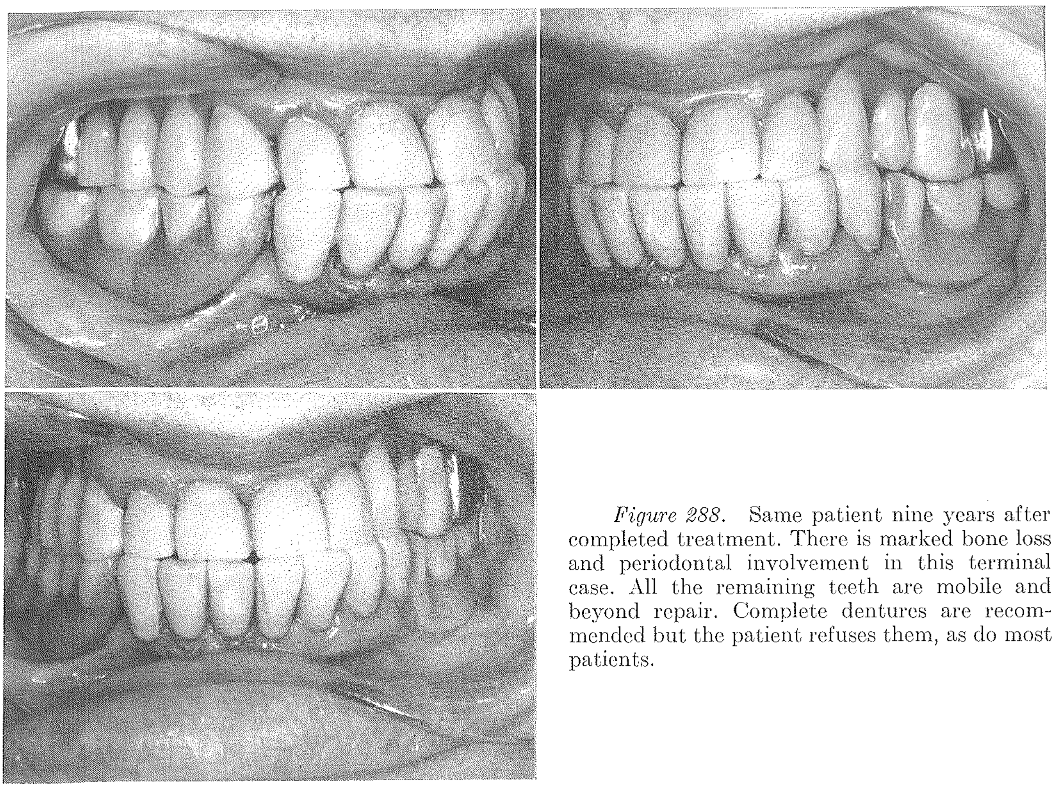


FIG. 288.

Figure 288. Same patient nine years after completed treatment. There is marked bone loss and periodontal involvement in this terminal case. All the remaining teeth are mobile and beyond repair. Complete dentures are recommended but the patient refuses them, as do most patients.

14

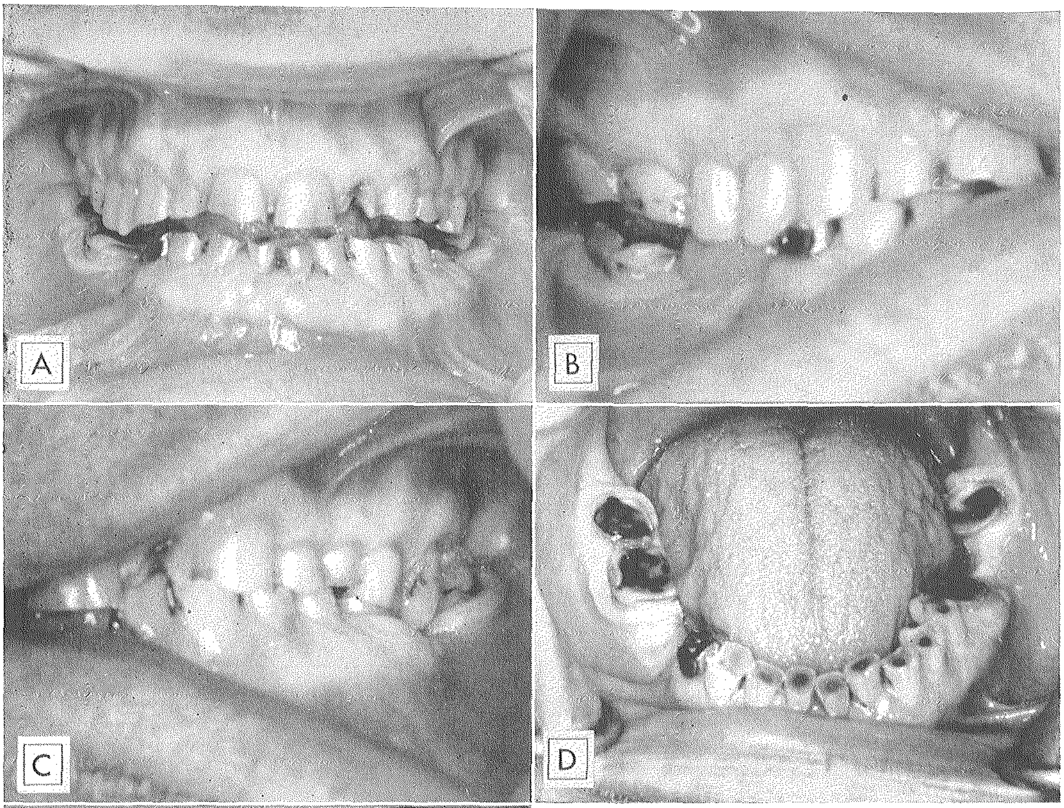
GROUP I CLASS 3

Procedures in Restoring Reduced Occlusal Vertical Dimension Brought About by Excessive Occlusal and Incisal Wear

Examination

The patient, a man aged 50 years, is a physically healthy and calm person with no apparent disturbing psychological traits. Clinical examination discloses that the teeth are very short and possess certain characteristic occlusal and incisal patterns brought about by excessive wear due to bruxism (Fig. 289*A*). His teeth seem to be unusually subject to wear. It was easy to grind and reduce them. The patient is not aware that this abnormal psychological habit takes place. Bruxism manifests itself in marked lateral and protrusive grinding movements when he sleeps. This abnormal wear took place over the years without interferences, resulting in a pattern of occlusion which is favorable to the supporting structures.

The mandibular right first molar, second molar, and left second molar have been missing for over twenty years. The opposing teeth elongated somewhat over these edentulous areas and the cusps do not show wear (Fig. 289*E*). In order for the patient to interdigitate his teeth in function, he pulls his mandible out of its centric relation every time he closes his jaws. Despite this, there is no temporomandibular



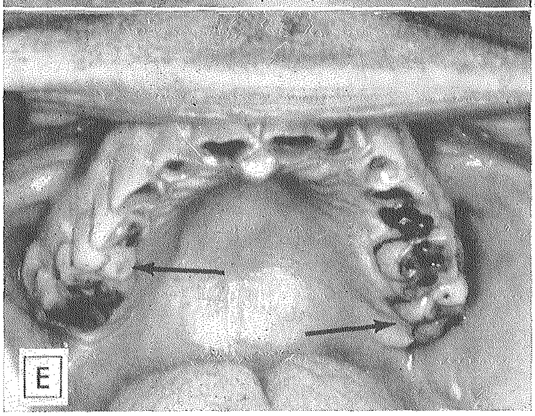


Figure 289. Patient with a decrease in the occlusal vertical dimension. *A*, Front view showing the abnormal wear and functional curve of occlusion. *B*, *C*, The right and left lateral views; notice the short, worn teeth. *D*, The occlusal view of the mandibular teeth. The molar teeth are flush with the gingiva. The black appearance is the result of repeated applications of silver nitrate to alleviate pain from thermal impulses. The mandibular incisors show deep facets. *E*, The occlusal view of the maxillary teeth. The right second bicuspid shows little occlusal wear because it does not have an antagonist. Neither has the molar on the left side.

joint disturbance. The interocclusal clearance measures approximately 10 mm. (Fig. 290). *The growth of the alveolar bone and gingival tissues, plus the continual eruption of the teeth, did not keep pace with or compensate for the excessive wear.* As a result, there is a decrease in the occlusal vertical dimension and muscular grimaces are manifested upon closure of the jaws with the teeth in contact. The study casts show the curve of occlusion and the short, worn teeth in occlusion (Fig. 291). The roentgenograms disclose healthy bone support for these short teeth (Fig. 292).

The esthetics are unsatisfactory and there is pain in response to thermal stimuli on many of the posterior teeth. The sensitivity had been temporarily relieved by repeated applications of silver nitrate over the years. Functional occlusion is markedly impaired and there is danger of the pulps becoming exposed. The gingival tissues are extremely healthy. The patient was previously advised to have all his teeth removed and submit to complete dentures.

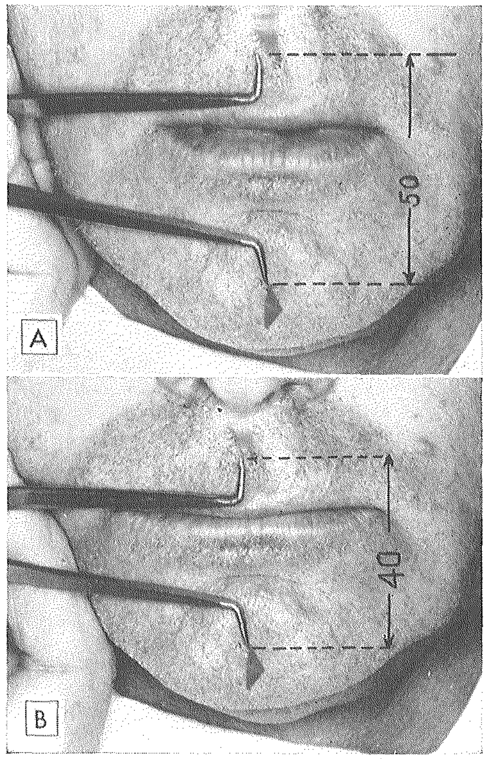


Figure 290. Measure the interocclusal clearance. *A*, The physiologic rest position measures 50 mm. *B*, Centric occlusion measures 40 mm. The interocclusal clearance is therefore 10 mm.

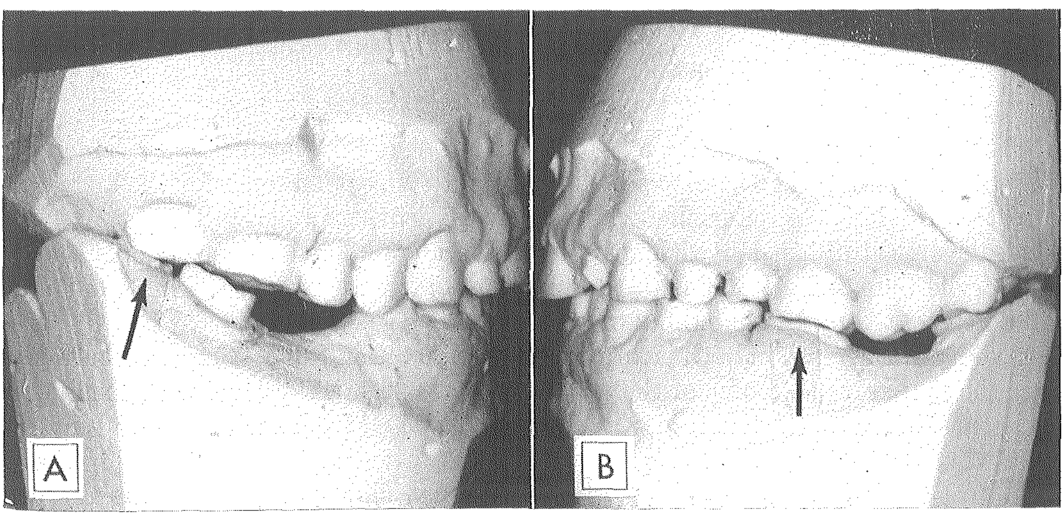


Figure 291. Study casts of the patient. Notice the very short posterior teeth.

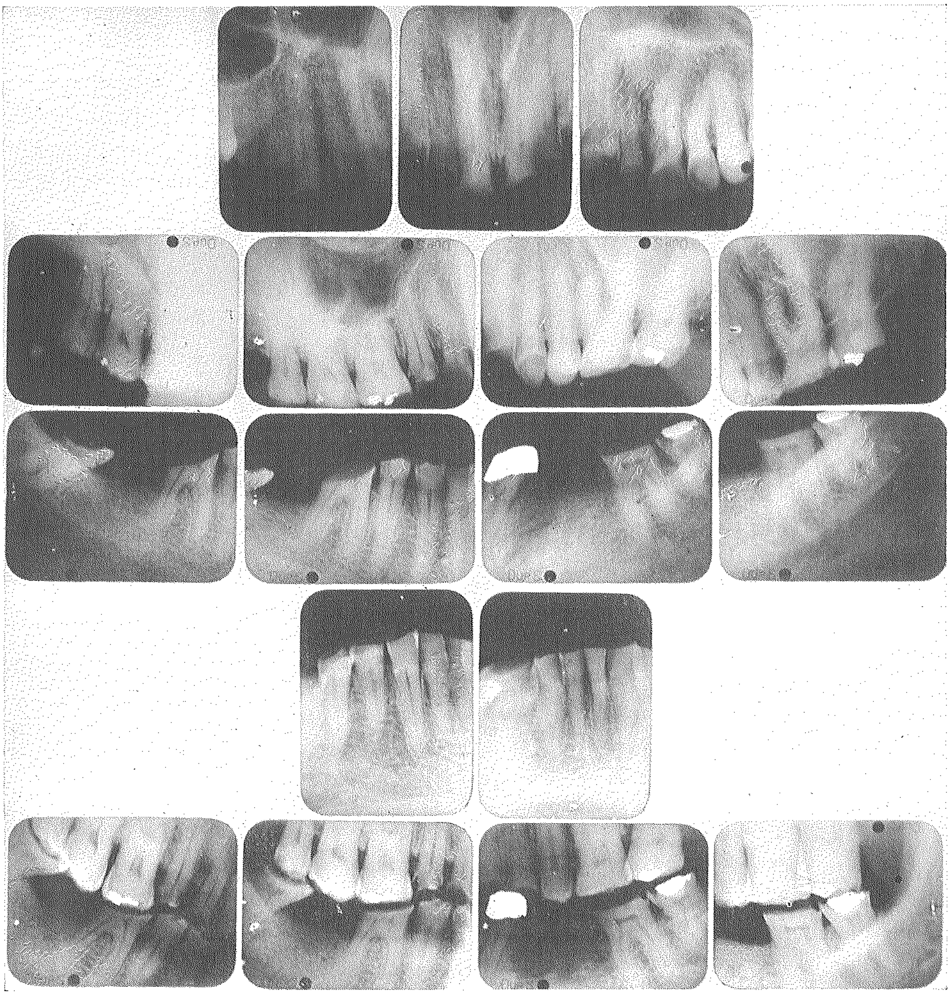


Figure 292. Roentgenograms of the patient before treatment.

Treatment Plan

Inasmuch as there is a decrease in occlusal vertical dimension, an arbitrary amount of 3 mm. in the anterior part of the mouth is decided upon for the increase, to restore the loss. To determine whether this patient can tolerate this increase in occlusal vertical dimension without detriment, it is planned to construct a metal and acrylic temporary splint with the additional increase of 3 mm. This appliance will be cemented on the mandibular teeth.

Many of the teeth in both jaws are too short to retain full coverage restorations after the preparations. Some of the molar teeth are practically level with the gingival tissues. More tooth structure will have to be exposed from such teeth by surgical removal of the gingival tissues. Some of the dense alveolar bone surrounding these short teeth will have to be chipped away so that longer clinical crowns can be utilized to support the full coverage restorations.

It is not advisable that the occlusal curve be altered or that the occlusal levels be reconstructed to any preconceived arrangement. Inasmuch as the vertical dimension is restored arbitrarily, one should not introduce new hazards which may affect the patient's functional occlusion. Any new curve in the occlusion will not be compatible with the wide range of mandibular movements employed during bruxism.

Anatomic interdigitating cusps on the restorations for such teeth are liable to prove uncomfortable. The patient's teeth have been functioning for many years in a so-called modified mortar and pestle type of occlusion that produced irregular cup-shaped facets, surrounded by pronounced enamel rims. This result was created without discomfort and without interferences. Therefore, it is planned to complete the restorations on the mandibular teeth first, with low cusp arrangements possessing sluiceways in the cast gold. The functional curve of occlusion will be preserved and duplicated as closely as possible. The maxillary posterior teeth will be restored with cast gold copings to which acrylic resin has been cured. These maxillary restorations will be cemented temporarily on the maxillary teeth for a three or four week period. During that time, the carved metal restorations on the mandibular teeth will cut and carve functional paths and patterns of bruxism in the softer plastic occlusal surfaces of the maxillary restorations, removing all the interferences. When the patient experiences no discomfort, these maxillary restorations will be removed and the functional patterns of the acrylic resin teeth will be duplicated in cast gold.

Inasmuch as all the teeth are embedded solidly in strong, healthy bone, there is no need to splint the abutment retainers for the fixed partial dentures in the mandible. The mandibular third molar on the right side will receive a full cast gold crown and the second bicuspid will receive a plastic veneer abutment retainer. The abutment retainers on the left side will be plastic veneer crowns. The pontics of both bridges will be cast gold occlusal surfaces with plastic teeth.

The maxillary and mandibular anterior teeth can be restored with plastic veneer crowns. To improve upon the esthetics, however, an attempt will be made to use porcelain fused to gold crowns. The remaining restorations will be plastic veneer crowns. The posterior restorations on the upper jaw will have functionally carved occlusal surfaces.

Treatment

The steps in the treatment of this patient are illustrated on the next few pages.

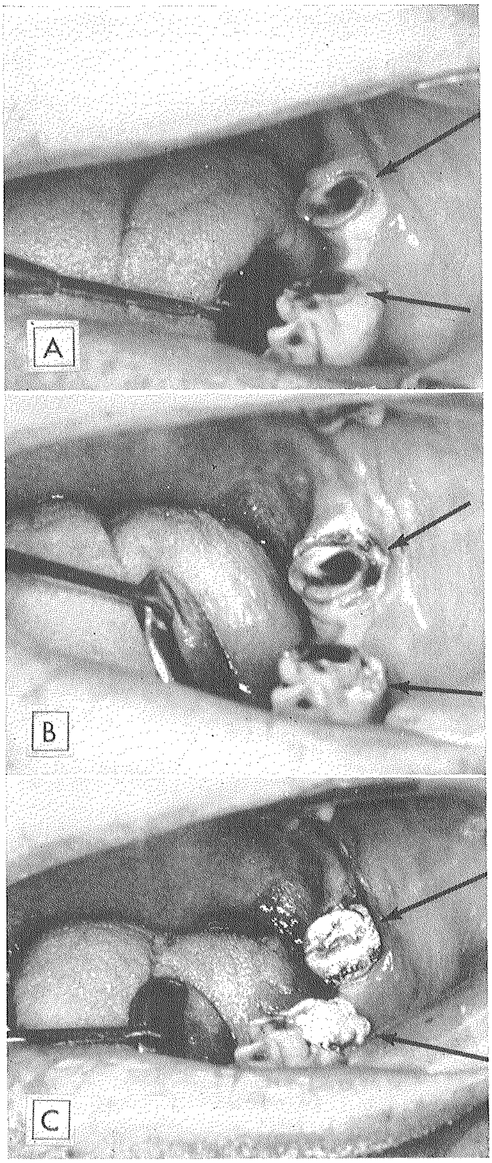


FIG. 293.

Step 1 (*Fig. 293*). Expose more of the clinical crowns on all the teeth with the wire electrodes of the Electrosurg machine. This is not accomplished in one sitting and the operator is advised to cut one quadrant at a time. Cut a little deeper than usual so that some of the thick alveolar bone will be exposed. At subsequent appointments, chip away a little of the sequestral bone, exposing still more of the clinical crowns. Cover the posterior teeth with aluminum shells filled with Ward's Surgical Cement. Construct a plastic provisional splint for the anterior mandibular teeth. See that the cut tissues are covered with the dressing at all times. After a few weeks, sufficient healing will have taken place to enable the operator to proceed with the next step. *A*, Thick tissue around teeth; *B*, tissue denuded; *C*, aluminum shells with Ward's Cement.

Step 2 (*Fig. 294*). Take a wax occlusal registration of the teeth in such a manner as to be able to articulate the study casts on the Hanau articulator by means of the face-bow. The purpose of this registration is to seat the oriented casts close to their incresaed occlusal relationship.

FIG. 294.

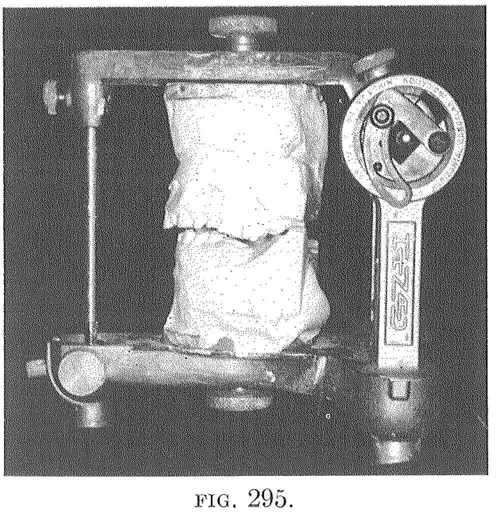


FIG. 295.

Step 3 (*Fig. 295*). Inasmuch as the interocclusal clearance measures approximately 10 mm., it is decided to increase the occlusal vertical dimension in the anterior region about 3 mm. This increase is accomplished on the articulator.

Step 4 (*Fig. 296*). Construct a splint that will articulate with the maxillary study cast. This splint is made out of cast metal supporting acrylic resin teeth that overlay the short mandibular teeth in the patient's mouth.

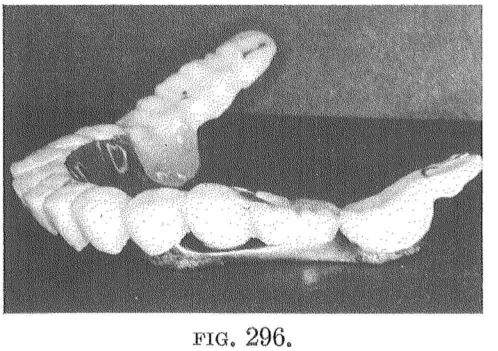


FIG. 296.

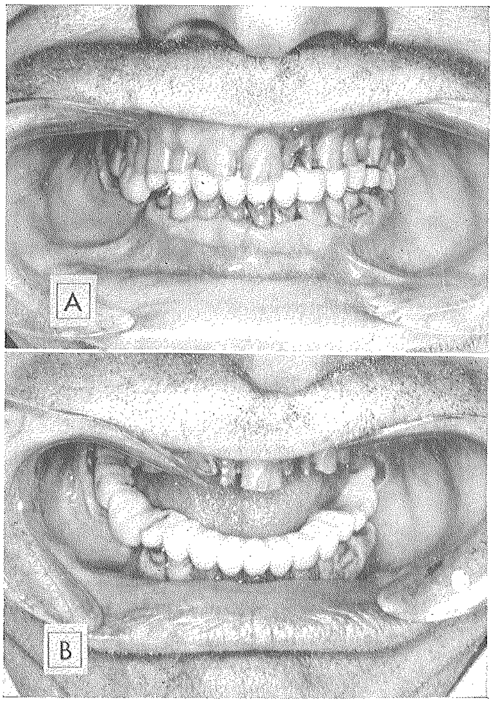


FIG. 297.

Step 5 (*Fig. 297*). Cement this splint onto the mandibular teeth with oxyphosphate of zinc cement so that it cannot be dislodged readily during the heavy gliding and sliding strokes that take place during bruxism. This splint will determine how much of the loss due to wear can be restored and tolerated. Remove the interferences on this splint until it does not resist the comfortable movements of normal and abnormal function of the mandible. When comfort and tolerance are reached (this can be determined usually in a few weeks), remove the splint and set it aside to be used as the occlusal rim in articulating the working casts later on. *A*, Front view of the cemented splint. *B*, Occlusal view showing the functional curves. After the splint is removed, construct and insert esthetic temporary restorations.

Step 6 (*Fig. 298*). At intervening appointments, prepare the mandibular teeth for acrylic veneer crowns and individual porcelain fused to metal copings. Take individual band impressions and construct metal dies. Insert the acrylic temporary splint.

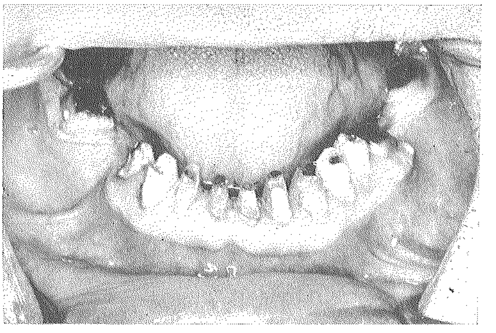


FIG. 298.

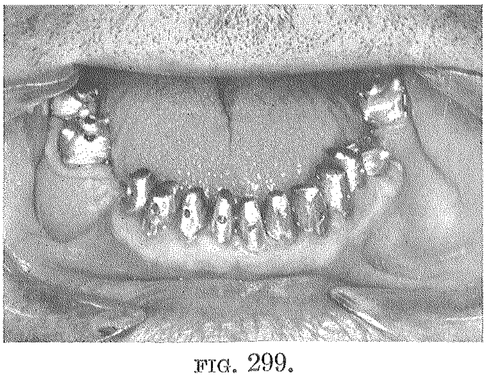


FIG. 299.

Step 7 (*Fig. 299*). Cast transfer copings for each die either in gold, in silver, or in "K" technique metal. Seat the transfer copings over the teeth and check for accurate seating.

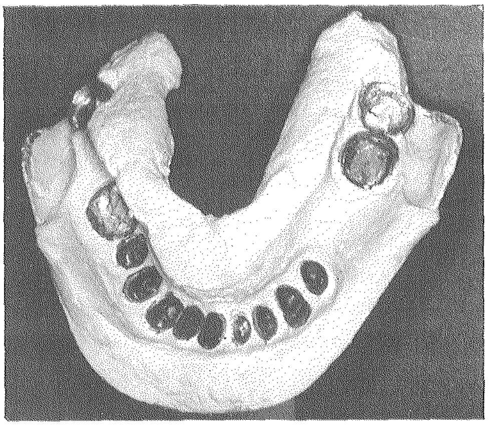


FIG. 300.

Step 8 (Fig. 300). Take a full plaster impression of the lower jaw with the transfer copings in place. Pour the working cast so that it can be articulated to the maxillary study cast previously attached to the mounting plate. It will be necessary to trim the occlusal areas of the plaster teeth in the upper study cast that did not wear because of the missing opposing teeth.

Step 9 (Fig. 301). Use the metal and acrylic splint that the patient wore in the beginning, as an occlusal rim, and re-articulate the mandibular working cast to the maxillary study cast on the articulator.

A, The articulated casts with the plastic splint and the occlusal rim.

B, The splint removed. The restorations on the lower teeth will occlude with the occlusal surfaces of the maxillary plaster teeth in the same satisfactory functional occlusal curve.

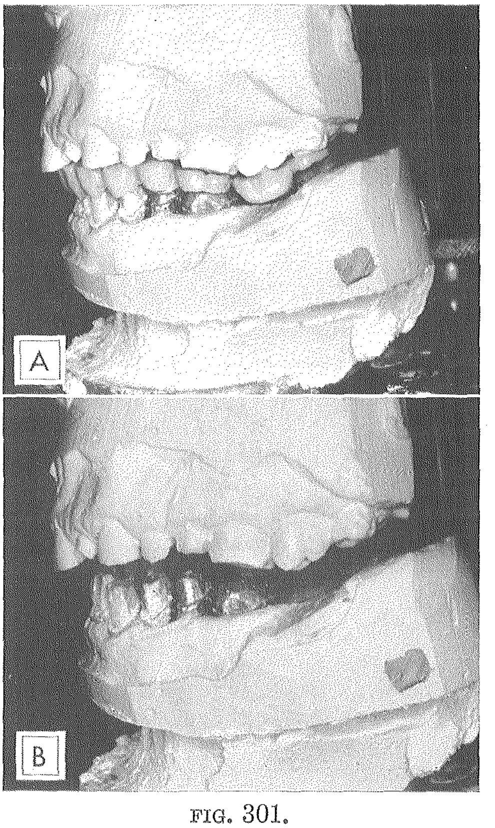


FIG. 301.

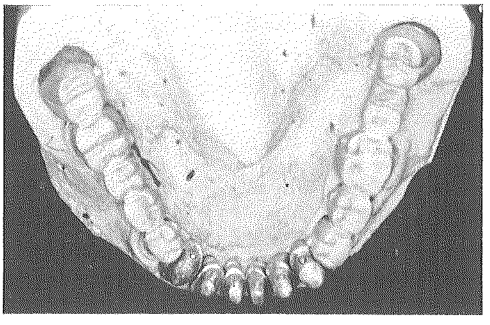


FIG. 302.

Step 10 (Fig. 302). Wax and cast full coverage restorations and fixed partial dentures. It may be necessary to take separate impressions with bridge trays after the retainers are cast, so that accurate bridge frames can be constructed. Wax and cast special high melting range gold copings for the mandibular anterior teeth. Take the color and shade for the porcelain and acrylic resin restorations.

Step 11 (Fig. 303). Try all the castings in the mouth and check for interferences and comfort. Notice how the occlusal curve of the restorations articulates with the existing curve on the maxillary teeth. Fill in the veneer crowns with white wax and bake porcelain on the gold copings. Try all these restorations on the teeth and reshape and align to your specifications. Check the occlusion again.

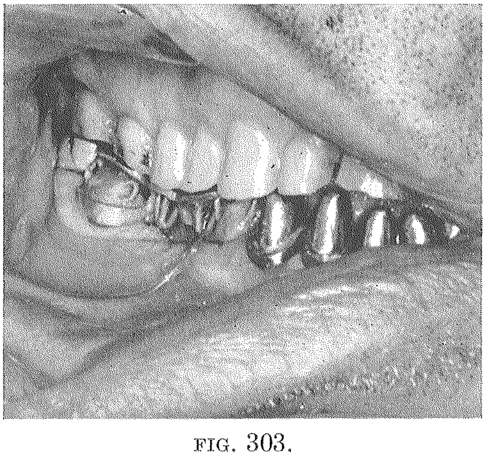


FIG. 303.

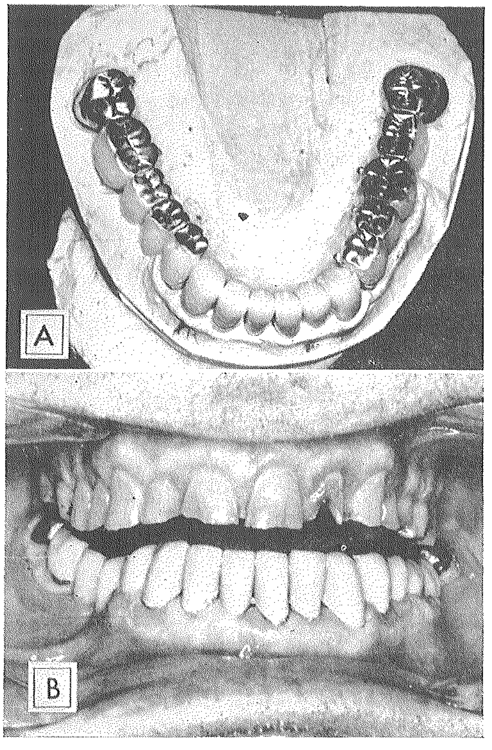


FIG. 304.

Step 12 (*Fig. 304*). Process the acrylic resin to the veneer crowns and bridge pontics. Glaze and stain the porcelain on the anterior restorations. Cement all the crowns and bridges on the prepared teeth temporarily. *A*, The completed restoration on the cast. *B*, The completed restorations in the mouth.

Step 13 (*Fig. 305*). At different intervals, prepare all the maxillary posterior teeth for veneer crowns. The six anterior teeth are prepared to receive porcelain fused on gold copings. Complete shoulders are created on the anterior teeth so that gold and porcelain can be accommodated. (The operator can construct plastic veneer crowns for these anterior teeth if he so desires.)

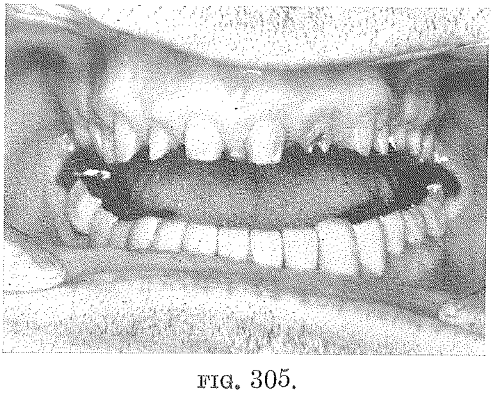
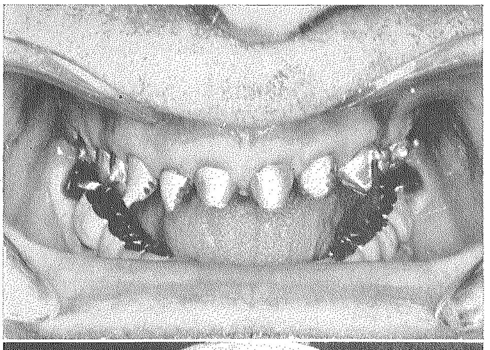


FIG. 305.

FIG. 306.



Step 14 (*Fig. 306*). Take individual band impressions of the prepared teeth. Construct metal dies and cast transfer copings. Seat the transfer copings on the teeth and test for accurate seating.

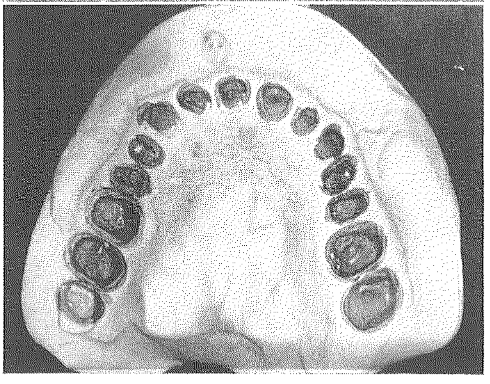


FIG. 307.

Step 15 (*Fig. 307*). Select a suitable aluminum tray and take a full plaster impression of the upper jaw with the transfer copings in position.

Step 16 (*Fig. 308*). Take a wax occlusal registration (*A*). Follow with an alginate impression of the completed lower jaw (*B*).

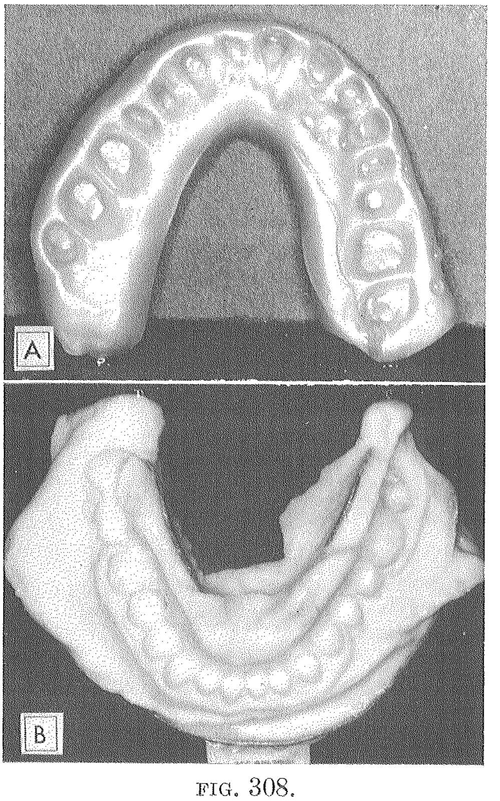


FIG. 308.

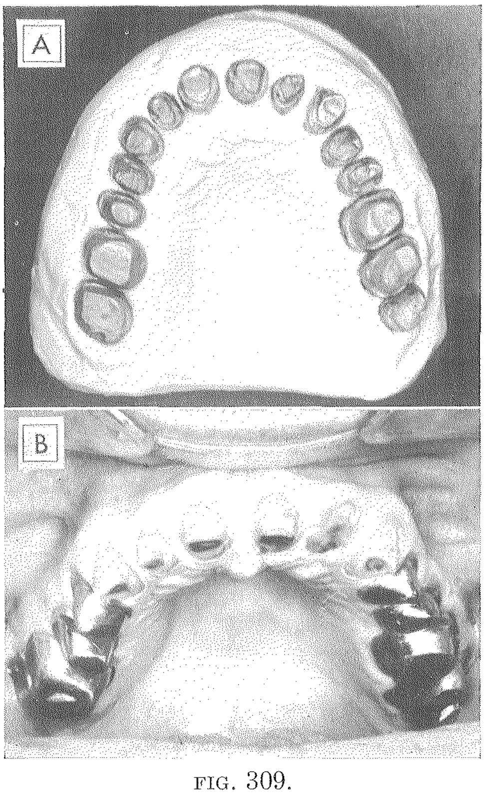
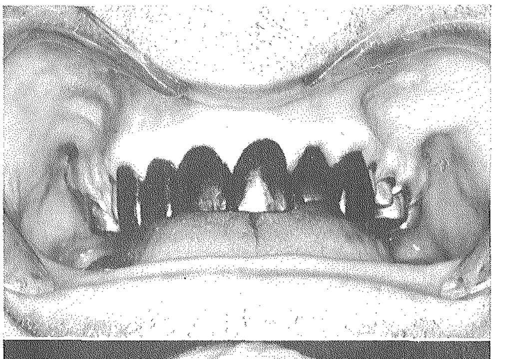


FIG. 309.

Step 17 (*Fig. 309*). Seat the dies and pour the casts (*A*). Mount them on the articulator. Wax and cast gold copings with type "C" gold for all the bicuspids and molars. Try these castings on the teeth (*B*). It may be necessary to adjust the contact areas on the molar castings where the teeth approximate so closely.

FIG. 310.



Step 18 (*Fig. 310*). Burnish and swage platinum matrices for the six anterior teeth and wax up crowns for them. Try these waxed teeth on the anterior preparations along with the gold copings and check for alignment, contour, and shape. The same procedure should be followed if the anterior restorations are to be plastic veneer or porcelain jacket crowns.

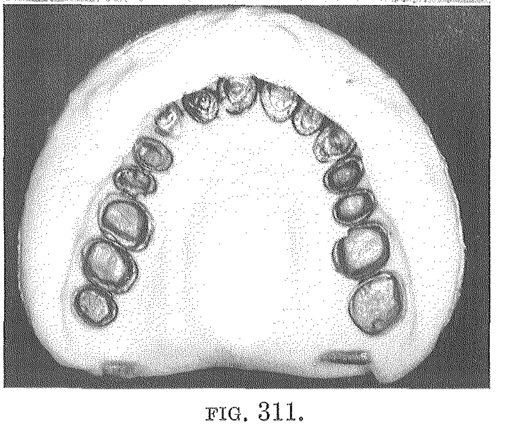


FIG. 311.

Step 19 (*Fig. 311*). Take another full plaster impression of the upper jaw with the gold copings and waxed matrices in place. After the cast is poured, re-articulate it with the poured cast of the completed mandible previously obtained.

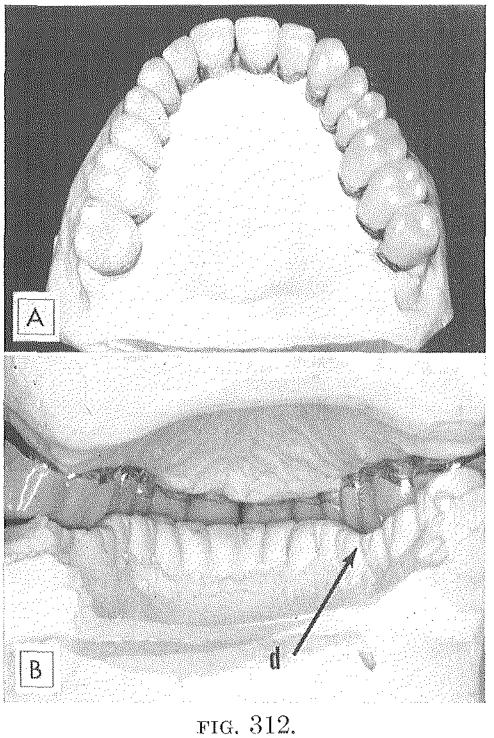


FIG. 312.

Step 20 (*Fig. 312*). Fabricate acrylic resin crowns cured to the bicuspid and molar cast copings. Plastic crowns without gold copings are apt to be dislodged by the powerful grinding strokes during bruxism. The purpose of these plastic crowns is to create the functional abnormal patterns of grinding, with the opposing gold occlusal restorations creating the patterns. Construct a six-tooth anterior temporary acrylic resin splint. *A*, The acrylic resin restorations on the dies. *B*, A lingual view of the articulated casts showing the wavy pattern of functional occlusion (*d*).

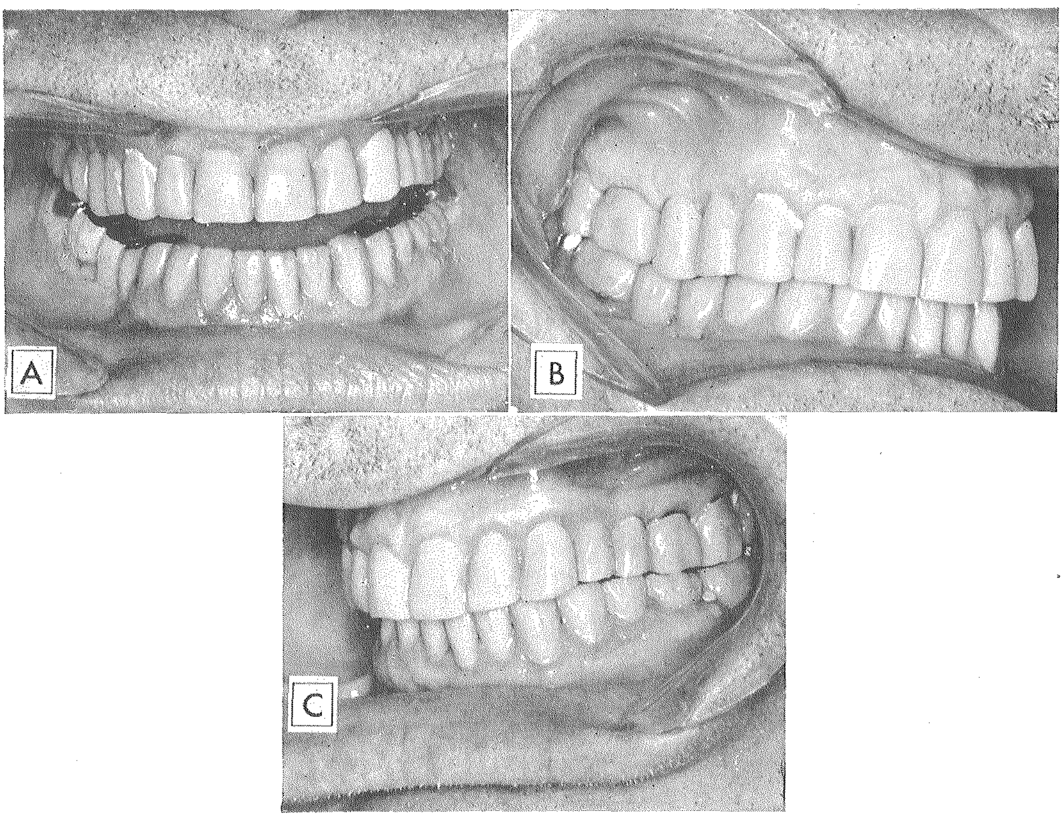


FIG. 313.

Step 21 (*Fig. 313*). Cement the acrylic resin cured to gold copings on the teeth. To prevent dislodgement of these posterior temporary restorations, the operator is advised to use oxyphosphate of zinc cement. Place the temporary anterior splint on the teeth with a zinc oxide and eugenol paste. For a period of approximately four weeks, the cast gold occlusal surfaces of the mandibular restorations cut functional and gliding paths into the occlusal areas of the softer posterior plastic teeth. All interferences are removed by the patient's wide lateral bruxism habits. *A*, An anterior view; *B*, the right lateral view; *C*, the left lateral view.

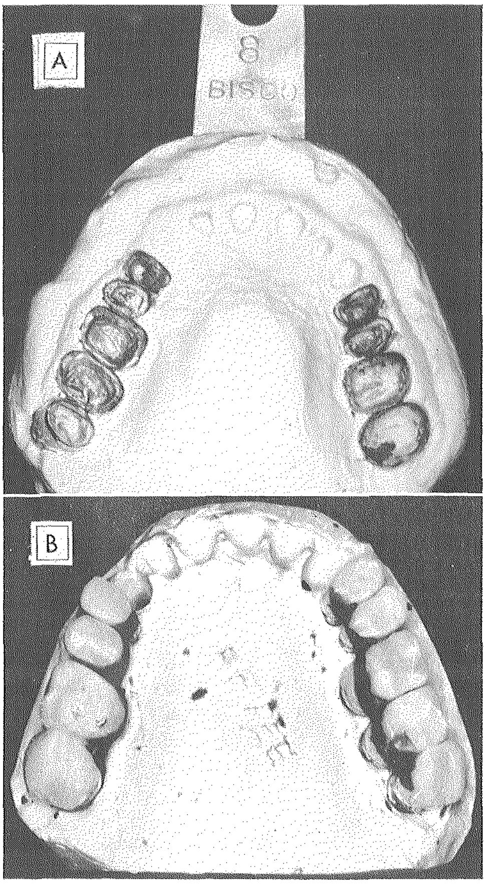


FIG. 314.

Step 22 (Fig. 314). When the patient is completely comfortable, the acrylic crowns are removed carefully with a crown remover. All cement is removed from the inside of the restorations and from the surfaces of the teeth. Replace these restorations on the teeth and take a full impression. Pour a new cast after seating the dies into the crowns. Wax or lute the acrylic resin crowns together so that they will not drop off or shift. *A*, The impression with the acrylic resin crowns. *B*, The restorations luted together.

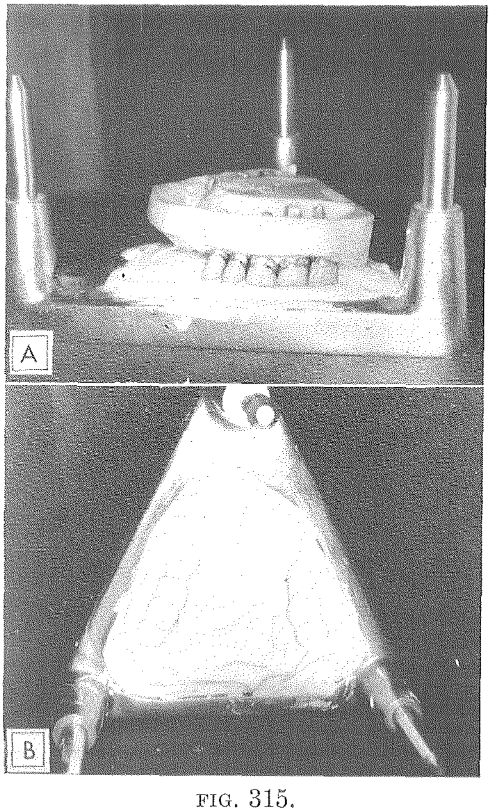


FIG. 315.

Step 23 (Fig. 315). Lubricate the occlusal surfaces of the ground-in restorations and invert the cast with the crowns into some partially set impression plaster. After the plaster is set, remove the cast and acrylic resin crowns. The occlusal surfaces of these ground-in restorations leave imprints in the plaster for duplication in gold. *A*, The cast with the acrylic resin crowns inverted in the plaster. *B*, The imprints of the occlusal patterns in the set plaster, ready for duplication in gold.

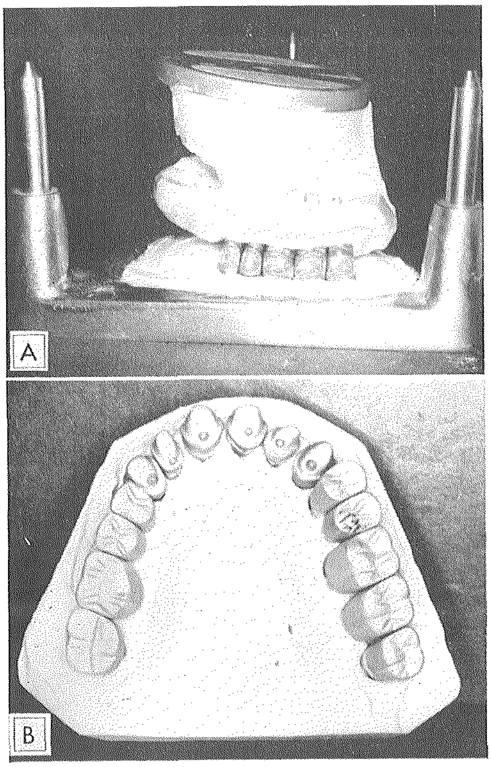


FIG. 316.

Step 24 (*Fig. 316*). Cast gold veneer crowns with the occlusal surfaces duplicated from the imprints in the plaster cast. High melting range gold copings are cast for the six anterior teeth to receive fused porcelain later on. There is no need to splint any of the posterior restorations because the bone support is excellent and sufficient tooth structure is present to support the restorations individually. The anterior restorations present a different problem. The lateral incisors are very short and individual restorations are apt to be dislodged. Therefore, the canine coping, lateral incisor, and central incisor are splinted together on each side. The central and canine restorations have sufficient tooth structure for retention and will carry and support the lateral incisor on each side. *A*, The cast gold restorations fitting in the imprints. *B*, An occlusal view of all the castings.

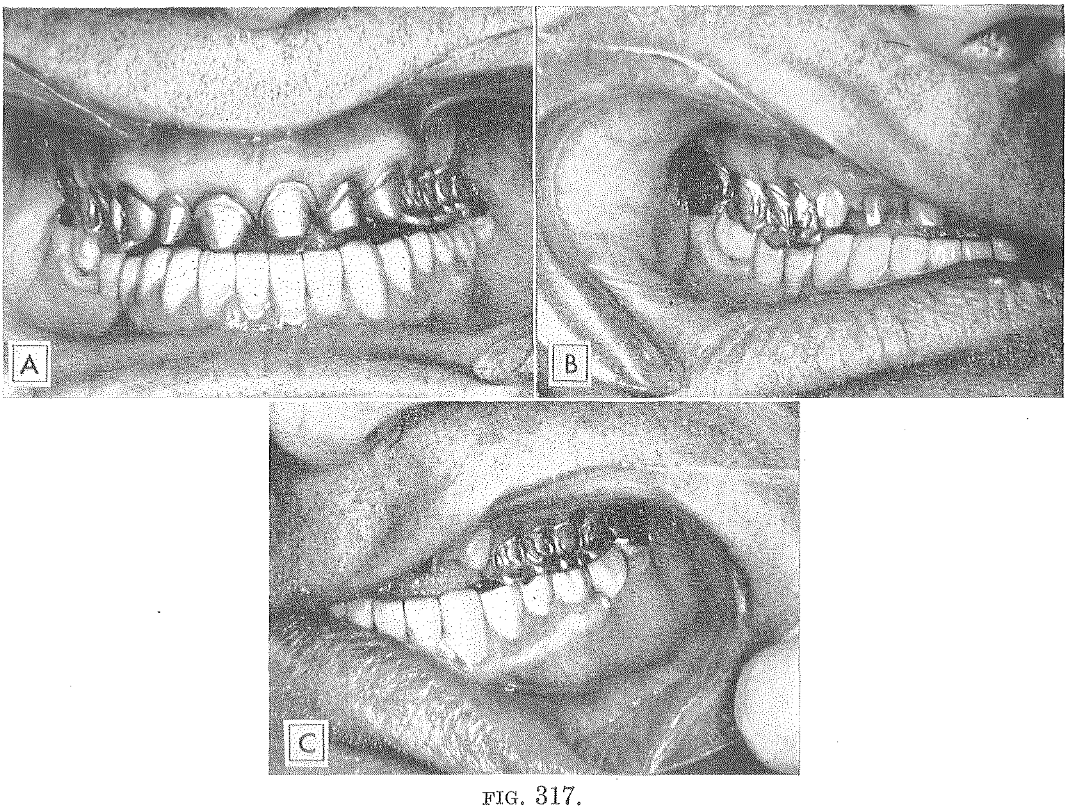


FIG. 317.

Step 25 (*Fig. 317*). Try all the castings on the teeth and make the necessary corrections in occlusion, proximal contact, and alignment. Check the interocclusal clearance and be sure that it does not exceed the tolerated distance established by the worn splint. *A*, Anterior view with castings on the teeth. *B*, *C*, Right and left lateral views.

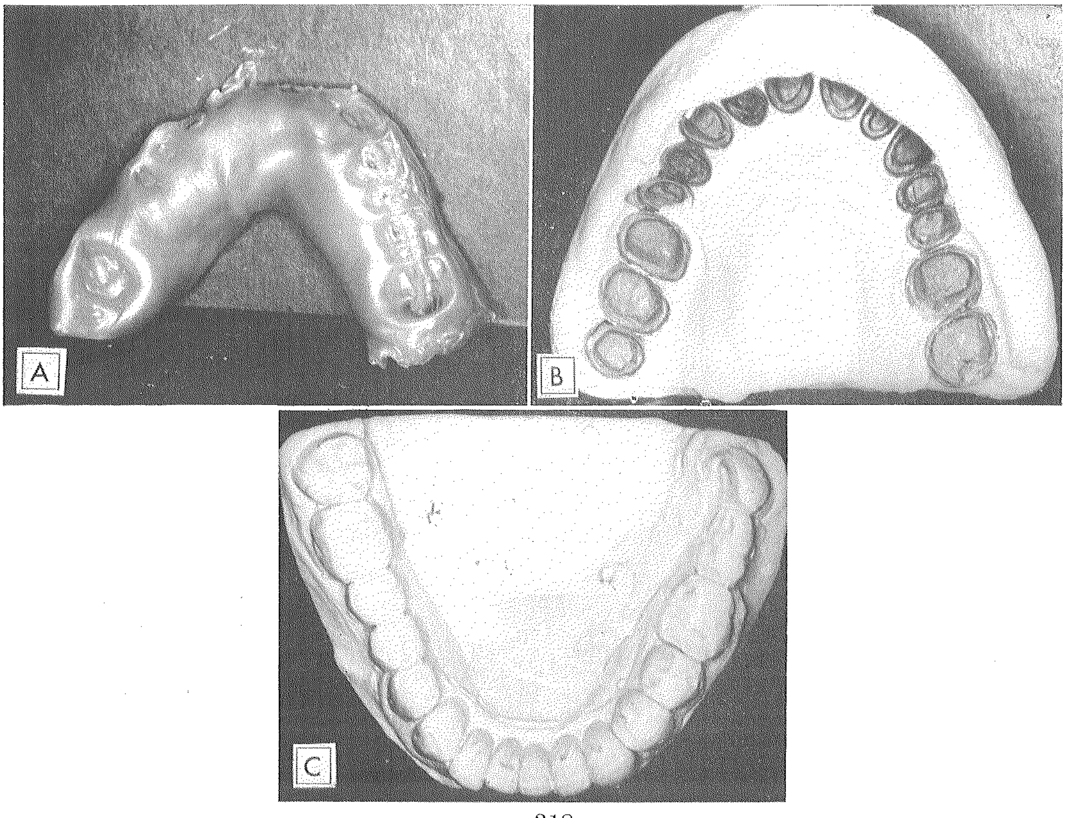


FIG. 318.

Step 26 (*Fig. 318*). In order to fuse porcelain to the anterior copings accurately, it is advisable to re-articulate the casts. The more variables in a procedure, the more chance for errors. Up to this point, many adjustments have been made on the restorations in the mouth and they do not relate in the same way on the articulator. Take a wax occlusal registration with the restorations on the teeth (*A*). Follow with a full plaster impression of the upper jaw with the castings on the teeth (*B*). The previously used lower cast is used to articulate with the new upper cast (*C*).

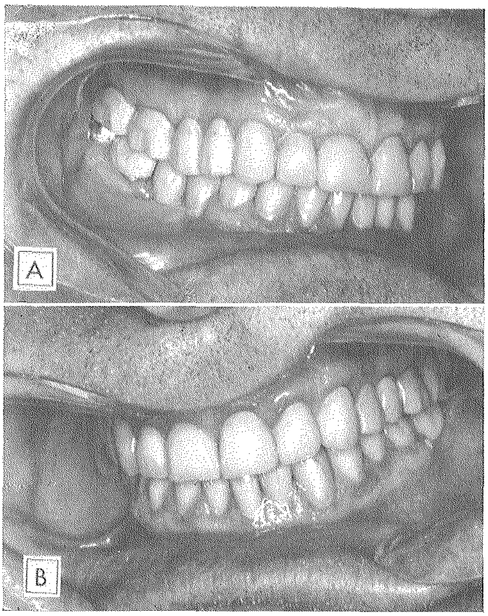


FIG. 319.

Step 27 (*Fig. 319*). Fuse porcelain to the anterior copings in a biscuit bake and fill in the metal veneer crowns with white wax. Try these restorations on the teeth and check for alignment.

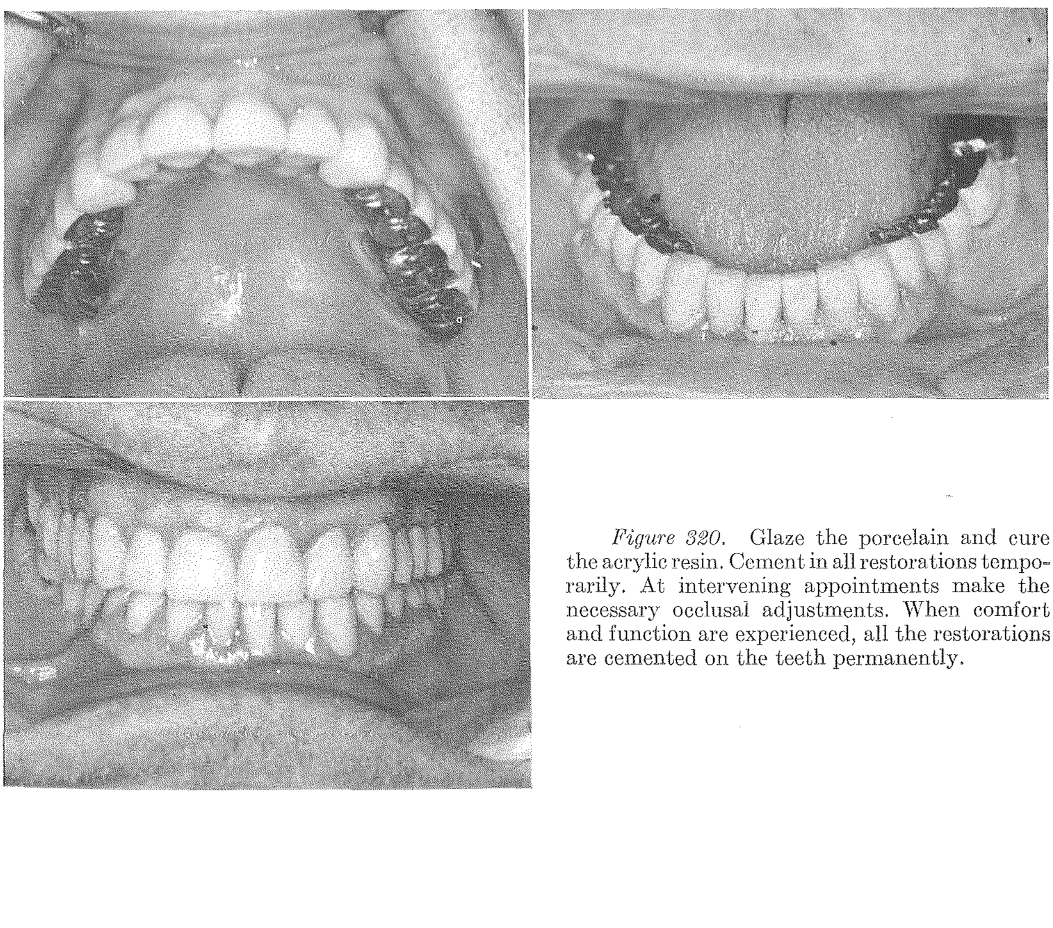


Figure 320. Glaze the porcelain and cure the acrylic resin. Cement in all restorations temporarily. At intervening appointments make the necessary occlusal adjustments. When comfort and function are experienced, all the restorations are cemented on the teeth permanently.

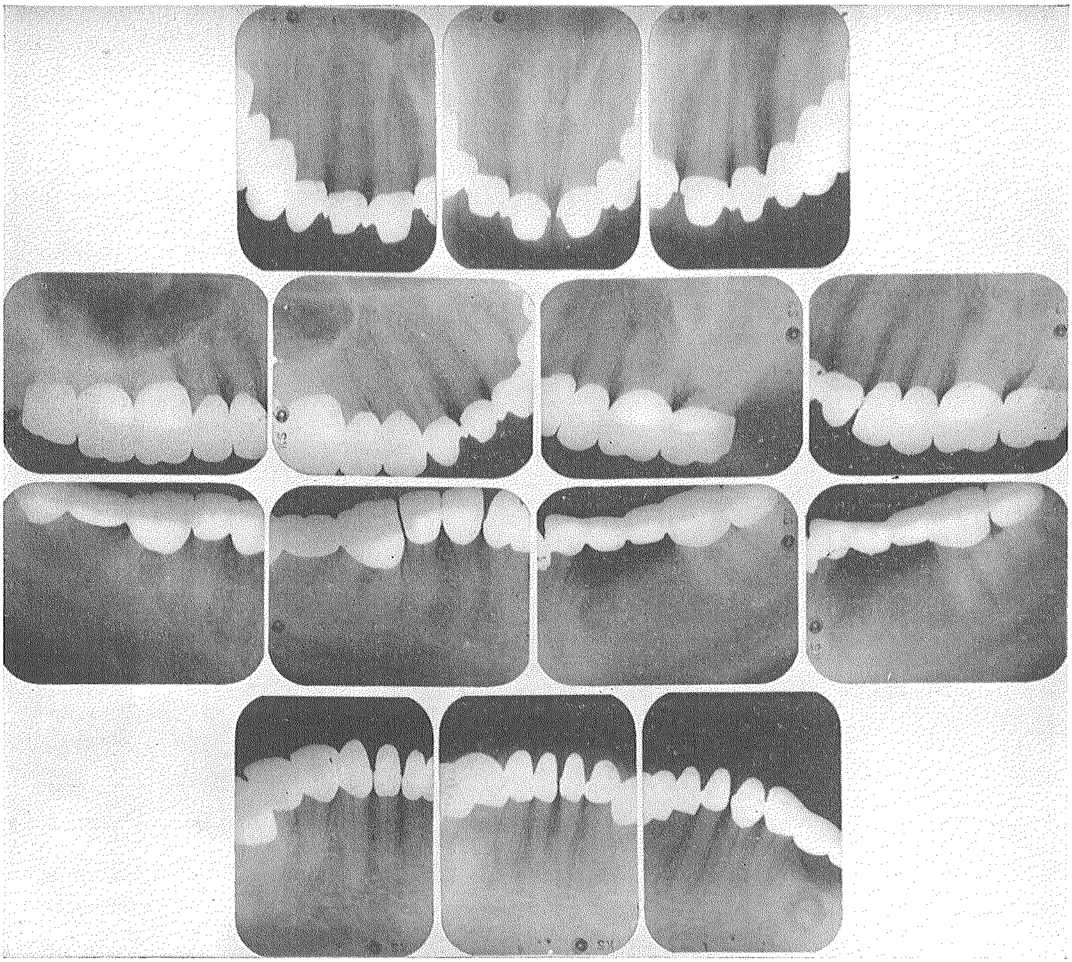


Figure 321. Roentgenograms of the patient after completion of the restorations.

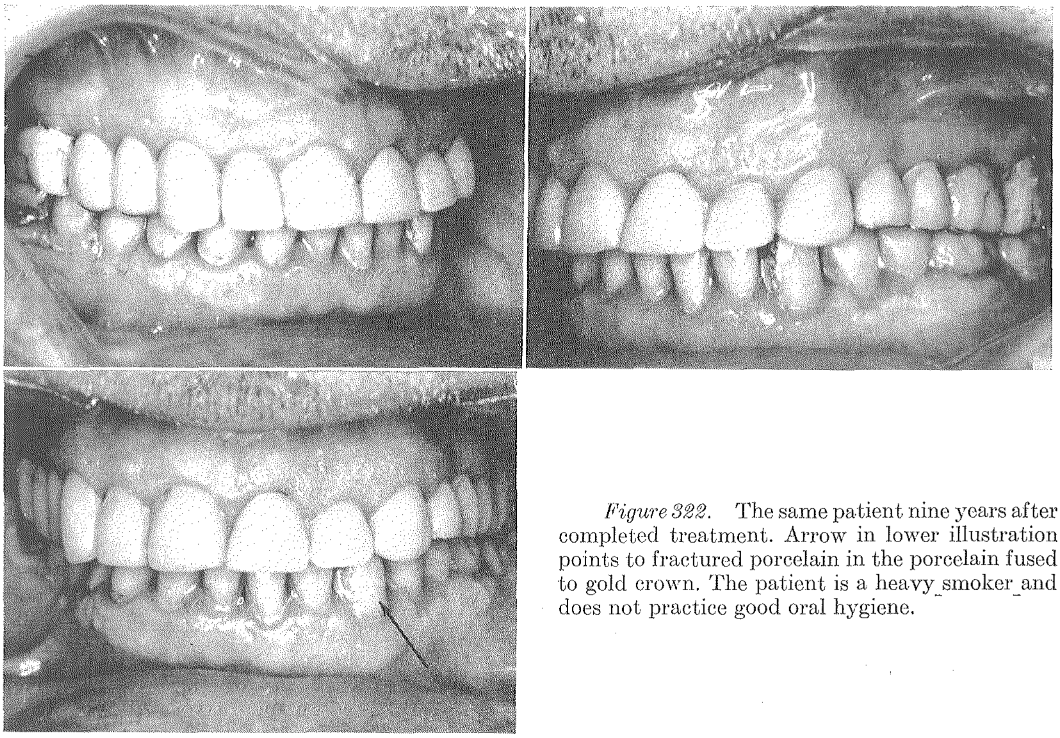


Figure 322. The same patient nine years after completed treatment. Arrow in lower illustration points to fractured porcelain in the porcelain fused to gold crown. The patient is a heavy smoker and does not practice good oral hygiene.

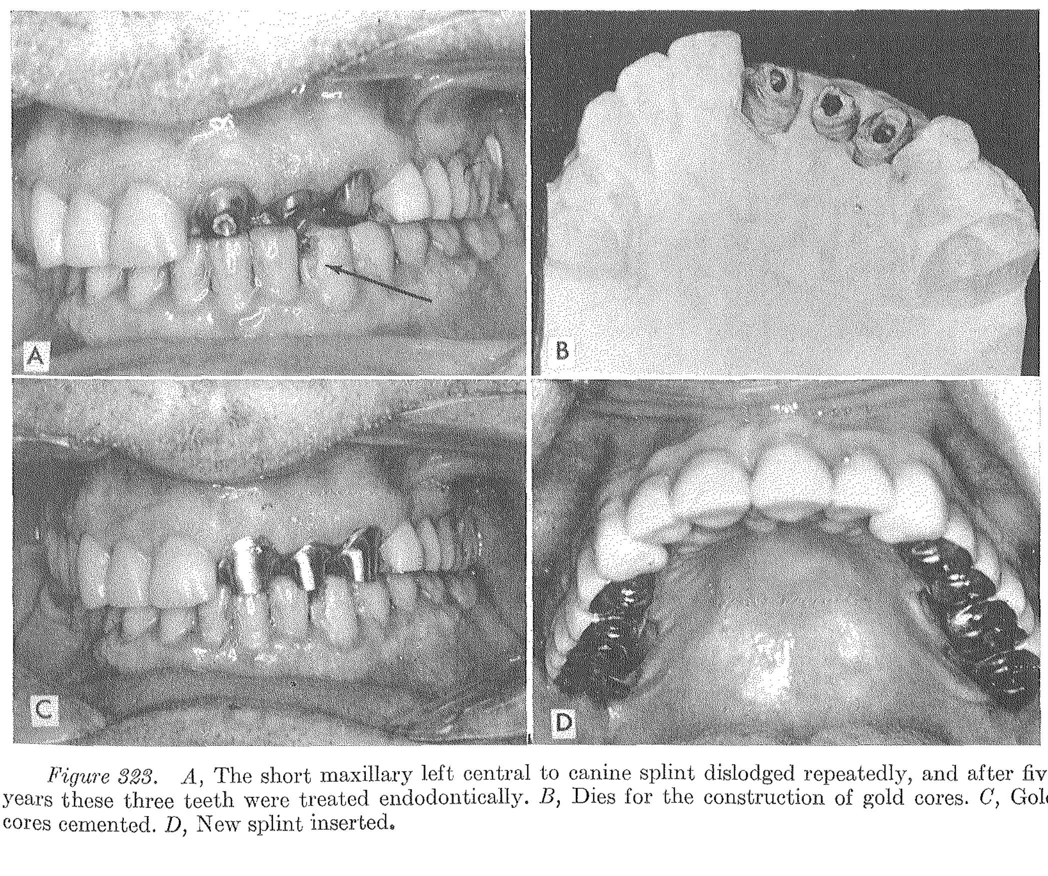


Figure 323. *A*, The short maxillary left central to canine splint dislodged repeatedly, and after five years these three teeth were treated endodontically. *B*, Dies for the construction of gold cores. *C*, Gold cores cemented. *D*, New splint inserted.

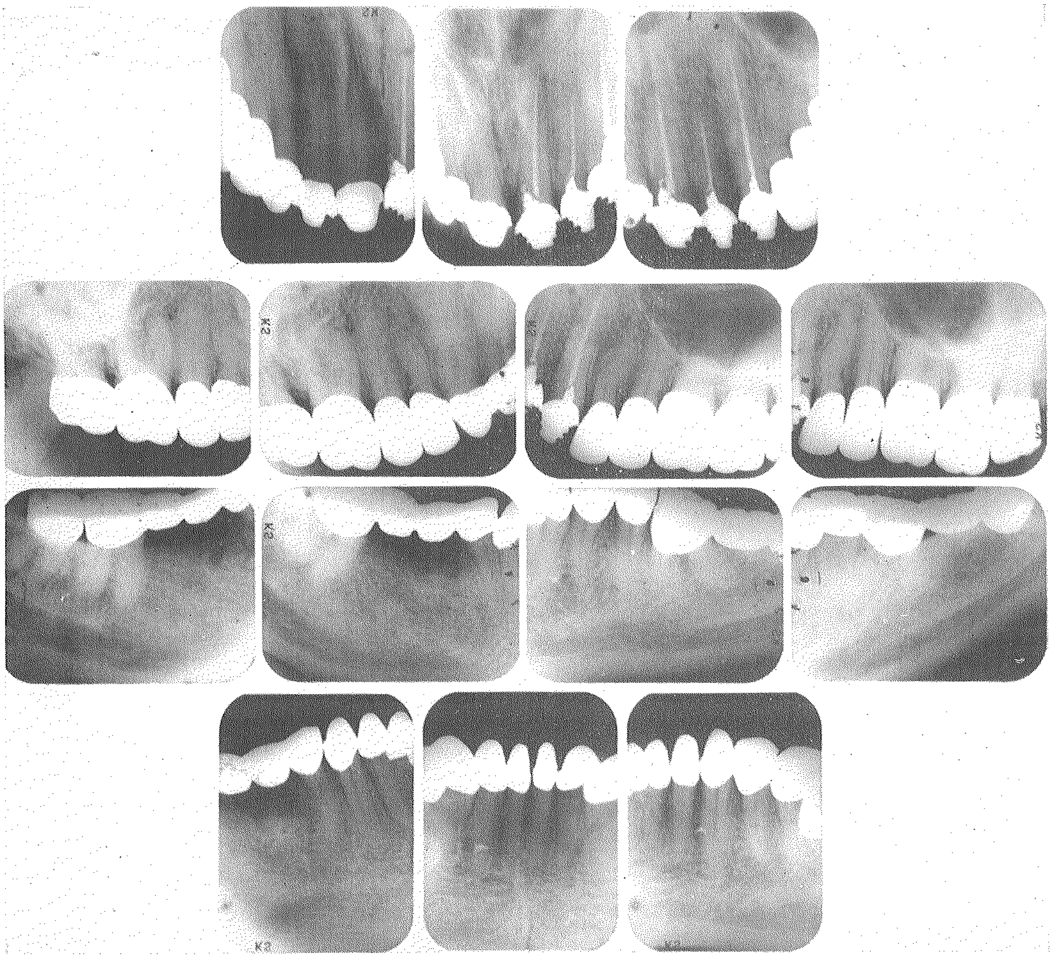


Figure 324. Roentgenograms of the patient nine years later.

15

GROUP II CLASS 1

Procedures in Rehabilitating an Entire Dentition Possessing a Satisfactory Occlusal Relationship

SATISFACTORY OCCLUSION, SOME TEETH MISSING

Examination

The patient, a man of 57 years, possesses a satisfactory functional occlusal relationship. The existing restorative work is of long duration (Fig. 325). The gingival tissues are comparatively healthy and there is the normal amount of bone resorption (Fig. 326). The maxillary first bicuspids are slightly mobile. The cementum is exposed on the maxillary teeth and a slight turning of the central incisors has taken place. The esthetics are not satisfactory. Decay has set in around many of the old restorations. Two of the porcelain pontics on the anterior mandibular fixed partial denture are replaced by acrylic resin teeth. The enamel of the maxillary canines has worn away the acrylic resin in the mandibular veneer abutment retainers (Fig. 325*A*). The right and left fixed partial dentures in both jaws have outlived their usefulness and food becomes packed around them. The patient's occlusion functions in a slightly rotary and partially protrusive motion. The occlusion nevertheless functions very satisfactorily. His main concern is the preservation of the remaining teeth and elimination of packing. The interocclusal clearance measures approximately 3.5 mm.

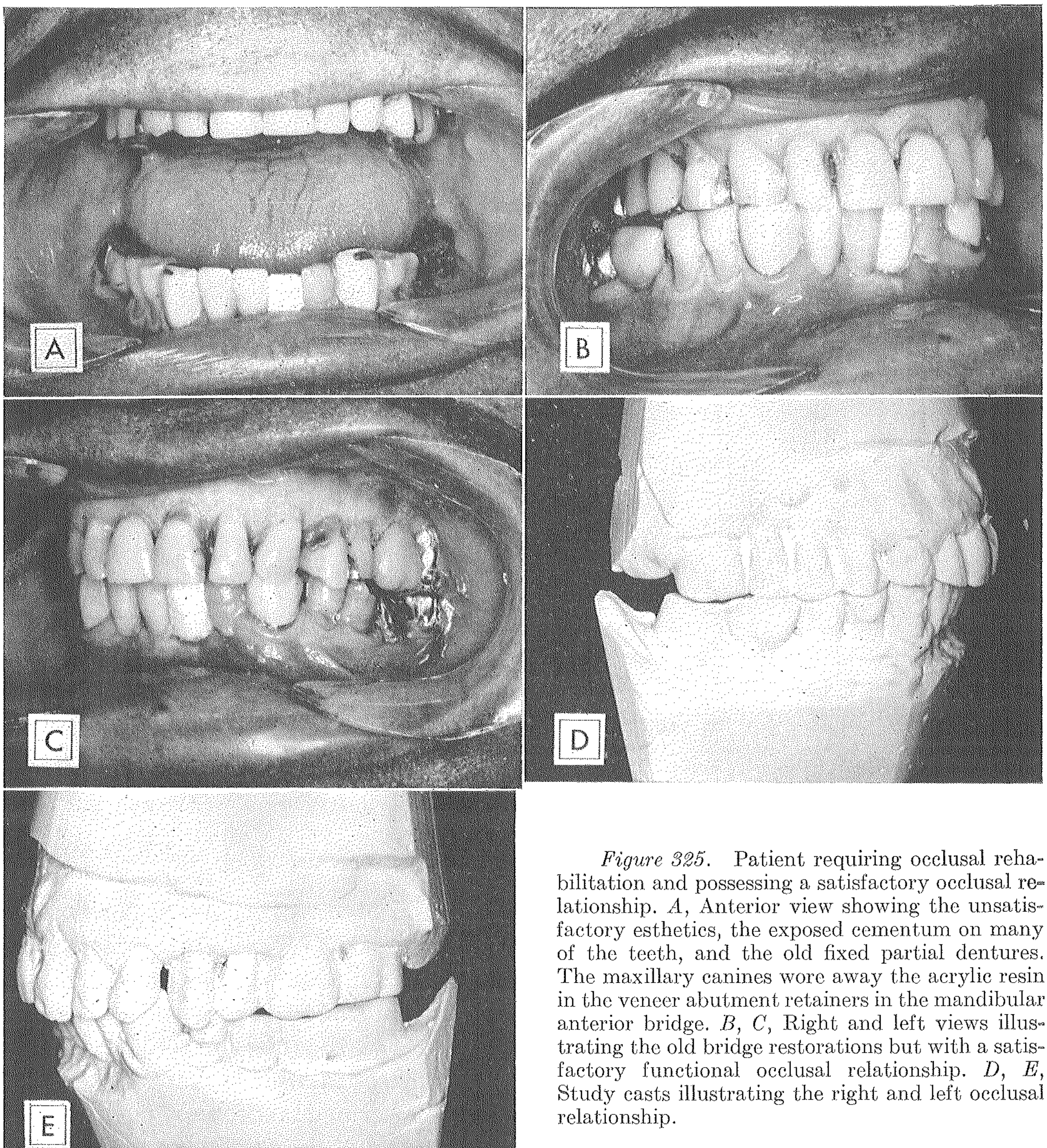


Figure 325. Patient requiring occlusal rehabilitation and possessing a satisfactory occlusal relationship. *A*, Anterior view showing the unsatisfactory esthetics, the exposed cementum on many of the teeth, and the old fixed partial dentures. The maxillary canines wore away the acrylic resin in the veneer abutment retainers in the mandibular anterior bridge. *B*, *C*, Right and left views illustrating the old bridge restorations but with a satisfactory functional occlusal relationship. *D*, *E*, Study casts illustrating the right and left occlusal relationship.

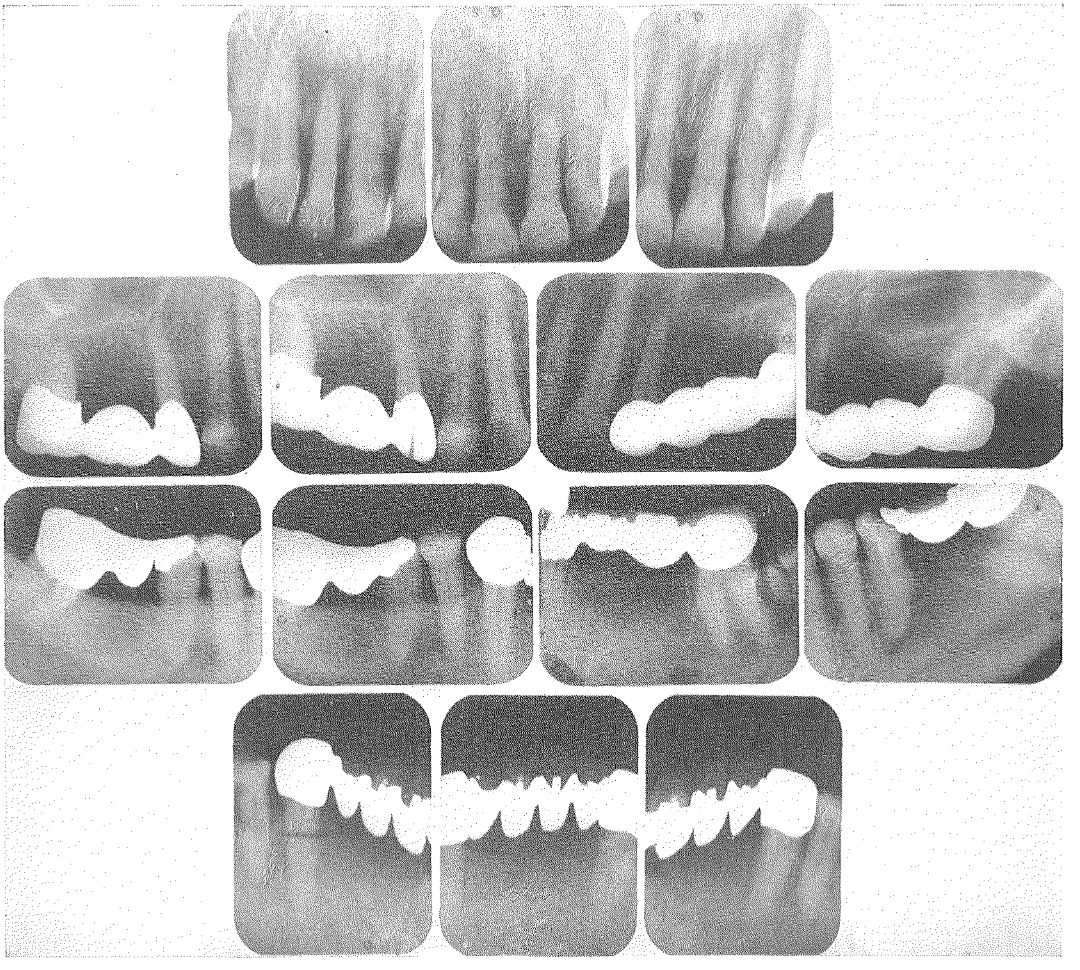


Figure 326. Roentgenograms before treatment.

Treatment Plan

It is planned to maintain the existing satisfactory occlusal relationship. New fixed partial dentures will replace the two posterior bridges in the upper jaw and in the lower jaw. Double abutment retainers will secure these four posterior bridges. A new anterior fixed partial denture will be constructed to replace the one in the mandible. The canine abutment tooth on each side has a strong, long root and can support the pontics of the fixed partial denture. Five maxillary veneer crowns on the anterior teeth will complete the restorative work. The occlusal surfaces of the restorations will be in cast gold and the pontics and veneer facings will be acrylic resin. The incisal edges of the mandibular anterior fixed partial denture will be gold. The bridges on one side will be constructed first, with the teeth in the opposite side acting as guides or "stops" in maintaining the tolerable and satisfactory occlusal relationship. Then the opposite side will receive restorations, with the contacting new ones acting as guides. The anterior restorations will be completed last.

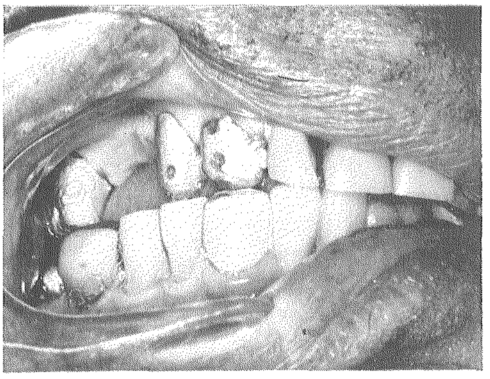


FIG. 327.

Step 1 (Fig. 327). The maxillary right posterior bridge is removed and the second molar is prepared for a full cast gold crown. The first bicuspid and canine are prepared for acrylic resin veneer crowns. Impressions are taken, dies are constructed, and transfer copings are cast for each prepared tooth. Seat the transfer copings on the prepared teeth and test for accuracy.

Step 2 (Fig. 328). Place some baseplate wax in the undercuts of the maxillary left bridge (*W* in part *A*) to facilitate the removal of the impression. Take a full plaster impression of the upper jaw with the transfer copings in position. An alginate impression of the lower jaw and a thin wax occlusal registration completes this step (*B*).

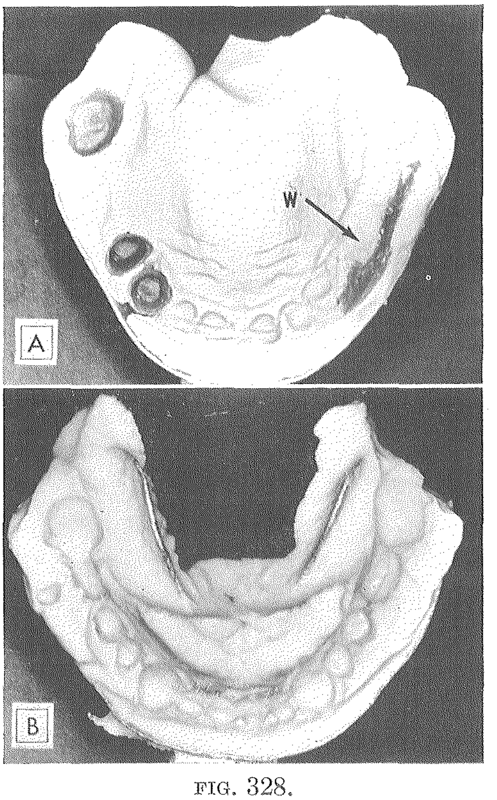


FIG. 328.

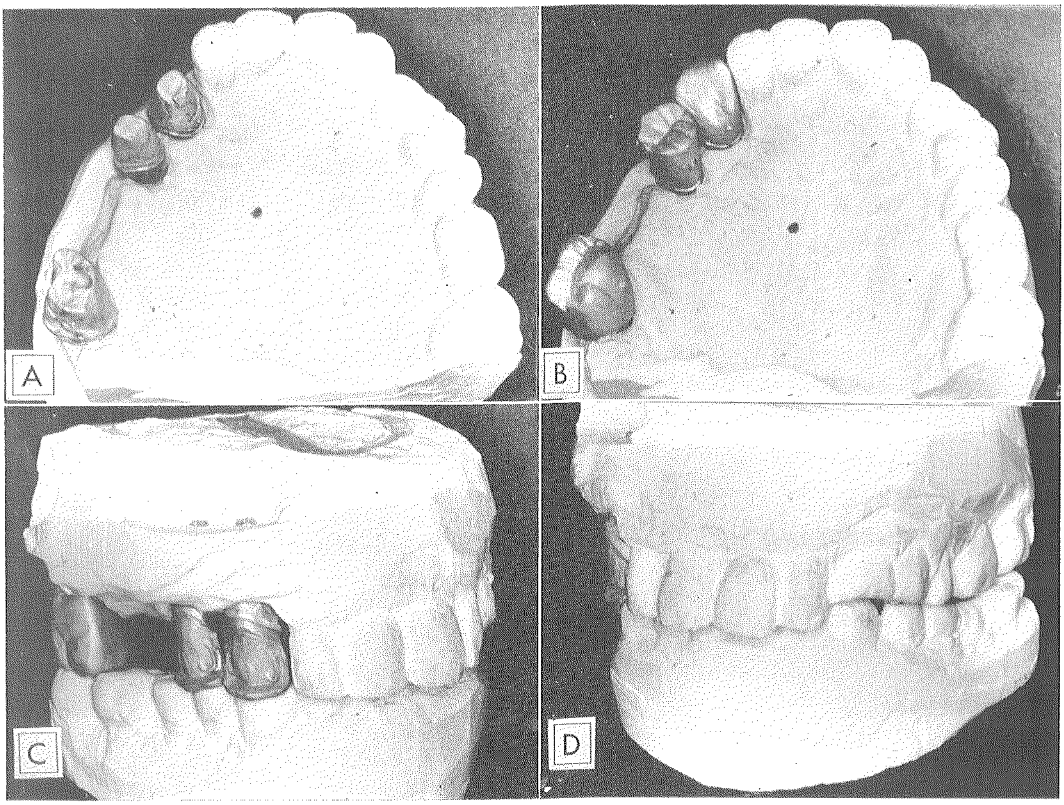


FIG. 329.

Step 3 (Fig. 329). Pour the casts and articulate them. Wax and cast the full gold crown and the acrylic resin veneer restorations. Use the occluding teeth on the left side as guides in the occlusion of the abutment retainers.

A, The working dies.

B, Occlusal view of the retainer castings.

C, These retainers are in harmonious occlusal relationship with the occluding teeth on the left side.

D, A lateral view of the abutment retainers in approximately the same occlusal relationship the patient had had before the old bridge was removed.

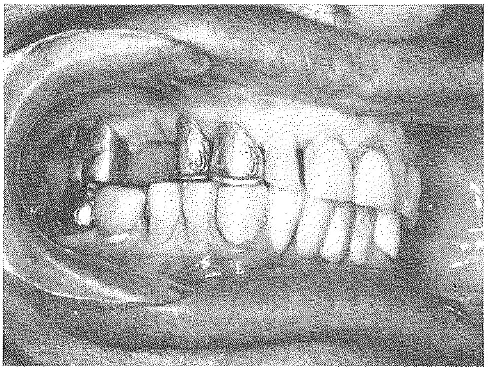


FIG. 330.

Step 4 (*Fig. 330*). Try the abutment retainer castings in the mouth and make all the necessary occlusal adjustments. Check the alignment of the restorations and the marginal gingival fit. Grind any interferences and use the occluding opposite side as reference.

Step 5 (*Fig. 331*). Remove the old bridge on the lower right side. Prepare the molar for a full gold crown and the two bicuspids for acrylic resin veneer restorations. Take band impressions and construct metal dies. Cast transfer copings for these dies. Fit the transfer copings on the prepared teeth. Take a full plaster impression of the lower jaw with the transfer copings in position and a check bite. Re-articulate the lower cast to the attached upper one.

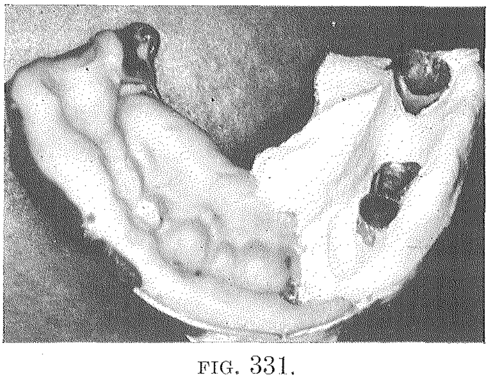


FIG. 331.

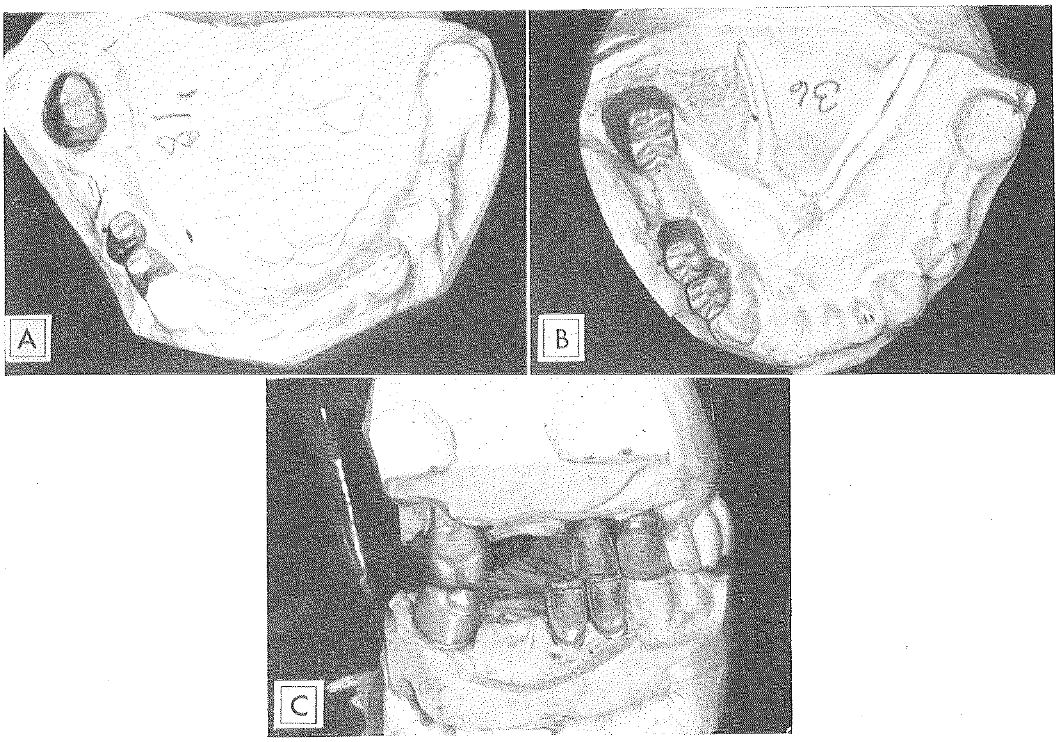


FIG. 332.

Step 6 (*Fig. 332*). Wax and cast the full gold crown and the two bicuspid acrylic resin veneer crowns. These restorations occlude with the abutment retainers on the upper right side at the same time that the opposing teeth occlude on the left side. *A*, The working dies on the lower cast. *B*, The cast abutment retainers. *C*, Occluding abutment retainers.

Step 7 (*Fig. 333*). Try the abutment retainers in the mouth and check the occlusion in all excursions, using the opposite side as reference. Make all the necessary adjustments as to gingival marginal fit, contact, and occlusion.

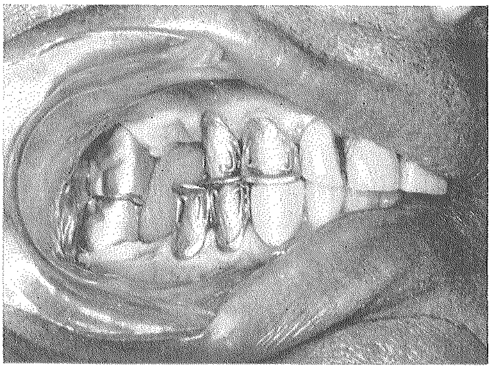


FIG. 333.

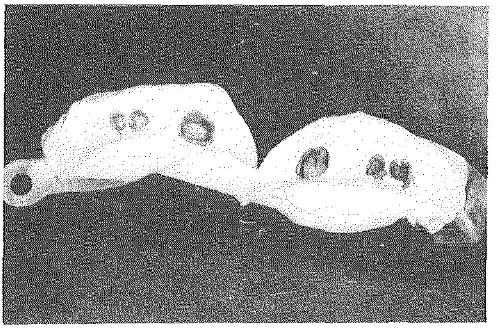


FIG. 334.

Step 8 (Fig. 334). It is advisable to splint the two anterior abutment retainers together. Take a plaster impression of each segment of the right side with individual bridge trays and with the retainers in position. After pouring these impressions in investment, solder the anterior abutment retainers.

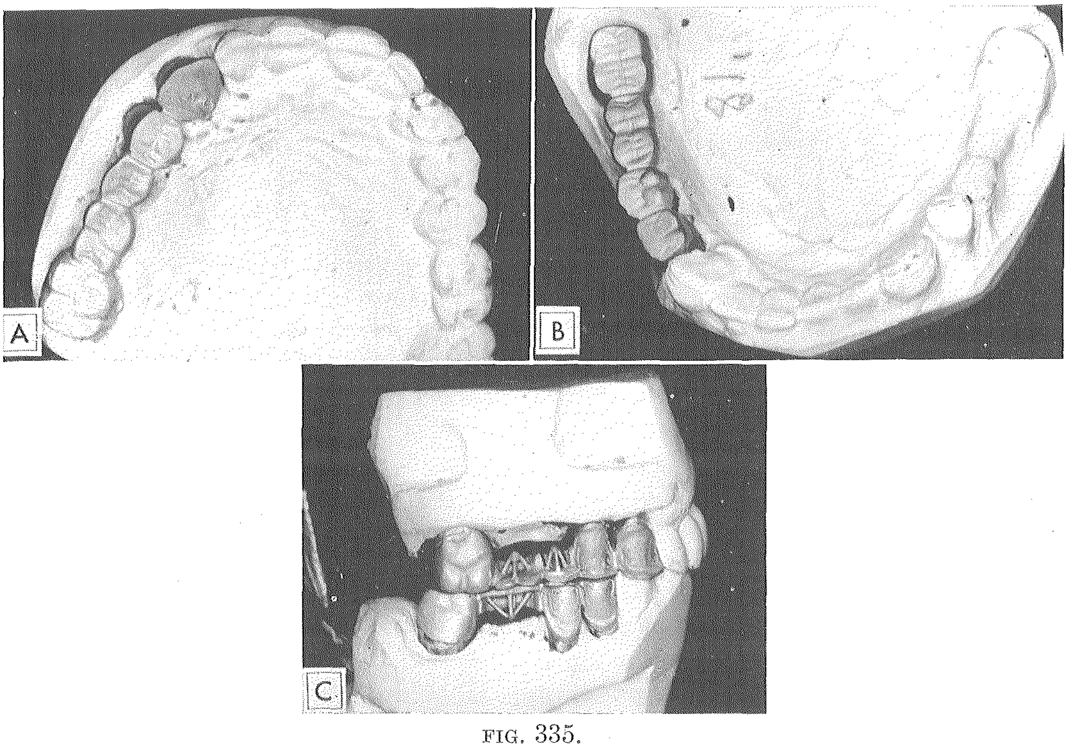
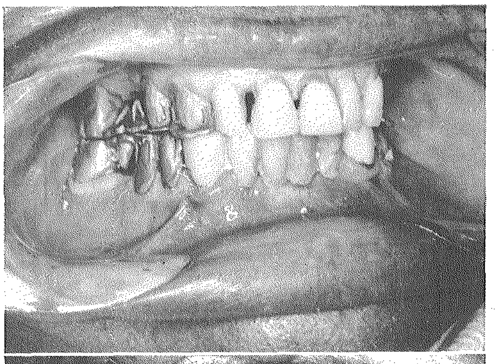


FIG. 335.

Step 9 (Fig. 335). Wax and cast the gold occlusal pontics of each bridge and solder them together to their respective retainers. *A*, Occlusal view of the upper right fixed partial denture framework. *B*, Occlusal view of the lower fixed partial denture framework. *C*, The bridge frames on the casts and in occlusion.

FIG. 336.



Step 10 (*Fig. 336*). Try both bridges in the mouth and make the necessary adjustments in regard to occlusion and alignment.

Step 11 (*Fig. 337*). Remove the old bridge on the left side and prepare the maxillary molar for a gold crown and the bicuspids for acrylic resin veneer restorations. Take individual band impressions, and construct the metal dies and cast transfer copings. After a full impression is taken of the upper jaw with the copings in position on the left side and the bridge frame on right side in place, the cast is articulated to the lower cast poured from an alginate impression.

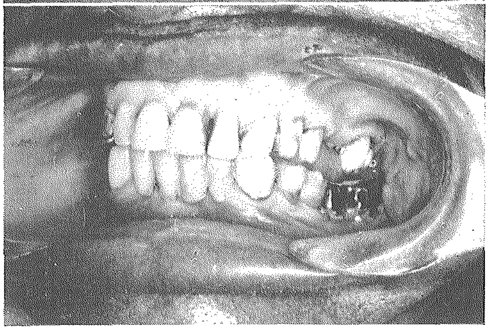


FIG. 337.

Step 12 (Fig. 338). Wax and cast the full crown for the molar and acrylic resin veneer restorations for the two bicuspids. Use the occluding right side as a guide in the occlusal relationship. *A*, Occlusal view of the abutment retainers on the left side and the bridge frame on the right side. *B*, The retainers in occlusion. The mirror shows the occluding contact on the right side.

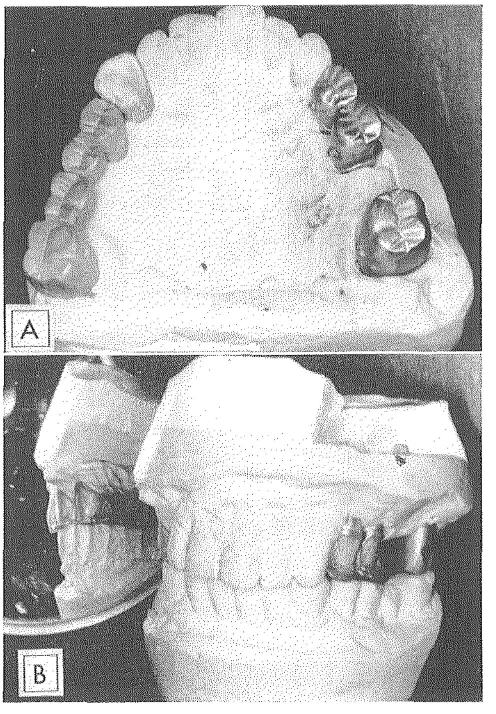


FIG. 338.

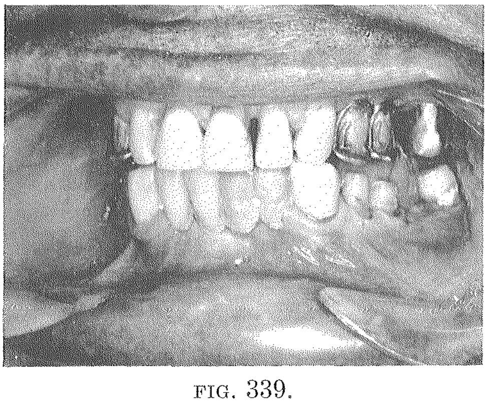
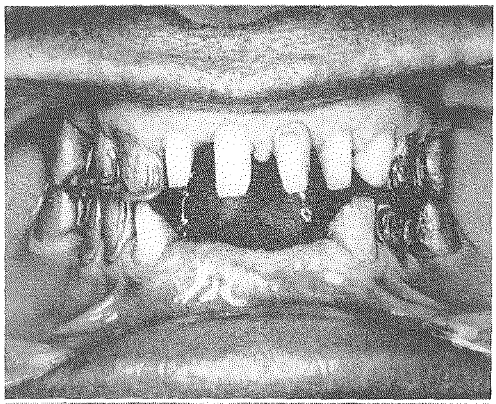


FIG. 339.

Step 13 (Fig. 339). Try the abutment retainers on the teeth with the bridge frames in position on the right side. Prepare the lower left molar for a full crown and the two bicuspids for acrylic resin veneer restorations. Splint double abutment retainers for these bridges. On the left side, carry out to completion the procedures already executed for the bridge frames on the right side.

FIG. 340.



Step 14 (Fig. 340). Try all the bridge frames in the mouth and make the necessary occlusal adjustments. Remove the anterior bridge in the mandible and prepare the canines for acrylic resin veneer crowns. Prepare the maxillary five anterior teeth for acrylic resin veneer restorations. Take band impressions for all of these prepared teeth and pack the dies.

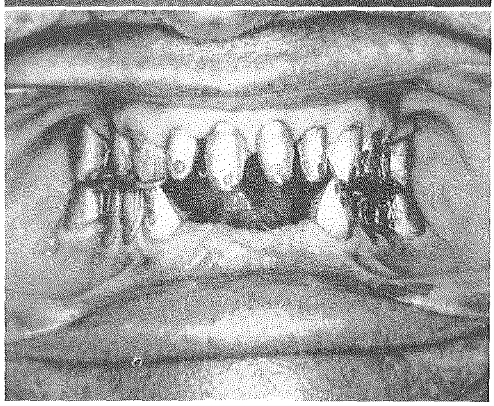


FIG. 341.

Step 15 (Fig. 341). Cast transfer copings for the prepared teeth and seat them in the mouth. Test for accurate seating. Insert the posterior fixed partial dentures and take a wax occlusal registration.

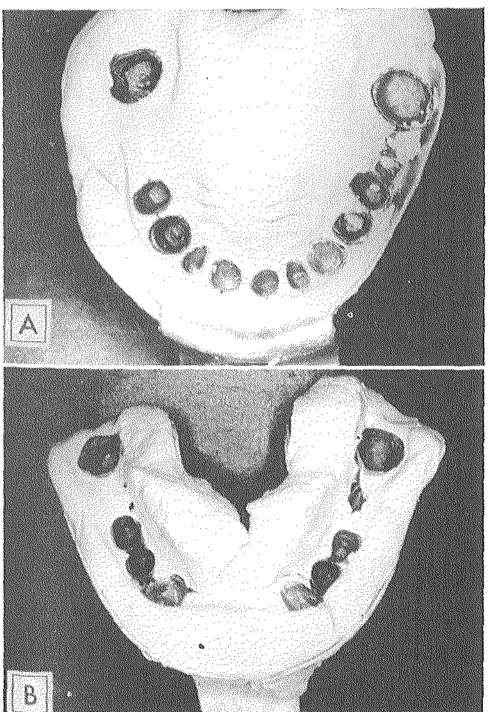


FIG. 342.

Step 16 (Fig. 342). Select suitable aluminum trays. Take a full plaster impression of each jaw with the fixed bridge frames and the anterior transfer copings in position. Pour the casts and articulate them.

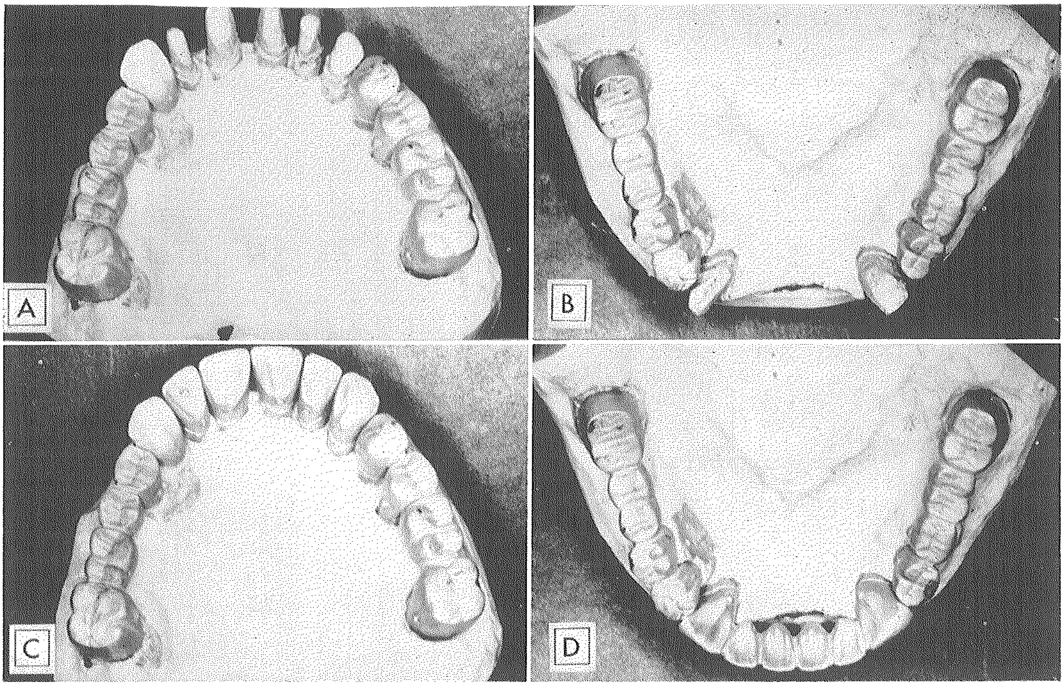


FIG. 343.

Step 17 (*Fig. 343*). Wax and cast the five maxillary anterior acrylic resin veneer crowns. Complete the mandibular canine-to-canine fixed partial denture frame with cast gold lingual pontics.

A, Maxillary cast with the bridge frames and the five anterior dies.

B, Mandibular cast with the bridge frames and the two canine dies.

C, Occlusal view of the upper restorations.

D, Occlusal view of the lower restorations.

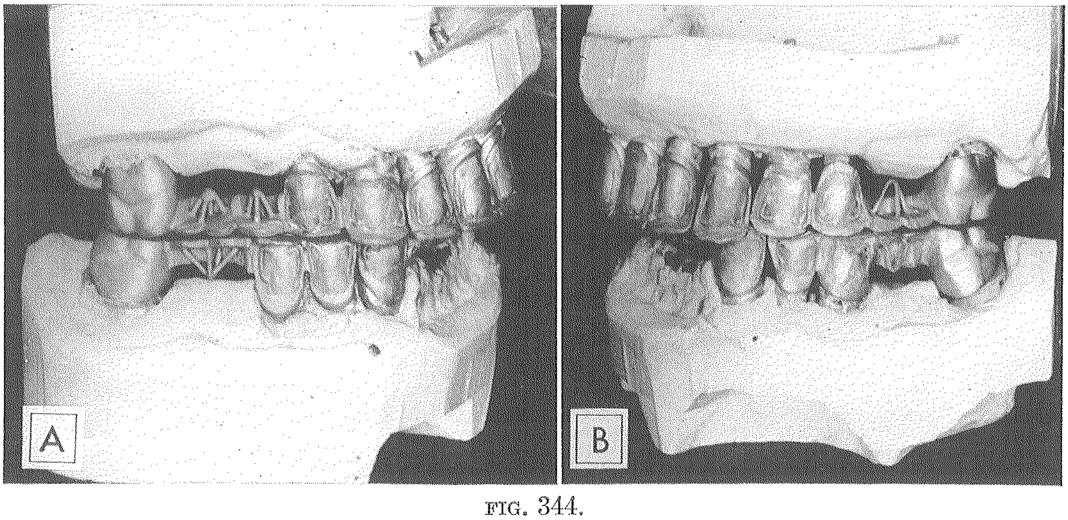


FIG. 344.

Figure 344 shows the right and left sides of the occluding restorations.

Step 18 (Fig. 345). Try all the bridge frames and the individual veneer crowns in the mouth. Make all the necessary adjustments as to occlusion and gingival adaptation.

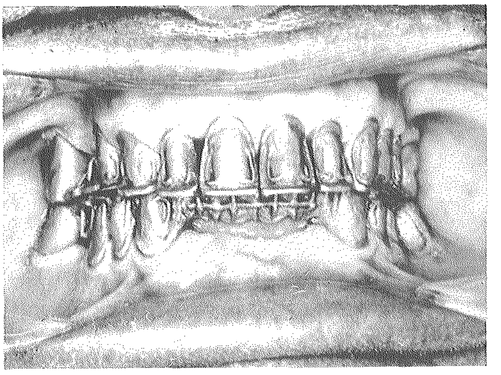


FIG. 345.

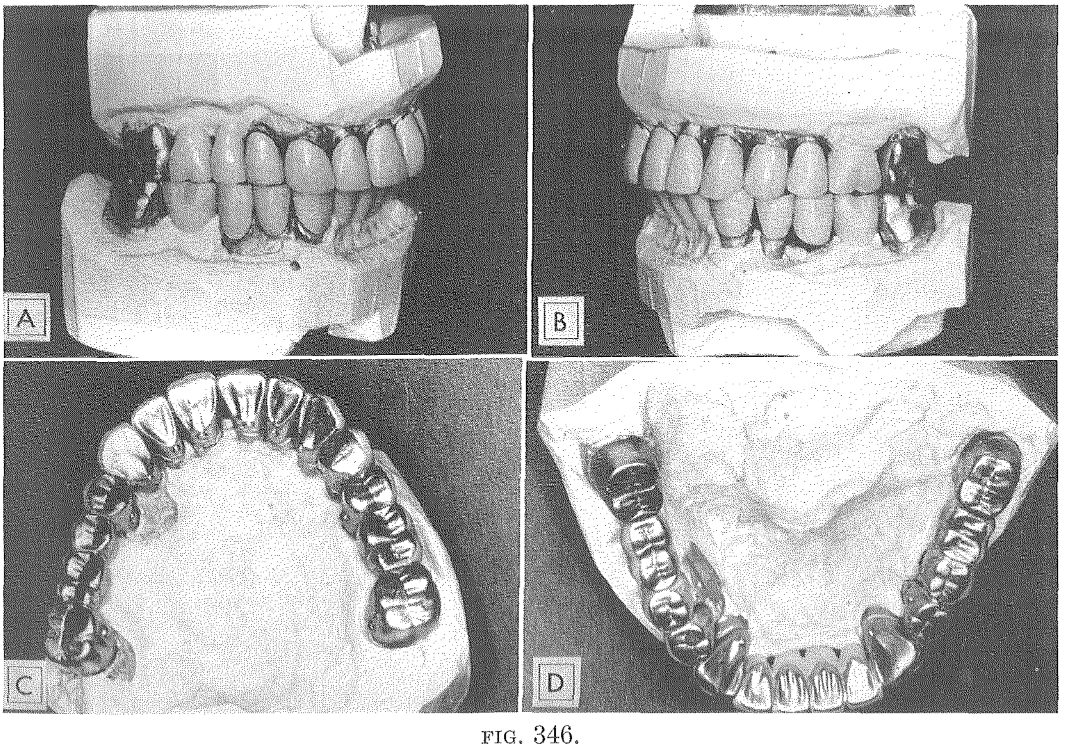


FIG. 346.

Step 19 (Fig. 346). Cure acrylic resin in the veneer crowns and in all the fixed partial dentures. *A*, Right side of the completed restorations. *B*, Left side of the completed restorations. *C*, Occlusal view of the upper jaw. *D*, Occlusal view of the lower jaw.

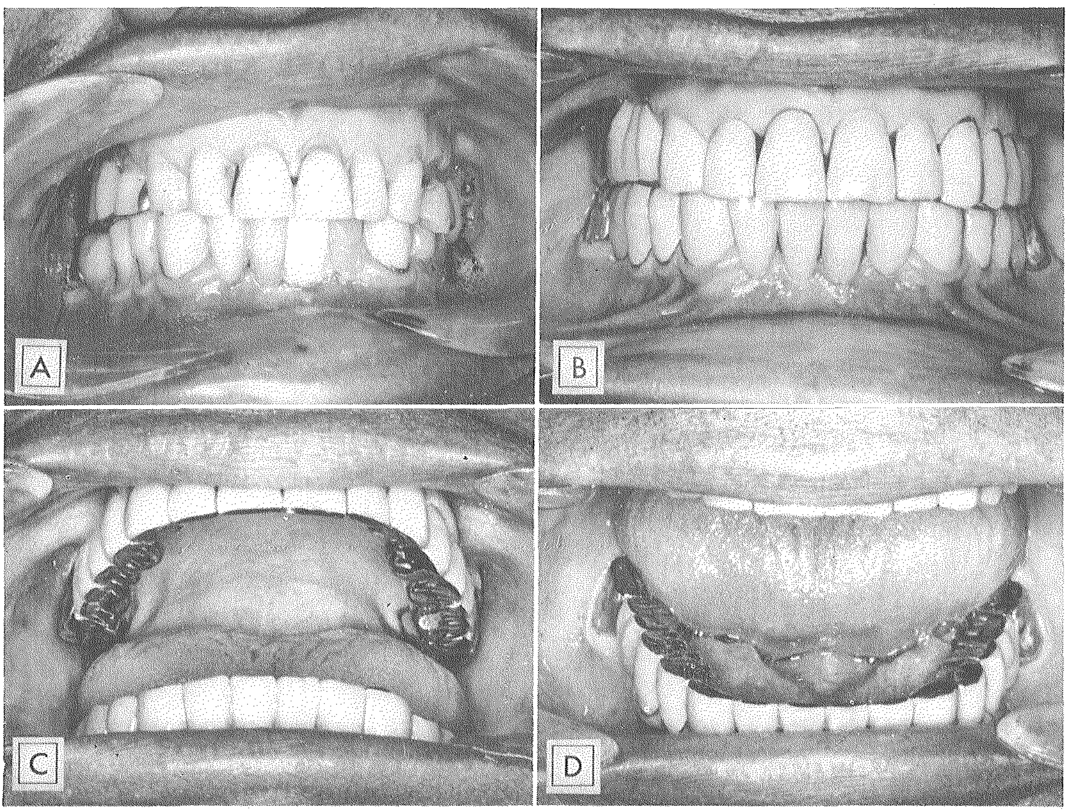


FIG. 347.

Step 20 (Fig. 347). Insert the fixed partial dentures with a temporary cement and the five maxillary veneer crowns with a permanent cement. When all adjustments are made so that the patient is comfortable, all the restorations are seated permanently. *A*, Anterior view before treatment. *B*, Anterior view after rehabilitation. *C*, Occlusal view of the upper jaw. *D*, Occlusal view of the lower jaw.

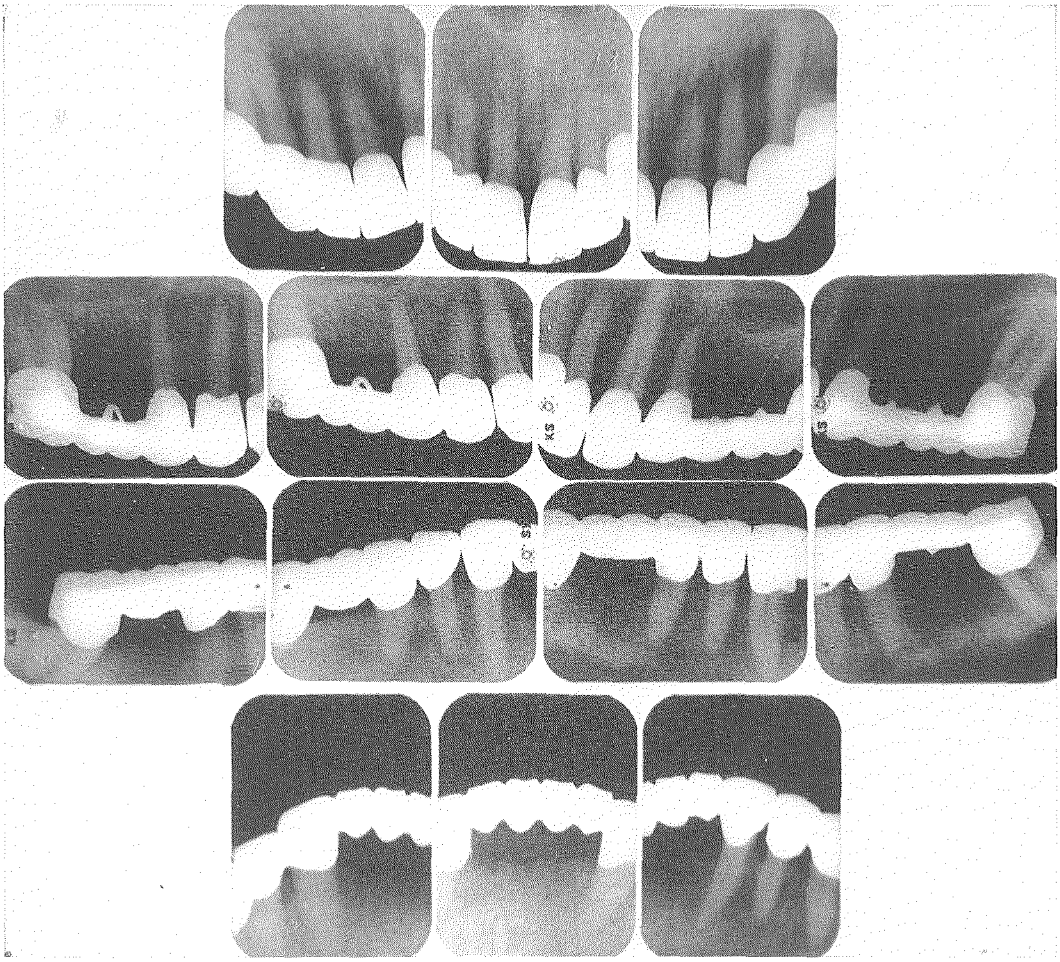


Figure 348. Roentgenograms after treatment.

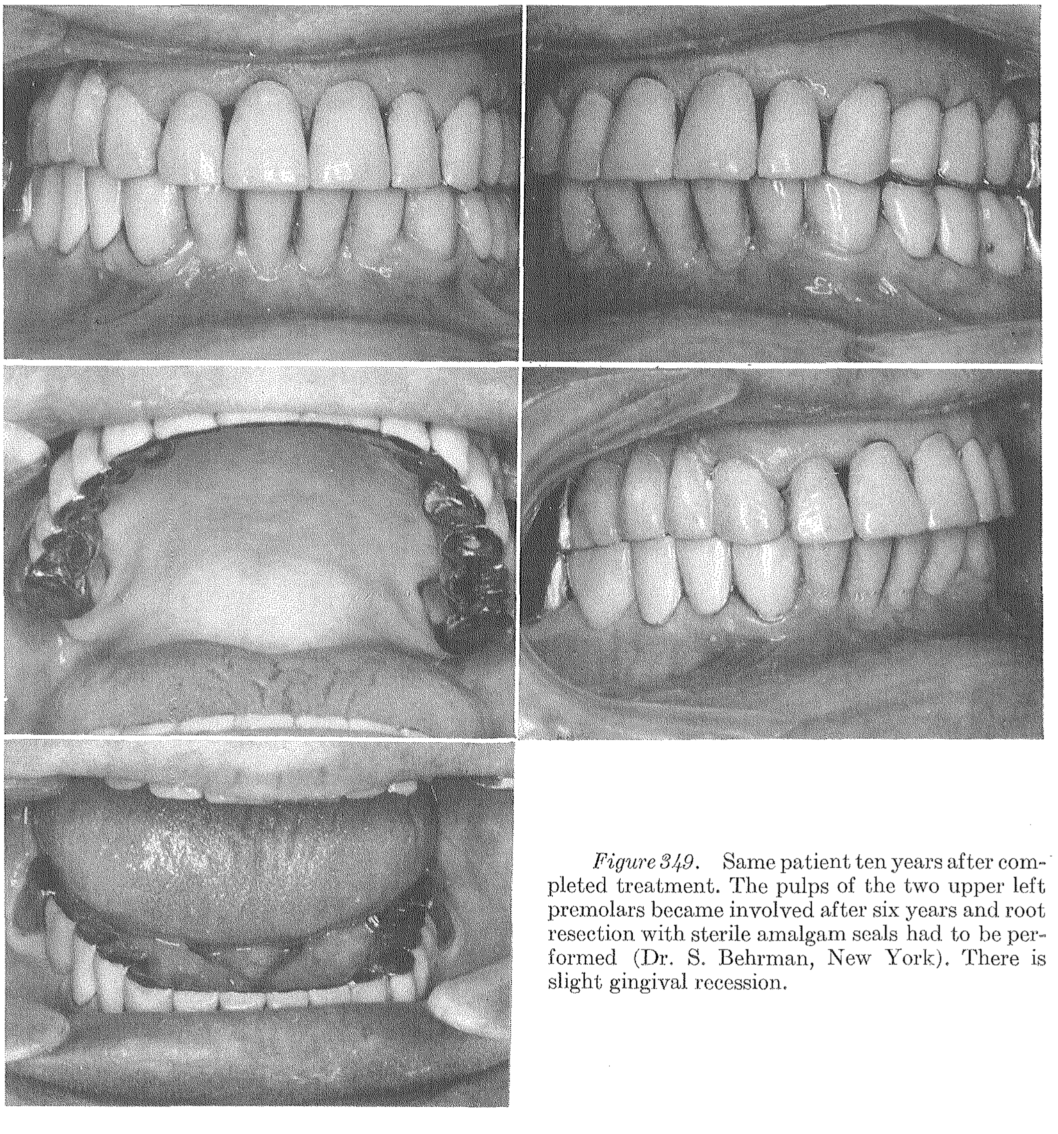


Figure 349. Same patient ten years after completed treatment. The pulps of the two upper left premolars became involved after six years and root resection with sterile amalgam seals had to be performed (Dr. S. Behrman, New York). There is slight gingival recession.

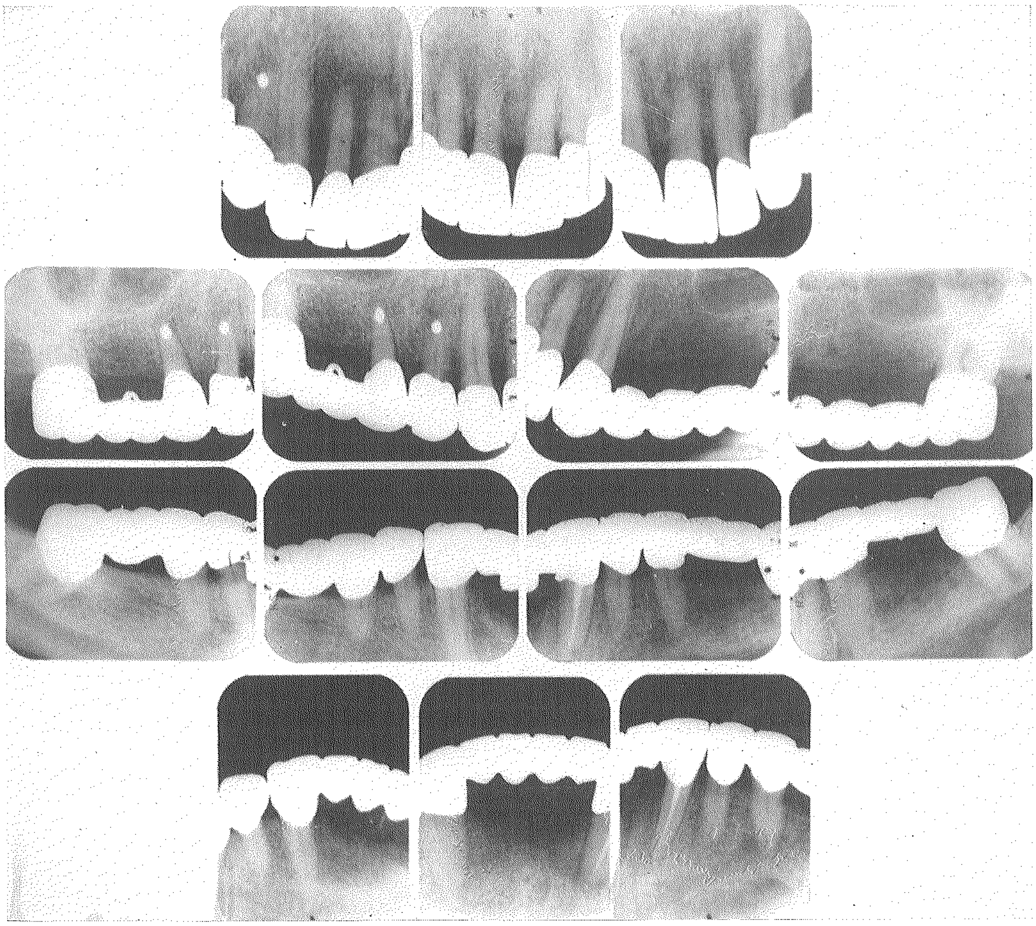


Figure 350. Roentgenograms ten years after treatment.

SATISFACTORY OCCLUSION, ALL TEETH PRESENT

On occasion, the operator is called upon to improve the esthetics of a patient possessing a full complement of natural teeth. If the condition necessitates full coverage restorations throughout, then the entire occlusion is involved. When the existing occlusal relationship is satisfactory, it should not be changed. Duplication of the occlusion is indicated and the guide tooth technique is advocated.

Examination

The patient in Figure 351 is a young man of 21 years, physically healthy but very disturbed about the appearance of his teeth. Clinical examination discloses a full complement of teeth with the exception of the maxillary right second bicuspid. The space became partially closed by the migration of the approximating teeth. Mottled enamel exists on *all* surfaces of the teeth. It is apparent that the mottled

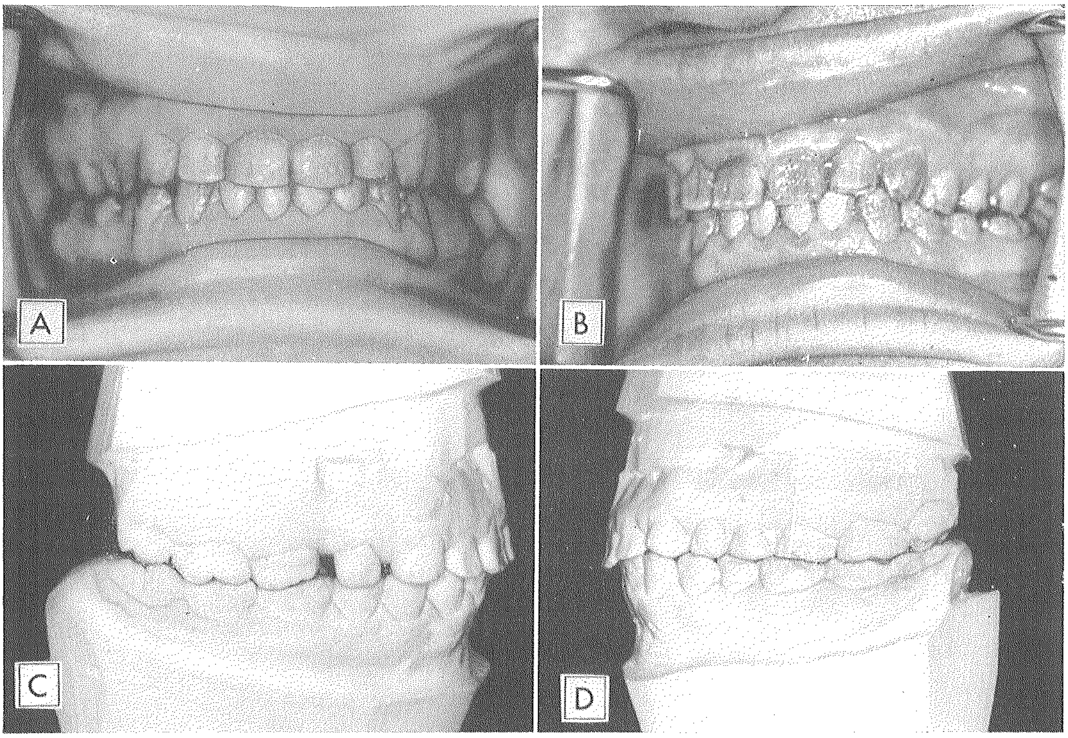


Figure 351. A young patient with a problem of esthetics who requires occlusal rehabilitation to improve upon the esthetics. The occlusal relationship must not be changed. *A*, *B*, Mottled enamel on all the surfaces of the teeth. *C*, *D*, Study casts showing the satisfactory occlusal relationship.

enamel on the occlusal surfaces of the posterior teeth in both jaws is worn. Most of the posterior teeth have large amalgam alloy restorations which have outlived their usefulness. The maxillary incisors are irregularly shaped and the dark, mottled condition presents a very unattractive appearance. The occlusion functions with a wide range of gluding and sliding lateral movements because the interfering mottled enamel cusps have been chipped away. The gingival tissues are slightly inflamed owing to sordes and neglect.

Treatment Plan

Porcelain jacket crowns placed on the unattractive maxillary incisors alone, to improve the esthetics, would fracture as the mottled occlusal surfaces of the molars and bicuspids wore down. Therefore, it is necessary to rehabilitate most of the dentition to make it possible for the porcelain jacket crowns on the anterior teeth to endure. All of the molar teeth (not necessarily the third molars) will receive full or acrylic resin veneer crowns. The maxillary right molar and first bicuspid will receive porcelain fused to metal crowns, each made a little wider, to close the space. The six maxillary anterior teeth and bicuspids will receive porcelain jacket crowns to improve the esthetics. It is not recommended that the mandibular six anterior teeth be treated with full coverage restorations. *Because of the youth of the patient and the delicacy of the small mandibular incisors, it is considered good practice to leave* *them alone.* Human hands cannot always reproduce these small, delicate teeth accurately by full coverage restorations and give satisfactory esthetic results with healthy pulps. Some of the mottled enamel on the labial surfaces of these mandibular teeth will be ground off. Inasmuch as the occlusion is satisfactory, no attempt should be made to destroy the existing comfortable relationship. A preconceived rearrangement of the teeth by prosthodontic means is apt to prove uncomfortable. Restorations on some occluding teeth will be accomplished first, with the remaining ones acting as guides in occlusion.

Treatment

All of the first molars in both jaws and the one upper right first bicuspid are prepared for full coverage restorations. The castings are constructed on the dies set in full casts (Fig. 352). These restorations occlude with each other at the same time as the untouched approximating teeth (Fig. 353). Then all of the remaining teeth are prepared for full coverage restorations with the crowns on the first molars

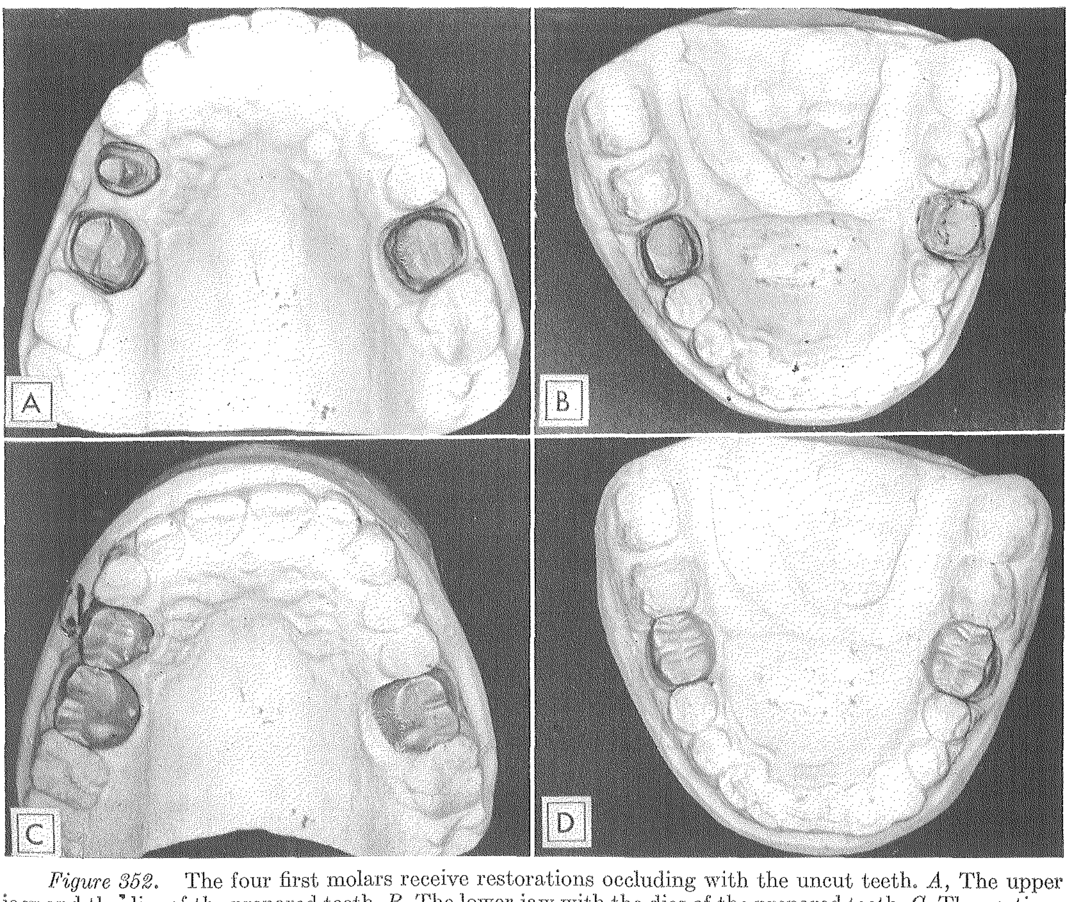


Figure 352. The four first molars receive restorations occluding with the uncut teeth. *A*, The upper jaw and the dies of the prepared teeth. *B*, The lower jaw with the dies of the prepared teeth. *C*, The castings in the upper jaw; the molar and the first biscuspid are made a trifle wider to close up the space. *D*, The castings in the lower jaw.

acting as guides (Fig. 354). Biscuit bake porcelain jacket crowns are tried in the mouth and after all corrections are made as to occlusion, alignment, and contacts, the restorations are cemented on the teeth (Fig. 355). With a Busch Silent stone, grind off some of the mottled enamel on the labial surfaces of the mandibular incisors and polish these cut surfaces with rubber wheels and polishing instruments. The functional occlusion, acceptable and satisfactory, was not disturbed. Any radical change in the occlusion of such a young person may prove disastrous. Figure 356 illustrates the treated patient ten years after completion. During that interim, an occasional porcelain jacket crown fractured and had to be replaced. Figure 357 illustrates the same patient nineteen years after completion.

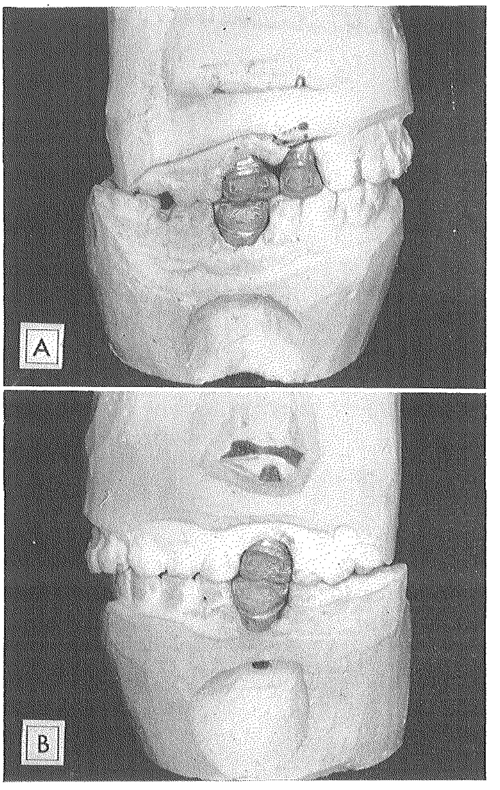


Figure 353. Lateral views of the castings. *A*, The right side, showing the space closed; notice the contacting approximating teeth as guides. *B*, The left side.

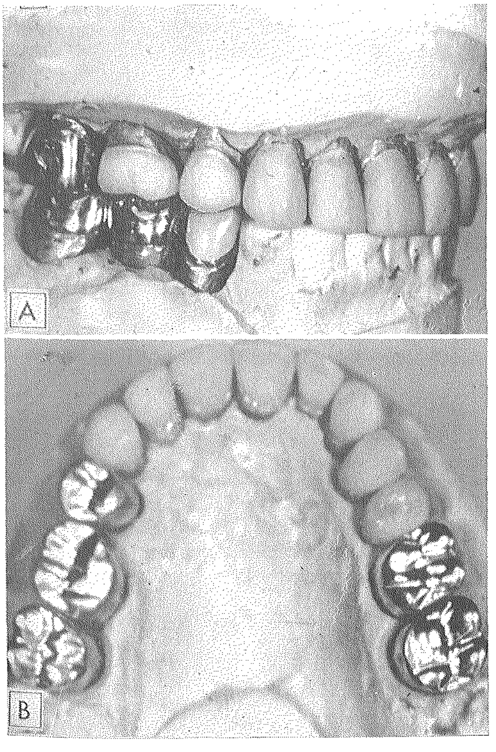


Figure 354. *A*, All of the restorations in the biscuit bake occlude with the completed guide teeth. The mandibular incisors are not touched. *B*, An occlusal view of the upper jaw with the completed restorations.

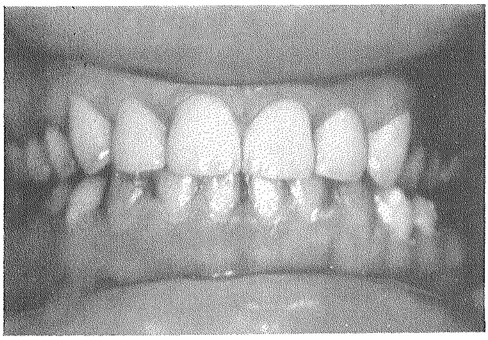


Figure 355. The patient at completion of treatment.

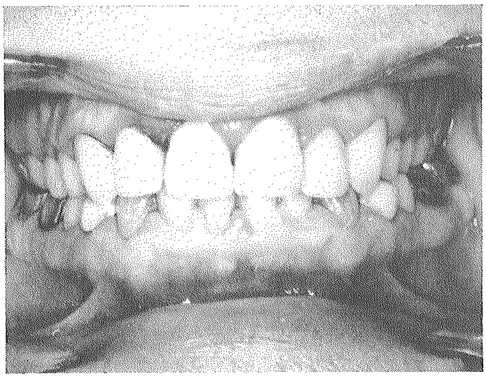


Figure 356. The patient ten years later.

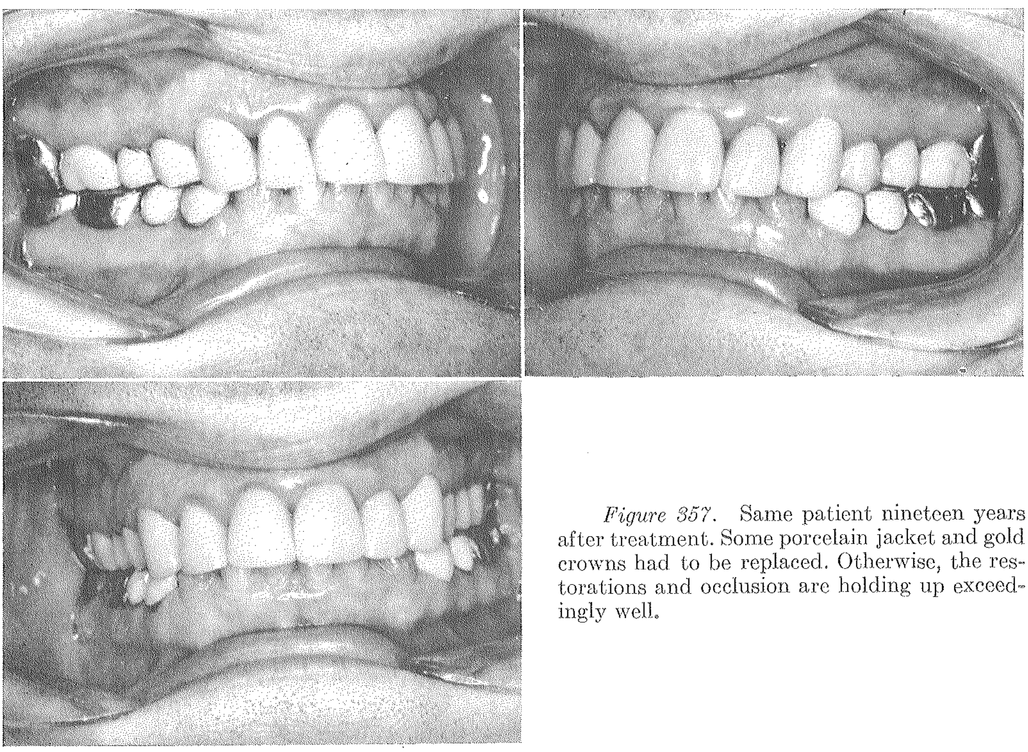


Figure 357. Same patient nineteen years after treatment. Some porcelain jacket and gold crowns had to be replaced. Otherwise, the restorations and occlusion are holding up exceedingly well.

16

GROUP II CLASS 2

Rehabilitating a Patient Possessing a Limited Number of Occluding Terminal Teeth in a Satisfactory Occlusal Relationship but Requiring Aid in Maintaining That Relationship in the Form of a Preliminary Occlusal Rim

Examination

The patient, a small woman of 52 years, is physically healthy though frail, and is apprehensive of losing all her teeth. She is a happy and composed person who will probably cooperate with the treatment plan presented. Clinical examination discloses that the maxillary teeth possess large restorations of amalgam, silicate cement, and plastic (Fig. 358). The mandibular molars and second bicuspids on each side are missing, and the six mandibular anterior teeth have extruded and are crowded

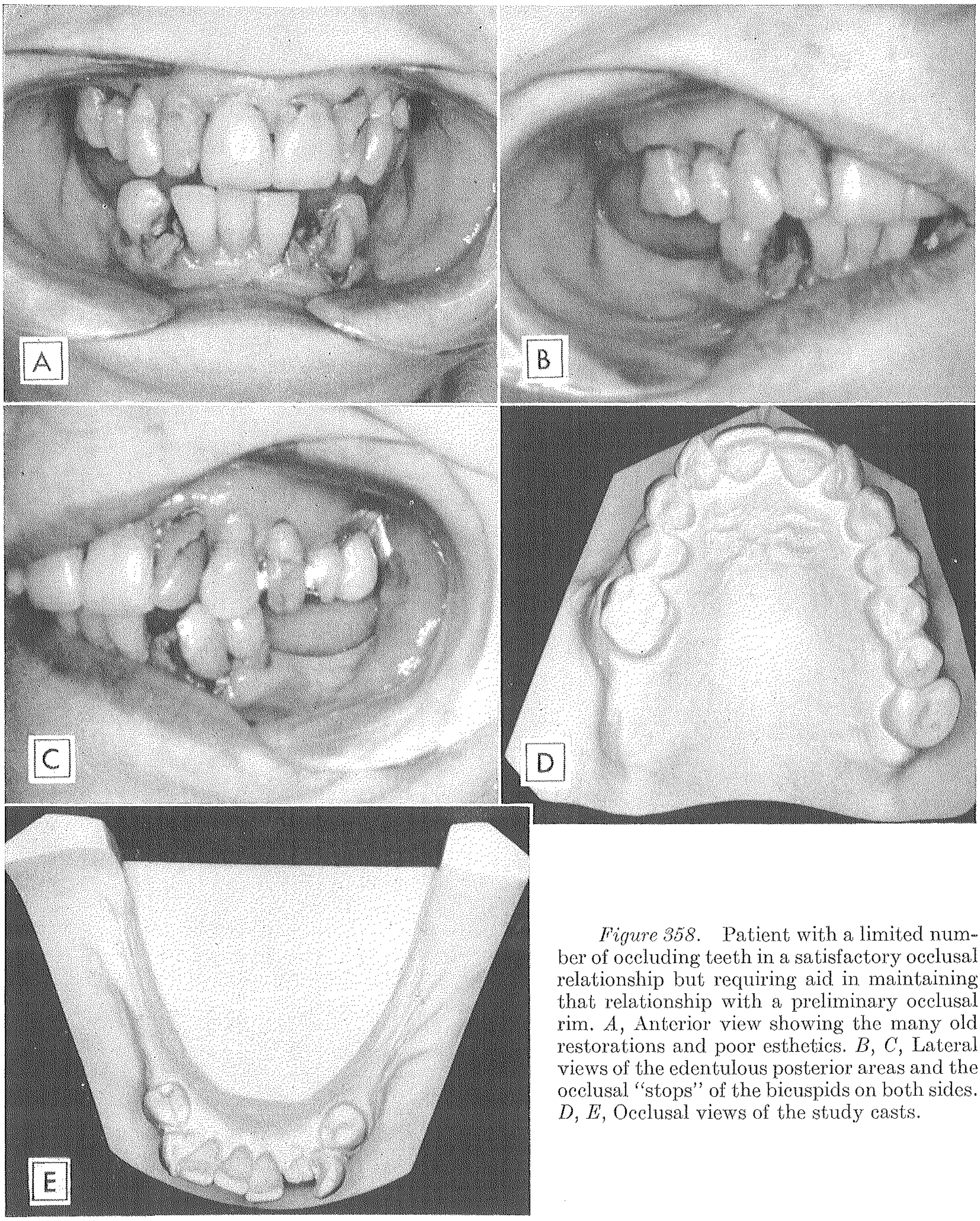


Figure 358. Patient with a limited number of occluding teeth in a satisfactory occlusal relationship but requiring aid in maintaining that relationship with a preliminary occlusal rim. *A*, Anterior view showing the many old restorations and poor esthetics. *B*, *C*, Lateral views of the edentulous posterior areas and the occlusal "stops" of the bicuspids on both sides. *D*, *E*, Occlusal views of the study casts.

and mobile beyond repair. The two remaining mandibular bicuspids are comparatively sound and healthy, except for the presence of caries in the gingival third of each tooth. They are embedded firmly in bone and occlude satisfactorily with the maxillary antagonists (Fig. 358*B* and *C*). The interocclusal clearance measures approximately 4 mm. The maxillary central incisors are very large and the lateral incisors are malposed. The maxillary left second molar is slightly mobile and the bifurcation is partially exposed. The maxillary first molar on the left side and the second and third molars on the right side are missing.

There is an anteroposterior asymmetry between the maxillae and the mandible. Although at present the mandibular incisors make contact with the lingual surfaces of the maxillary incisors (they have extruded over the years), the patient gives the history that for a long time a space existed between these mandibular incisors and the maxillary ones in centric occlusion. This is an important observation, because, in order to make the anterior restorations touch the lingual surfaces of the teeth in the upper jaw, it would be necessary to construct extraordinarily long mandibular central and lateral incisors. To create a level with the posterior teeth would require increasing the occlusal vertical dimension beyond the limits of this patient's interocclusal clearance. Two teeth possess root canals that have been incompletely filled, but there are no apparent periapical disturbances (Fig. 359). The occlusion functions in a chopping motion with the force of mastication on the anterior teeth. The mandibular incisors have very little bone support and should be removed. She was advised to have all her teeth removed. I consider this case a terminal one. The patient is willing to try rehabilitation with the hope that the procedure will delay the absolute necessity for complete dentures.

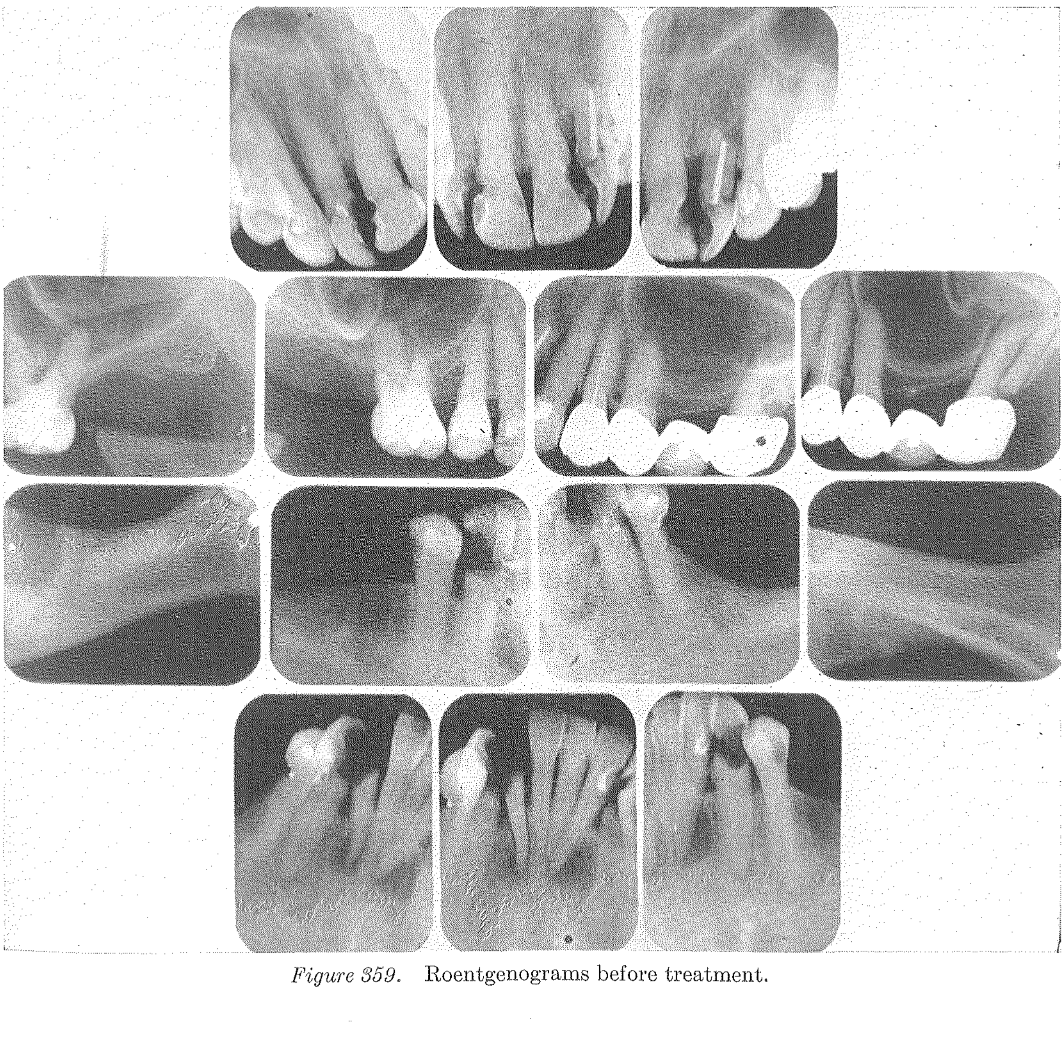


Figure 359. Roentgenograms before treatment.

Treatment Plan

To allay the patient's apprehension, every effort must be made to save teeth. The unsatisfactory mandibular incisors and canines will be extracted. Every tooth in the maxillae will be retained, even the incompletely filled pulpless teeth and the partially mobile upper left second molar. When all efforts to save teeth have been exhausted, the patient becomes resigned to their removal, and the danger of creating psychological disturbances in the patient is minimized. The mandibular incisors will be removed from the cast and a preliminary occlusal rim will be constructed as an aid in maintaining the occlusal vertical dimension as established with the two remaining first mandibular bicuspids in contact with the maxillary ones.

The right first maxillary molar and remaining contacting bicuspid will receive acrylic resin veneer crowns and the left missing first molar will be replaced with multiple abutment retainers of acrylic resin veneer crowns on the left canine and two bicuspids. The first molar pontic will have a lock-in device that will accommodate itself into a receptacle cut in the cast gold crown retainer on the weak and problematical second molar. Should this molar have to be extracted at a later date, it will not be necessary to remake the entire fixed prosthesis. All that will be required is to cut off the lock-in device and remove the tooth. The five remaining maxillary teeth will be treated with porcelain jacket crowns, to improve the esthetics. The four mandibular incisors and canines are crowded. Upon their removal the space between the first bicuspid on each side can receive a fixed bridge. The veneer crown abutment retainers will house boxings for a lingual bar removable partial denture with internal attachments.

Treatment

The steps in the treatment of this patient are outlined in the next few pages.

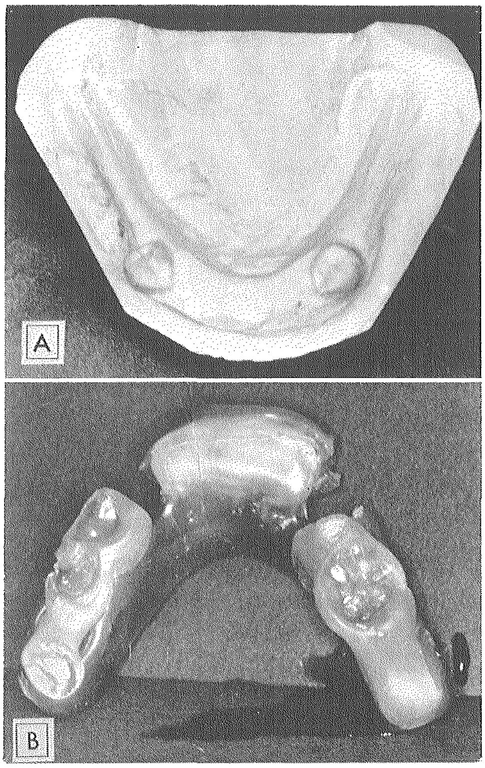


FIG. 360.

Step 1 (*Fig. 360*). Duplicate the study casts and remove the mandibular plaster incisors and canines. Construct a preliminary occlusal rim to assist the mandibular bicuspids as guides in maintaining the occlusal vertical dimension. From this same mandibular cast, construct a removable partial denture with buccal arm clasps, to be inserted as a temporary replacement when the mandibular six anterior teeth are removed. *A*, The mandibular cast; *B*, the occlusal rim.

Step 2 (*Fig. 361*). Remove the six mandibular anterior teeth (*A*) and insert the temporary removable partial denture (*B*).

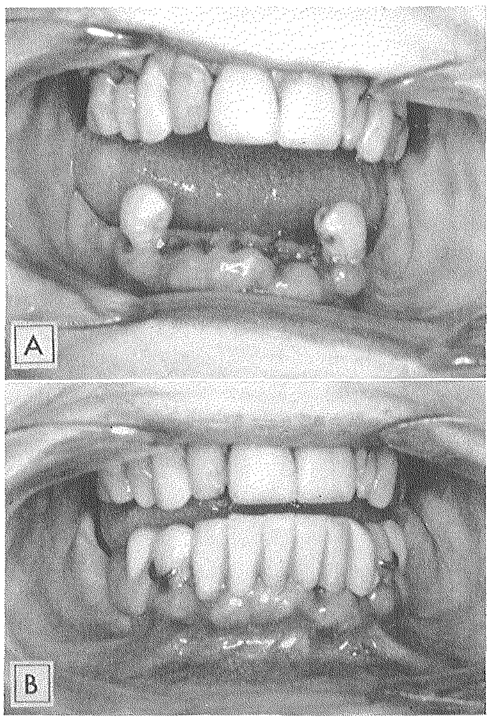
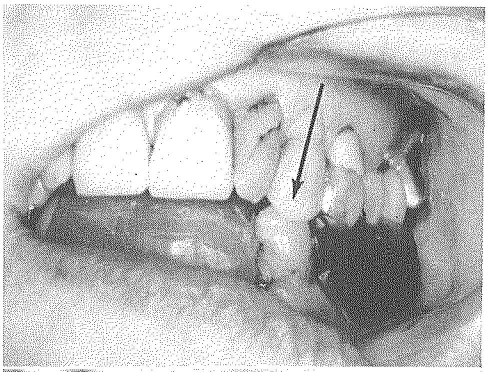


FIG. 361.

FIG. 362.



Step 3 (Fig. 362). Try in the preliminary occlusal base plate and wax occlusal rim. Trim and warm the wax so that the rim occludes with the maxillary teeth and the mandibular bicuspids interdigitate with the opposing teeth at the same time.

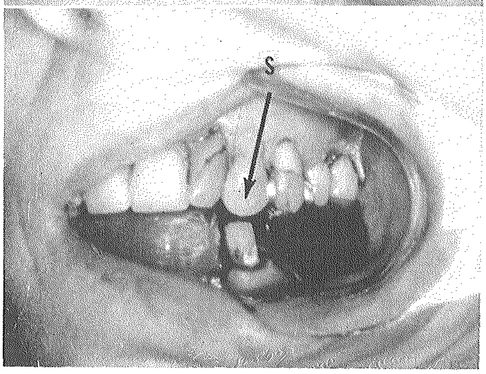


FIG. 363.

Step 4 (Fig. 363). Prepare the mandibular bicuspids for acrylic veneer crowns. Insert the marked preliminary occlusal rim. Notice the occlusal relationship and see that there is sufficient clearance between the prepared teeth and the maxillary antagonists (*S*).

Step 5 (Fig. 364). Take band impressions of the two prepared bicuspids and construct metal dies. Cast transfer copings for these prepared teeth.

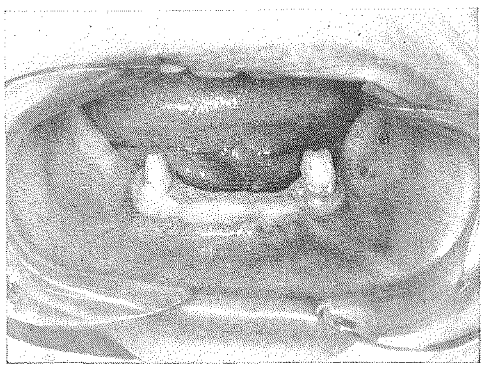


FIG. 364.

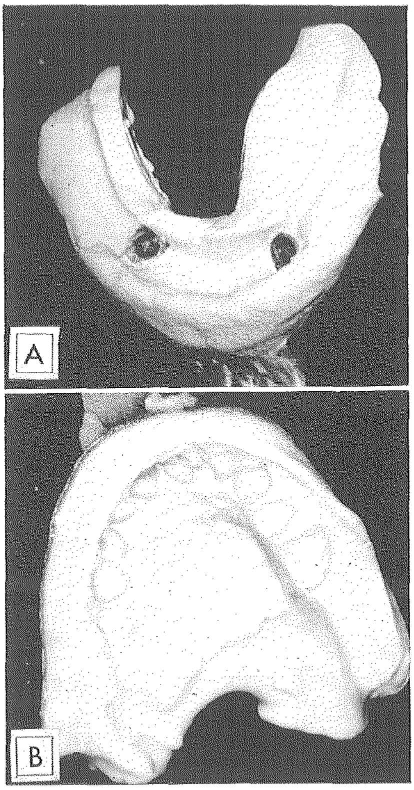


FIG. 365.

Step 6 (Fig. 365). Fit the transfer copings on the prepared teeth and take a full plaster impression of the mandible with the transfer copings in position (*A*). An alginate impression of the upper jaw is the next procedure (*B*). Use the occlusal rim to articulate the casts.

Step 7 (Fig. 366). Construct two acrylic resin veneer crowns for the prepared bicuspids and cut out areas on the distal surfaces for internal attachments. Try the castings on the teeth and insert the preliminary occlusal rim and test the occlusion. Grind the gold castings until they occlude with the upper teeth at the same time when the occlusal rim is in its proper relationship. The cusps of the posterior maxillary teeth must adapt themselves correctly into the corresponding depressions in the wax of the rim. *A*, The occlusal rim and castings in approximate proper relationship. *B*, An occlusal view showing the depressions in the wax extensions made by the maxillary teeth.

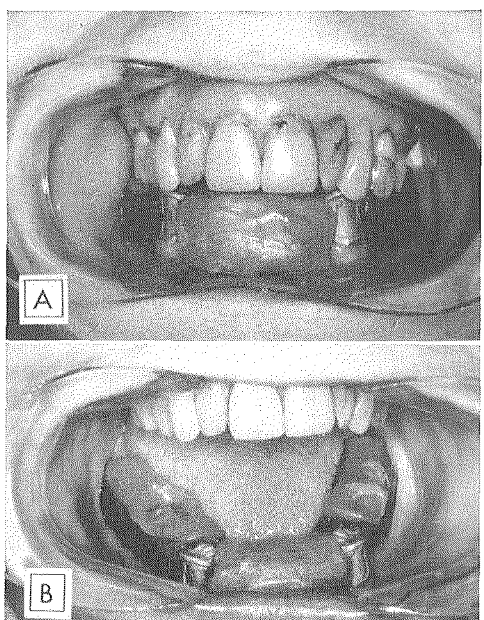


FIG. 366.

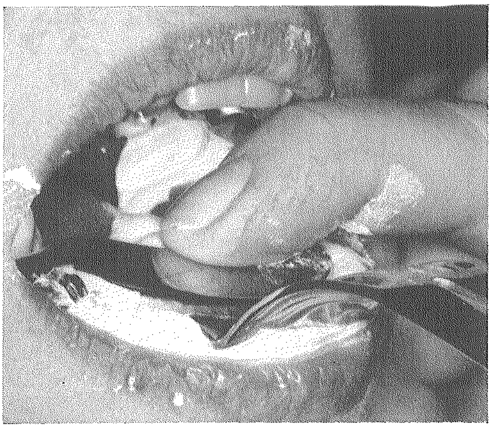


FIG. 367.

Step 8 (*Fig. 367*). Take a plaster impression of the mandible with the abutment retainers in place. Use the previously poured maxillary cast with the occlusal rim, and rearticulate the casts.

Step 9 (*Fig. 368*). Construct a fixed partial denture with cast gold pontics that will receive acrylic resin teeth. Try this restoration in the mouth and test for alignment and occlusion. Because the original mandibular incisors were crowded, the distance between the bicuspids is decreased. Only five pontics can be accommodated to fill in the edentulous area.

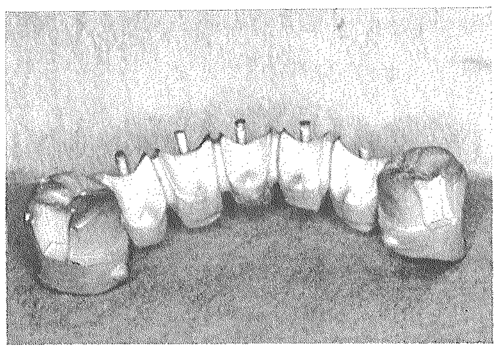


FIG. 368.

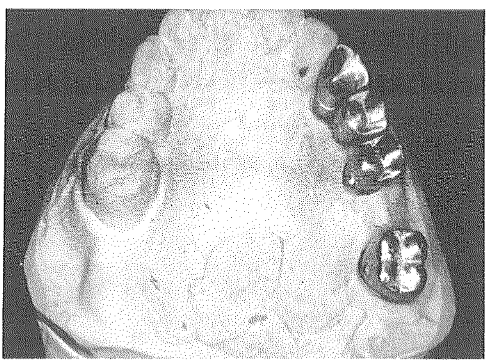


FIG. 369.

Step 10 (*Fig. 369*). Prepare the maxillary teeth on the left side for abutment retainers, to support a fixed partial denture. Cast veneer crowns for the canine and first and second bicuspids and a full crown for the second molar.

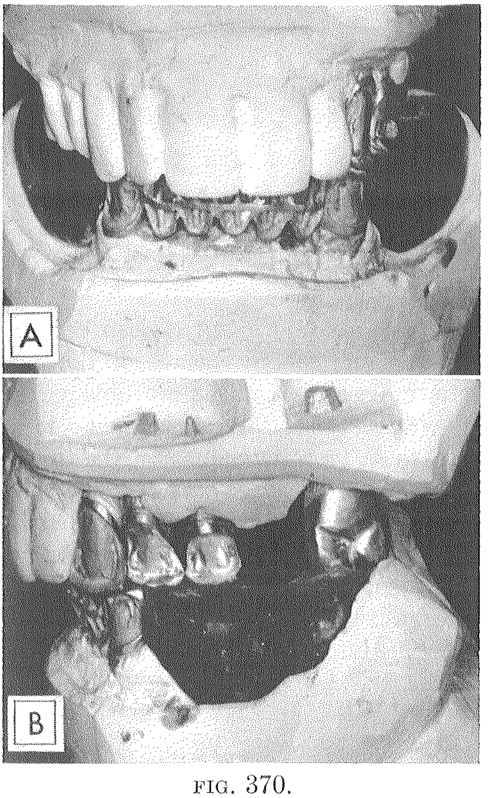


FIG. 370.

Step 11 (*Fig. 370*). Construct a new occlusal rim, using the occluding bicuspids as guides. Check the occlusal vertical dimension and remount the casts. Take an impression with plaster of the three veneer castings in the mouth and solder these three retainers to serve as a multiple retainer. *A*, The anterior view; *B*, the left side.

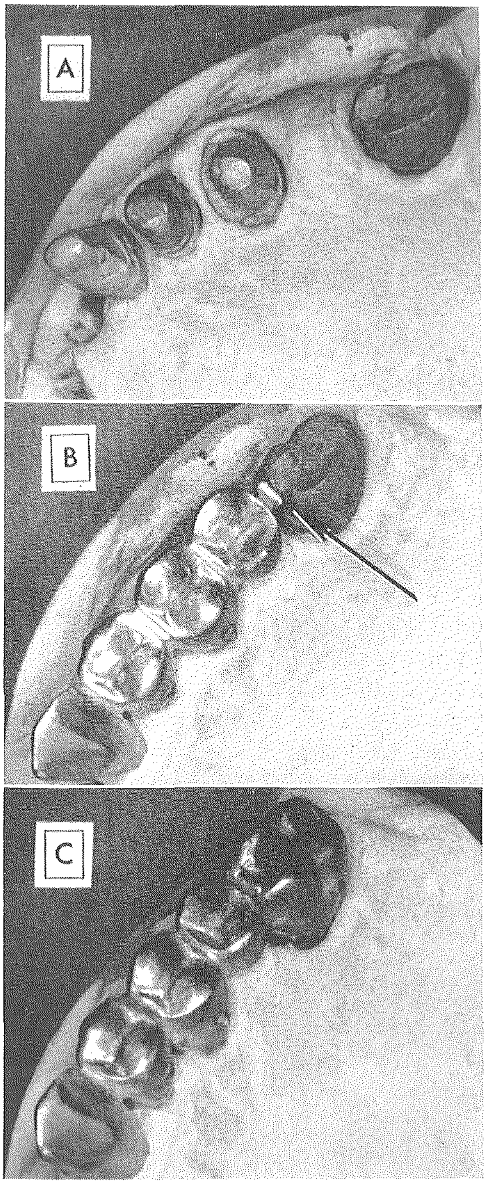


FIG. 371.

Step 12 (*Fig. 371*). Cut a deep occlusal recess in the mesioclusal surface of the cast molar crown. Construct a fixed-movable partial denture with cast occlusal surfaces and a lock-in device that accommodates itself into the cutout part on the molar casting. *A*, The metal dies on the upper cast. *B*, The fixed partial denture on the dies without the second molar crown in place; the arrow points to the projection. *C*, The fixed partial denture and the projection fitting into the accommodating receptacle on the molar crown.

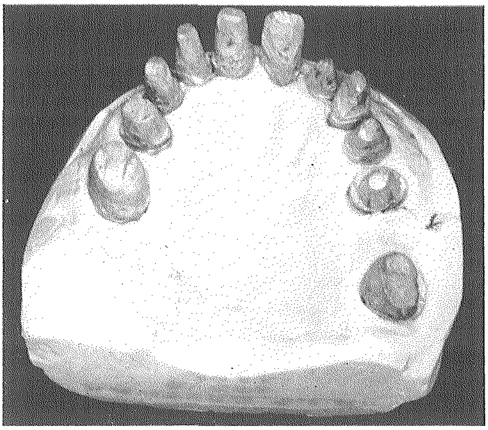


FIG. 372.

Step 13 (*Fig. 372*). Complete the preparations on all of the remaining teeth for full coverage restorations. Take band impressions and construct metal dies. Cast transfer copings on the fabricated dies and follow with a new plaster impression of the upper jaw with the copings in position and with the left fixed partial denture in place. Pour the cast and remount on the articulator.

Step 14 (*Fig. 373*). Cast the mandibular lingual bar frame and lingual arms of the removable partial denture. Solder the female attachments on both bicuspids. Form wax bases over the denture casting.

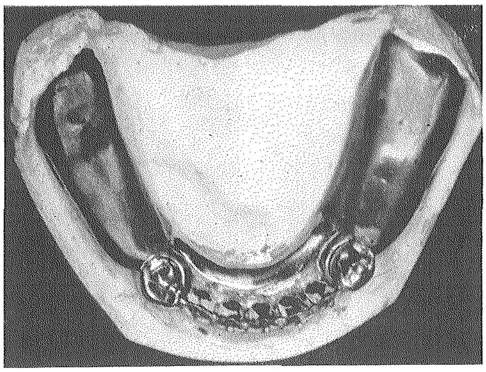


FIG. 373.

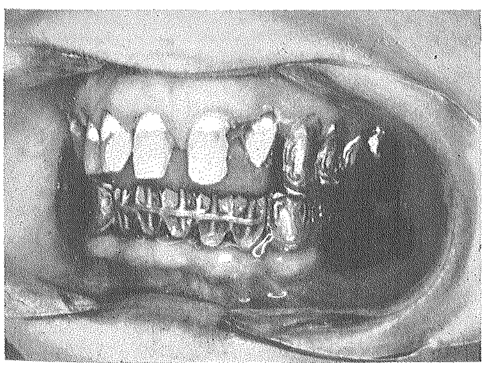


FIG. 374.

Step 15 (*Fig. 374*). Try the mandibular fixed bridge and removable partial denture in the mouth. Insert the fixed partial denture in the upper jaw and check for alignment and occlusion.

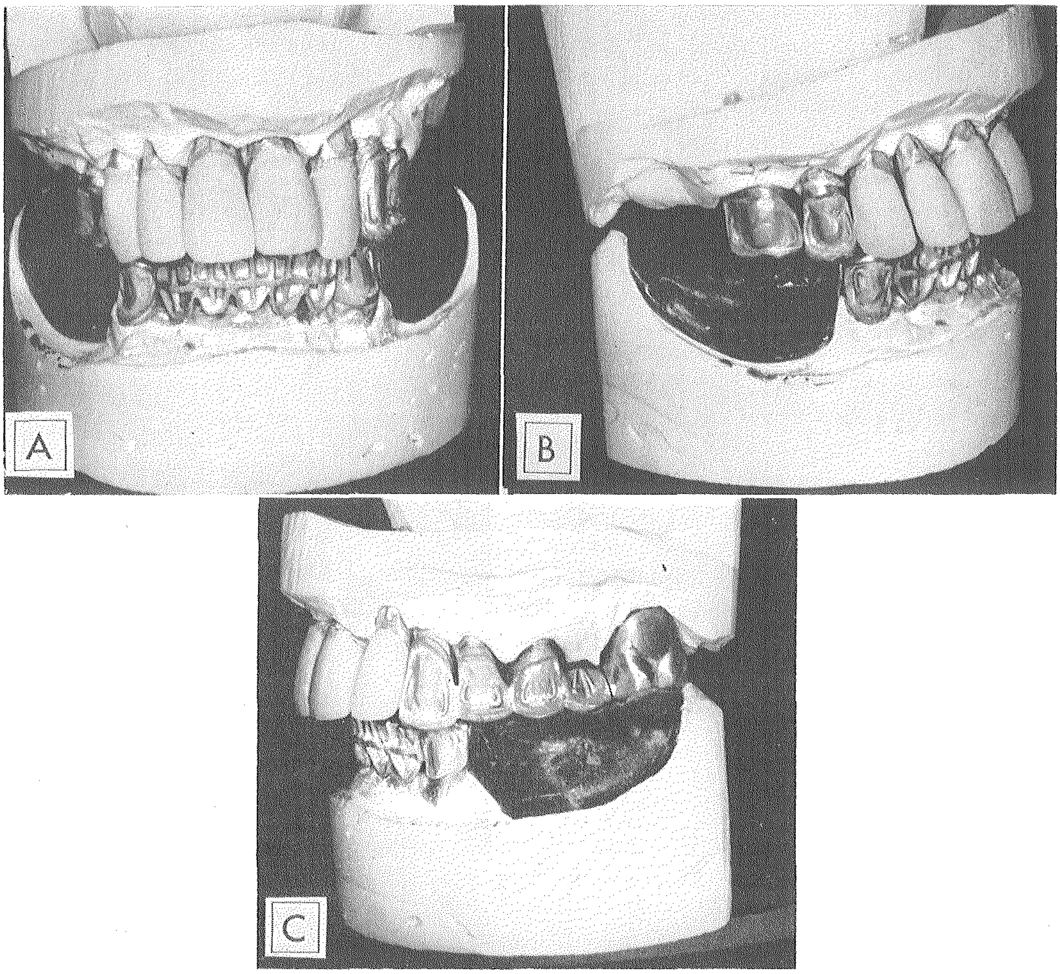


FIG. 375.

Step 16 (*Fig. 375*). Fire biscuit bake porcelain jacket crowns for the five maxillary anterior teeth. Try them in the mouth and make the necessary adjustments as to contact, alignment, and anatomic form. Fill in the veneer crowns with white wax and try them in the mouth also. A try-in of the removable partial denture with the artificial teeth in wax is advisable. *A*, Anterior view of the biscuit bake porcelain jacket crowns. *B*, and *C*, Lateral views of the restorations prior to completion.

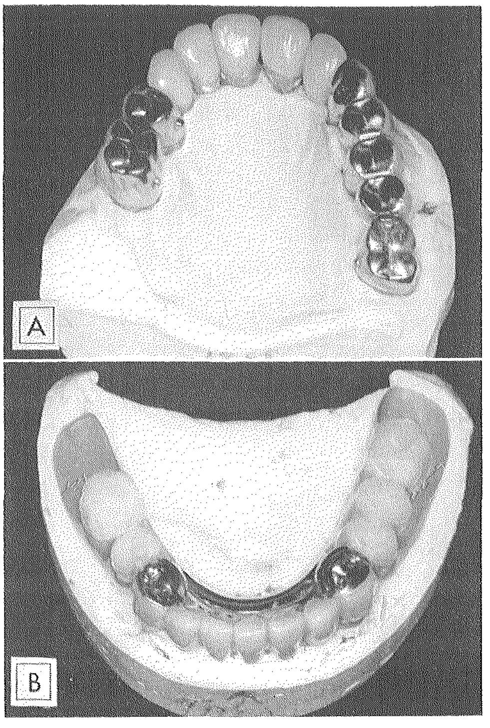


FIG. 376.

Step 17 (*Fig. 376*). Cure the acrylic resin in the veneer crowns and fixed partial dentures. Glaze and stain the five porcelain jacket crowns. Complete the mandibular removable partial denture. *A*, Occlusal view of the completed maxillary restorations. *B*, Occlusal view of the completed mandibular restorations.

Step 18 (*Fig. 377*). Insert the restorations temporarily with the exception of the five porcelain jacket crowns. These are seated with oxyphosphate of zinc cement or Di-Cem. *A*, Labial view of the mandibular fixed partial denture. *B*, Lingual view of the fixed partial denture.

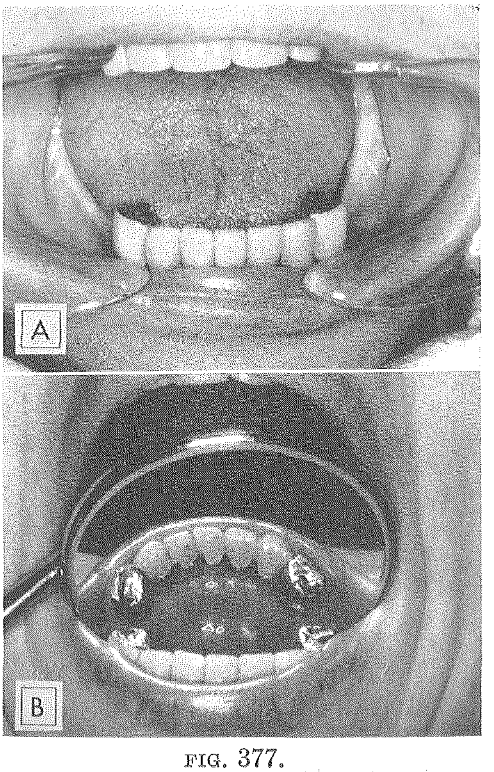


FIG. 377.

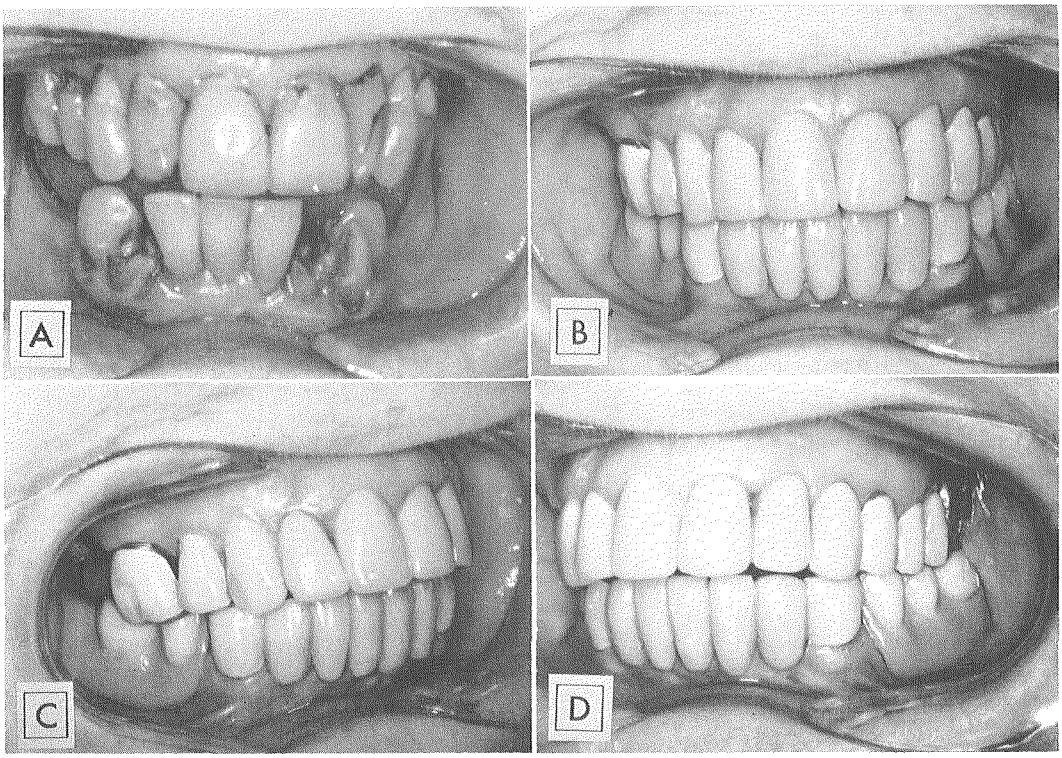


FIG. 378.

Step 19 (Fig. 378). After all adjustments are made and the patient is comfortable, the crowns and fixed partial dentures are cemented permanently. *A*, The patient before treatment. *B*, Anterior view after occlusal rehabilitation. *C* and *D*, Lateral views of the completed case.

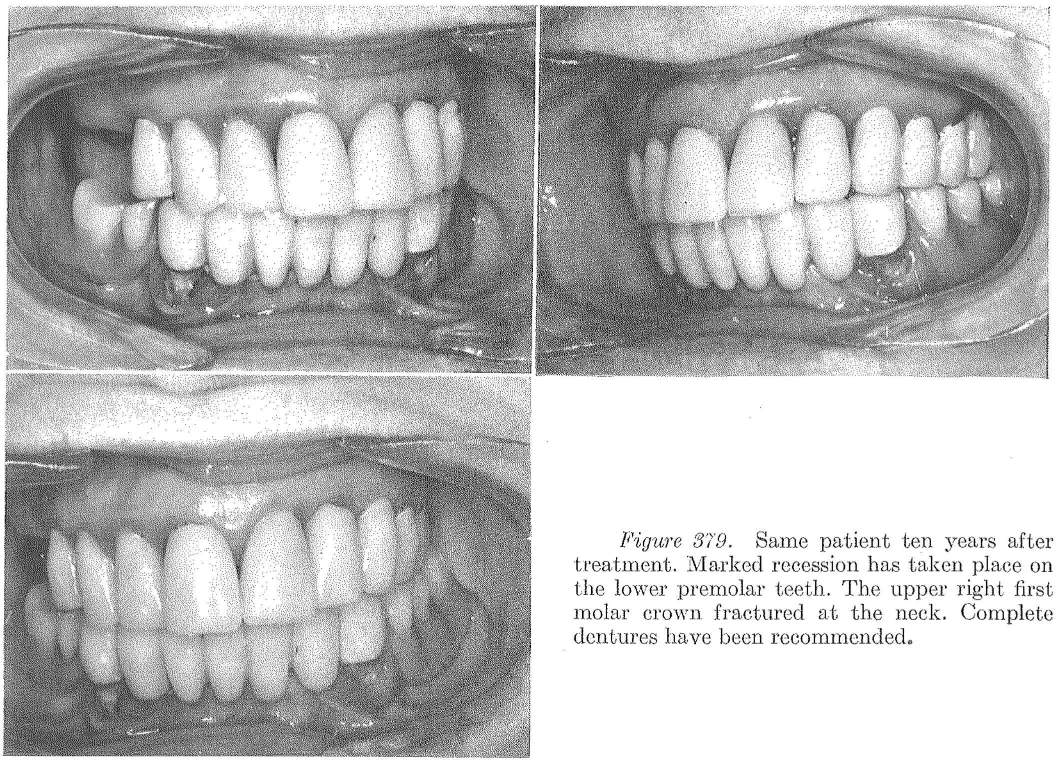


Figure 379. Same patient ten years after treatment. Marked recession has taken place on the lower premolar teeth. The upper right first molar crown fractured at the neck. Complete dentures have been recommended.

17

GROUP III

Procedures in Rehabilitating a Dysfunctioning Occlusion with the Aid of Maxillary Surgery or Orthodontic Treatment

Examination

The patient, a woman of 45 years, is physically healthy but psychologically disturbed because of the prognathous mandible. Her strong desire for esthetic improvement in general is apparent by the surgical correction of her nose (Fig. 380*A*). Although the esthetics are her chief complaint, restoring her occlusion to proper function must receive primary consideration. The study casts show the marked asymmetry between the mandible and the maxillae (Fig. 380*E*). All of the molars and one bicuspid on each side of the mandible are missing, and the patient cannot masticate effectively. Several prosthetic restorations in the past did not help her in this regard, and as a result she does not wear the removable partial denture with clasps. This accentuates the prognathism. Her occlusion, such as it is, functions only on the anterior teeth. The gingivae are comparatively healthy. Her interocclusal clearance measures approximately 2.5 mm. The anterior teeth have cervical silicate cement restorations and one mandibular incisor is chipped.

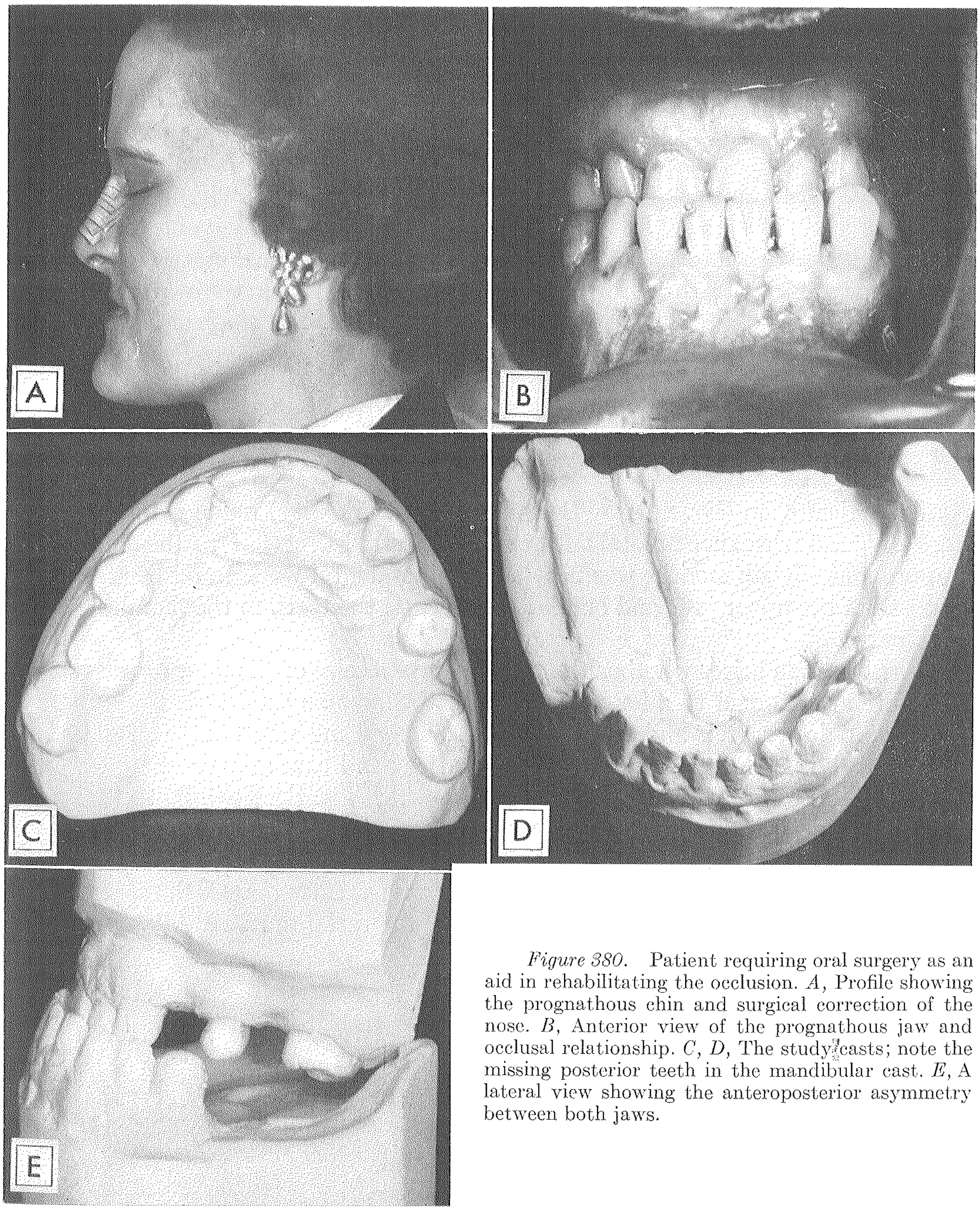


Figure 380. Patient requiring oral surgery as an aid in rehabilitating the occlusion. *A*, Profile showing the prognathous chin and surgical correction of the nose. *B*, Anterior view of the prognathous jaw and occlusal relationship. *C*, *D*, The study casts; note the missing posterior teeth in the mandibular cast. *E*, A lateral view showing the anteroposterior asymmetry between both jaws.

Treatment Plan

Only a radical procedure can help make it possible for the prosthodontist to rehabilitate such a mouth and bring about a successful, functioning occlusion. At the same time, the esthetics of the chin can be improved. It is therefore recommended that an oral surgeon reduce the mandible surgically. After healing, this patient can then be treated as a patient in group I class 3 (loss of the occlusal vertical dimension because all posterior teeth in one jaw are missing and those remaining are not in an acceptable occlusal relationship). The mandibular first bicuspids will receive acrylic resin veneer crowns to support a removable lingual bar partial denture with internal attachments. To improve upon the esthetics, the six mandibular anterior teeth will be treated with porcelain jacket crowns. Two fixed partial dentures will replace the missing maxillary teeth. The six maxillary anterior teeth will receive porcelain jacket crowns.

Treatment

An oral surgeon (Dr. Stanley Behrman, New York City) reduced the mandible surgically, and permanent metal sutures were inserted (Fig. 381). A healing period of approximately six months was necessary before dental work could be started on the teeth in the upper jaw, and one full year before the teeth in the mandible could be prepared.

The question arises whether the tongue and muscles of the floor of the mouth, heretofore accustomed to a longer vestibule, will have any deleterious effect upon the reduced lower arch and its restorations. Only time will tell. Such a treated patient is advised that postoperative observations and care are essential at regular intervals. This case illustrates the extremes to which a patient will go to secure the esthetics she desires. Figure 390 illustrates the patient seven years after completion of the occlusal rehabilitation. The patient is still comfortable and experiences no ill effects from the reduced mandible. It was necessary for her to seek the services of a plastic surgeon to reduce the length of some of the facial muscles. A "face lifting" added to the esthetic improvement.

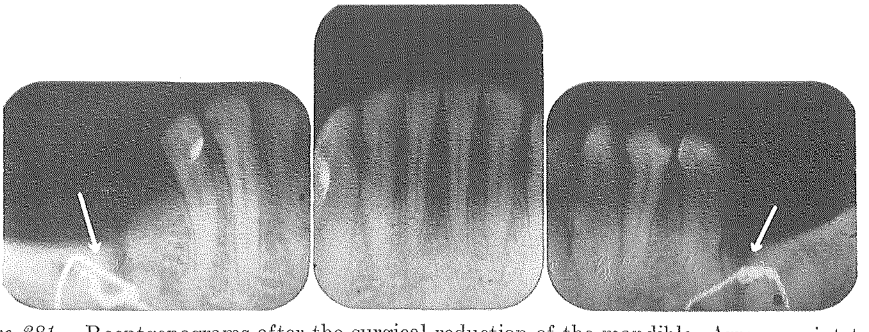


Figure 381. Roentgenograms after the surgical reduction of the mandible. Arrows point to the wire ligatures.

Step 1 (*Fig. 382*). Prepare all of the teeth in the maxillae for porcelain jacket crowns and full coverage restorations for the fixed partial dentures. This is accomplished in several appointments. Take band impressions and construct metal dies and cast transfer copings for these dies. With the transfer copings in place, take a plaster impression of the upper jaw and an alginate impression of the lower jaw.

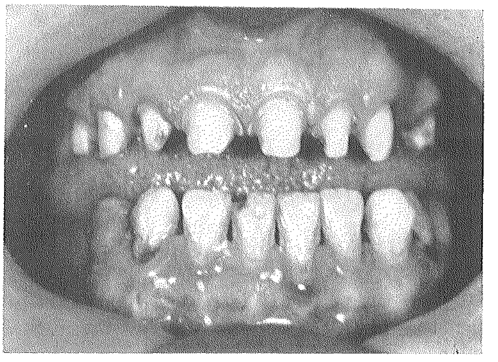


FIG. 382.

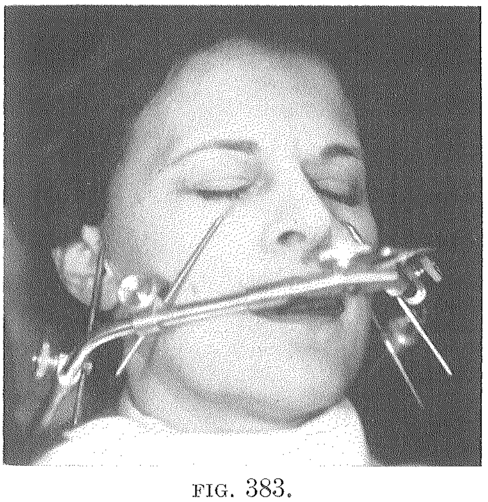


FIG. 383.

Step 2 (*Fig. 383*). Fabricate an occlusal rim for the mandible, and insert it in the mouth. Trim the wax until the contact with the maxillary teeth comes within the limits of the patient's interocclusal clearance. With the facebow, transfer this relationship to the articulator.

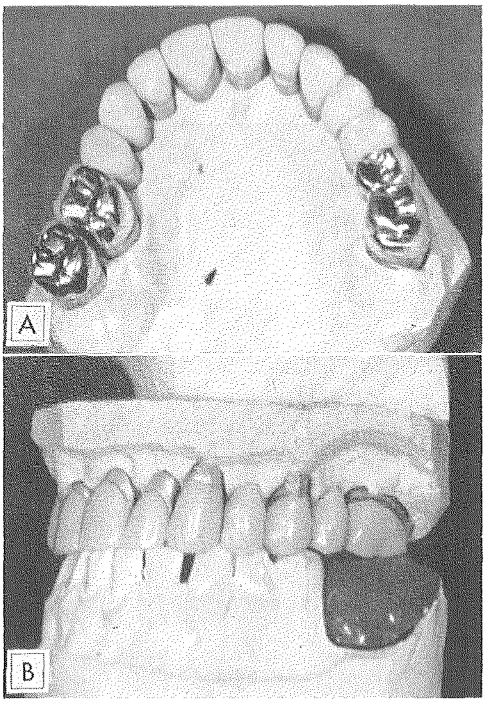


FIG. 384.

Step 3 (Fig. 384). Construct six porcelain jacket crowns and fixed partial dentures to replace the missing teeth. *A*, Occlusal view of the maxillae with the completed restorations. *B*, The maxillary restorations in occlusion with the anterior mandibular teeth and the occlusal rim.

Step 4 (Fig. 385). Cement all of the upper restorations in the mouth and after the mandible is healed sufficiently, prepare the remaining teeth in the lower jaw for full coverage restorations.

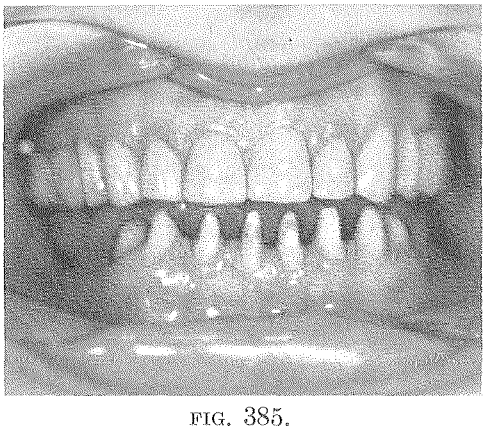


FIG. 385.

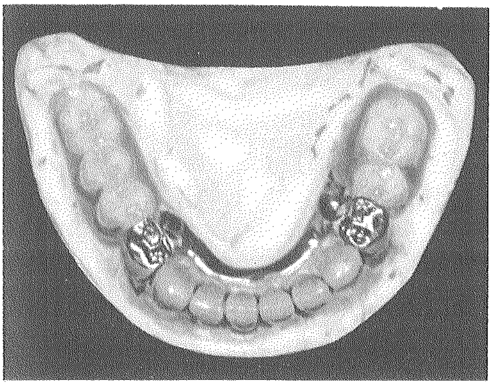


FIG. 386.

Step 5 (*Fig. 386*). Fuse six porcelain jacket crowns for the anterior teeth and construct acrylic resin veneer crowns on the bicuspids. These bicuspid retainers house internal attachments for the removable partial denture.

Step 6 (*Fig. 387*). Cement the porcelain jackets on the teeth permanently and cement the remaining restorations with a temporary medium until the patient is comfortable. *A*, Anterior view of the completed restorations. *B*, Profile view of the patient after surgical reduction of the mandible.

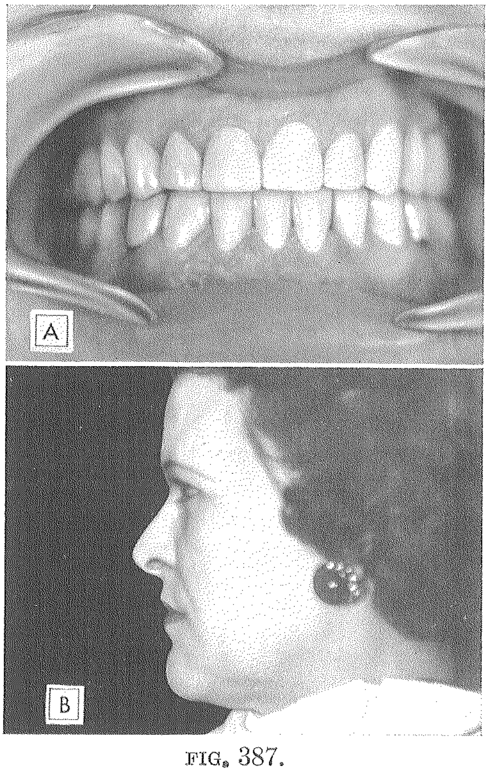


FIG. 387.

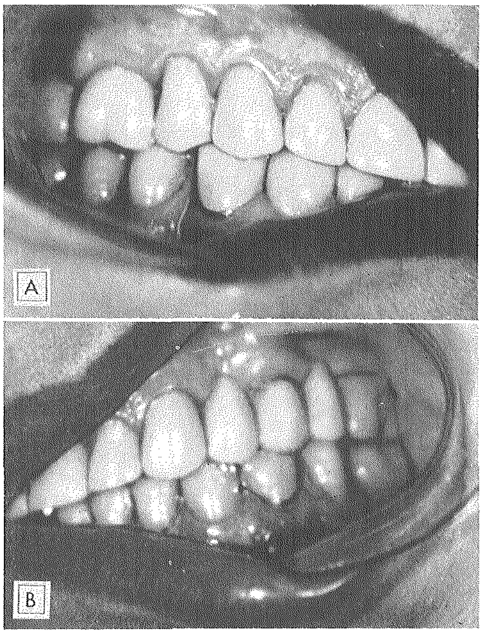


FIG. 388.

Step 7 (*Fig. 388*). Cement all the restorations permanently. Make occlusal adjustments just as in complete dentures. *A* and *B*, Lateral views showing cuspal interdigitation of the teeth.

Figure 389*A* shows the study casts before rehabilitation. Figure 389*B* shows the casts after complete rehabilitation.

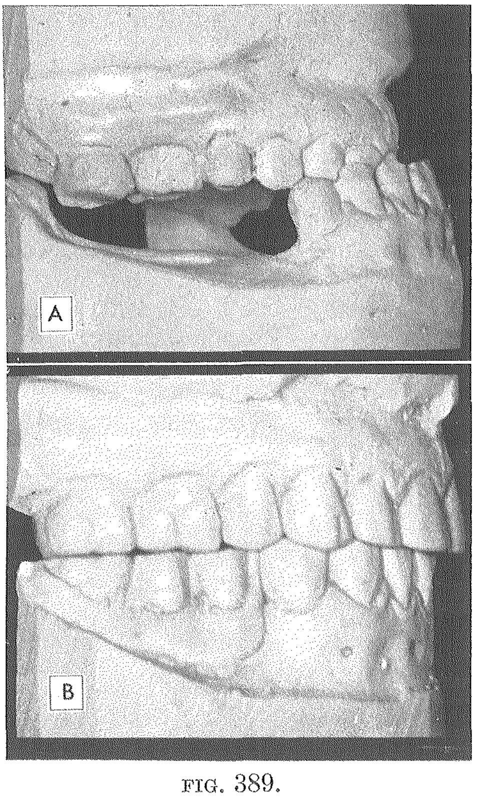


FIG. 389.

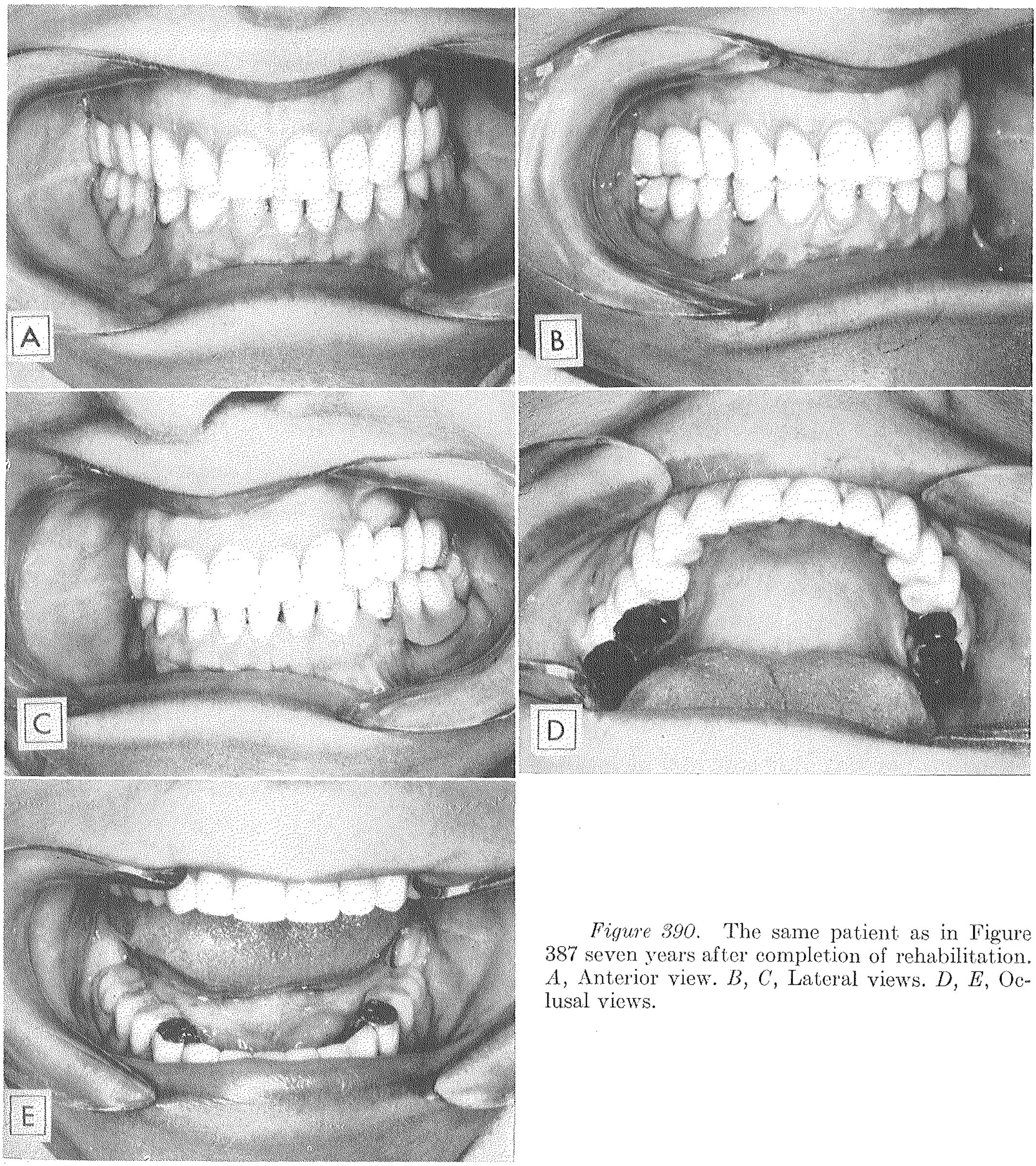


Figure 390. The same patient as in Figure 387 seven years after completion of rehabilitation. *A*, Anterior view. *B*, *C*, Lateral views. *D*, *E*, Occlusal views.

ORTHODONTIC AID

Orthodontic procedures are often indicated as an aid in occlusal rehabilitation, particularly in young adults. Generally, the movement of teeth is not recommended in patients of middle age. However, in a few cases the orthodontist has been successful in moving teeth so that they can be splinted by the prosthodontist in rehabilitation of the occlusion. The practice of orthodontics is a specialty, covered in texts by orthodontists.

The patient whose study casts are shown in Figure 391 is a young pretty girl of 21 years who is aware of the poor esthetics of her teeth. The maxillae were protrusive and the maxillary right bicuspids were malposed. The anterior teeth as well as the molars were extraordinarily large. The bicuspids in the mandible were malposed and disturbed her entire occlusion. Orthodontic treatment corrected the malocclusion. One bicuspid on each side of both jaws was removed in the treatment procedures. The study cast of the mandible shows a small space between the first molar and the bicuspid on each side (Fig. 392*E*). The teeth in the upper jaw responded more favorably to the extraction of the bicuspids; the space left by the missing bicuspid closed up on each side. The anterior teeth in the upper jaw are filled with discolored restorations. The posterior teeth possess old alloy restorations that have outlived their usefulness.

After the orthodontic correction of her occlusion the patient is classified in group II class 1, and the existing comfortable occlusal relationship must be maintained. The first step in the rehabilitation procedures is the preparation of the four first molars for full coverage restorations (Fig. 393). The maxillary first molars receive acrylic resin veneer crowns. The mandibular first molars receive porcelain fused to gold crowns with small cantilever extensions. This type of restoration was decided upon in the lower jaw to improve the esthetics (Fig. 394).

The next procedure is the construction of porcelain jacket crowns for the maxillary six anterior teeth and the first bicuspids. The remaining molars in both jaws are covered with acrylic resin veneer crowns. The mandibular anterior teeth and first bicuspids are not touched at all because they are healthy and sound and do not

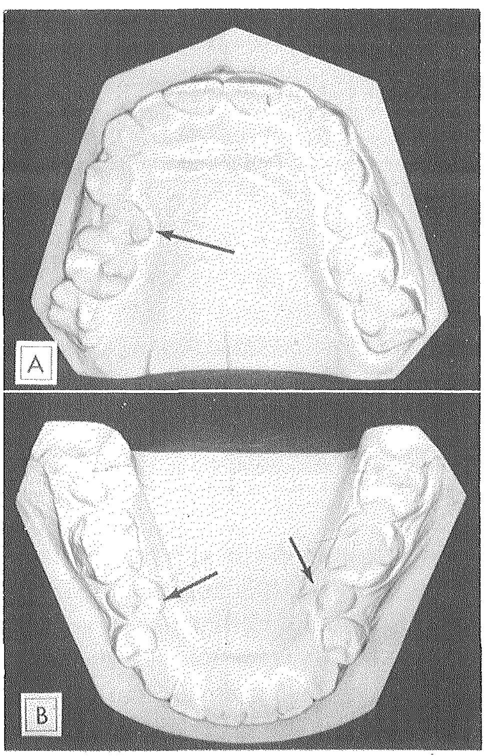


Figure 391. Study casts before orthodontic treatment. Arrows point to malaligned bicuspids.

contribute to any esthetic problem. The porcelain jacket crowns are made a trifle narrower and the posterior teeth in the upper jaw are constructed a little wider. This procedure gives the effect of not-too-wide anterior teeth and improves the esthetics measurably. Figure 395 illustrates the completed rehabilitation.

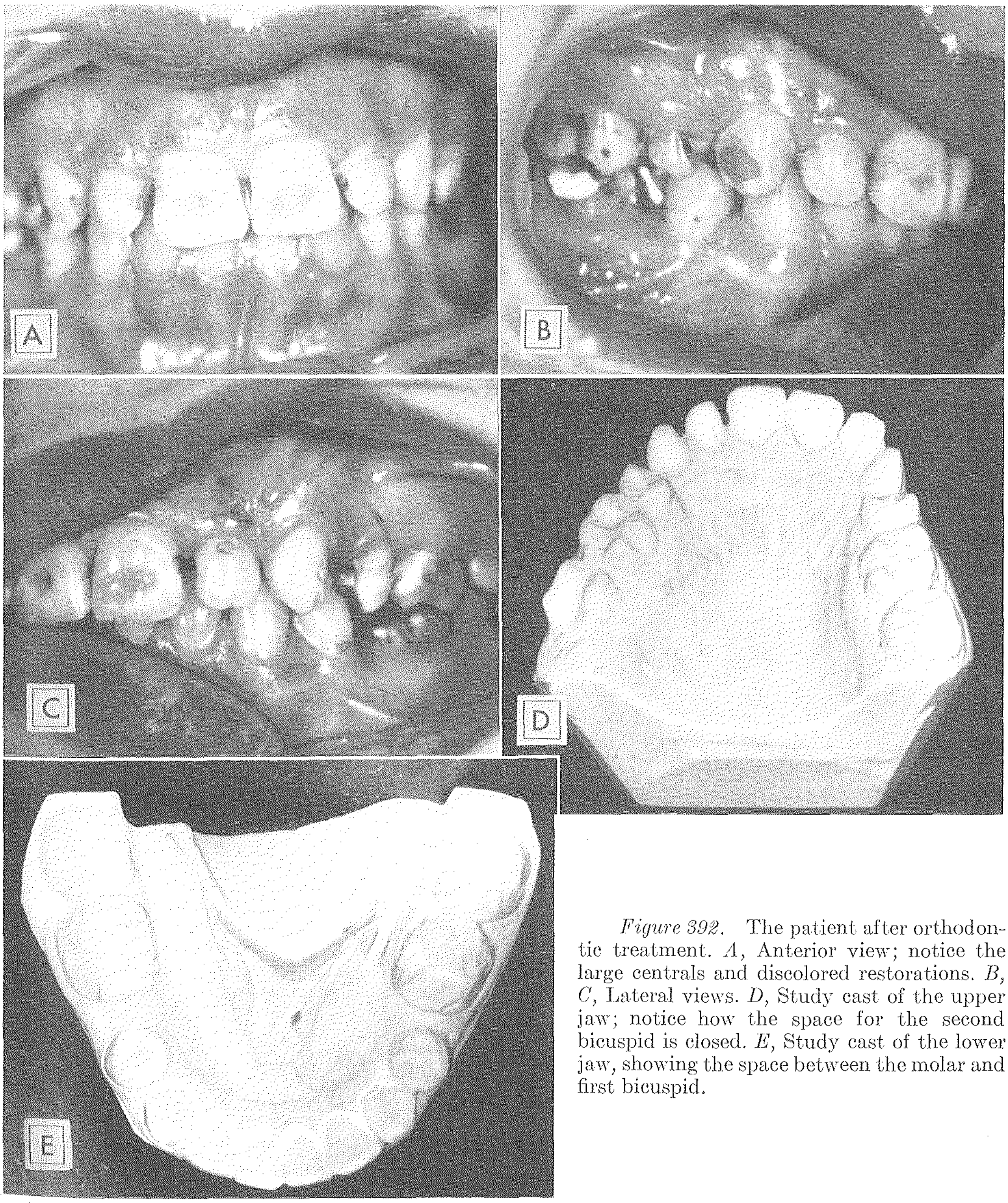


Figure 392. The patient after orthodontic treatment. *A*, Anterior view; notice the large centrals and discolored restorations. *B*, *C*, Lateral views. *D*, Study cast of the upper jaw; notice how the space for the second bicuspid is closed. *E*, Study cast of the lower jaw, showing the space between the molar and first bicuspid.

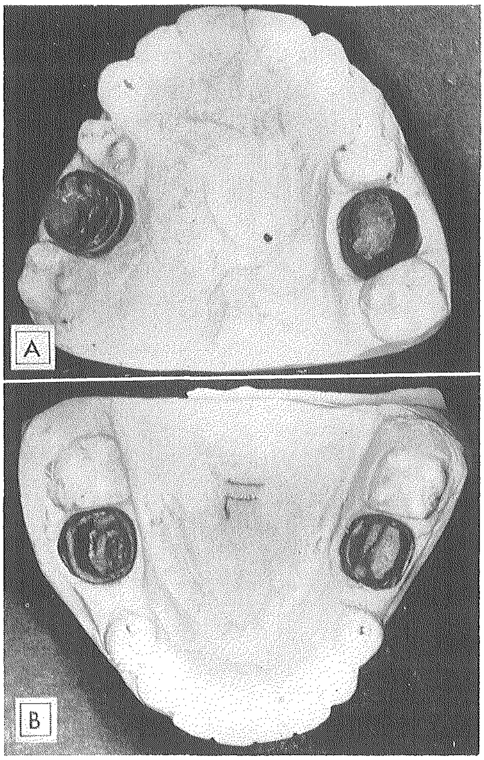


Figure 393. The dies for the four first molars.

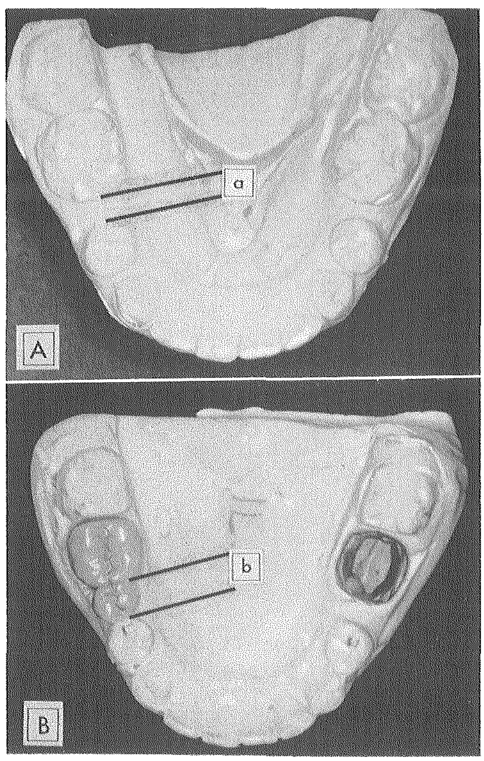


Figure 394. *A*, The space (*a*) is too narrow for a bicuspid. *B*, Porcelain fused to a gold frame makes it possible to construct a bicuspid of normal size (*b*).

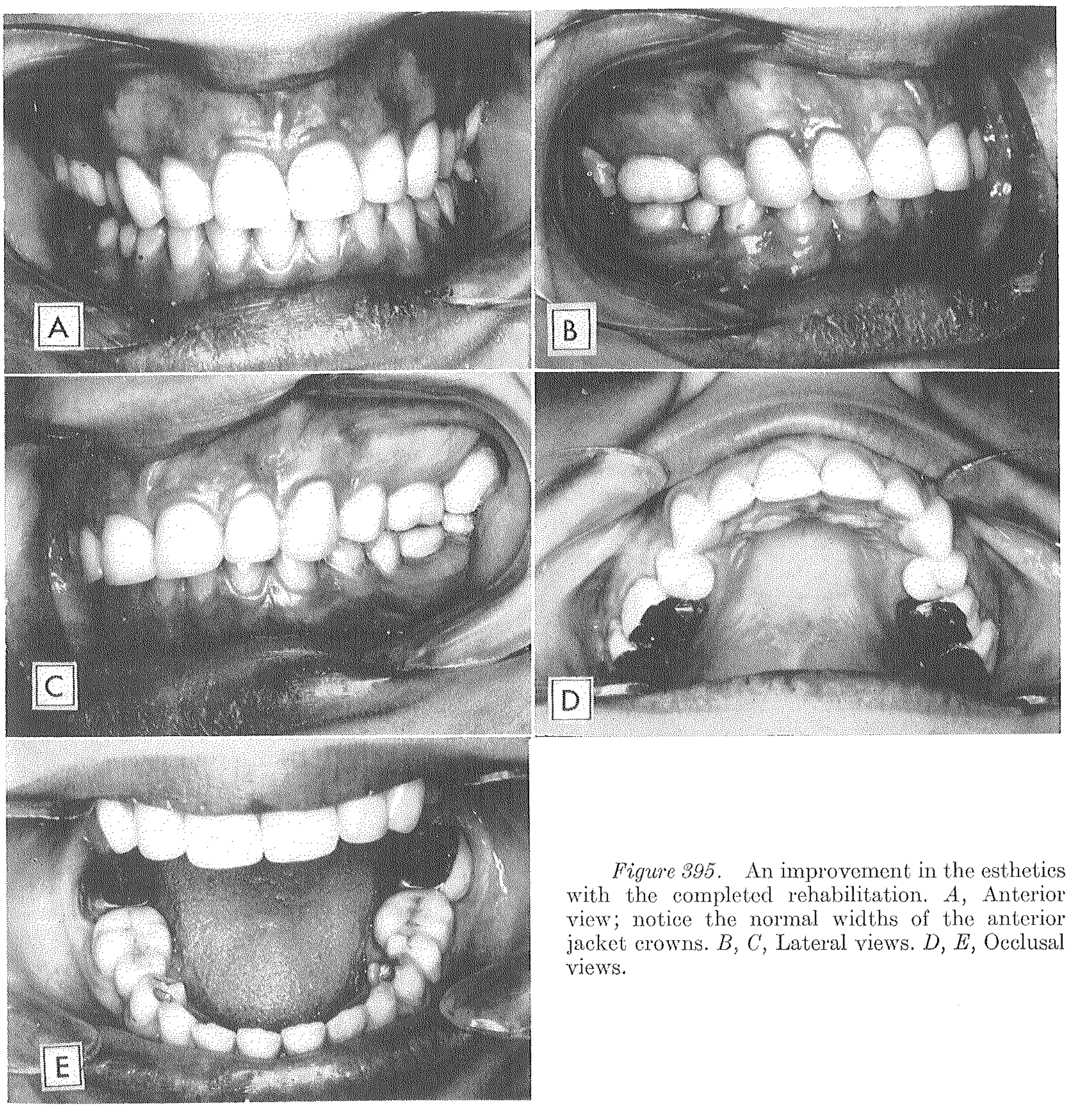


Figure 395. An improvement in the esthetics with the completed rehabilitation. *A*, Anterior view; notice the normal widths of the anterior jacket crowns. *B*, *C*, Lateral views. *D*, *E*, Occlusal views.

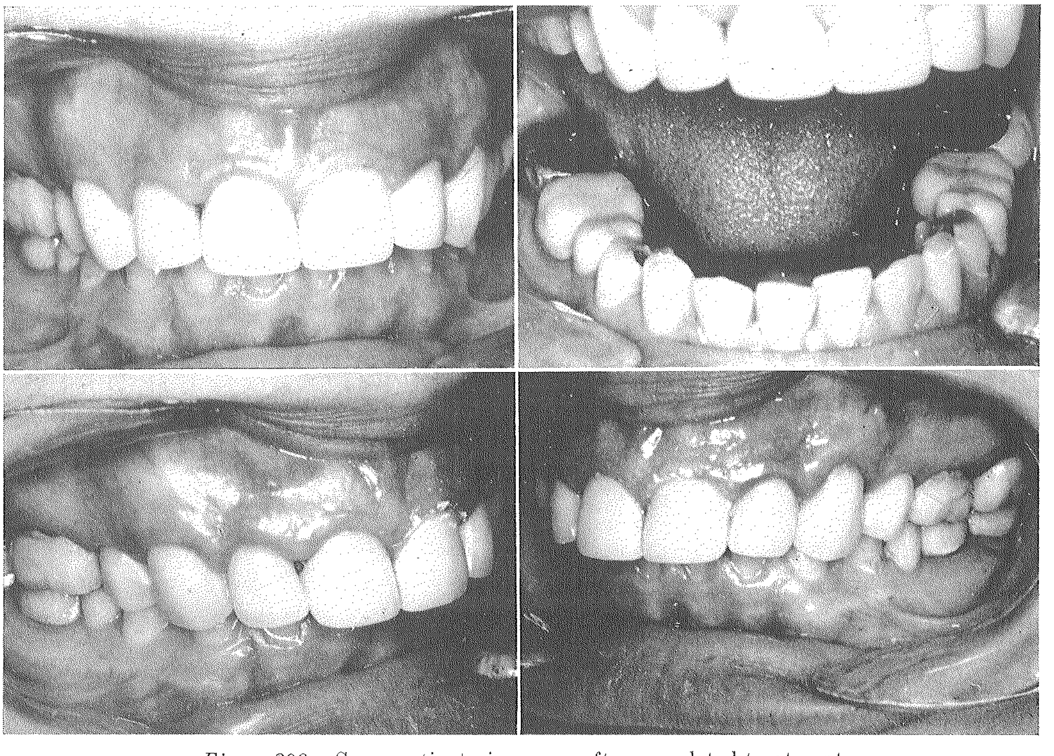


Figure 396. Same patient nine years after completed treatment.

18

GROUP IV

Sectional Treatment in Occlusal Rehabilitation

There are patients who are unable to undergo extensive dental treatment in the rehabilitation of both jaws. This inability may be due to some physical ailment or abnormality. The time consumed in the operative procedures may tax the health of the patient. Then, there is the person who cannot afford the cost of rehabilitating the entire dentition at one time. The age of the patient, either very young or very old, sometimes necessitates treatment in part, over extended periods, until rehabilitation in full is completed. Sectional treatment cannot be recommended in all cases, because the teeth or the occlusion may not lend itself to partial therapy.

The patient who is to be treated in stages is examined and the treatment plan is outlined and presented in the same way as previously described. All old and inadequate restorations are removed and the decay is excavated, then the teeth are filled with a good strong cement. Sectional treatment may include one complete jaw or a quadrant of one jaw. It may include the construction and insertion of one fixed partial denture. It is indicated primarily when the existing occlusion is satisfactory, particularly in group II patients.

SECTIONAL TREATMENT BECAUSE OF ECONOMICS

Figure 397 illustrates a patient who is concerned about his upper teeth. An old fixed partial denture from canine to canine suddenly broke off, taking the crowns

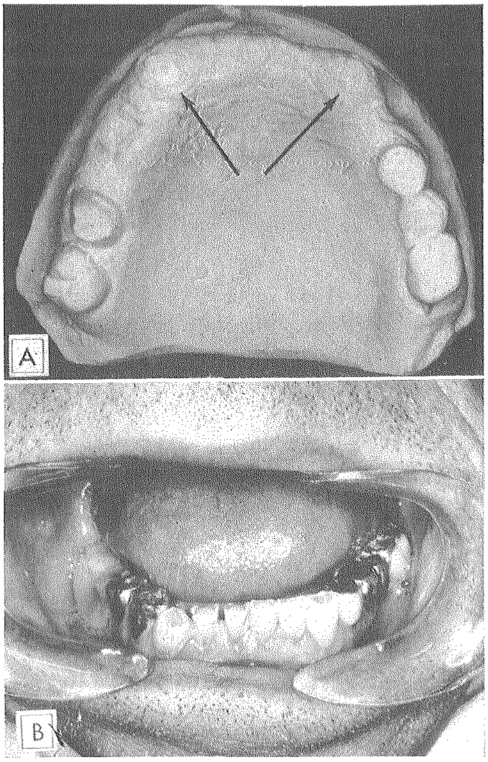


Figure 397. Sectional treatment of the upper jaw only. *A*, Two canine roots remain in the anterior part of the jaw. *B*, The lower jaw, which will not be included in the treatment at this time.

of the abutment teeth with it. Prior to this accident, the occlusion functioned to satisfaction.

Examination

The patient, a professional man of 68 years, is physically healthy but slightly nervous. The maxillary central and lateral incisors are missing and the canines, which heretofore supported a fixed partial denture, are broken off at the cervical margins, slightly beneath the gingiva (Fig. 397*A*). The maxillary right first and second bicuspids and the first molar are missing. An old fixed partial denture supports the upper left molar pontic. The mandibular incisors and canines are worn and present facets with sharp enamel rims. The bicuspids have full gold crowns and support a distal extension removable partial denture with internal attachments. The gingival tissues are healthy and strong. The interocclusal clearance measures 2 mm. The upper right second molar occluding with its antagonist in the lower jaw is the only occlusal stop that can be used as a record of the patient's centric occlusion.

Treatment Plan

The patient cannot afford to undergo complete rehabilitation, so it is decided to rehabilitate the teeth in the maxillae first. The gingival tissues around the maxillary canine roots will have to be removed to expose more tooth structure for retention of the abutment retainers. Endodontic treatment is necessary for these two canine roots. A cast gold core with a post is advocated for each treated root. A preliminary occlusal rim will assist the occluding second molar on the right side in maintaining the satisfactory occlusal relationship. The old fixed partial denture on the left side will be removed. A new fixed partial denture will be constructed from the upper right second molar to the right canine and thence to the left canine. The veneer crown on the left canine will have a distal receptacle to house a cast lock-in device on the biscupid of the second bridge. This bridge will be a cast gold crown on the left third molar to the veneer crown on the first molar and will support a second molar and a large bicuspid pontic. By this plan, one complete fixed bridge is avoided.

(*Text continued on page 319.*)

Step 1 (*Fig. 398*). Complete the endodontic treatment on the canine roots. Remove sufficient gingival tissue from around each root to expose more of the tooth structure.

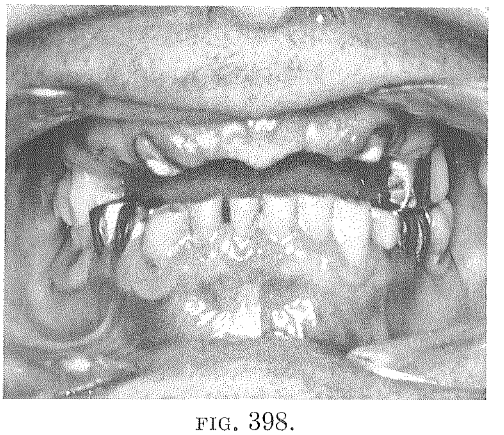


FIG. 398.

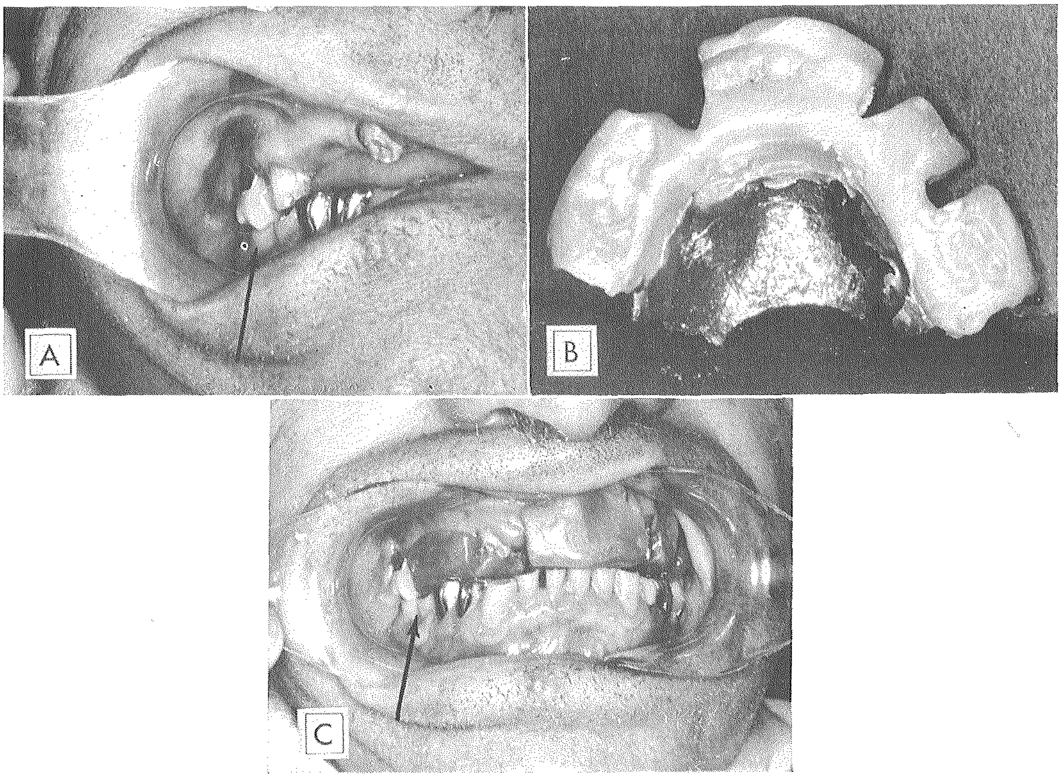


FIG. 399.

Step 2 (Fig. 399). Construct a preliminary occlusal rim from the study cast. Insert this in the mouth and trim the wax until the maxillary second molar occludes with its antagonist in the lower jaw. *A*, The occlusal stop of the maxillary molar and the one on the removable partial denture in the lower jaw. *B*, The preliminary occlusal rim. *C*, The preliminary occlusal rim trimmed until the guide teeth occlude.

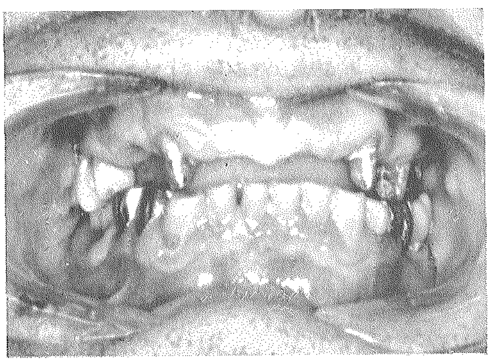


FIG. 400.

Step 3 (Fig. 400). Prepare the canine roots for the reception of cast gold cores. Take the impressions and articulate the casts. Construct a gold core with a post for each prepared root and cement them in permanently with oxyphosphate of zinc cement.

Step 4 (Fig. 401). Extend the shoulder of each root slightly beneath the gum. Prepare the remaining abutment teeth and take individual band impressions. From the dies, fabricate transfer copings and fit these copings on the prepared teeth. Take a plaster impression with the copings in position and, with the preliminary occlusal rim as a reference, mount the poured casts on the articulator.

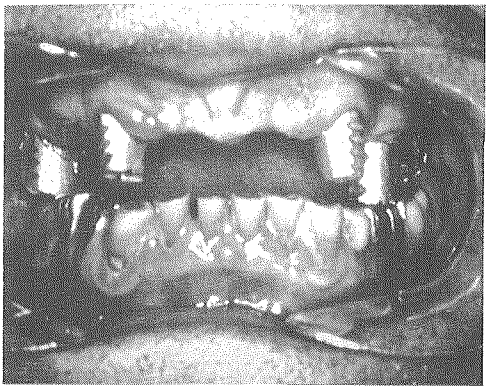


FIG. 401.

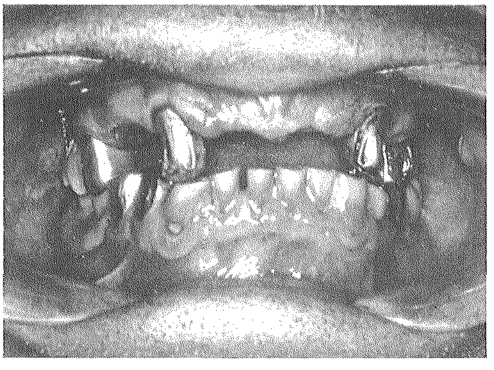


FIG. 402.

Step 5 (Fig. 402). Cast acrylic resin veneer crowns for the canines and bicuspids. Full gold crowns are cast for the last molar abutment teeth. Fit these castings on the teeth and make the required occlusal adjustments. Examine the gingival margins and see that the metal does not impinge upon the soft tissues.

Step 6 (Fig. 403). Take a wax occlusal registration with the abutment retainers in place, as a check bite to rearticulate the working cast. Follow with a full plaster impression of the upper jaw with these castings in place. Remount on the articulator after pouring the cast. Construct the framework for the two interlocking maxillary fixed partial dentures.

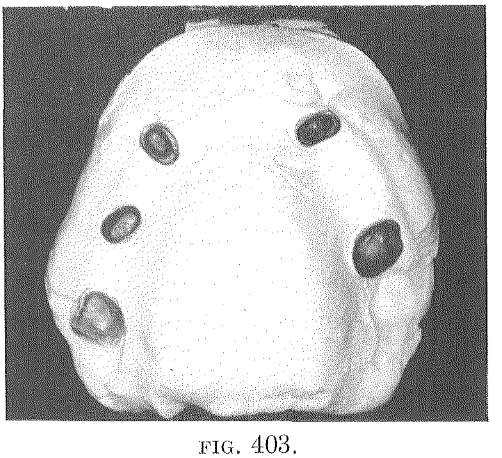


FIG. 403.

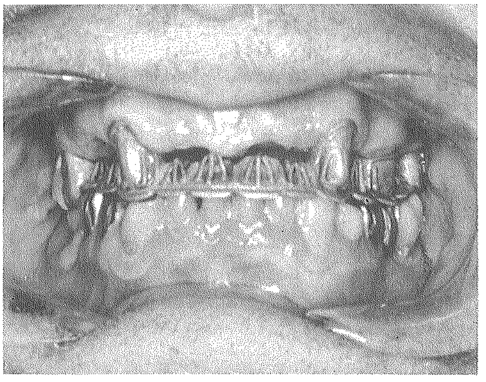


FIG. 404.

Step 7 (Fig. 404). Seat the frames for the two interlocking bridges on the teeth. The fixed partial denture on the right side extends from the first molar to the canine on the left side. The bridge on the left side extends from third molar to the first molar and second bicuspid, with a lock-in device that accommodates itself in a receptacle of the left canine retainer. Make the necessary occlusal adjustments on the cast occlusal gold surfaces.

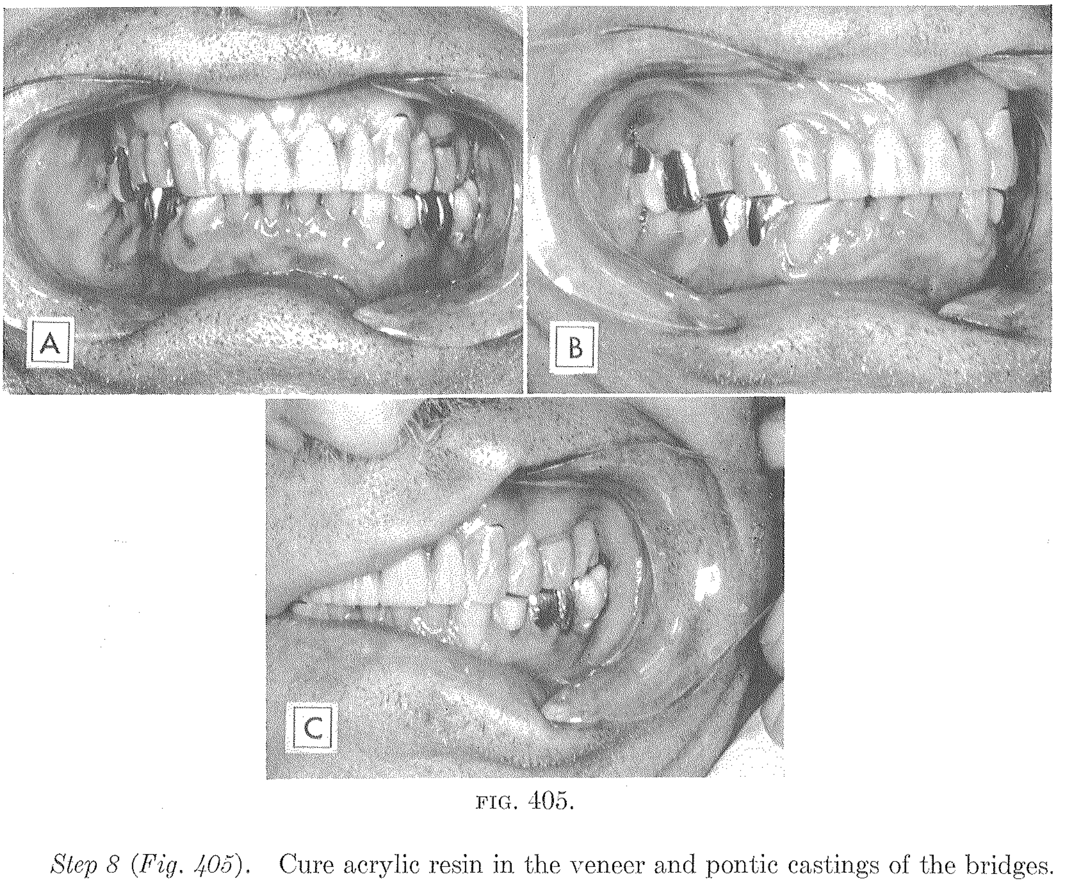


FIG. 405.

Step 8 (Fig. 405). Cure acrylic resin in the veneer and pontic castings of the bridges. When all adjustments have been made and the patient is comfortable, cement the fixed partial dentures in place. At a later date, the mandibular teeth can be rehabilitated to occlude with the restored maxillary ones. *A*, Anterior view of the completed restorations. *B* and *C*, Right and left lateral views.

SECTIONAL TREATMENT BECAUSE OF THE AGE OF THE PATIENT

Examination

The patient, a young girl of 12 years, is a physically healthy youngster but emotionally disturbed regarding her teeth. Even at this young age, esthetics are very important, and she appears very shy and self-conscious regarding the unattractive teeth (Fig. 406). She has developed bruxism and abnormal lip and swallowing movements. For three years prior to this examination she had been under orthodontic care and frequently heard discussion about her dentition including the fact that little could be done for her, and the possibility that she might be edentulous in a few years. This made the child nervous and bruxism developed. The gnashing and grinding took place at night and was so pronounced that the incisal edges of the mandibular deciduous central incisors wore down (Fig. 406*B*). Her swallowing habits became abnormal because she could not masticate. The bicuspid regions of both jaws were pulled in lingually. This is a case of partial anodontia, with only five permanent teeth in the maxillae and seven in the mandible. The roentgenograms show no permanent teeth that will erupt later (Fig. 407 and 408).

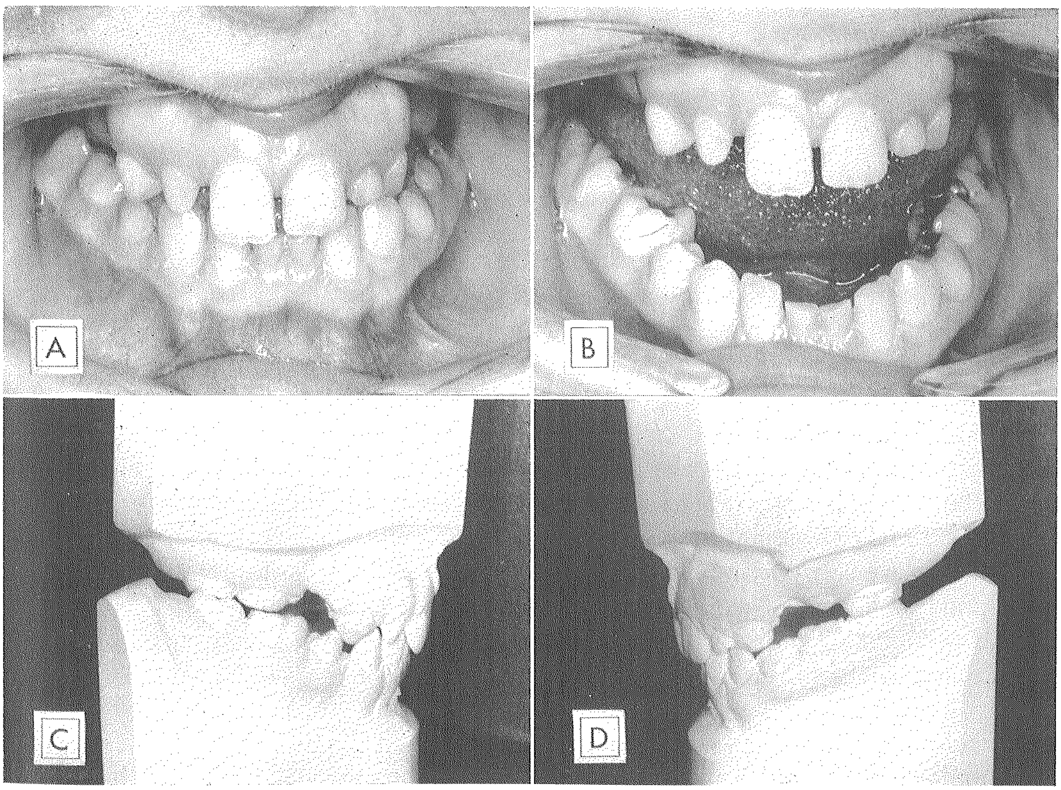


Figure 406. Sectional treatment of a condition of anodontia in a child of twelve. *A*, Anterior view, showing insufficient occlusion for normal function. *B*, The mandibular central incisors are worn at the edges due to bruxism. *C*, *D*, Lateral views of the study casts.

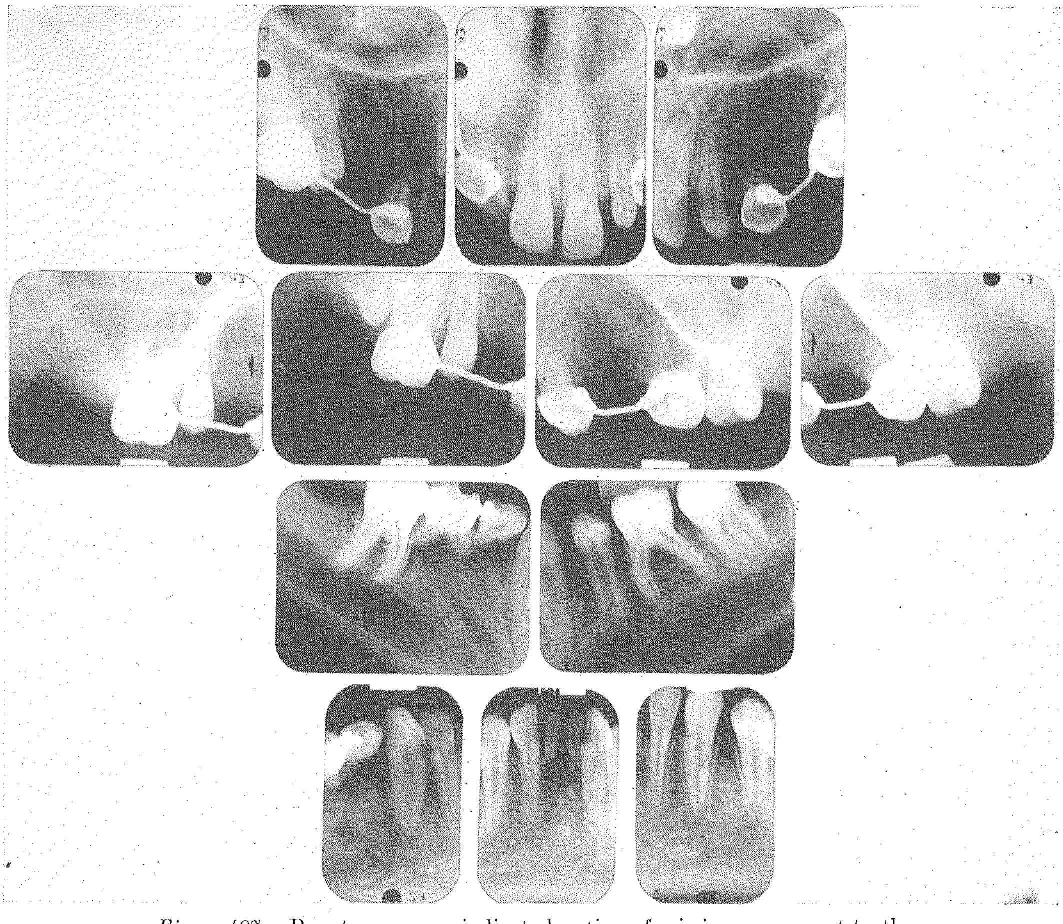


Figure 407. Roentgenograms indicate location of missing permanent teeth.

Maxillary Teeth. The permanent maxillary central incisors have elongated and seem to fit into the worn deciduous antagonists in lateral protrusive excursions (Fig. 409). The permanent right lateral incisor is peg-shaped and the left lateral incisor is deciduous. Both maxillary canines are deciduous and the permanent canines are congenitally missing. There is a large space between the right deciduous canine and the second deciduous molar. All the permanent molars are missing. Only one permanent bicuspid has erupted in the region where a normal second molar would be. There is a space between the left deciduous canine and the second deciduous molar. The permanent molars on this side are congenitally missing. A permanent second bicuspid is partially erupted and makes mesial contact with the second deciduous molar.

Mandibular Teeth. The central incisors are congenitally missing in the mandible and the permanent lateral incisors and canines on both sides are present and erupted. The permanent bicuspids on the right side of the mandible are congenitally missing, as are the second and third permanent molars. Only the first permanent molar has erupted, and the two deciduous molars are still in place. The left side presents only one permanent bicuspid and one permanent first molar, and the deciduous molar is retained.

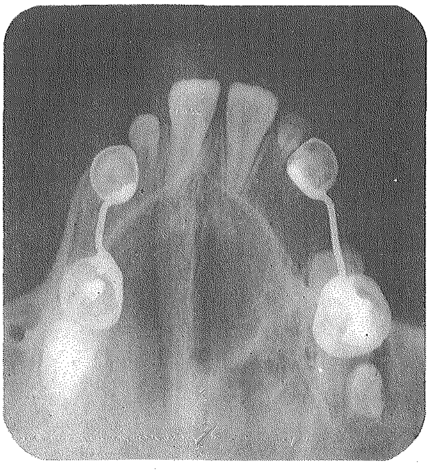


Figure 408. Roentgenogram of the upper jaw, occlusal view.

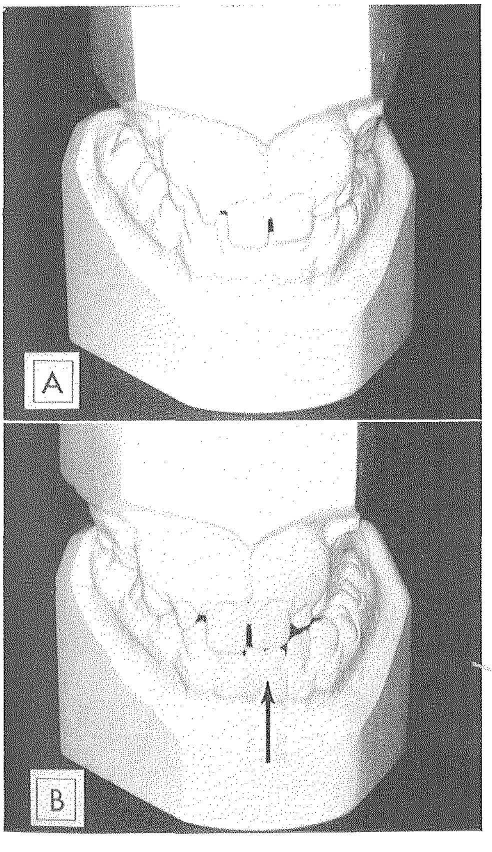


Figure 409. Study casts showing the path of bruxism. *A*, Casts in centric occlusion. *B*, Maxillary cast in lateral bruxism movement. Notice the maxillary central incisor adapting itself in the worn edge of the deciduous central incisor of the lower jaw.

The study casts show the asymmetry of the jaws and the pulled-in alignment of the teeth. The gingival tissues are comparatively healthy. The occlusion is inadequate and proper mastication is difficult.

Treatment Plan

This patient must be treated immediately to overcome the psychological disturbances caused by the objectionable esthetics. It is imperative that masticatory function be established. Every attempt will be made to retain the deciduous teeth as long as possible. Something must be done to prevent further elongation of the maxillary central incisors, the two permanent teeth that will be so important for restorative work in later years. A fixed partial denture is contemplated for each side of the maxillae from deciduous molar to deciduous canine to bring about an occlusion for mastication. The molar on each side will receive an acrylic resin veneer crown. Each deciduous canine will receive a cast gold coping with a metal lingual stop and the crown and pontic will be acrylic resin. It is advisable to wait and see if the partially erupted permanent bicuspid on the left side will erupt further before a bridge is considered. If this tooth does not erupt further, then the bridge will by-pass it. The peg-shaped permanent lateral incisor and the left deciduous one will be treated with acrylic resin jacket crowns.

The mandibular deciduous and permanent teeth will be left alone at this time, with the exception of the two partially worn deciduous central incisors. After the maxillary permanent central incisors are beveled off a trifle, the two partially worn mandibular deciduous incisors will receive two acrylic resin jacket crowns for esthetics.

The parents are told that this patient will be under dental treatment for the rest of her life and that it will be necessary to make replacements at intervals. The treatment and recommended procedures will depend upon the length of time the deciduous teeth will be retained, and upon the reaction in jaw growth to the fixed restorations. The longevity of the color and the wear of the acrylic resin restorations will also be determining factors in changing the crowns and bridges. One factor is very important, and that is that something must be done for this young patient as soon as possible. The treatment will be extended over the years, therefore it can be considered in the classification of sectional treatment.

Treatment

The maxillary right side received an acrylic crown on the peg-shaped lateral incisor and a fixed partial denture from the deciduous canine to the second deciduous molar. Figure 410 shows: *A*, the teeth prepared on the right side; *B*, the working upper cast with the dies; and *C*, the completed restorations.

The maxillary left side received the fixed partial denture with the acrylic pontic by-passing the partially erupted second bicuspid. Figure 411 shows: *A*, the abutment teeth prepared; *B*, the working cast. Notice the partially erupted permanent bicuspid that will erupt no further; and *C*, the completed fixed partial denture.

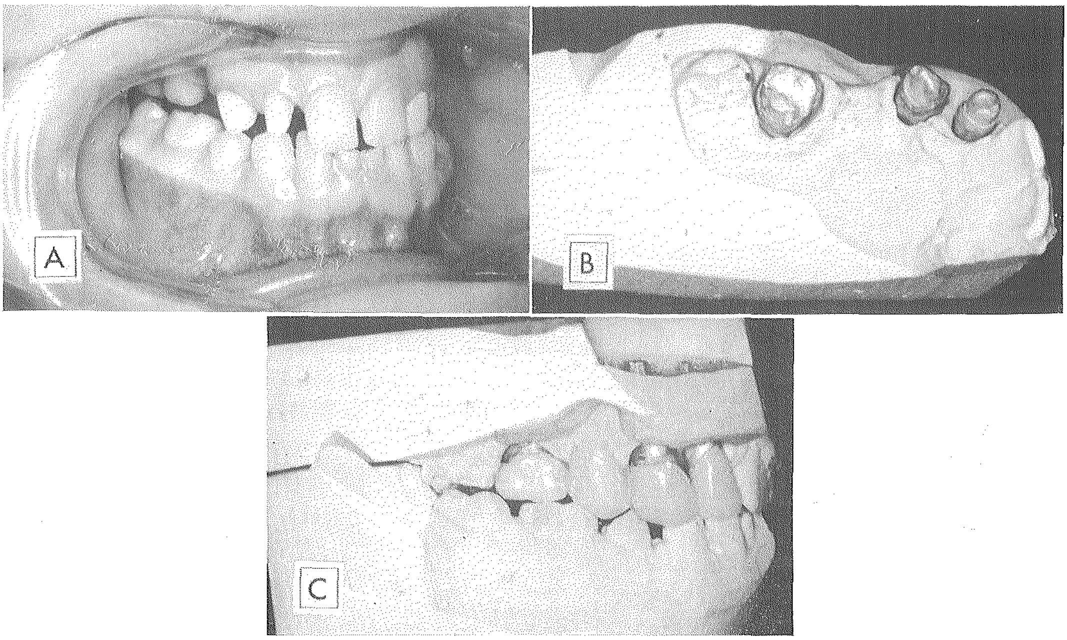


FIG. 410

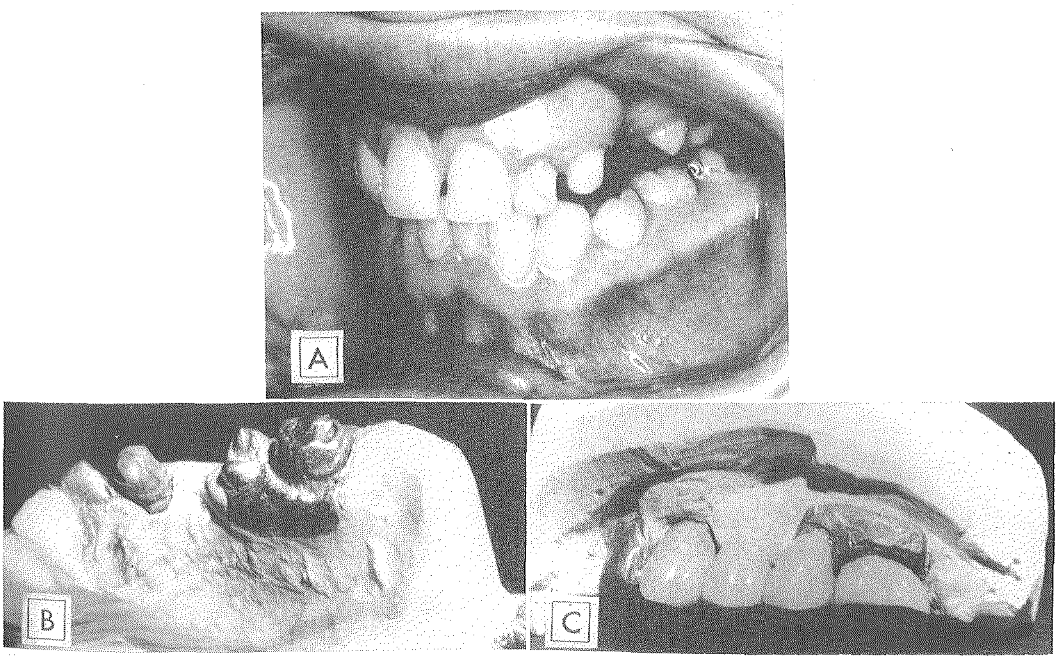


FIG. 411.

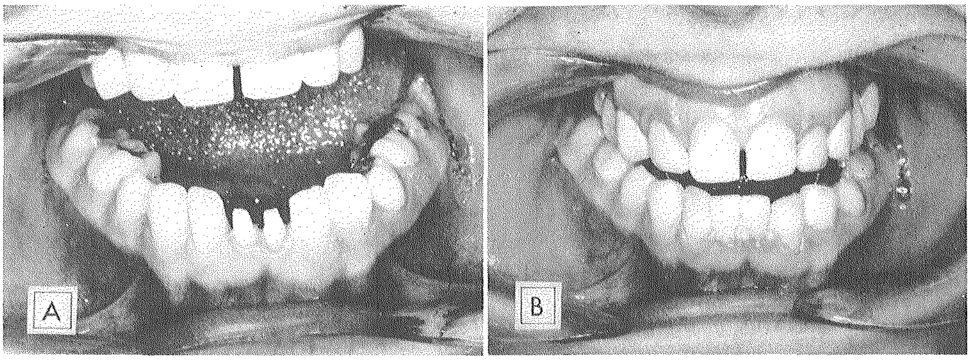


FIG. 412.

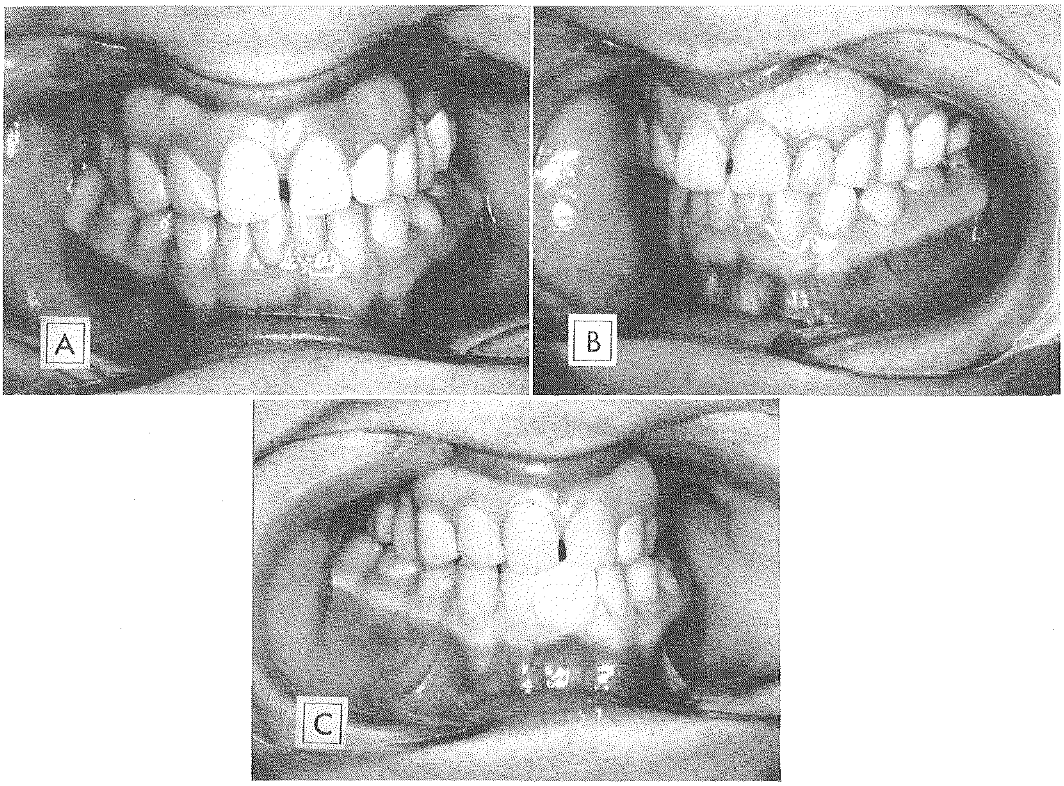


FIG. 413.

The mandibular deciduous central incisors were prepared for acrylic resin crowns. These were splinted together for retention. In Figure 412*A* the deciduous teeth have been prepared. Figure 412*B* shows the acrylic resin jacket crowns inserted.

All of the restorations are inserted permanently on the teeth. The esthetics are improved and occlusal function is established. This patient is placed on maintenance treatment. Every six months, study casts will be poured to note any changes in the restorations because of jaw development. Psychologically, the patient has improved. The interesting point will be the length of time these restorations will endure. Figure 413*A* is an anterior view of the completed mouth of the child; Figure 413*B* and *C* are left and right lateral views.

An excessive vertical overlap combined with an excessive horizontal overlap should not be altered when rehabilitating the occlusion. Figure 414 illustrates a middle-aged patient with an excessive vertical overlap who requires reconstruction. Because of economic reasons, the treatment plan was classified as sectional. The upper jaw required immediate attention. A preliminary occlusal rim was constructed (Fig. 414*B*) and the tolerant centric occlusion was recorded along with the few remaining guide teeth. The four maxillary incisors were removed and after healing, the maxillary canine and first premolar on the right side and the canine and second molar on the left side were prepared for cast gold and veneer crowns with cutouts to receive internal attachments. The preliminary occlusal rim previously constructed was inserted to check whether sufficient tooth structure was reduced from the occlusal and incisal areas (Fig. 414*C*). The full coverage restorations were cast, tried on the prepared teeth, and ground into occlusion in accordance with the method described on page 189. The preliminary occlusal rim was inserted as an aid in maintaining the tolerant vertical dimension of occlusion (Fig. 414*D*). Figure 415 illustrates the final steps in the completion of the upper jaw. An anterior fixed partial denture from canine to canine was constructed and the original overlap and overjet

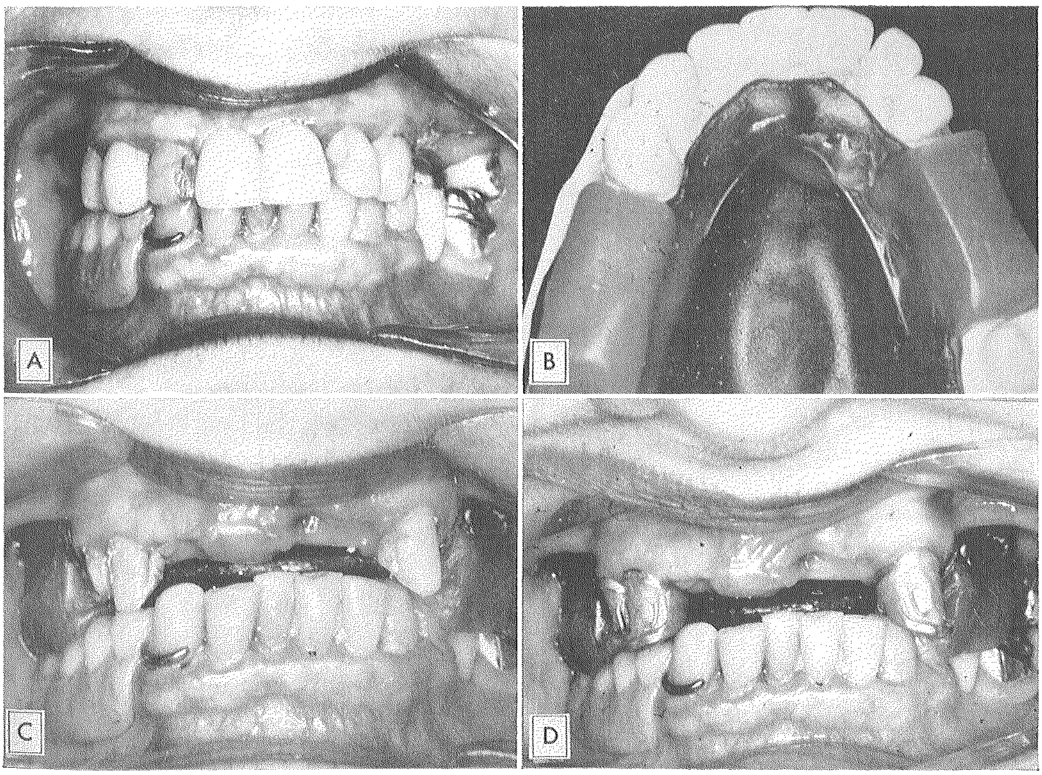


Figure 414. Sectional treatment. Only the upper jaw has been rehabilitated, because of financial reasons. *A*, Satisfactory functional occlusal relationship before treatment. *B*, Preliminary occlusal rim constructed and fitted prior to removal of the four maxillary incisors. *C*, Prepared four remaining teeth with the preliminary occlusal rim in position. *D*, Veneer castings in place with the preliminary occlusal rim in position.

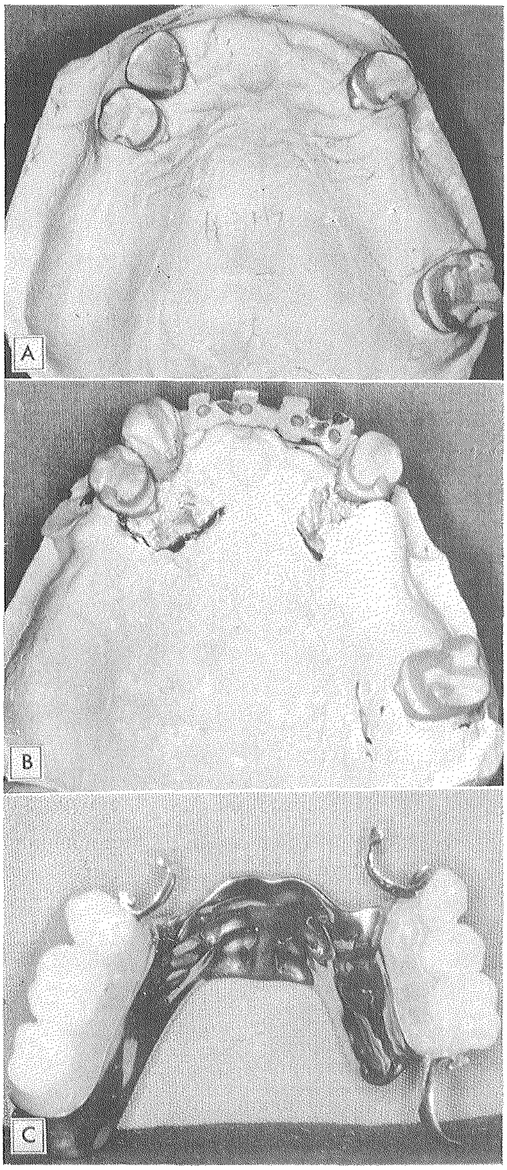


Figure 415. Same patient as shown in Figure 414. *A*, Veneer crowns on working cast with cutouts, and lingual shoulders for internal attachments and lingual arms to receive a removable partial denture. *B*, Anterior fixed bridge frame soldered to the canine retainers. *C*, The completed removable partial denture with internal attachments.

were maintained. Acrylic resin crowns were cured to the anterior metal frame because of the closeness of the occlusion. The mandibular incisors strike against the cingula of the acrylic jackets. An internal attachment removable partial denture completed the rehabilitation of the upper jaw. At another time, when economics permit, this patient will have the lower jaw treated and the occlusal relationship as well as the overlaps maintained.

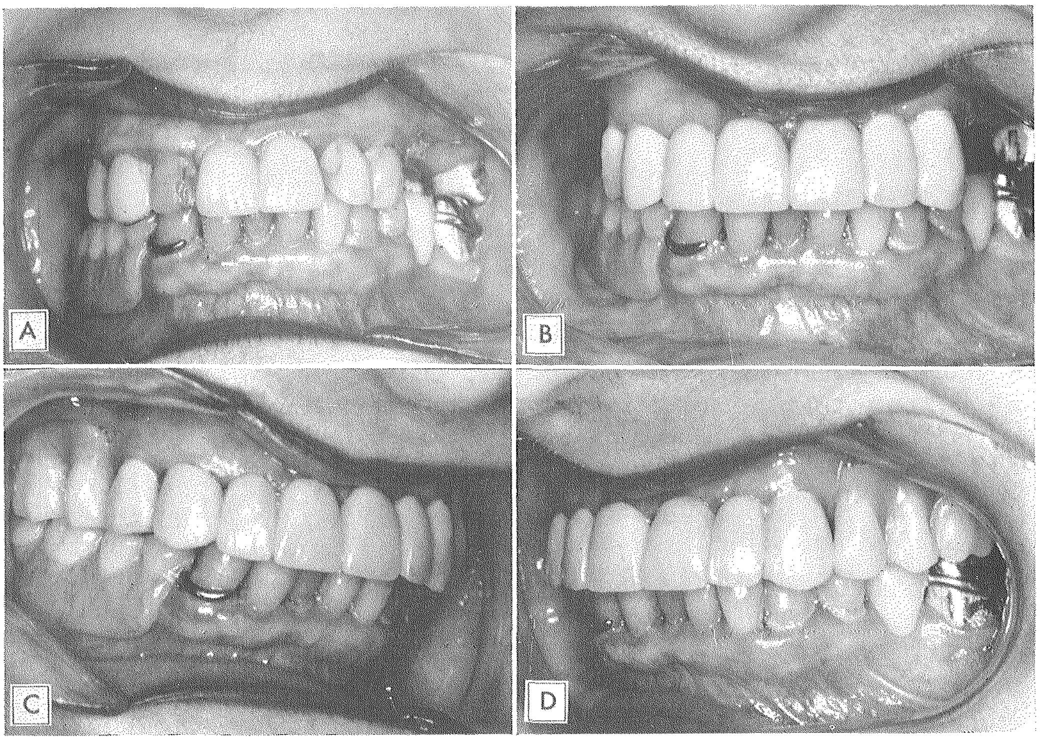


Figure 416. Same patient as shown in Figure 414. The completed sectional treatment. *A*, Before rehabilitation of the upper dentition. *B*, Anterior view showing duplication of the vertical and horizontal overlaps. *C*, Right side. *D*, Left side. At a later date the lower dentition can be rehabilitated, and the acceptable functional occlusal relationship can be maintained.

19

MANAGEMENT OF PROBLEM OCCLUSIONS

The Prognathic Jaw Occlusion

Occlusion Influenced by Abnormal Tongue and Swallowing Habits

Abnormal Functional Occlusion of Convenience (Acquired)

It is the aim and purpose in occlusal rehabilitation to end with improved esthetics, retention of the remaining teeth and restorations, satisfactory occlusal function, and comfort for the patient. There are persons, however, who present themselves with oral conditions and physical abnormalities that limit the prognosis to only partial success, and sometimes the indications are unfavorable for an attempt at occlusal rehabilitation. Rehabilitation may last ten years in one patient and only a year or two in another. The operator is not able to determine beforehand just what the hard and soft tissues can and cannot tolerate.

A satisfactory result is not always contingent upon the ability of the operator or his technicians, nor is it based upon the use of a particular articulator. Certain clinical factors beyond the dentist's control, and some limitations to routine procedures resulting from the materials at his command, impede the successful completion of occlusal rehabilitation. That is why it is advantageous for the doctor to be able to recognize conditions in and around the mouth that would tend to contraindicate occlusal reconstruction. It is sometimes more important to know what not to treat than how to treat an occlusion.

The operator should consult with practitioners in specialized fields regarding some of the existing abnormalities, and perhaps the orthodontist, the prosthodontist, the oral surgeon, or the periodontist may be able to contribute to the improvement of these conditions.

There are many cases confronting the dentist that present difficult problems when occlusal rehabilitation is contemplated. I have stated that jaws and teeth relationships vary and that chewing patterns differ. Teeth with or without cusps, in asymmetric jaws, out of alignment, objectionably spaced, protruding, overlapped, and the like, function or have functioned despite these so-called abnormal conditions; however, because of these irregularities, the plan of treatment will frequently have to deviate from the usual plans. When the time comes to restore a lost, collapsed, or reduced occlusion, for patients possessing these conditions, the dentist must ask himself, "Should I treat this patient with the hope that something better can be accomplished in the occlusion for optimum function, should I duplicate the previous occlusal relationship with its spaced and overlapped teeth, or should I leave the occlusion alone?"

The responsibility for the treatment plan of occlusal rehabilitation and esthetic improvement should not be placed upon the technician because he is obliged to follow the prescription written by the dentist. It is the dentist who sees the patient and who must recognize the existing limitations which may hinder correction or improvement of a dysfunctioning occlusion. He should discuss the problem with his technicians for better understanding so that the team can cooperate to bring about the best possible result for the benefit of the patient.

If the dentist undertakes a case for rehabilitation that is amenable to correction and improvement, the chance for a satisfactory result is good. This knowledge depends upon the ability to recognize what not to treat, which occlusion should be duplicated, and which occlusion should be altered. *We must not be carried away by any desire to "correct" a so-called abnormal condition lest we forget the impracticability of treating or changing it.*

OCCLUSION WITH THE PROGNATHIC MANDIBLE

In many cases, the middle-aged patient with a prognathic jaw and requiring rehabilitation of his dentition hopes for correction of the protruding chin. Restorations of crowns and bridges cannot reduce a chin. For the average patient with a protruding chin very little occlusal rehabilitation is recommended. Prognathic relationships are best duplicated and only required restorations, periodontal treatment, and replacement of missing teeth are advisable. Prognathism from the prosthodontic point of view may be classified as false or true.

A false prognathism may be brought about by an interfering tooth or teeth, which usually have drifted because of missing teeth. It has been my clinical observa-

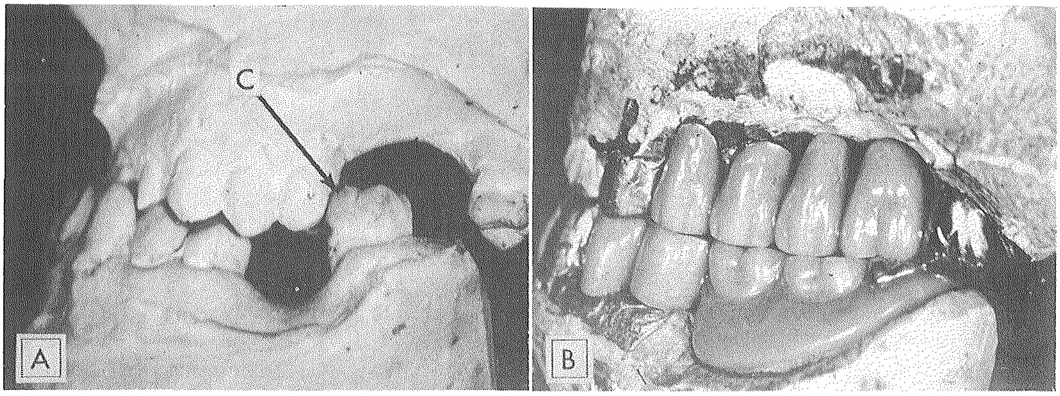


Figure 417. *A*, A false prognathous condition brought about by interfering teeth (*C*). *B*, Removal of the offending teeth permits occlusal rehabilitation procedures to improve upon the prognathous condition. (Courtesy Dr. Ira Klein, New York.)

tion that the false prognathism had always been present to some small degree before the migration of a tooth or teeth worsened the condition. The increased prognathism may often be reduced by releasing the "locked" mandible. Sometimes this is accomplished by reducing the offending tooth with stones or by removing it. Once this is done, the restorative means of rehabilitating the dentition is a routine procedure. Figure 417 illustrates a condition in which the prognathism is accentuated because of the interfering molar. When the molar was removed, the mandible assumed its original edge-to-edge relationship.

A true prognathism is definitely due to developmental anteroposterior difference in size between the maxillae and the mandible. Correction of the protruding chin by prosthodontic measures is impossible. The lips, cheeks, and muscles of mastication are in harmony with these bony asymmetries, resulting in characteristic expressions and smiles. We are confronted with asymmetries not only of the bones but also of the neuromuscular system, the ligaments, and the temporomandibular joints. The patient with the prognathic mandible more often than not has a short upper lip or one that appears short because of the prominent chin. The short upper lip is also in harmony with the vertical dimension of occlusion. As a rule the patient functions in a chopping up and down motion. Providing such a patient with restorations with which to function laterally with so-called balancing contacts will prove detrimental to the masticatory apparatus.

REHABILITATING A PROGNATHIC OCCLUSION

It is not advisable to "jump the bite" when reconstructing a dysfunctioning prognathic occlusion. To do so would necessitate increasing the vertical dimension of occlusion (raising the bite) beyond the limits of the physiologic rest position. Furthermore, the anterior maxillary crowns will have to be "toothy," a factor to contend with, particularly when the upper lip is short. The oversize restorations will not be in harmony with the prognathic chin. Facial expressions usually change for the worse because the upper lip is distended when the maxillary crowns are slanted labially to create an abnormal edge-to-edge or slight overlap contact. These tilted restorations create a concavity between the gingival tissues and the restored anterior teeth (Fig. 418). Food debris collects in this depression to bring about a periodontal disturbance and caries in the cementum of the roots. The increase in the vertical dimension and the construction of posterior restorations with deep occlusal carvings will contribute to the unsuccessful result.

Although the patient with a prognathic jaw can function satisfactorily in limited ranges he does find some difficulty when the posterior teeth in one or both jaws are missing and when the occlusal relationship is lost. In such cases, the occlusion has to be rehabilitated and the prognathic relationship maintained without increasing the vertical dimension (Fig. 419). Preliminary occlusal rims are constructed on the removable partial denture framework having wax mounds. If the occlusion is collapsed, then the 2.5 to 3 mm. average interocclusal space measurement may be used as a starting point in establishing the vertical dimension of occlusion. The prognathism must be duplicated (Fig. 420).

Sometimes, such a patient cannot function with or will not accept a removable partial denture, for reasons known only to himself. Although not recommended as routine procedure, radical resection of the prognathic mandible proves successful. The patient shown in Figure 421 refused to wear a removable partial denture. After successful resection of the mandible by an oral surgeon,* the remaining nine maxillary anterior teeth and premolars were prepared to receive veneer crowns splinted together. The preparations had retention pits in the premolars. After completion of the case, his habit of bruxism increased because he had freedom of jaw movement. In a few weeks his powerful rubbing movements actually tore the left lateral and central gold castings apart. The tear was not at the soldered connection but in the labial portions of the castings. The pointed mandibular canines were reduced and reshaped as much as possible and a new splint was constructed, this time with reinforced "angle-iron" type of cast gold bar, soldered to the veneer castings and ground and polished evenly and smoothly. The occlusal surfaces of the premolars and the

* Dr. Stanley Behrman, New York City.

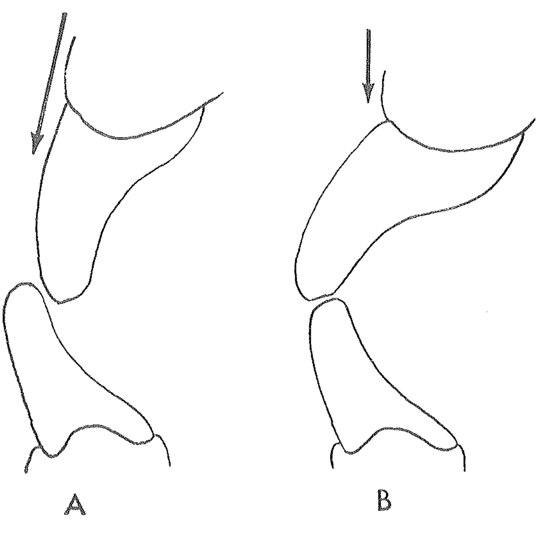


Figure 418. Markedly prognathous teeth should not be corrected by tilting the maxillary teeth with porcelain jacket crowns to meet the mandibular teeth. *A*, Deflecting contour of the gingiva is in harmony with the deflecting contour of the anterior teeth. *B*, Deflecting contour of the gingiva meets the slanted jackets so that debris and food collect and inflame the gum tissue.

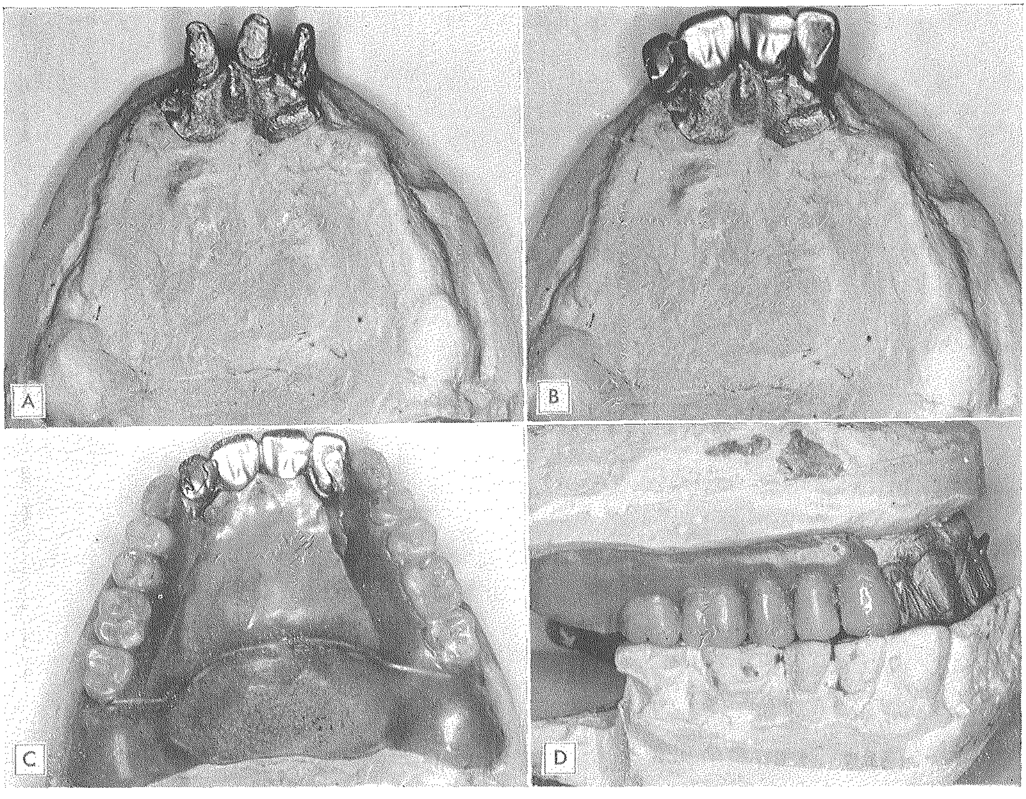


Figure 419. Prognathic occlusal relationship due to osseous difference in anatomic size should be duplicated when restorations are indicated. *A*, Three remaining teeth in upper jaw. *B*, Four unit veneer splint with the right lateral pontic receiving internal attachment. *C*, Full palate partial denture. *D*, Prognathic occlusal relationship maintains.

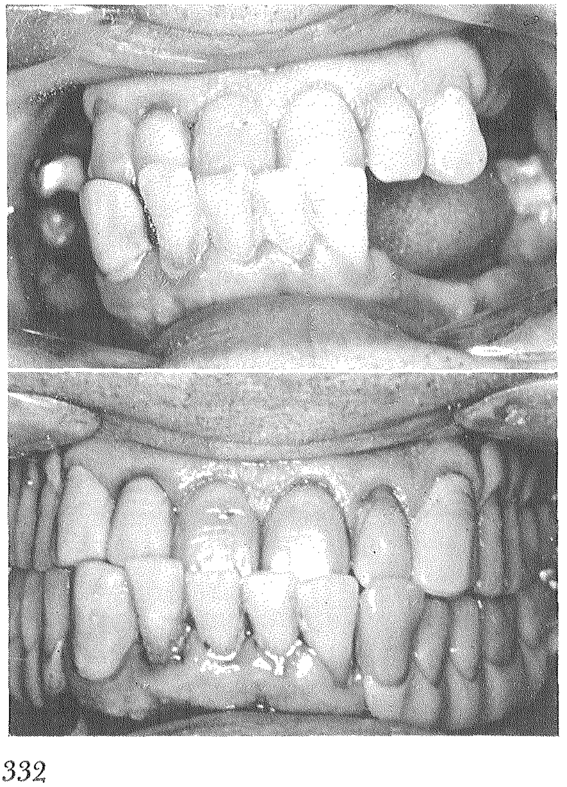


Figure 420. Rehabilitated dentition in a prognathic jaw twelve years after treatment.

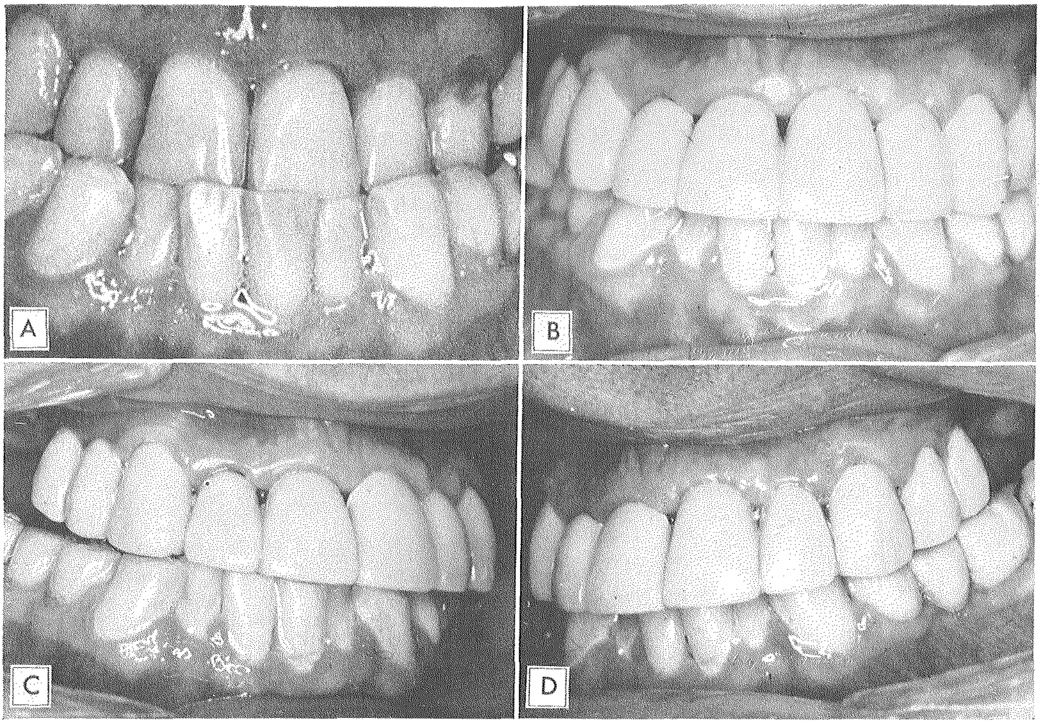


Figure 421. Surgical correction of a prognathic mandible. *A,* Before resection. *B, C, D,* After surgery and insertion of crowns.

cantilever pontic on each side of the splint were flat. This new splint permitted bruxism without discomfort. The patient was warned that the cantilever effect of each free-end pontic might cause the splint to loosen.

OCCLUSION WITH AN ANTERIOR OR POSTERIOR CROSSBITE

A crossbite in an occlusion that is to be rehabilitated because of impaired function presents problems that cannot always be solved. The operator must differentiate between a crossbite of the arches of the jaws and a crossbite of the teeth alone. A crossed condition due to the teeth alone sometimes may be brought into alignment successfully with full coverage restorations. Developmental asymmetries of the jaws, however, contribute to an interarch cross that should not be corrected with restorations (Fig. 3*B*, p. 10). Lateral excursions are usually impossible because of the locked occlusion. During the masticatory cycle, the patient functions in a chopping up and down motion. Over the years, the neuromuscular system becomes accustomed to this pattern of mandibular motion and the introduction of a new occlusal relationship is difficult or impossible to tolerate. It is advisable to maintain the cross relationship when rehabilitating such an occlusion.

The definite position and extent of the temporomandibular articulation and the form of the glenoid fossa are determined by the occlusion of the teeth. If the occlusion is in crossbite relation, a lateral deviation of the mandible may be established.

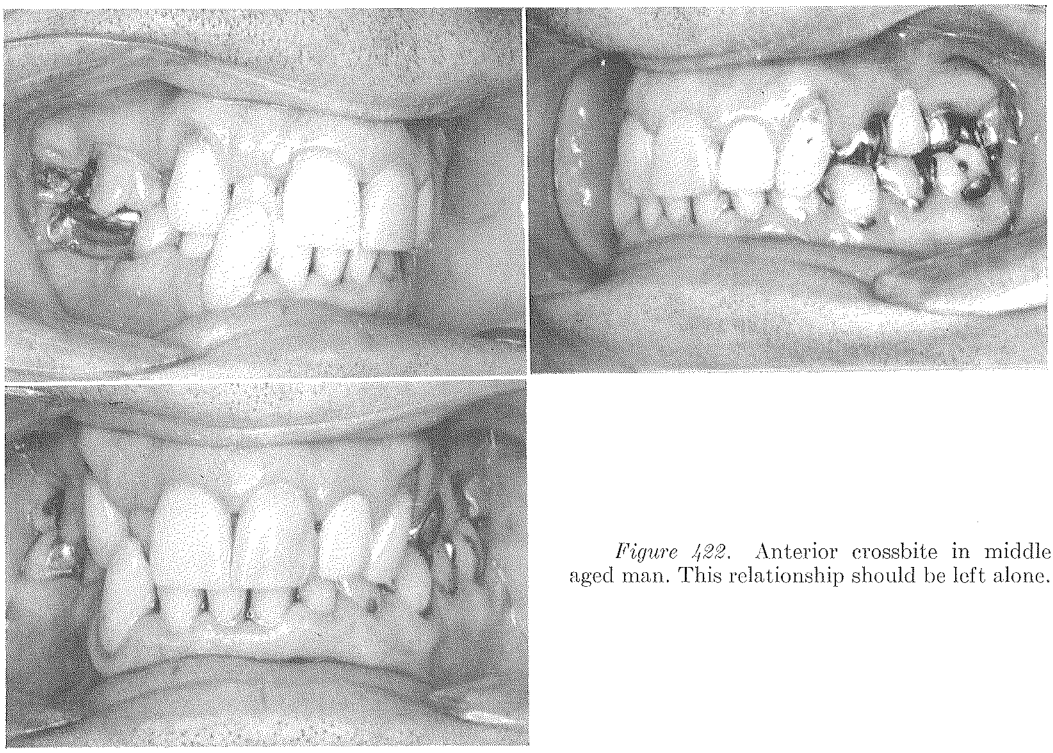


Figure 422. Anterior crossbite in middle aged man. This relationship should be left alone.

Figure 423. A crossbite influenced by early loss of the first molar and subsequent drifting of the teeth.

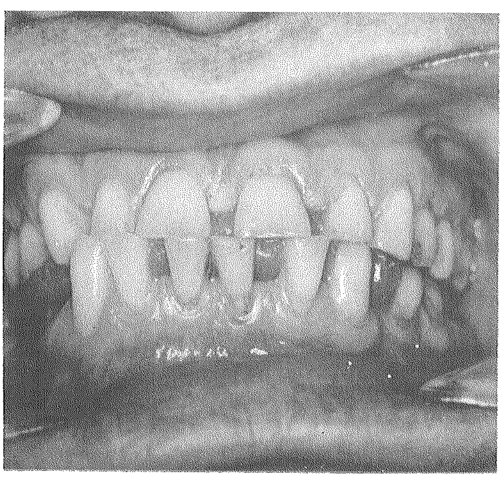


Figure 424. Abnormal tongue and swallowing habits frequently cause separation of the anterior teeth.

A crossbite may be acquired by the drifting of teeth, as illustrated in Figure 423. In this case, the early loss of the mandibular first molar and the subsequent movement and disarrangement of the premolars and canine were contributing factors in the crossbite. A tooth in lingual position in a patient of middle age may respond favorably to a full coverage restoration. It also may require extensive treatment of one or more of the opposing occluding teeth. Reduction and reshaping of the opposing teeth are necessary to make way for clearance of the newly covered tooth in its various paths of function. A thorough study of the pulp will be a deciding factor in determining the steps to be followed in the preparation.

ABNORMAL TONGUE AND SWALLOWING HABITS

An occlusion influenced by abnormal tongue and swallowing habits sometimes escapes the eye of the operator until he is beset with difficulties. An oversized muscular tongue exerts a powerful force, usually against the lingual surfaces of the mandibular and maxillary teeth. Over the years, this phenomenon contributes to fanning and subsequent separation of the anterior teeth (Fig. 424). The unesthetic change is a gradual one and when the middle-aged patient requests esthetic improvement the operator should not commit himself regarding the success of treatment. To alter the occlusion of such a patient in order to improve the esthetics will not succeed. Reducing the vestibule of the mouth by bringing the anterior teeth back orthodontically to the position the patient would like will trap the muscular tongue temporarily. Splinting these teeth together is of no advantage and rehabilitation will fail because the tongue and abnormal swallowing habit will force the restored teeth and the splint out of alignment. If the abnormal swallowing habit involves sucking, the bicuspids are frequently "sucked" in.

THE OPEN BITE

When abnormal habits caused by a large, muscular tongue play the major role in the establishment of a crossbite, the condition is practically impossible to correct (Fig. 425), and the patient's attention should be called to it. Sometimes the inter-

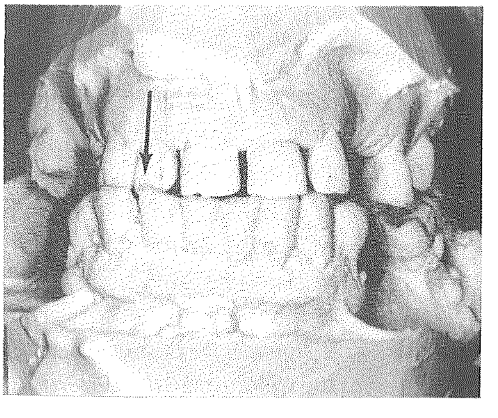


Figure 425. A crossbite influenced by an abnormal muscular tongue habit.

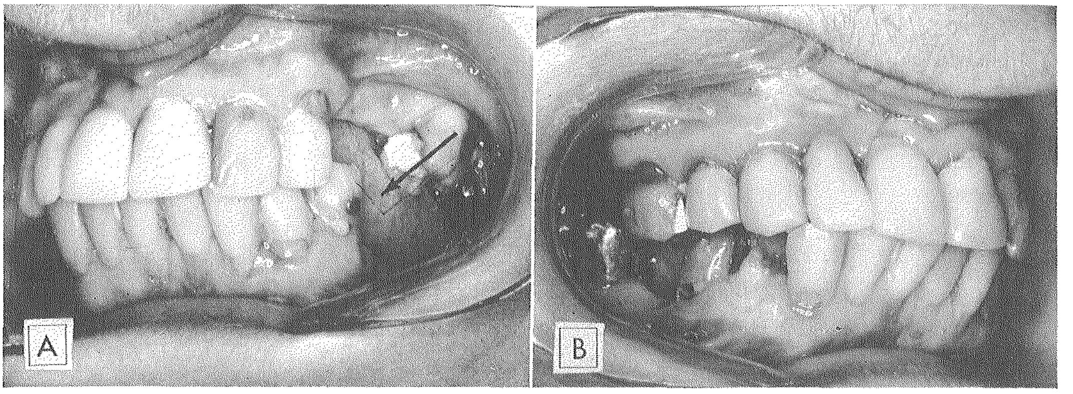


Figure 426. A muscular tongue can force the anterior teeth in both jaws in a forward direction. *A*, The arrow points to the tongue. *B*, Note the forward movement of the anterior teeth.

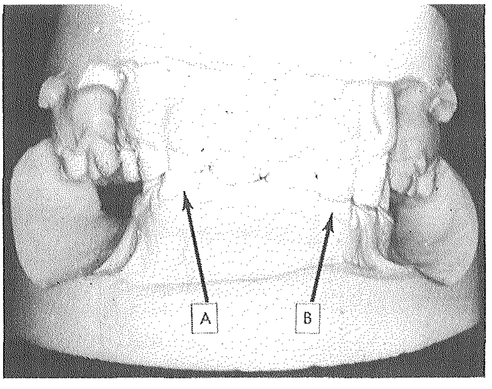


Figure 427. Owing to loss of the posterior teeth, this patient developed a functional occlusion of convenience. Normal and abnormal mandibular movements functioned in areas *A* and *B*. Muscle habits of many years caused by this pattern of chewing will sometimes be difficult to overcome or correct.

fering tongue and abnormal swallowing habits contribute to an open bite, that is, the failure of all or some of the teeth to occlude normally when the jaw closes. It is characterized by the presence of a space between the front maxillary and mandibular teeth. Consultation with an orthodontist will convince the operator that this condition in middle-aged patients does not respond favorably to treatment. Despite the fact that an open bite prevents a patient from incising food completely, most patients with such a condition manage to eat well and to masticate. As a rule, an open bite should be left alone.

ABNORMAL FUNCTIONAL OCCLUSION OF CONVENIENCE

Some patients will have a difficult time getting accustomed to an occlusion that has been rehabilitated. Prior to treatment, the patient may have developed a functional occlusion because of discomfort, pain, or interferences in the teeth, or because of insufficient teeth for mastication (Fig. 427). When such an occlusion is treated, the muscles resist the new job they are compelled to do. It takes time for the muscles and nerves to become adjusted. Salzmann[1] expresses it logically: "Inasmuch as the rehabilitated occlusion is different than before the dental work was performed, the proprioceptive response in idle swallowing and in mastication is disturbed. Mouth

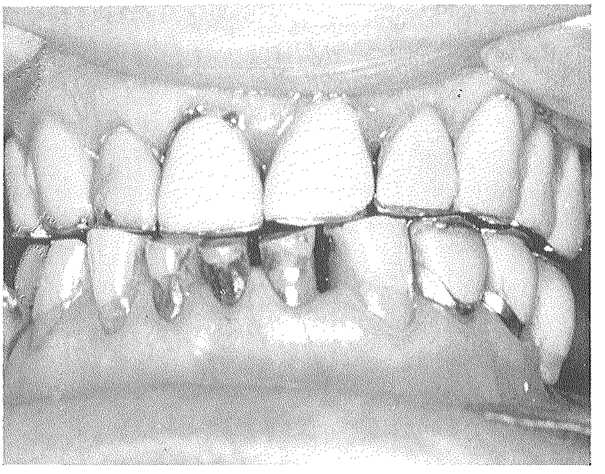


Figure 428. Owing to excessive bruxism and the inability of the gold on the occlusal and incisal surfaces to wear, an abnormal functional occlusion of convenience was created. Rehabilitation of such an occlusion may not prove successful. If treatment is absolutely necessary, then that recommended on page 242 is advocated.

rehabilitation changes the physical conditions but does not immediately change innervation and proprioceptive response. The kinesthetic sense is disturbed and new patterns of function have to be learned by the patient. Some individuals require a comparatively longer period of training and some, especially those with psychosomatic involvement, may never be able to learn new functional patterns." Unless the patient thoroughly understands the possible consequences of occlusal reconstruction and is willing to accept some responsibility as to its success, the operator is cautioned about undertaking the case. Dentists, like physicians, would like all of their patients to respond favorably to treatment. It is a recognized fact, however, that there are some patients who do not.

In the treatment of a patient with an abnormal functional occlusion of convenience, it is advisable to establish the occlusal vertical dimension the same way as for complete dentures. The restorative work should be inserted temporarily and for a longer period of time than in so-called normal cases. On occasion, temporary work may be inserted so that one may observe whether the patient can become accustomed to the new and "proper" reconstruction. The patient may never be able to tolerate a radical change in occlusion despite the fact that, theoretically, it can be considered the correct occlusion for him. *It is well to heed the sound advice of Trapozzano,[2] that the occlusion must be fitted to the patient instead of adjusting the patient to the occlusion.*

References

1. Salzmann, J. A.: Editorial. N.Y. J. Dent., *27*:4, 1957.
2. Trapozzano, V.: Occlusion in relation to prosthodontics. D. Clin. North Amer., March, 1957, p. 324.

20

THE TERMINAL DENTITION AND THE PREVIOUSLY TREATED PATIENT

THE TERMINAL DENTITION

When the operator recognizes the hopelessness of rehabilitating mobile, extruded teeth and those with extensive caries, old leaky restorations, and the like, he should consider such a dentition as a terminal one. A terminal case is one in which all remaining teeth must be removed and complete dentures inserted. However, if the patient understands the meaning of the word, terminal, some rehabilitated terminal dentitions may last two to ten years with good care. *The patient must be made fully aware that such treatment is costly and that the duration of the treatment is problematical.* Terminal means that the operator and the patient have to make one of three decisions, namely: 1, remove all the remaining teeth and accept complete dentures immediately; 2, proceed with extensive rehabilitation if the patient can afford the cost; or 3, remove all infected teeth, correct all disorders, and follow with inexpensive replacement of missing teeth, treatment of remaining teeth, and continual periodontal nursing. When all efforts to save the teeth have been exhausted, the patient becomes more resigned to their loss and a bit more amenable to wearing complete dentures.

THE CLIP-ON OR SNAP-ON DENTURE FOR THE TERMINAL CASE

On occasion, the operator is confronted with a condition in which only two canine teeth or roots exist in the mandible. When these terminal teeth or treated roots are embedded in strong bone, they can be retained. Gold cores are constructed

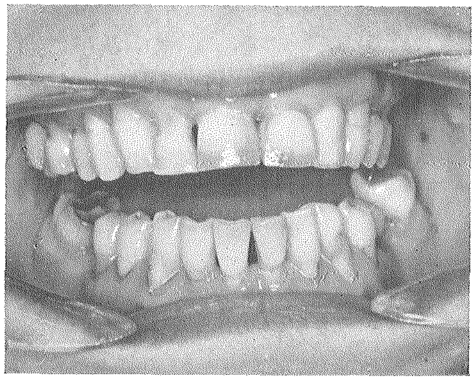


Figure 429. Excessively mobile teeth should not be splinted with extensive and costly restorations. Complete dentures are indicated. Some patients prefer to keep terminal teeth as long as possible, and have leaky restorations patched until such time when function is poor and pain and discomfort are present.

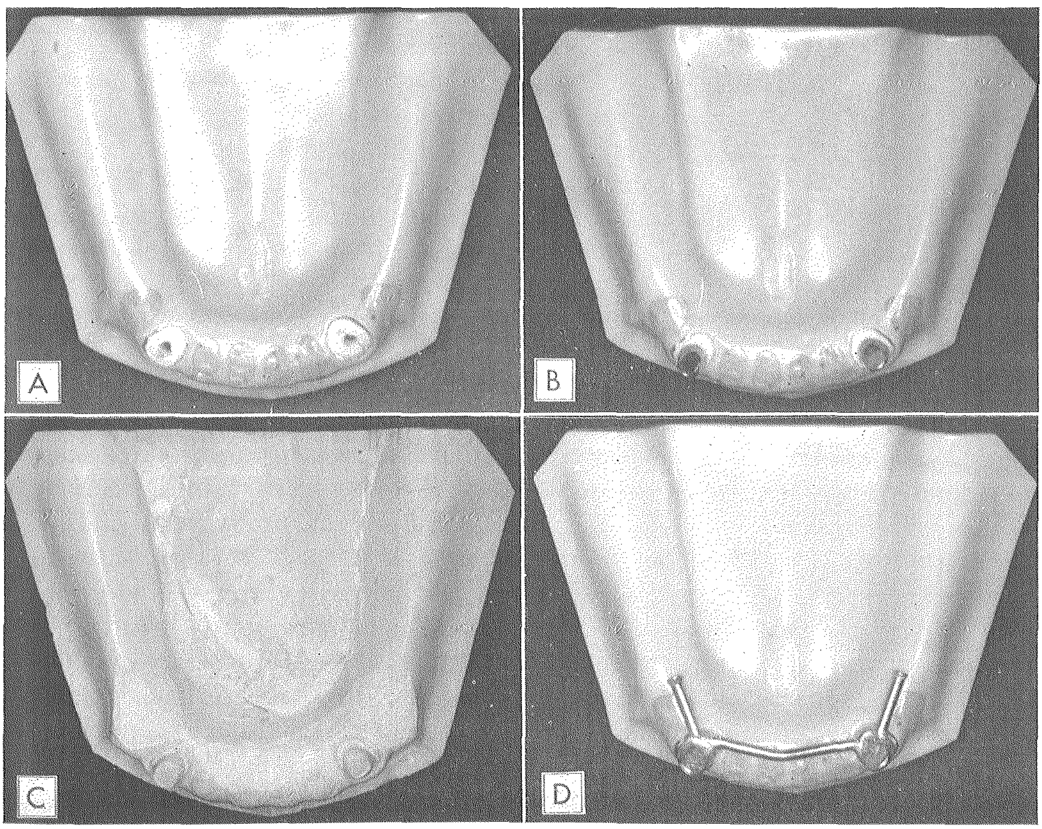


Figure 430. The snap-on attachment denture over two remaining mandibular roots. *A*, After successful endodontics, the canals are prepared for the reception of gold cores without collars *B*, The gold cores are cemented and a master impression is taken of the entire jaw with elastic impression material. *C*, The master working cast. *D*, The Baker snap-on attachment bar and copings are assembled and soldered then tried in the mouth.

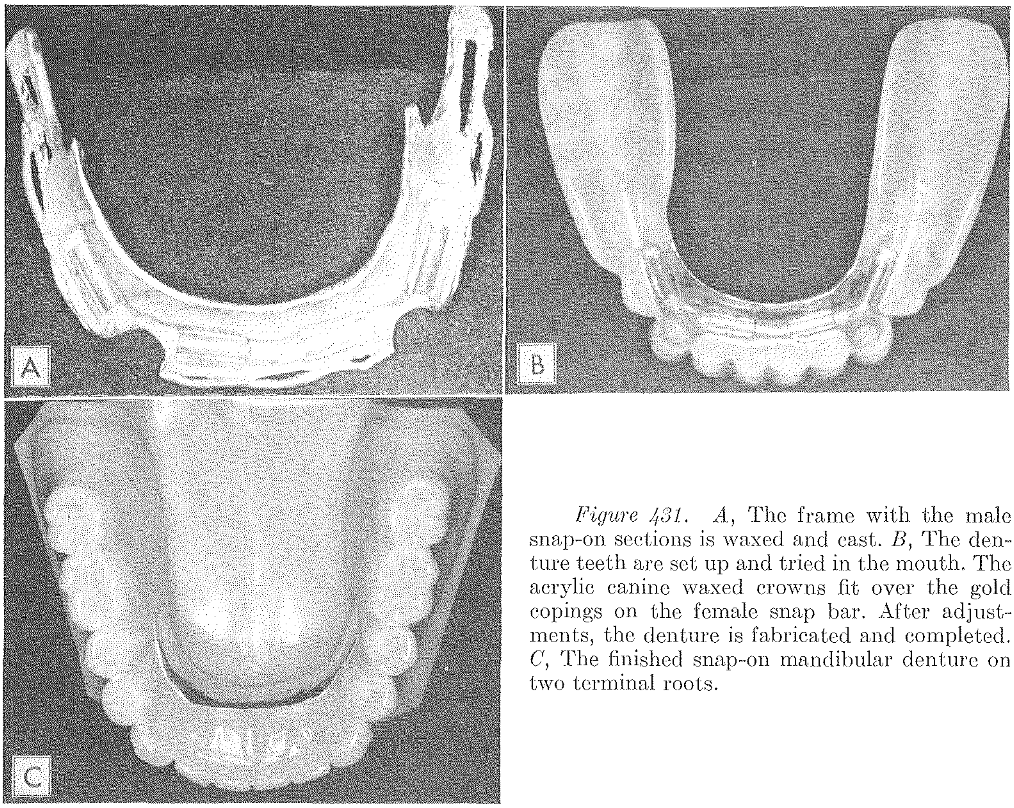


Figure 431. *A*, The frame with the male snap-on sections is waxed and cast. *B*, The denture teeth are set up and tried in the mouth. The acrylic canine waxed crowns fit over the gold copings on the female snap bar. After adjustments, the denture is fabricated and completed. *C*, The finished snap-on mandibular denture on two terminal roots.

and cemented into the prepared roots. The snap-on attachment is fabricated and the lower denture is more secure in the mouth than a complete denture for the lower jaw.

Construction of the Snap-on Attachment

Let us take a typical case illustrated on a typodont (Fig. 430). Endodontic treatment has been completed on the two pulpless remaining canines in the mandible. Two gold cores are constructed without collars and cemented into the prepared canine roots. Impressions are taken of these cemented cores in the mouth and two cast gold copings are made over each core. The occlusal registration is recorded, and then an overall master elastic impression is taken with the abutment coping retainers in place. This impression is a full jaw impression and includes all the edentulous areas. Follow with a full impression of the opposing upper jaw. The impressions are poured in hard stone and articulated. We are ready to assemble the male section of the snap-on attachment which is the bar connector. This bar is cut and contoured to the crest of the ridge. Lute the fitted bar to each abutment retainer with sticky wax and solder each gold coping to the bar. Use either No. 650 or 750 solder. Any plier or scratch marks on the soldered bar are removed with a rubber wheel. The operator is cautioned not to remove too much surface so that the female section is not impaired. Try the soldered frame on the two canines in the mouth. If the fit is satisfactory there is no need to take further impressions.

Partial gold castings are recommended for the denture. The metal retention for acrylic resin should be approximately 1 mm. behind the supporting male bar. If desired, the denture can be constructed without a partial metal casting. Place the clip or sections of clips on the bar which is seated on the working cast to determine the fit and correct length(s). The clip(s) should be as close to the abutment retainers as possible. If a high spot appears on the bar due to contouring, remove that high spot immediately instead of adjusting the female or clip section. Wax and set up the denture teeth, and after a try in, complete the restorations (Fig. 431).

THE TERMINAL DENTITION DUE TO EXCESSIVE RUBBING OR BRUXISM

Figure 432 illustrates the terminal dentition of the mandible. Bruxism is pronounced, the bone is lost, and the remaining teeth are mobile. A partial denture was constructed and as each tooth was lost, a pontic was added to the inexpensive partial denture. Finally all the remaining anterior mandibular teeth were removed and a new partial with wire clasps around the two remaining left premolars was fabricated. This patient understands her plight and is grateful that all the teeth were not

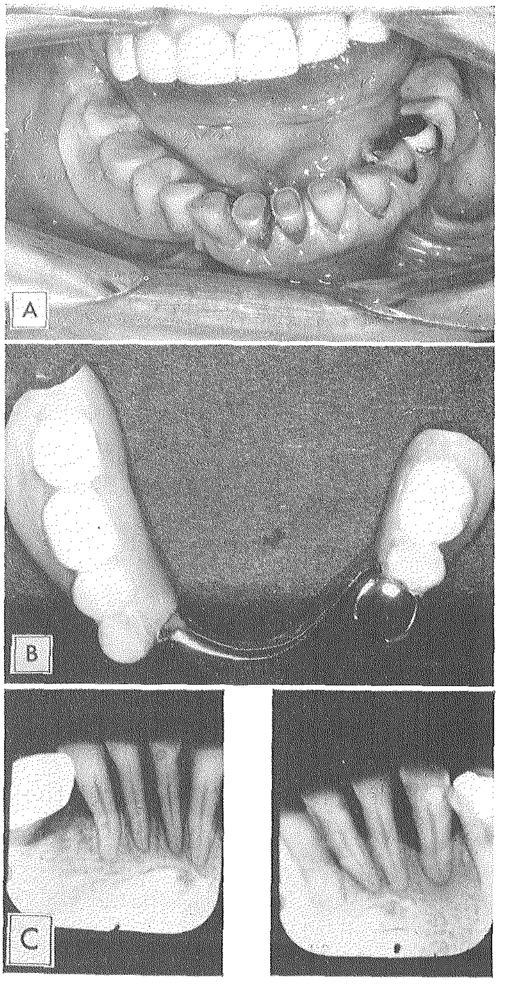


Figure 432. *A*, Terminal remaining mandibular teeth resulting from uncontrollable bruxism with the inexpensive removable partial denture. *B*, The acrylic partial denture with a wrought lingual bar and clasp. As an anterior tooth (teeth) is lost, an additional tooth can be added to the partial. When all efforts to save teeth have been exhausted, the patient accepts the need for complete dentures. *C*, Roentgenograms of the lower anterior teeth showing the marked loss of bone.

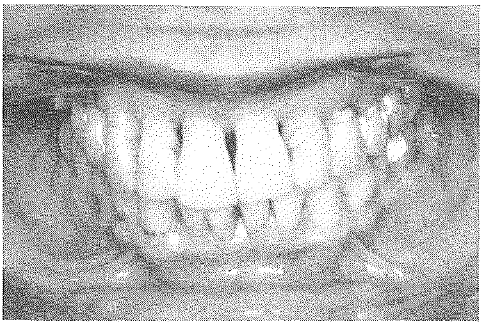


Figure 433. Gingivectomy around terminal teeth, without regard for the esthetics. It is impossible to construct porcelain jacket crowns on such teeth without making them appear grotesque.

removed. She is gradually getting accustomed to the feel of the denture and is resigned to the loss of the remaining teeth. The teeth on the partial denture are acrylic resin to accommodate the uncontrollable bruxism.

MOBILE TEETH

In some persons who require occlusal rehabilitation, the situation is aggravated by periodontal disease. It is imperative that all gingival disturbances be corrected and that loose, unsatisfactory teeth be removed. It would be a shame to insert elaborate restorations over teeth that may be retained in the mouth for only a short time. If mobile teeth have a good chance of repair and if the health of the patient and his oral hygiene habits are satisfactory, then correct periodontal treatment and fixation of the slightly mobile teeth may be indicated. Sometimes, surgical removal of diseased tissue may be necessary to clear up the pyorrhea. However, if surgical treatment is planned, consideration must be given to esthetics. Mindful that esthetics is the most important aspect of rehabilitation in the eyes of the patient, the prosthodontist must be able to foresee the appearance of the porcelain jacket crowns covering teeth from which so much tissue has been removed (Fig. 433). In some cases it is impossible to use normal-size porcelain jacket crowns to cover teeth with the cementum exposed without making them appear grotesque. Despite the fact that the periodontal condition has been cleared, such a patient is often unhappy because of the long teeth and wide interproximal spaces that pack food. The periodontist should warn the patient, particularly if a woman, that the esthetics will not prove satisfactory after the gingivectomy. Have her decide whether such a procedure is more important to her than the appearance of the teeth. The onus of beautifying such cases should not be placed upon the prosthodontist.

SPLINTING AND MULTIPLE ABUTMENT RETAINERS

While I hesitate to interject the statement at this time for fear of being misunderstood, I am convinced that today there are recommendations being made indiscriminately to splint teeth permanently on patients in middle age. If there is much bone loss and little chance for repair, splinting, particularly of a fixed nature, is contraindicated.

We must differentiate between multiple abutment retainers in fixed and removable partial dentures and the splinting of loose teeth. When the prosthodontist joins teeth to support a pontic, these joined teeth help the fixed or removable bridge, like a crutch. But all teeth supporting artificial ones must be healthy and strong and not periodontally involved. When loose teeth are splinted to strong teeth it is always a question whether the loose teeth will become strong or the strong teeth will become loose. The splinting of mobile teeth may give rigid mesiodistal stability but will definitely give no buccolingual rigidity unless the splint is carried all around the arch. A quadrant splint is often displaced in lateral or protrusive movement. Roentgenograms disclose the resorption of the labial or buccal plate of bone even though the teeth are splinted. Figure 434 represents the casts of a patient whose anterior teeth were splinted and have drifted en masse toward the labial direction (Fig. 435).

The operator should be aware of the fact that loose teeth are not the primary causative factors producing the masticatory breakdown. They are the result of the damaging elements responsible for the periodontal condition. These responsible

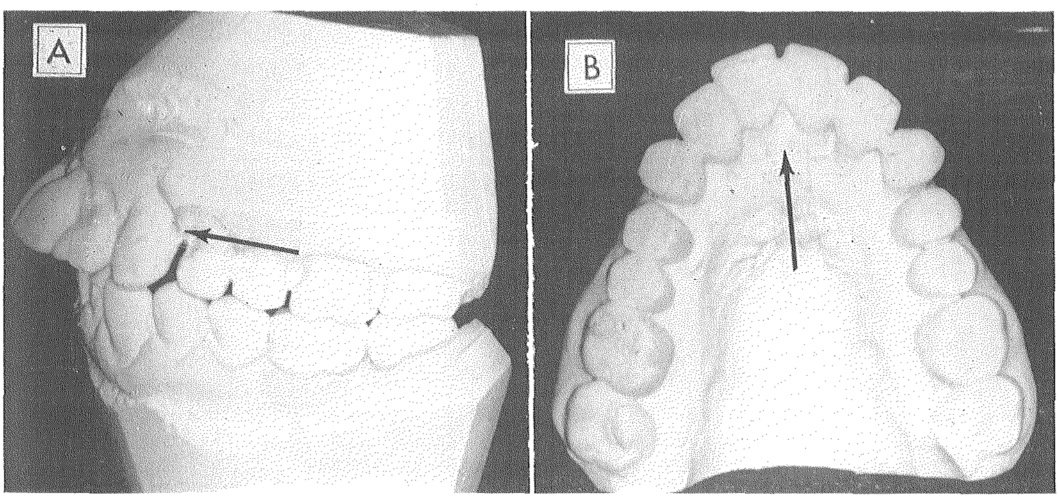


Figure 434. Casts showing the anterior drift of the splinted anterior teeth. *A*, *B*, The periodontal disturbance continues despite the splinting of the mobile teeth. The splint and teeth will move as a unit.

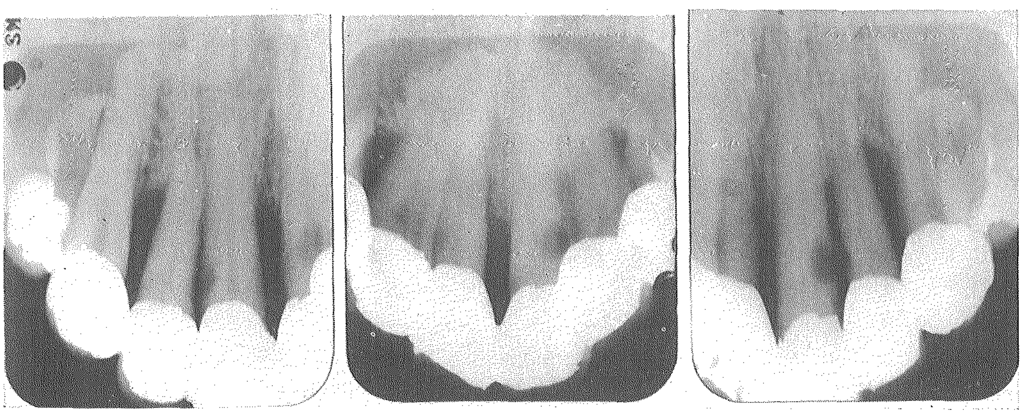


Figure 435. Roentgenograms of the patient in Figure 434. Notice the decay in the root portions of the splinted teeth.

Figure 436. Roentgenograms of a patient with periodontosis. These teeth, without sufficient bone support, cannot stand the rigors of preparation for full coverage restorations.

disturbances cannot be removed by splinting loose teeth together. Lieban[2] wrote, "Some operators splint loosened teeth if there is extensive periodontal involvement. The prognosis for such teeth may be definitely hopeless because of mobility and loss of supporting structures. If several periodontally involved teeth are united by a fixed splint, and one of these teeth is not amenable to treatment, the splint is holding a tooth that should be extracted; retention of such a tooth will cause disease to spread to the adjacent teeth. It is illogical to attach bridgework on diseased teeth."

Splinting of sound though mobile teeth is often indicated in occlusal rehabilitation. The decision whether to splint varies with the individual case and depends upon the anatomy, condition, and position of the teeth; the bone factor; the age, sex, and physical and periodontal health of the patient; the esthetics; the degree of mobility; and the number of missing teeth and abutment teeth. In many terminal dentitions it depends upon the willingness of the patient to undergo expensive treatment. It also depends upon the philosophy and beliefs of the operator and whether he holds to the concept that teeth move in function. The mobility of teeth in patients of middle age may be the result of inflammatory changes in the periodontal membrane, the occlusion, or poor oral hygiene. The prognosis for stabilizing such teeth by eliminating the causes is favorable. Tooth mobility which results primarily from bone loss is corrected with great difficulty.[1]

Terminal teeth can sometimes be useful in function and esthetics when splinted,

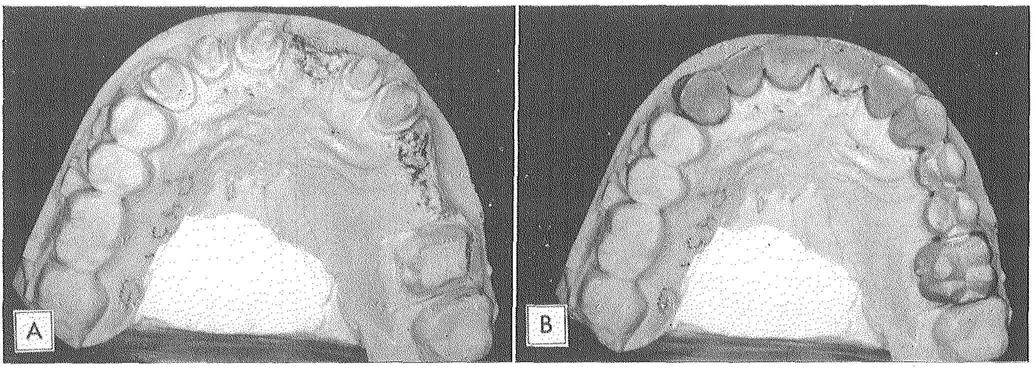


Figure 437. Large fixed bridge splint. *A*, Working cast of six prepared abutment teeth will support three pontics. *B*, Lingual view of the soldered gold splint bridge frame.

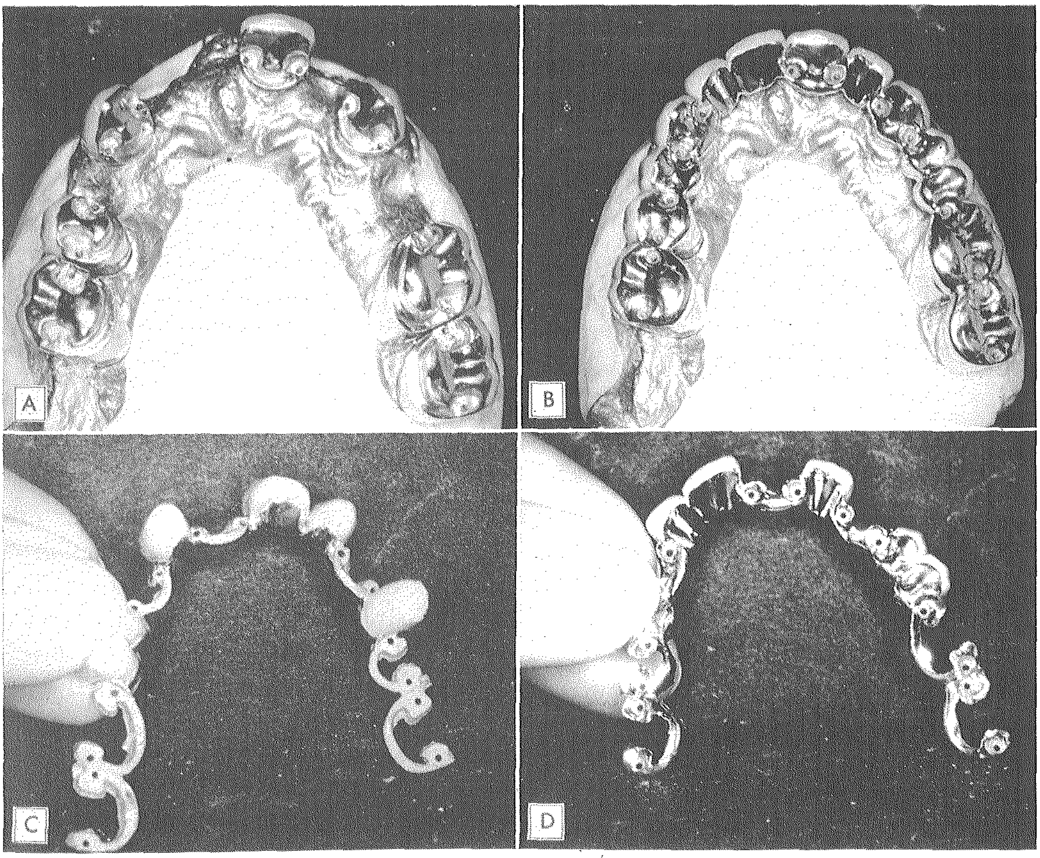


Figure 438. The Quasi splint. *A*, Full coverage restorations on the master casts possessing lingual shoulders and receptacles in the gold. *B*, The soldered removable splint in position. *C*, The gingival view, and *D*, The occlusal view of the splint.

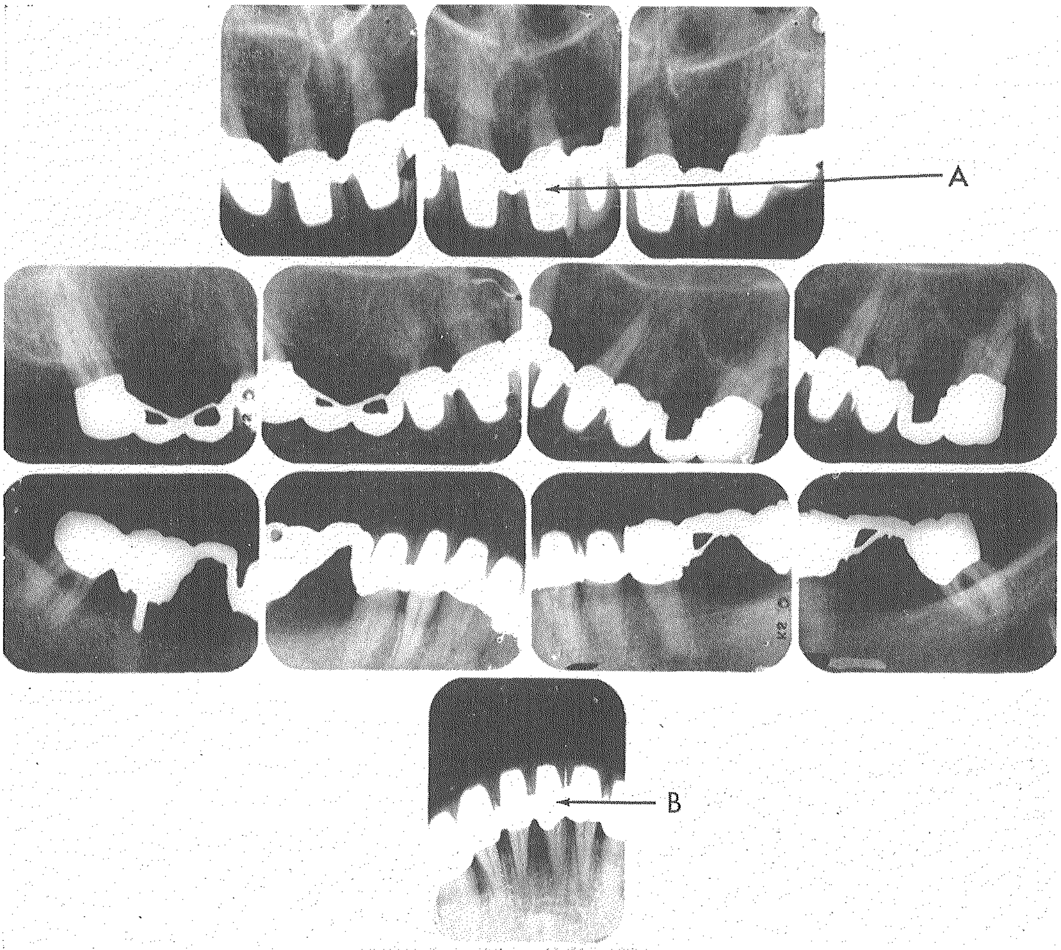


Figure 439. Disadvantage of splinting teeth with veneer or porcelain crowns. In most cases, it is impossible to remove sufficient tooth structure to accommodate thickness of metal and esthetic material without endangering the pulp and duplicating the original contour, and creating an abnormal crown–root ratio (*A* and *B*).

but their durability is a matter of conjecture. Splints in general may be fixed, removable, or fixed removable. The splint can be in the form of a fixed bridge (Fig. 437), when there are more abutment retainers than pontics. This splint has only three pontics but has six abutment retainers. Another type of splint may consist of special precious metal screws and sleeves to fasten a rigid gold or steel-chrome alloy, and is known as the Overby splint. Pontics for missing teeth can be included in this device. Holes of proper gauge are drilled in the cingula of the six anterior teeth to receive the threaded sleeve. This form of splinting is intricate, and mobile teeth often tend to break the cementing medium that retains the threaded sleeve and loosen part of the splint, and caries sets in.

The Quasi removable splint (Fig. 438) is another device some practitioners prefer to utilize in a terminal dentition. Full coverage restorations are inserted on prepared teeth. Lingual and occlusal surfaces of the retainers are so prepared as to receive the splint which connects the crowns into a fixed or removable bridge or splint.

SPLINTING MANDIBULAR INCISORS

Splinting mandibular incisors to approximating canines is a difficult undertaking and frequently is contraindicated. Small, thin, and delicate lower anterior teeth cannot always submit to removal of sufficient tooth structure to accommodate both gold and esthetic material of porcelain or acrylic resin in full coverage restorations. This procedure not only necessitates the destruction of too much protective tooth structure, but their radical reduction aggravates the condition so that the mobility is increased and the periodontal disturbance worsened because of the gold collars and the necessity of overcontouring the restorations on the splint to hide the gold thus satisfying the esthetic demands of the patient (Fig. 439). A type of splint for mandibular mobile incisors in which full coverage restorations are not resorted to is the Nu-Dent pin splinting technique (Figs. 440 and 441).

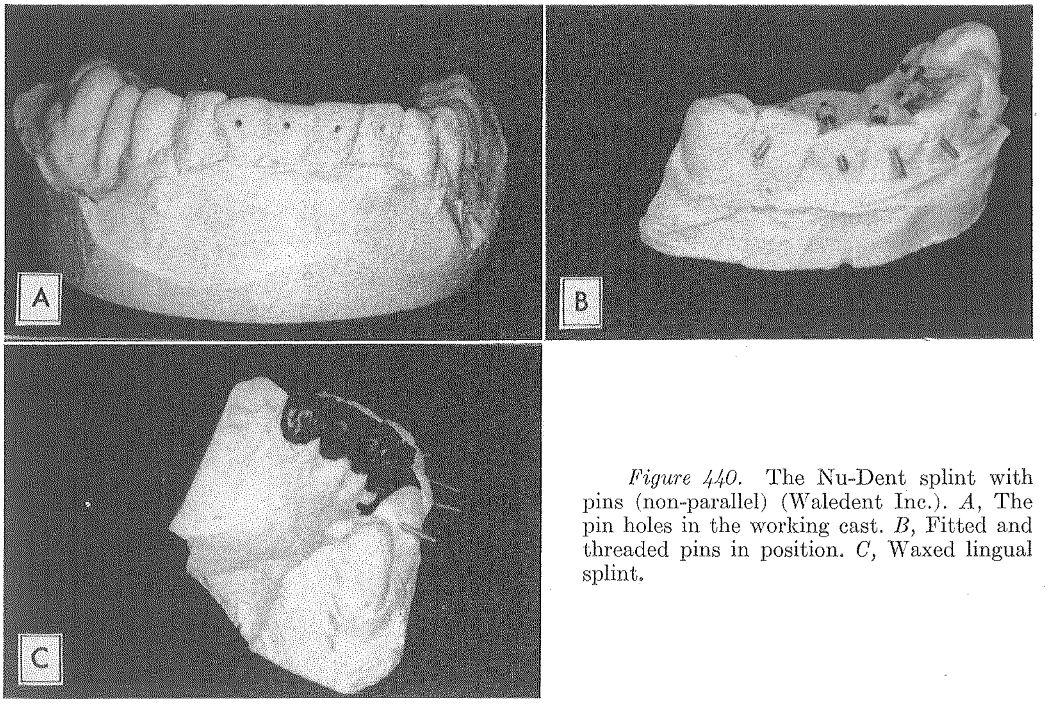


Figure 440. The Nu-Dent splint with pins (non-parallel) (Waledent Inc.). *A*, The pin holes in the working cast. *B*, Fitted and threaded pins in position. *C*, Waxed lingual splint.

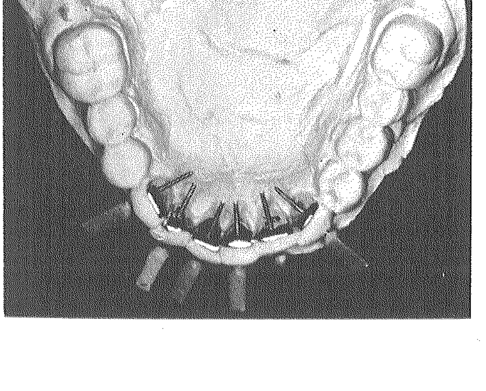


Figure 441. The completed splint.

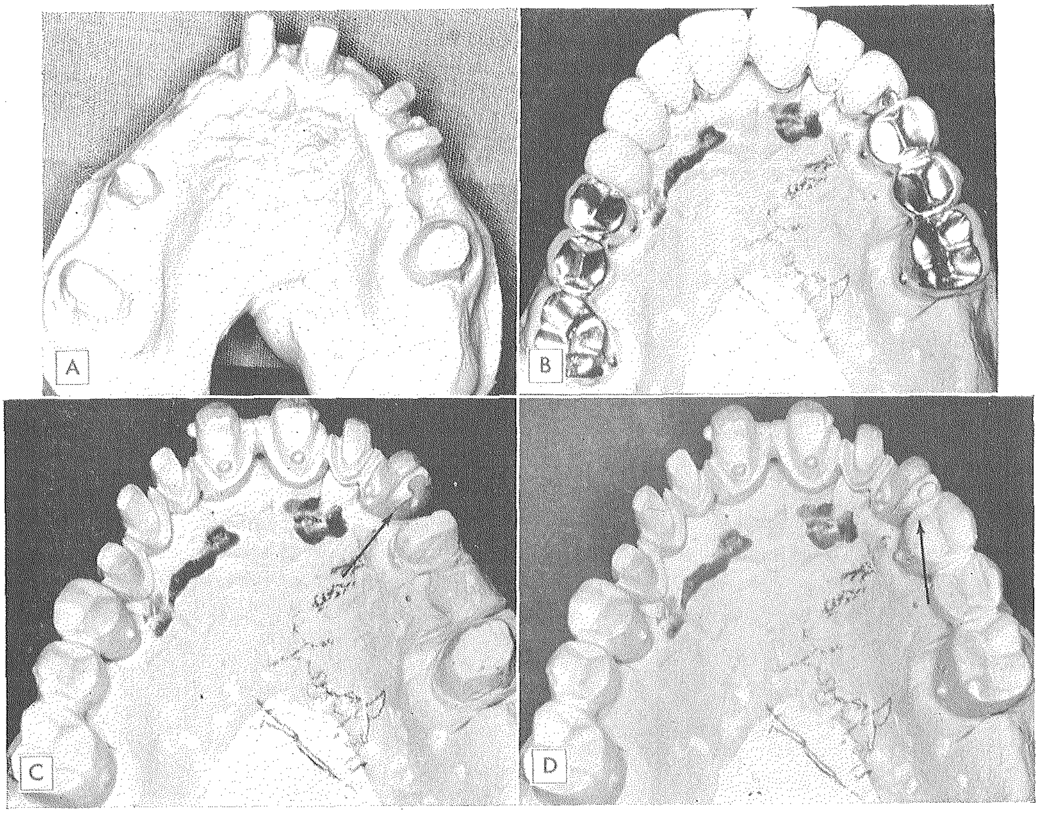


Figure 442. A large, around-the-arch, fixed splint can be broken up into segments. *A*, Cast of prepared terminal teeth. *B*, Two sections of completed splint. *C*, Ten unit splint section on right side. Arrow points to lock-in device (receptacle). *D*, Two frame sections of splint in place with the arrow pointing to the male lock-in extension seated in its receptacle.

Around-the-Arch Splint

In a mouth with many remaining teeth, one large, around-the-arch splint has never met with my favor. A large splint contracts during its construction and tends to pull and force abutment teeth away from their intended and comfortable positions. However, in a terminal dentition with *few* remaining teeth, such a large fixed appliance is recommended. Sometimes, precision rests or deep dovetail lock-in devices are utilized as connecting links so that the few teeth are not displaced and held in a "straitjacket" (Fig. 442).

Figure 443 illustrates the patient with few terminal teeth in whom a splint around the arch was indicated. The teeth in the lower jaw were satisfactorily completed by her previous dentist. The periodontist cleared the gingival disturbances and the remaining maxillary teeth were prepared. A gold core was constructed and cemented on the upper right canine root and a large splint of acrylic resin cured to soldered cast copings was constructed to keep it as light as possible (Fig. 444). The completed splint was cemented with Opotow's zinc oxide and eugenol cement. The splint will be checked at regular intervals. Should any emergency arise, it can be tapped off. It is intended to keep this large splint in this state, and never resort to permanent cementation. The patient understands the reasons for this procedure as well as the limited duration of the few remaining terminal teeth. Figure 445 illustrates how closely the horizontal overlap and incisal guide angle was duplicated.

TREATING SPACED TERMINAL ANTERIOR TEETH REQUIRING FIXATION

A cast of partially mobile remaining terminal teeth, which contribute to a wide diastema, is shown in Figure 446. The patient was insistent upon retaining these few teeth. The periodontist treated them and finally recommended a fixed anterior

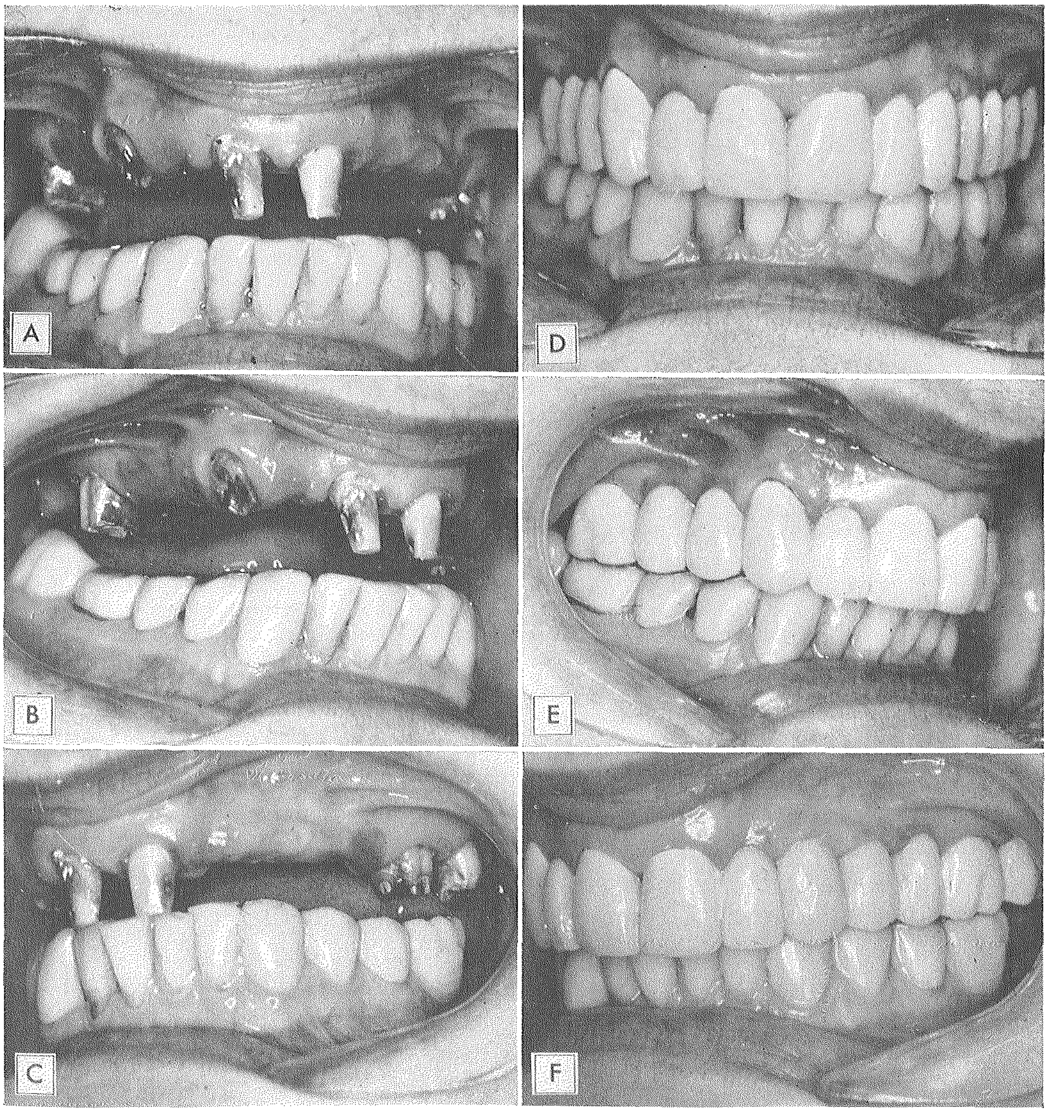


Figure 443. Treatment of six terminal maxillary teeth. *A*, Anterior view showing retained canine root and teeth previously prepared by another dentist. The mandibular dentition was rehabilitated by the same dentist. *B*, Right side. *C*, Left side. *D*, Completed around-the-arch splint, anterior view. *E*, Right side, and *F*, Left side of completed upper terminal teeth.

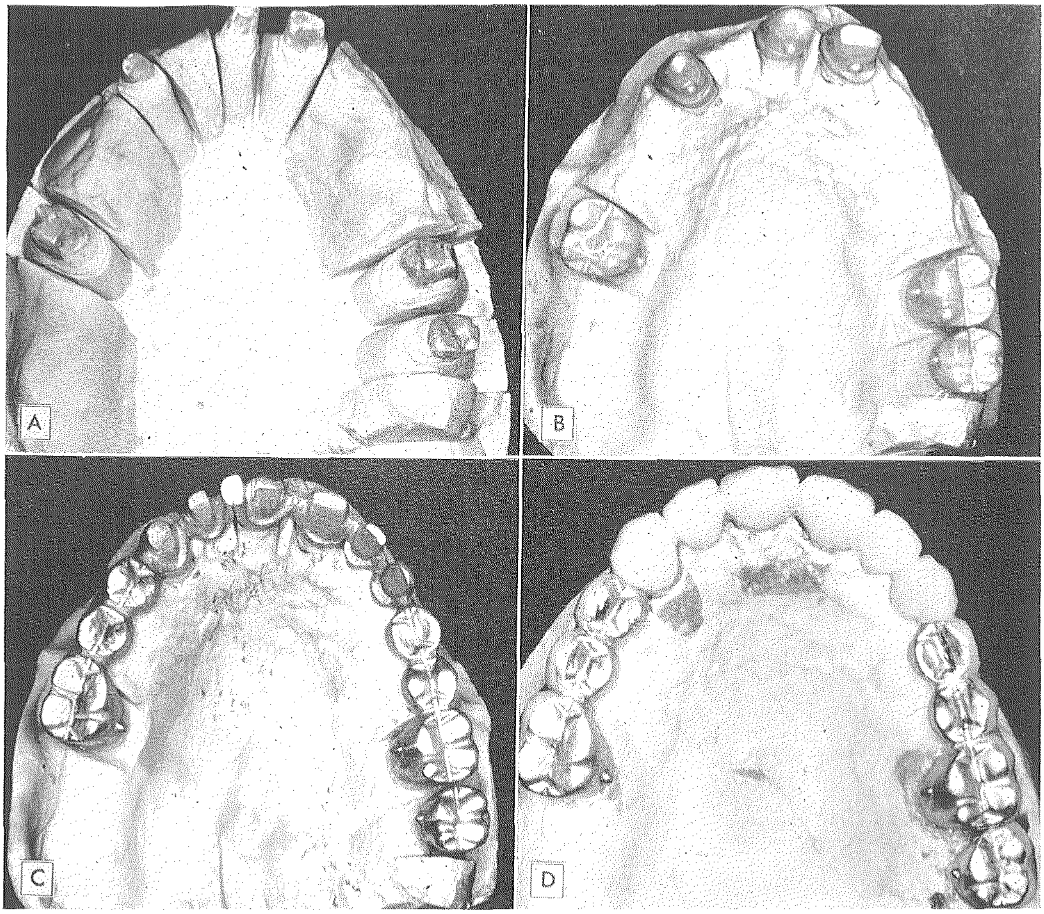


Figure 444. Same patient as shown in Figure 443. *A*, After endodontic treatment the right canine root received a cast gold core and the remaining teeth were reprepared. Dies and master cast were constructed from an elastic impression. *B*, The three posterior teeth received acrylic veneer crowns while the three remaining anterior teeth received cast gold copings. *C*, Around-the-arch fixed splint frame. *D*, Completed splint. The six anterior teeth are acrylic resin cured to gold for esthetics and the remaining bridges and pontics are acrylic veneers (see text).

splint to support a partial denture. It is impossible to construct a fixed splint on such spaced teeth without making them appear grotesque; this was explained to the patient, who expressed the opinion that the large diastema was not objectionable to him. The following procedures were carried out: A fixed bridge splint of acrylic veneer crowns was constructed from the left canine to the left central incisor. The remaining anterior teeth on the right side were splinted with three acrylic resin veneer crowns to reduce the wide diastema a trifle. The lingual gold surfaces of the central crowns were cut so as to receive cast dovetail lock-in devices from the gold removable partial denture. The canines received internal precision attachments (Fig. 447). The splint consisted of three segments, the three unit fixed bridge on one side, the three unit splint on the other, and the lock-in devices from the removable partial denture bracing the two anterior splints.

When there are only a few terminal teeth, it is pointless to try to retain them. Figure 448 illustrates the roentgenograms of such a dentition. The few remaining

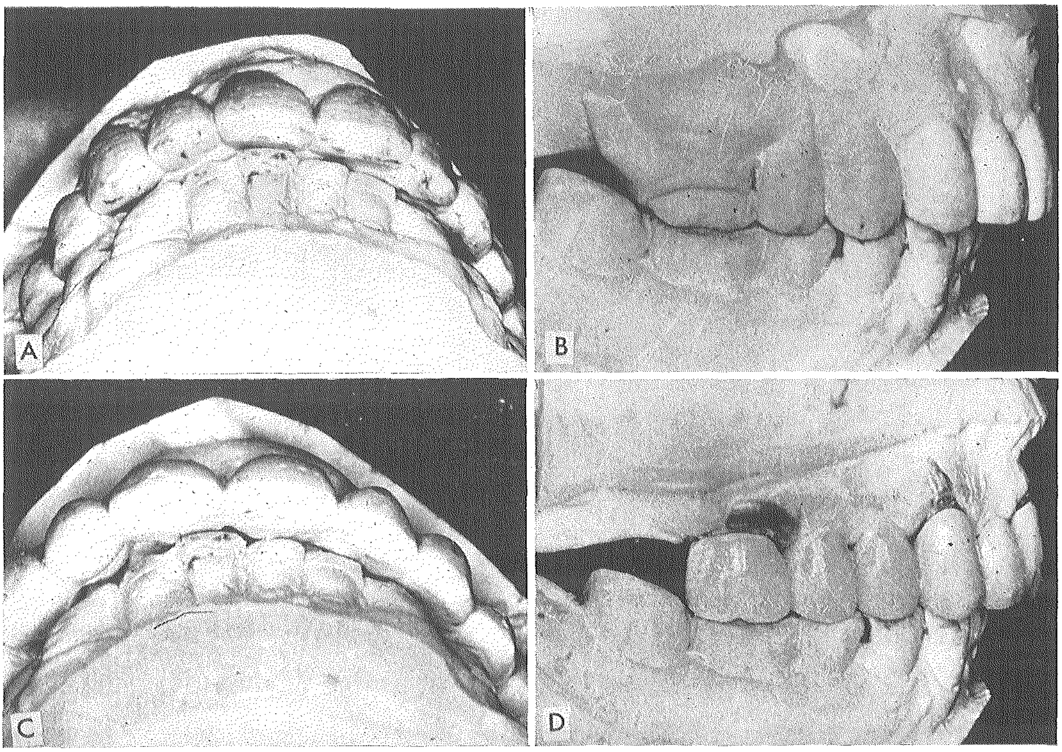


Figure 445. Same patient as shown in Figure 443. The vertical and horizontal overlaps in the study casts (given by the previous dentist) were duplicated in the treatment. *A*, Lingual view of the study cast. *B*, Lateral view of the study cast. *C*, Lingual view of the completed upper splint. *D*, Lateral view of the splint. Notice how the occlusal relationship and overlaps appear nearly the same.

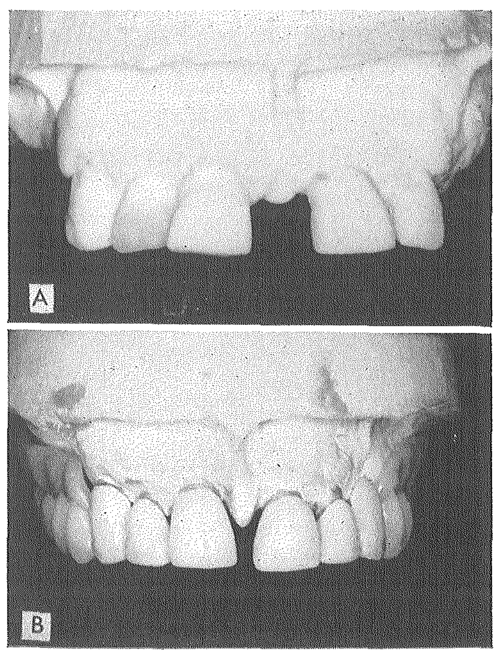


Figure 446. Solving the problem of splinting terminal, widely spaced mobile anterior teeth. *A*, Study cast of five remaining maxillary mobile teeth and a very wide diastema. It is impractical to splint all the five teeth with crowns because the restored splinted teeth would appear too wide and grotesque. *B*, The completed three section splints. The diastema is reduced a great deal.

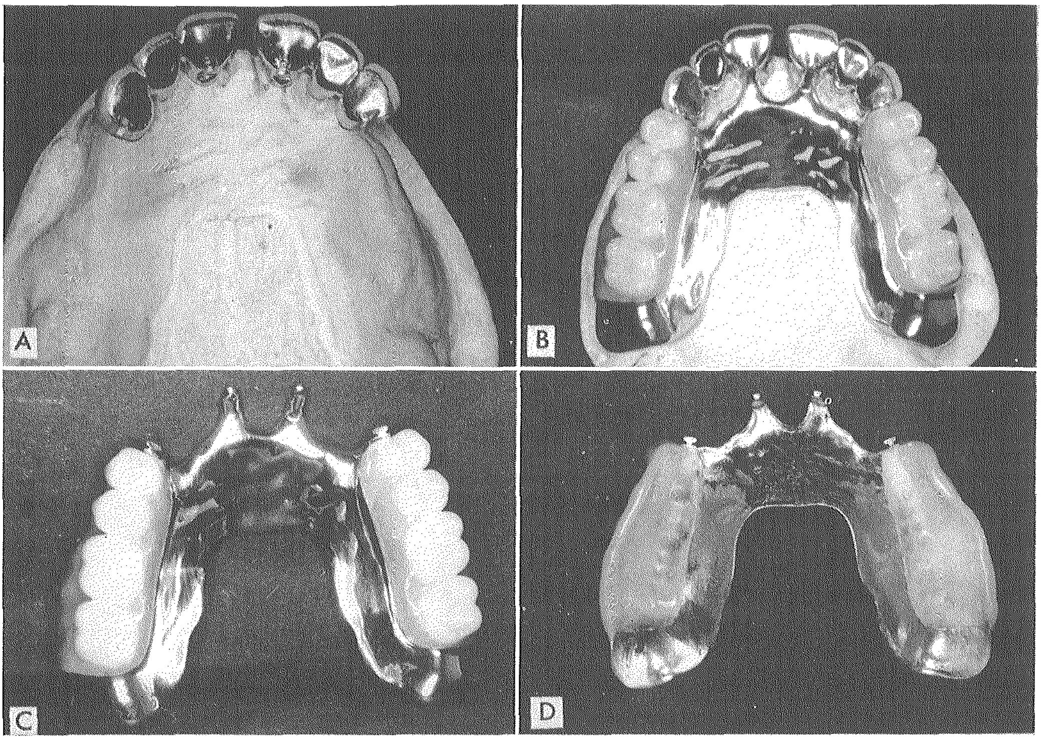


Figure 447. Treatment plan of patient shown in Figure 446. A fixed three unit splint was constructed on the right side and the left central and lateral incisors were splinted and carried a cantilever canine pontic. Each canine received internal attachments. The lingual surfaces of the two central castings received precision rests. *B*, A removable partial denture casting had two arms with the male precision rests on each end to aid in stabilizing the mobile teeth. *C*, Occlusal view of the partial denture showing the male precision rests for the central incisors and the male attachments for the canines. *D*, The palatal view. The problem was solved by use of two anterior three unit fixed splints and the removable partial denture with precision rests which stabilized the anterior splints.

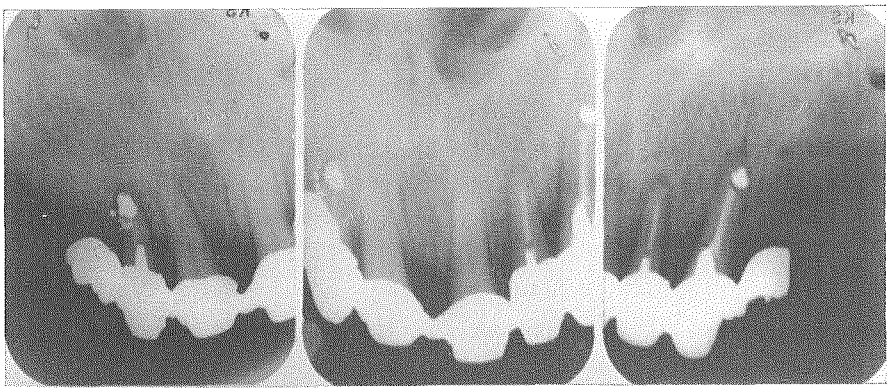


Figure 448. Roentgenograms of splinted teeth with cantilever pontics receiving the stress of a precision removable partial denture. These terminal teeth should be removed.

pulpless stumps, with root resection and amalgam seals, were subjected to additional stress by a fixed cantilever splint with a pontic soldered to each end, and supported a removable partial denture with internal precision attachments. These few teeth and an old splint contribute little to retention and function. A complete denture is definitely indicated.

It has been stated that when all efforts to save terminal teeth have been exhausted, the patient becomes amenable to complete dentures. Figure 449 illustrates

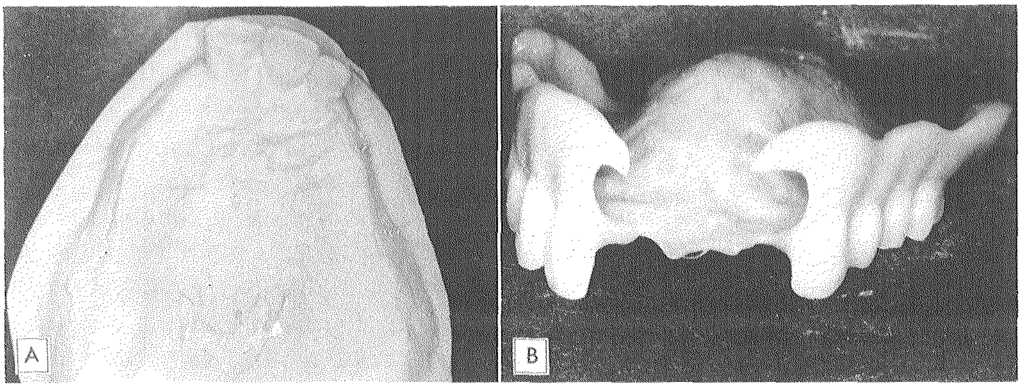


Figure 449. A flexible full palate partial denture using flexible labial arms instead of metal clasps on three terminal teeth.

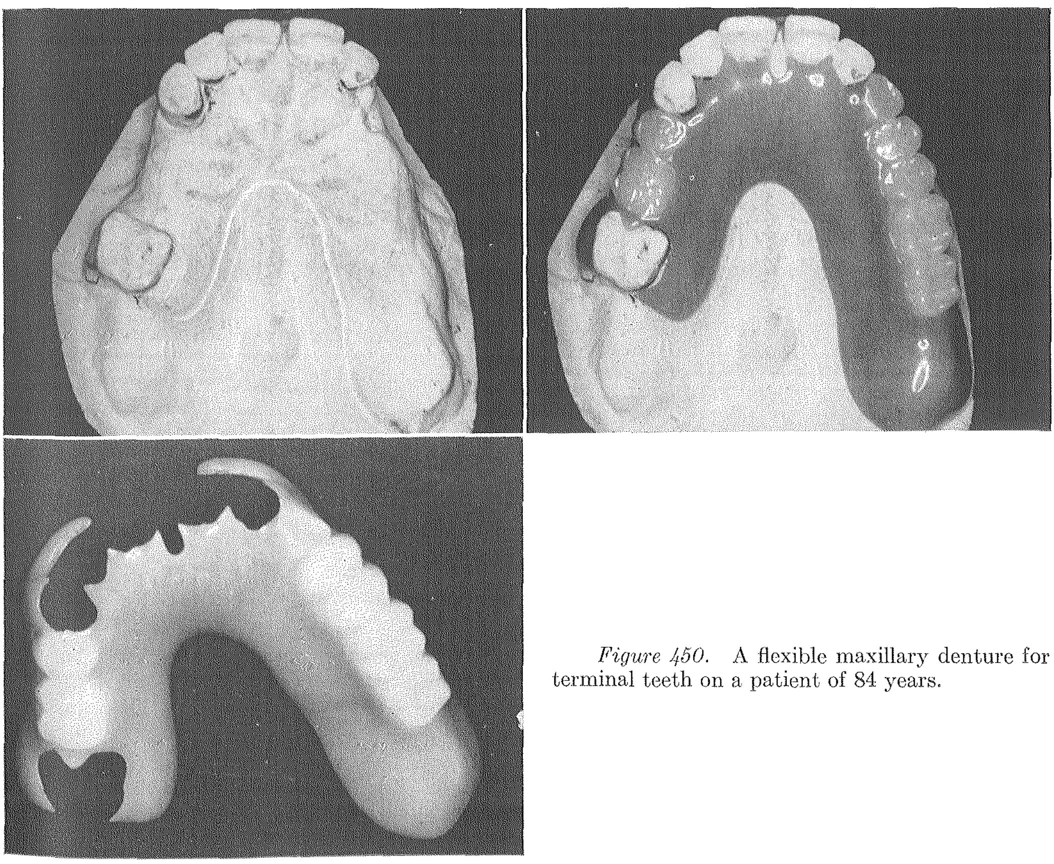


Figure 450. A flexible maxillary denture for terminal teeth on a patient of 84 years.

a patient with only three remaining maxillary incisors. The two central incisors and the lateral incisor were patched and filled with several large silicate cement and acrylic resin restorations. The limited number of teeth and their precarious condition made it impractical to restore them with any type of crown to support a removable partial denture with clasps or internal attachments. A Flexiplast or flexible full upper denture was made, with two buccal arms of the same material that slipped over the slight undercut of the alveolar plate above the right central and left lateral incisors. This was fabricated at a minor cost to the patient. Furthermore, the full palate of this partial denture prepares the patient for a complete denture when the three terminal teeth have to be removed.

THE PREVIOUSLY TREATED PATIENT

Sometimes a patient presents himself for correction of occlusal rehabilitation that has been completed a short time previously by some other practitioner. Such a patient brings many problems to the new dentist. Tact and kindness in the management of this patient are of prime importance. For some reason, the reconstruction did not prove "successful" and the patient perhaps has lost faith in dentistry. That faith will not be restored by belittling the work of the previous dentist. It is possible that the patient was physiologically incapable of responding to the type of treatment given. The new operator has the advantage with regard to treatment because he already knows what will not be tolerated by the patient's tissues. It is imperative that the prosthodontist determine whether the patient has developed troublesome psychoneurotic patterns of behavior regarding the conditions in and around the mouth. In the dental profession, opinions regarding treatment and management of an individual case are not always the same. The operator should try to determine the contributing cause or causes for the failure of rehabilitation. Failure may be due to any one or a combination of the following:

1. Esthetics that do not please the patient.
2. Unreasonable demands by the patient.
3. Restorations encroaching upon the interocclusal space.
4. Deficient and poor quality technical work.
5. Deflecting contours of the restorations not in harmony with the gingivae and lips.
6. Unfavorable mental and physical health.
7. Poor hygiene habits.
8. Psychosomatic manifestations or syndromes of the temporomandibular joint.
9. Intolerance to the restoration.
10. Marked periodontal pathosis.
11. Excessive splinting of the teeth.
12. Human frailties.
13. Personality clashes between patient and dentist.

14. Failure of the neuromuscular mechanism to react favorably to a change in the occlusion.
15. Incompleted dental treatment.
16. Altering the vertical and horizontal overlaps.
17. Changing an acceptable occlusal curve.
18. Pain and discomfort in the teeth, gingivae, or temporomandibular joint.
19. High fee for treatment.
20. Compromising the treatment plan to satisfy the patient's demands.

Sometimes the patient has a legitimate reason for the dissatisfaction and sometimes not. The new operator should determine this and, if possible, contact the previous dentist for any advice he can obtain for the patient's welfare. If necessary, the dentist should seek consultations and other opinions regarding the management of the previously treated patient. If the esthetics of the previously completed restorations do not satisfy the patient, the new operator is cautioned about condemning and removing them unless he is certain he can improve upon their appearance. There is no way of knowing entirely what type and how much tooth structure is present beneath each restoration, or of determining the condition of the pulps and other factors responsible for the unsatisfactory esthetics.

If the occlusion encroaches upon the patient's interocclusal clearance, then removal of all restorations is recommended. If many of the porcelain jacket crowns are broken, it may be an indication that this medium is contraindicated. *The patient must be given to understand that new problems may arise after the removal of the previously constructed restorations.* It is difficult to place such a patient at ease because of the discomfort, inconvenience, and increase in cost of the new rehabilitation. A complete and thorough history of the case, cooperation with the previous dentist (perhaps in the form of consultation), and an accurate evaluation of the patient's psychological behavior will be the determining factors in the decision whether the operator should attempt to re-treat the mouth.

The doctor should check the margins of the crowns for overhang that irritates the tissues, or for shyness that permits decay to set in. Perhaps the design of the fixed or removable partial denture is inadequate. Are the occlusal patterns too steep or too shallow? Has there been any provision for asymmetries in the jaws, gingivae, or teeth? Does the patient suffer from abnormal habits of clenching or grinding of teeth? Inquire from the patient what difficulties he experiences. Sometimes a splint or a fixed partial denture is overcontoured and contributes to a speech defect, gingival irritation, or some other abnormal manifestation.

We can divide previously treated cases of occlusal rehabilitation into three groups: those that have had reconstruction within two years; those done five to eight years earlier; and those done ten or more years earlier. A problem that faces the operator is the patient whose occlusion has been completed within one year and the patient whose occlusion was completed some time earlier. In the latter case, deterioration of the restorations has begun to take hold. Usually the patient is not in pain and is unaware of the breakdown of the once-beautiful restorations. Unless he has been prepared and constantly reminded that rehabilitation of a dentition cannot last indefinitely, he will suddenly lose confidence in his dentist. When made

Figure 451. A provisional splint in two sections. The right section has an acrylic rest against the lingual of the lateral of the large left splint. Provisional one or two piece acrylic resin splints are recommended to maintain the satisfactory vertical dimension of occlusion, aid in mastication, and provide esthetics after all the teeth are prepared.

aware of breakdown, that patient considers the conditions due to "improper dental treatment" even though the treatment resulted in satisfactory function for ten years or more. We sometimes lose such a patient to a new operator who can readily find fault, unjustifiably, with what was done.

RE-TREATING AN OCCLUSION TEN YEARS OR MORE AFTER REHABILITATION

It has been stated that acrylic wears and discolors, that some pulps fail to survive, and that caries occurs around old restorations. Furthermore, bone resorbs as part of the aging process, and the gingiva recedes or develops a disturbance. *When function has been and still is satisfactory, the first important step in re-treating such a dentition is to measure and record the existing comfortable interocclusal space and centric occlusion.* Sometimes a provisional acrylic resin splint, in one piece or in two sections (Fig. 451), is recommended to maintain the tolerant vertical dimension of occlusion. It also provides acceptable esthetics while protecting the newly prepared teeth.

Figure 452 illustrates a middle-aged woman who had her dentition rehabilitated about twelve years previously. Some restored teeth had been removed, and some porcelain jacket crowns had fractured. Notice the excessive horizontal and vertical overlaps. The left maxillary central and lateral porcelain jacket crowns were intact and satisfactory even after so long a time, and it was decided to leave these restorations alone. She was an understanding patient but placed great importance upon esthetics, and every effort was made to obtain an esthetically satisfying result for her. She was aware that porcelain might fracture and that restorations do not last indefinitely. It was important that the new operator evaluate the patient's psychologic behavior and ascertain whether he should dismiss her or treat her, because she understood her oral condition. The interocclusal space was measured and recorded. Occlusal rims were fabricated on the study casts (Fig. 453) to use as a means of duplicating her satisfactory centric occlusion along with the remaining teeth in contact. Porcelain jacket crowns and fixed bridges were inserted in the upper jaw.

Porcelain jackets were inserted on the lower anterior teeth which supported an internal attachment removable partial denture (Fig. 454). Figure 455 compares the newly completed retreated dentition with the one that had been completed twelve years earlier. The overlaps were closely duplicated.

MANAGEMENT OF THE PREVIOUSLY TREATED CASE THAT HAS BECOME TERMINAL

When most of the restorations on a previously treated patient are of the full coverage type, neither clinical nor roentgenographic examination can always disclose the condition of the tooth structure beneath the crowns and bridges. Trying to remove key old restorations may necessitate removal of the teeth. Unless the patient is willing to accept responsibility for any deleterious effect, the new operator should avoid removing the restorations and should classify such a dentition as terminal. If the decision is made to retain the old restorations and teeth, the patient must not be left with the impression that these teeth and old restorations will last a long time. If the new operator removes the old restorations, he may then have to make the decision that all the teeth should be removed. The patient is usually shocked at this conclusion (if not prepared beforehand) and may even blame the new operator for his plight (Figs. 456 and 457). The patient who is unhappy about

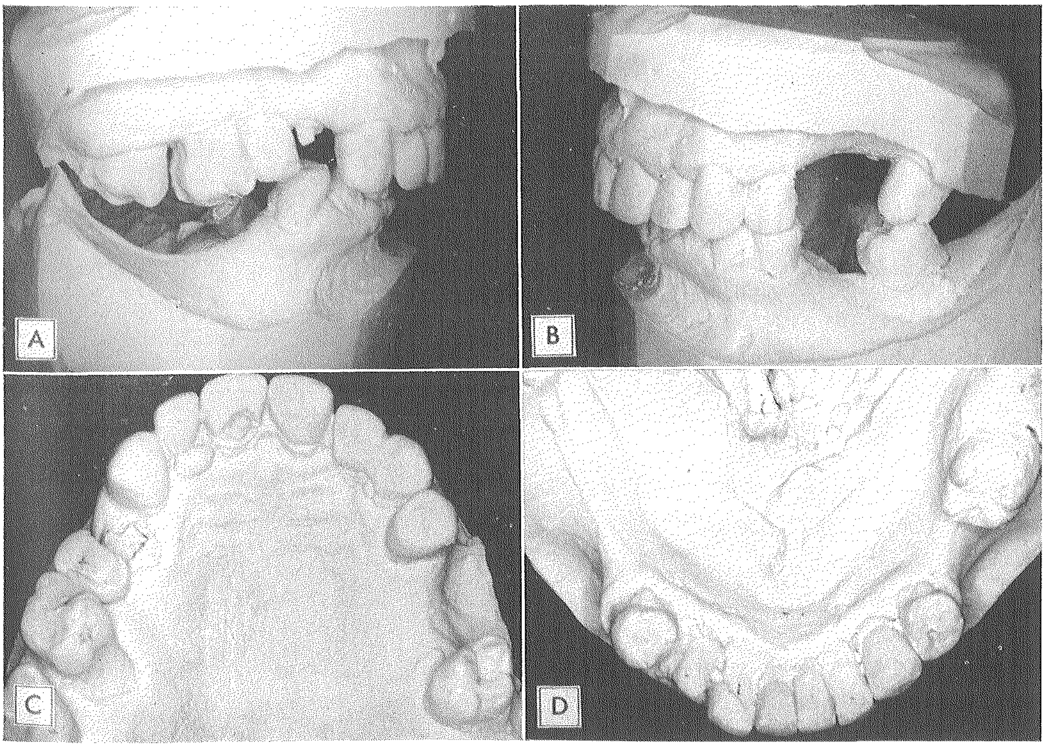


Figure 452. Study casts of a previously treated patient twelve years after rehabilitation. *A*, The right side. *B*, The left side. *C*, Cast of the upper jaw, and *D*, Cast of the lower jaw. Occlusal relationship is satisfactory and should be recorded before preparing the teeth.

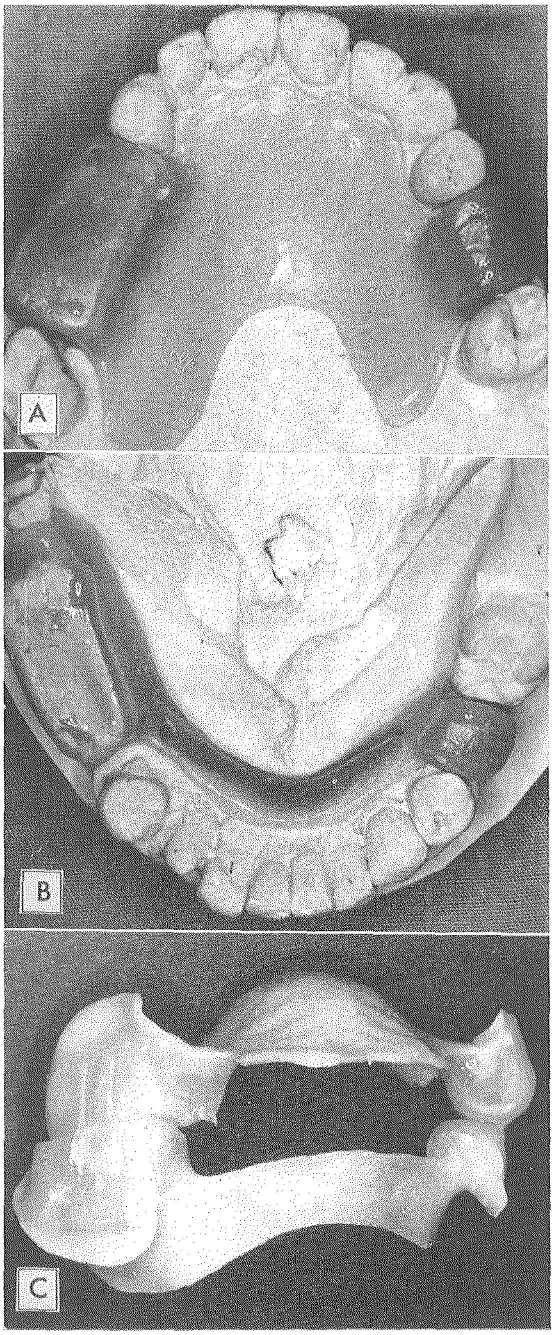


Figure 453. Same patient as shown in Figure 452. *A* and *B*, Preliminary occlusal rims on the study cast. *C*, Occlusal rims removed from the patient's mouth after registration of contacting guide teeth to be used as a means of duplicating the tolerant vertical dimension of occlusion and the overlaps.

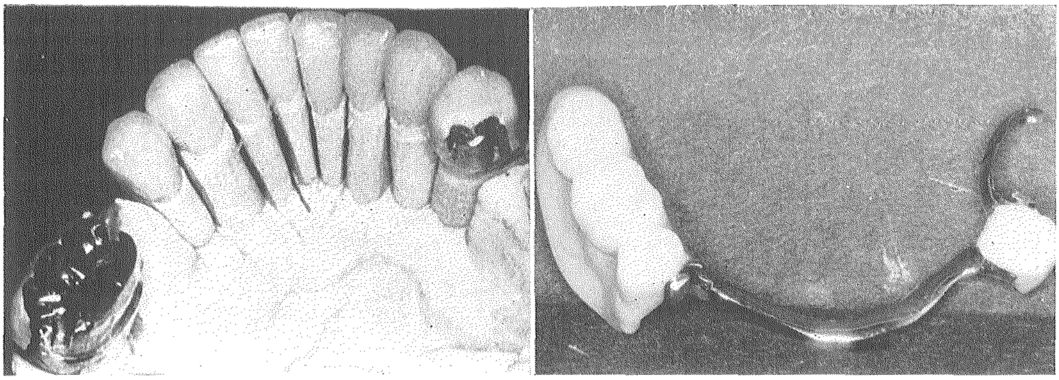


Figure 454. Same patient as shown in Figure 452. The lower jaw received porcelain jacket crowns and porcelain fused to gold abutment retainers for a removable partial denture with internal attachments. The teeth in the upper jaw received porcelain crowns and a fixed bridge. The left central and lateral old porcelain crowns were left intact, there being no need to remake them.

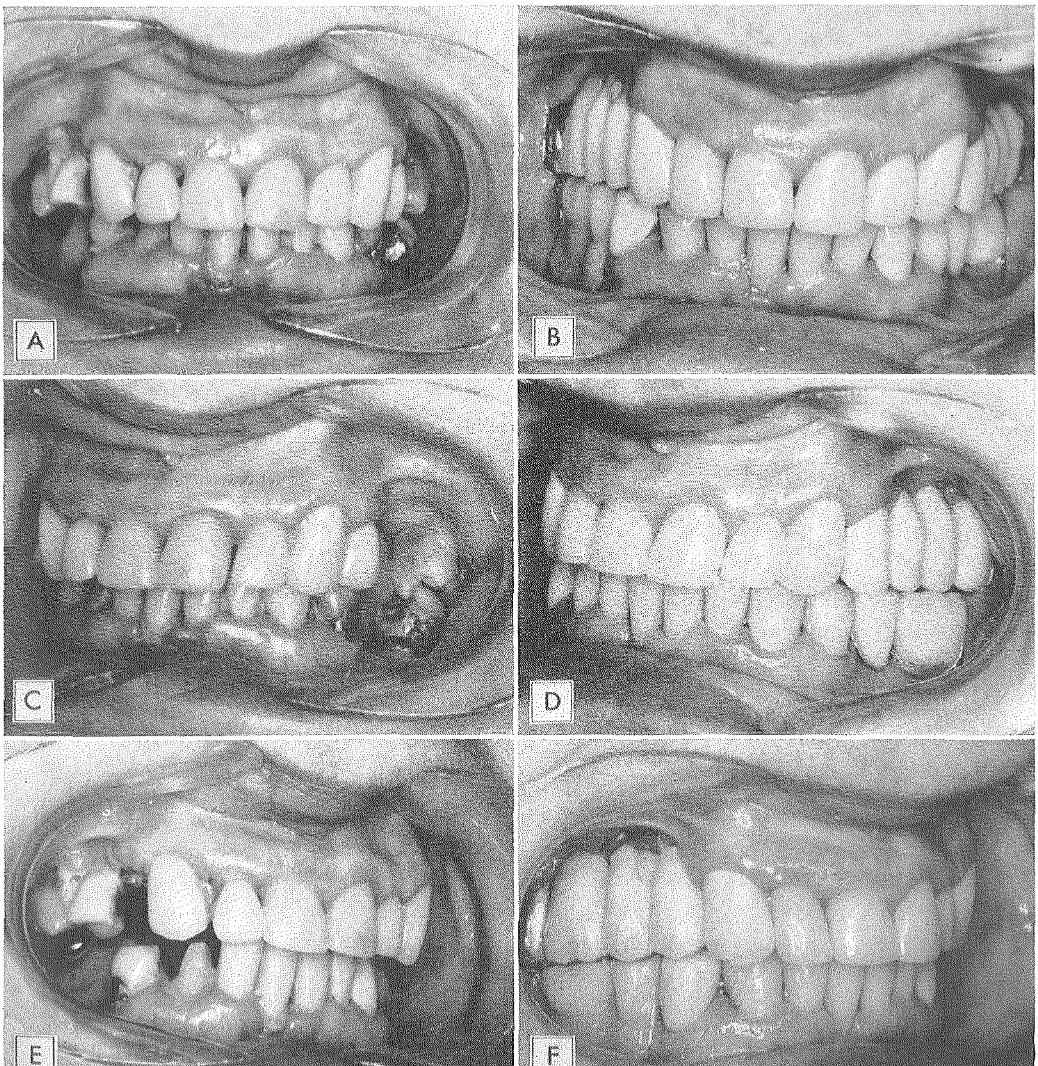


Figure 455. Same patient as shown in Figure 452. *A, C, E,* Before treatment. *B, D, F,* Completed rehabilitation with approximately the same vertical dimension of occlusion and the same vertical and horizontal overlaps as before retreatment.

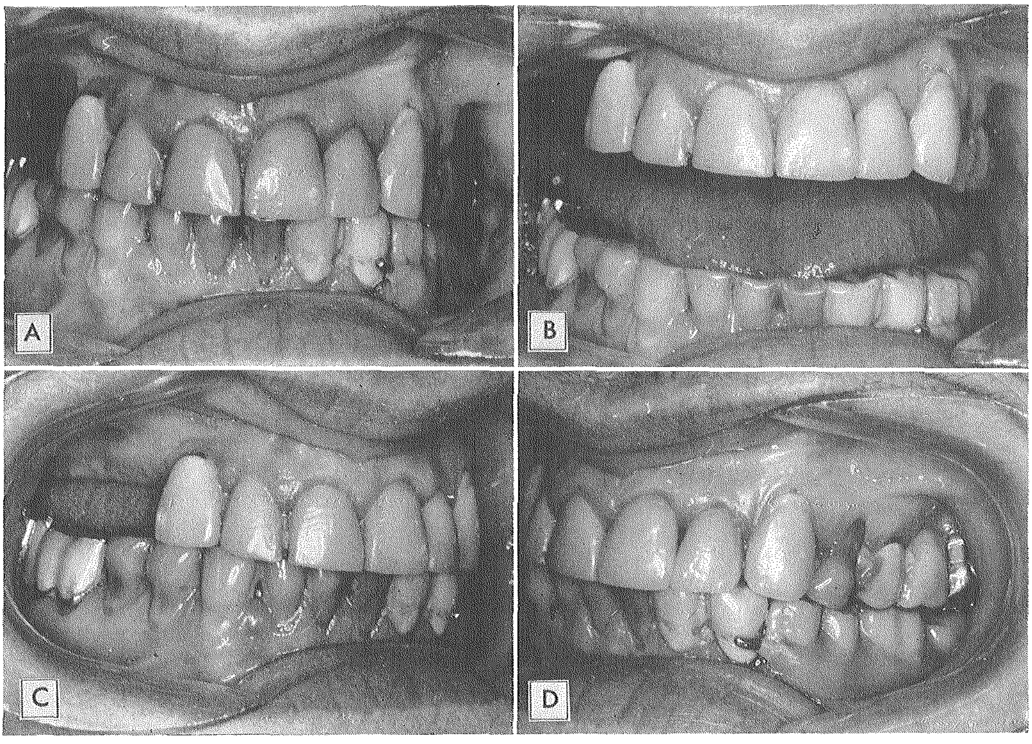


Figure 456. This dentition was rehabilitated about ten years earlier and the patient refused to accept the fact that the remaining teeth were terminal and complete dentures were indicated. *A*, The right maxillary canine was abscessed and root resection was done about six years earlier. The remaining teeth are mobile. *B*, Notice wear caused by bruxism on the incisal edges of the three untouched mandibular incisors. *C*, There is marked recession around the right mandibular canine and premolars and the crater excavation. *D*, Notice the recession on the maxillary premolar and the patched lower left lateral incisor and canine. Bruxism caused the forward movement of the teeth and the loss of supporting bone. The patient was irate because she had expected the rehabilitation to last longer than ten years. It is best not to retreat a patient who is emotionally upset.

the rehabilitation that was completed five to eight years earlier may not have been given to understand the shortcomings of the materials used in dentistry. He may be a disagreeable person who foists his wrath and frustration upon the new dentist. The dentist is advised to avoid becoming involved in any way with such a patient.

MANAGEMENT OF THE PREVIOUSLY TREATED UNSUCCESSFUL RAISED OCCLUSION

An occlusion which has recently been treated and has proved unsuccessful usually causes the patient to be unhappy and antagonistic. Such a rehabilitated dentition is unsatisfactory primarily because the vertical dimension of occlusion has been increased beyond the limits of the physiologic rest position. Unsatisfactory esthetics and the high cost of the extensive dental treatment are additional factors contributing to the dissatisfaction of the previously treated patient.

SYMPTOMS OF THE RAISED OCCLUSION

Abnormal clinical manifestations associated with a raised occlusion may be pain and discomfort in the temporomandibular joint areas brought about by strained ligaments and muscle spasms. Function is not at its optimum and the patient's speech may be impaired, thick, and lisping. Pain may exist in some restored teeth, and the gingiva may be red and inflamed around the restorations. Usually the patient complains about the esthetics because it is not what he expected, and perhaps the limitations in obtaining desirable esthetic improvement were not thoroughly impressed upon him.

RE-TREATING THE RAISED OCCLUSION

The new operator should not give assurances that redoing the occlusion will eliminate all the troublesome conditions. Reducing the raised occlusion is the first procedure in order to give relief from pain. Warn the patient that some restorations may fracture or some may be perforated during this procedure. Tests for high spots and interferences to be ground are made in centric tapping, swallowing, chewing, and rubbing contacts, as described on page 189. This reduction of restorations may require several visits before pain and discomfort are eased. *When comfort is obtained,*

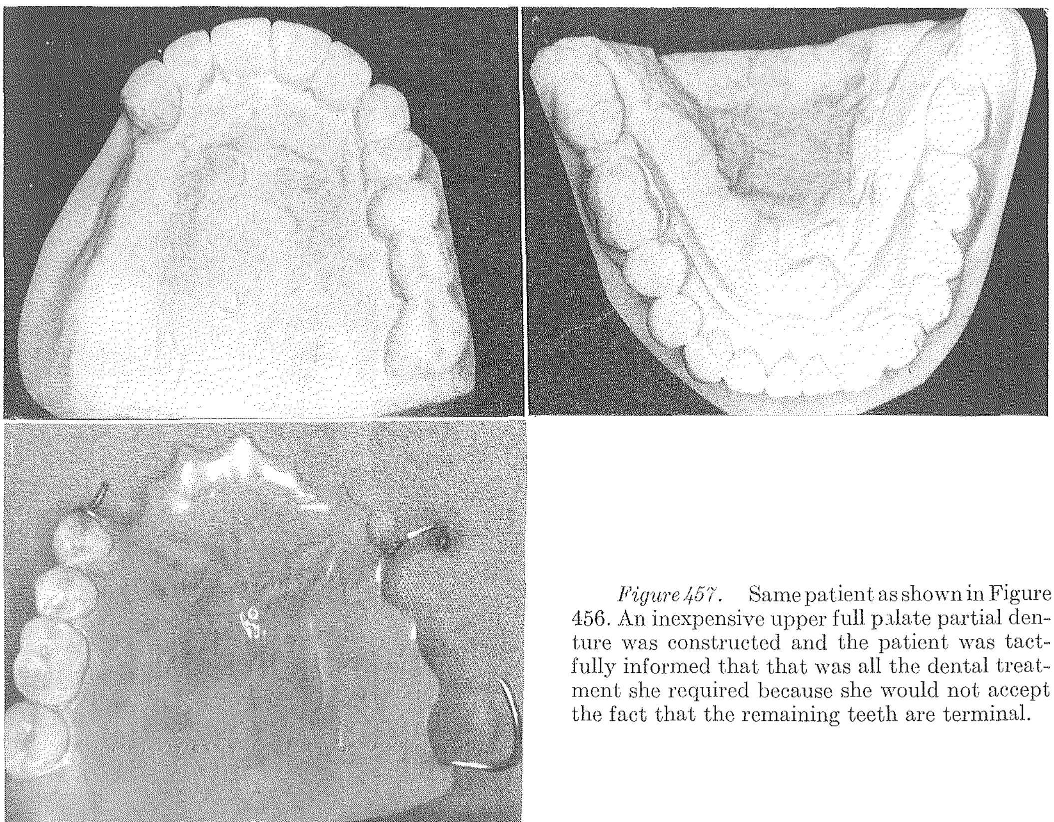


Figure 457. Same patient as shown in Figure 456. An inexpensive upper full palate partial denture was constructed and the patient was tactfully informed that that was all the dental treatment she required because she would not accept the fact that the remaining teeth are terminal.

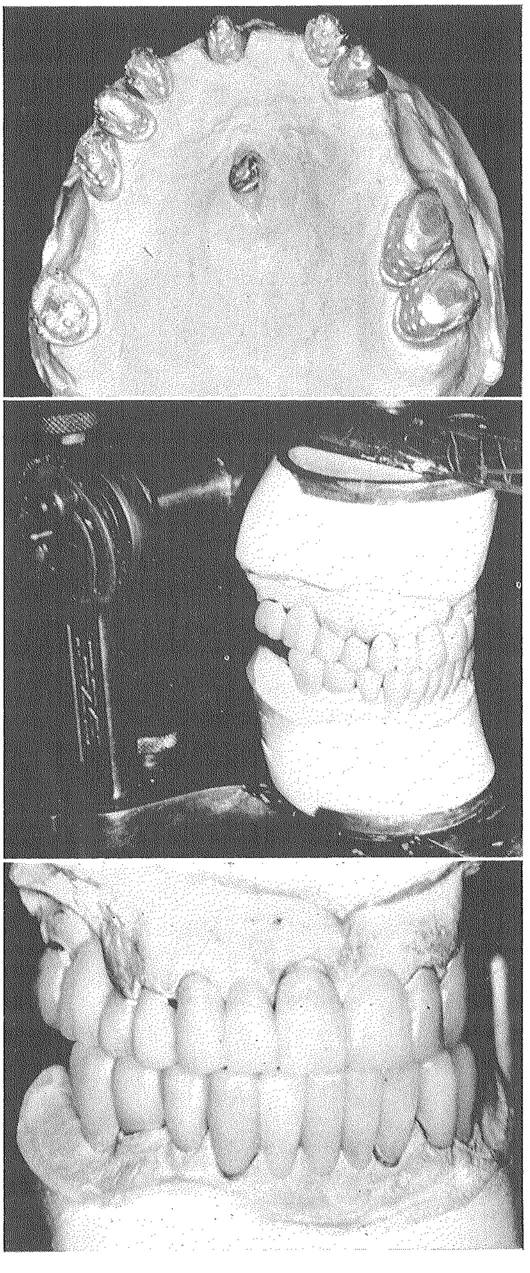


Figure 458. Treatment of a raised bite dentition. All restorations are removed. Construct acrylic resin crowns and bridges cured to gold copings and frames, using the average 2 to 3 mm. interocclusal space as a starting point. The cast gold prevents dislodgement. At each visit after cementation, the operator reduces the occluding and incisal areas until comfort and function are achieved. Once the tolerant occlusal relationship is recorded, it can be used as a guide later on.

the new interocclusal space is measured and recorded. This measurement will be the guide in restoring the correct occlusal relationship when all the restorations have been removed. The next step is to remove the restorations. The operator may find that insufficient tooth structure has been removed for the preparation of some teeth or that too much has been removed and the teeth are extremely sensitive or that some teeth have become mobile. The pulps may be irreparably damaged, so that the original retreatment plan may have to be altered. Perhaps a fixed bridge may have to be replaced by a removable one. These possibilities should be tactfully explained before attempting to remove the recent restorations. Rerehabilitating an unsuccessful occlusion is a very difficult undertaking and unless the patient is reasonable in his expectations as well as cooperative, the operator should not treat the patient.

Sometimes it is a good policy to remake the restorations on one side first, using the corrected occlusal relationship on the opposite side as a guide. Still another method is to remove all the existing restorations responsible for the raised bite immediately, and construct gold copings and bridge frames to which acrylic resin can be cured (Fig. 458). These temporary restorations are constructed to an arbitrary interocclusal space and cemented on the previously prepared teeth. The cast gold will prevent dislodgement. At each visit after cementation, the operator reduces the occluding and incisal surfaces until comfort is achieved. This method is indicated when bruxism is pronounced. Once the tolerant occlusal relationship is reached the interocclusal space is recorded and the temporary restorations are tapped off to be used as the guide later on.

THE INCOMPLETE RAISED OCCLUSION

Figures 459 and 460 show the partially completed rehabilitated occlusion three weeks after cementation of the restorations in the lower jaw. The patient complained of pain in the lower left premolar region and discomfort in the temporo-

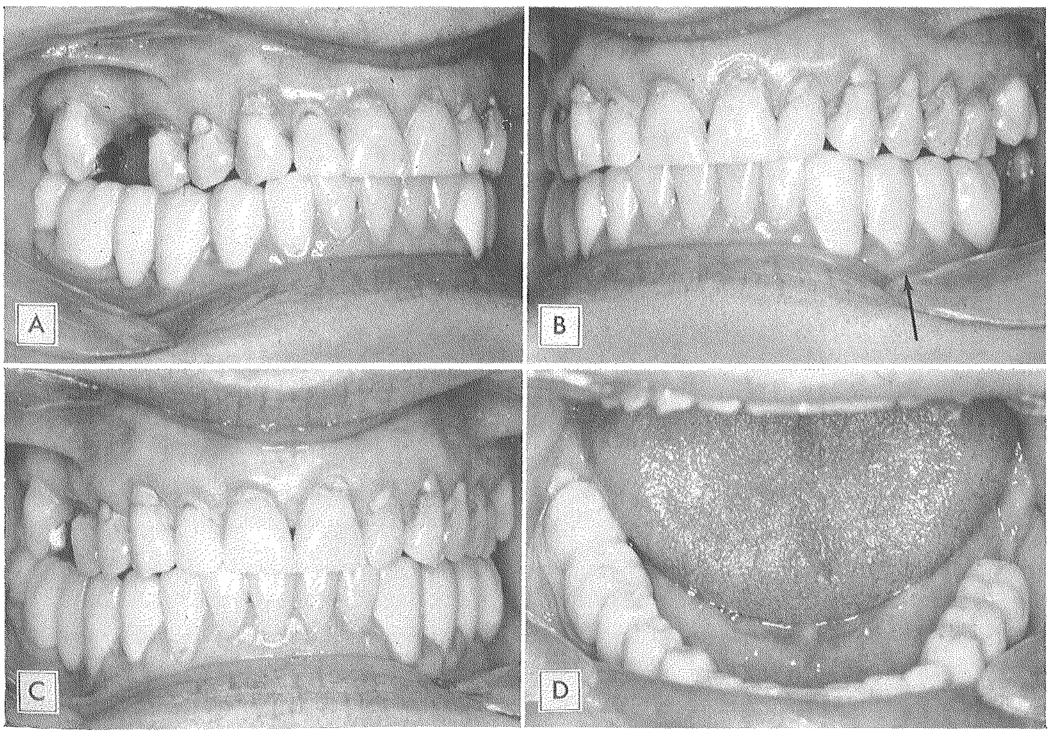


Figure 459. Previously treated lower dentition and a raised bite beyond the limits of the physiologic rest position. *A*, Right side. Porcelain fused to gold fixed bridge splint. *B*, Left side. Overextended four unit porcelain fused to gold splint on the canine and premolars with a free-end cantilever molar pontic was responsible for severe pain due to the pump handle effect. Arrow points to gingival inflammation three weeks after insertion due to raised bite. *C*, Anterior view. *D*, Notice the broad occlusal table. The patient suffered severe pain and discomfort in the temporomandibular joint area (see text for treatment procedures).

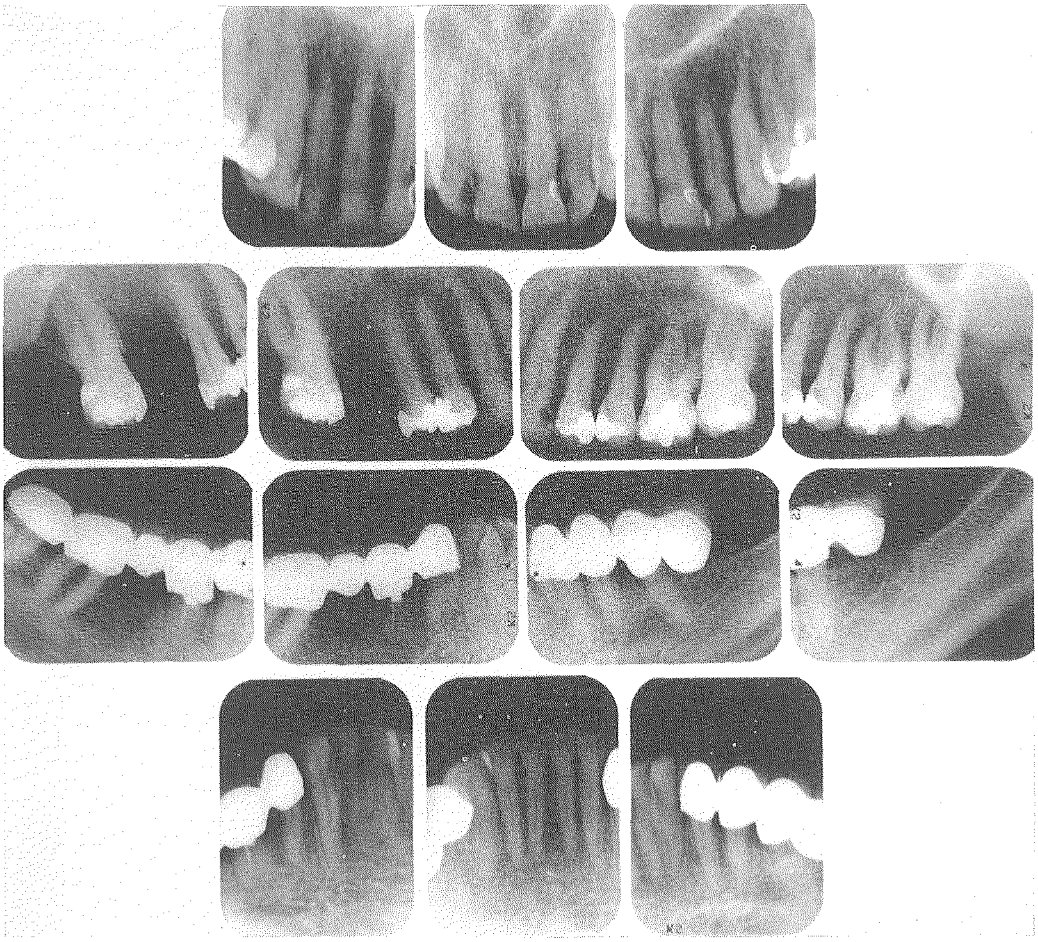


Figure 460. Roentgenograms of the patient shown in Figure 459.

mandibular joint areas. The pain, plus the high cost of the treatment, disturbed her and she appeared very emotionally upset. Such a patient, psychologically disturbed, irritated, and sometimes angry, should not be treated. Inasmuch as it is the dentist's duty to relieve the patient of pain if he recognizes the cause, such procedures should be undertaken after thorough case presentation. Thorough and detailed records of existing conditions as well as what procedures are planned should be recorded. Full roentgenogram series, Kodachrome pictures, and articulated study casts are absolutely necessary.

It was determined that the patient's primary desire was esthetics (although this was denied) and porcelain fused to gold restorations were inserted in the lower jaw. Examination proved that the vertical dimension of occlusion was increased beyond the limits of tolerance to make room for these esthetic crowns and bridges. This was responsible for pain and discomfort in the joint areas. The previous operator had constructed a four unit fixed porcelain fused to gold splint which included the canine and two premolars. A free-end molar pontic was cantilevered off the three splinted teeth. The raised bite plus the cantilever action of the free-end pontic was responsible for the pain in the second premolar. To hide the gold collars of the restorations, they were extended below the gingiva and were responsible for inflammation and bleeding. The cantilever molar pontic was severed and all the restorations were ground and reduced with stones during several visits. Pain and discomfort disappeared after about five treatments. Because such a patient would be difficult to treat, it was decided not to remake the restorations, and she was tactfully advised of this.

References

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2. Lieban, E. A.: Pulpal irritation and devitalization as a result of preparation of teeth for complete crowns. J.A.D.A., *51*:681, 1955.

21

OCCLUSIONS AFFECTED BY ACCIDENT OR DISEASE

ACCIDENTS TO THE MASTICATORY APPARATUS

A serious accident to the masticatory apparatus that disturbs the occlusion introduces conditions which make occlusal rehabilitation a difficult undertaking. Sometimes the movements of the mandible are permanently impaired or the nerves and muscles seriously damaged for an indefinite period. If the temporomandibular joint is damaged, an oral or orthopedic surgeon should be consulted.

Figure 461 illustrates a young woman of 39 years, whose occlusion was disturbed because of an accident that resulted in the fracture of the zygomatic arch on the right side. The facial nerve and muscles of the face and jaws were severely damaged. After treatment of the fracture by the surgeon, the patient could not masticate because the mandible did not function normally in its movements. Because of the excruciating pain in her face and teeth, oral hygiene was not strictly adhered to and decay set in on most of her teeth. Some teeth had to be extracted. All of the remaining ones on the injured side were mobile and did not intercuspate. The prognosis of rehabilitating this mouth is contingent upon the severity of the damage and the future complications.

The patient may be considered in the classification of group II class 1. Restorations were completed on the teeth on the damaged side with the occluding teeth on the opposite side acting as guides in restoring the occlusal relationship. Then the restorations on the injured side were used as guides in the construction of restorations for the teeth on the uninjured side. The maxillary left cuspid remained as the key tooth and received a distal gold inlay and a cervical silicate cement restoration.

No anatomic articulator or face-bow participated in the treatment because registrations on the face and jaw would have been too painful. Only a wax occlusal registration and an ordinary straight line articulator were utilized. Adjustments were made on the restorations during the many try-in sessions in the mouth.

It is hoped that the facial asymmetry caused by the injury to the nerves and muscles will improve in time. Correction of the occlusion made it possible for her to masticate without pain. As a morale builder, the esthetics was improved by constructing porcelain jacket crowns on the maxillary incisors. The mandibular in-

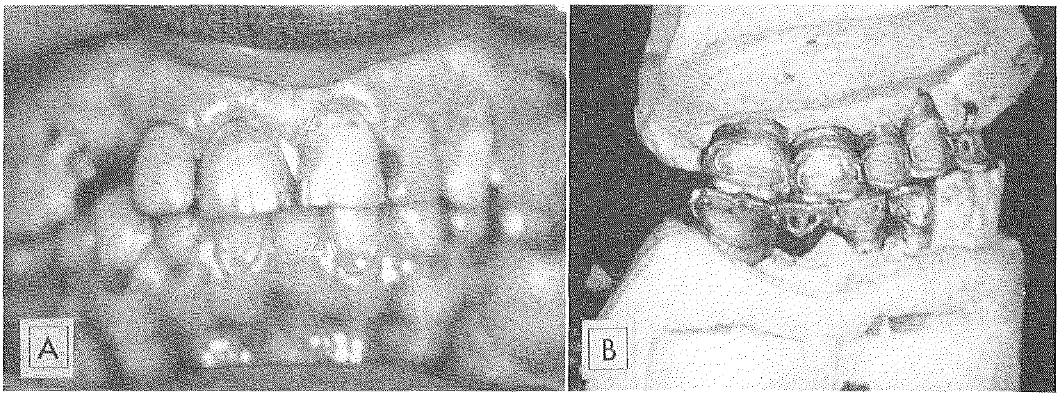


Figure 461. An accident to the teeth resulted in a fracture of the zygomatic arch, muscular and nerve injury, and continued terrific pain. *A*, Anterior view of the disturbed occlusion and unsatisfactory esthetic and gingival conditions. It was painful to use cheek retractors. *B*, The teeth on the injured side received restorations with the occluding teeth on the normal side acting as guides in maintaining the occlusion.

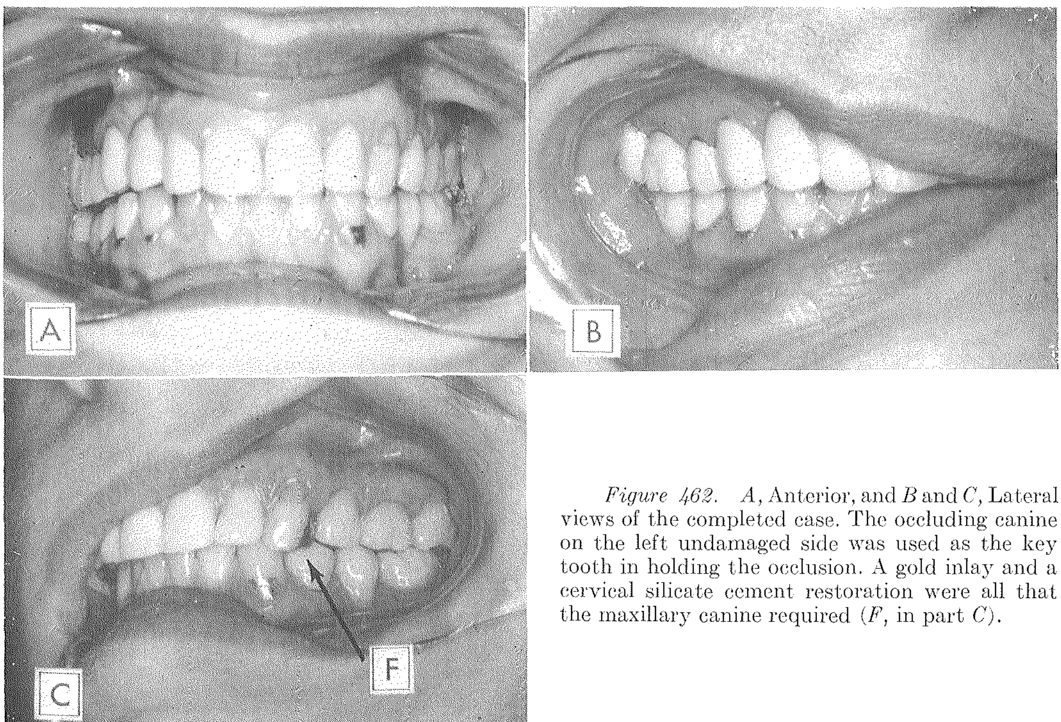
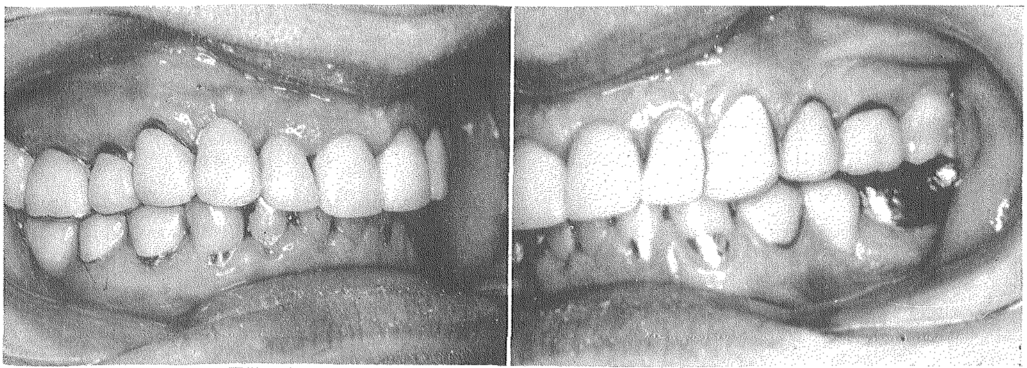


Figure 462. *A*, Anterior, and *B* and *C*, Lateral views of the completed case. The occluding canine on the left undamaged side was used as the key tooth in holding the occlusion. A gold inlay and a cervical silicate cement restoration were all that the maxillary canine required (*F*, in part *C*).



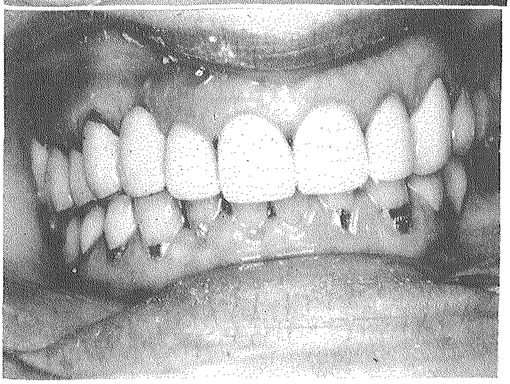


Figure 463. Same patient as shown in Figure 459 eleven years after treatment. The maxillary left canine received a veneer crown thirteen years after completion.

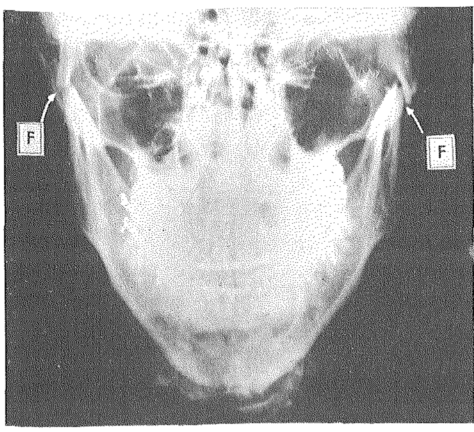


Figure 464. Frontal skull roentgenogram showing the fractured condyles (*F*).

cisors were not treated with full coverage restorations, but three cervical cavities received small gold foil restorations at a later date (Fig. 462). Three months after completion the patient complained of pain when she chewed on the right side. Undoubtedly there had been an adjustment in the occlusion and that side was disturbed. The crowns and bridge were removed and the double abutment retainers were separated. A new fixed partial denture was constructed, still using the opposite side as a guide. Postoperative care and attention for such a patient must be taken into consideration at the beginning of treatment. It will continue for a long time, and both patient and dentist should prepare for any contingency. Figure 463 shows the patient thirteen years after completion.

If the accident results in a bilateral fracture of the condyles (Fig. 464), then rehabilitation will have to bear watching. Success or failure is not always within the control of the operator. In this particular patient, all that was done by the oral surgeon was to wire the jaws with the teeth in centric occlusion. He felt that no surgery was necessary or advisable to unite these fractured heads to the rami. No

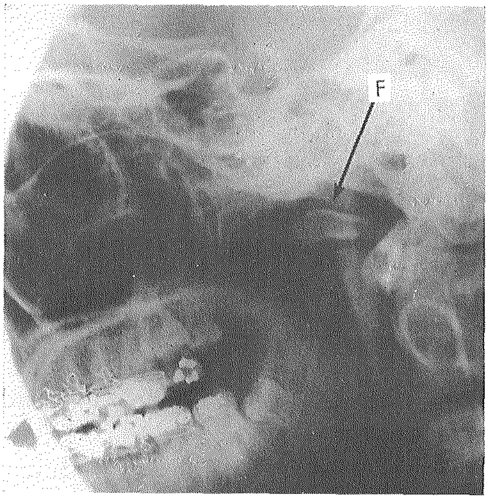


Figure 465. Another roentgenogram showing a fractured and displaced condyle (*F*). The patient's mandibular movements function normally.

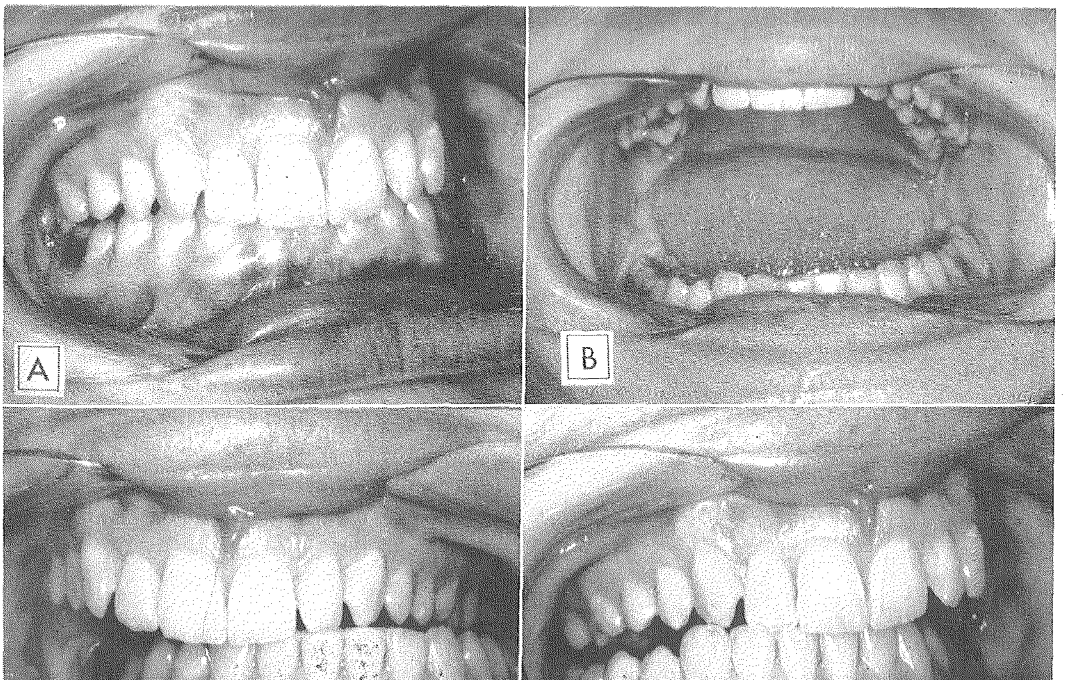


Figure 466. The same patient as shown in Figure 465. *A*, Centric occlusion. *B*, The mouth open. *C*, *D*, Lateral excursions after training the patient to put the muscles to work. The unattached fractured condyle does not inhibit these movements.

restorative rehabilitation with crowns and bridges was necessary either. It is interesting to note, particularly for those who place so much significance on the temporomandibular joint in recording and determining the movements of the mandible, that these fractured, unattached condyles offer no indication whatsoever of their prime importance in support of this theory. This patient, even after five years, has a satisfactory functional occlusion without discomfort. No doubt nature has encouraged some of the elevator and depressor muscles to participate in some functional lateral movements of the mandible.

The temporomandibular joint is not like a ball in a socket. *The condyles, the terminal segments of the mandible, are suspended in a hammock of muscles and ligaments, cushioned and loosely sandwiched between synovial fluid and membranes.* Inasmuch as the musculature is the dominant factor in the movements of the mandible, the muscles can be trained to perform their tasks even without a condyle. Figure 465 shows a young patient with a fractured condyle. The segment is completely separated from the mandible and has assumed a position in which it cannot contribute to jaw movement. After fixation to permit nature to adjust and heal the injured parts, the patient learned to open and close the jaw in all movements and in a very short time (Fig. 466). Should a patient in need of occlusal rehabilitation have a fractured condyle, procedures should not be initiated until the functional movements of the mandible are restored.

PAGET'S DISEASE

Sometimes the operator is called upon to treat a patient in whom a systemic disease is responsible for certain abnormal oral conditions.

Figure 467 illustrates a patient with Paget's disease. The skull is commonly involved early in the disease and becomes enormously enlarged, and the maxillae also increase in size. There is a marked anteroposterior disproportion in size between the maxillae and the mandible (Fig. 468). A pronounced osteoporosis of the maxillae

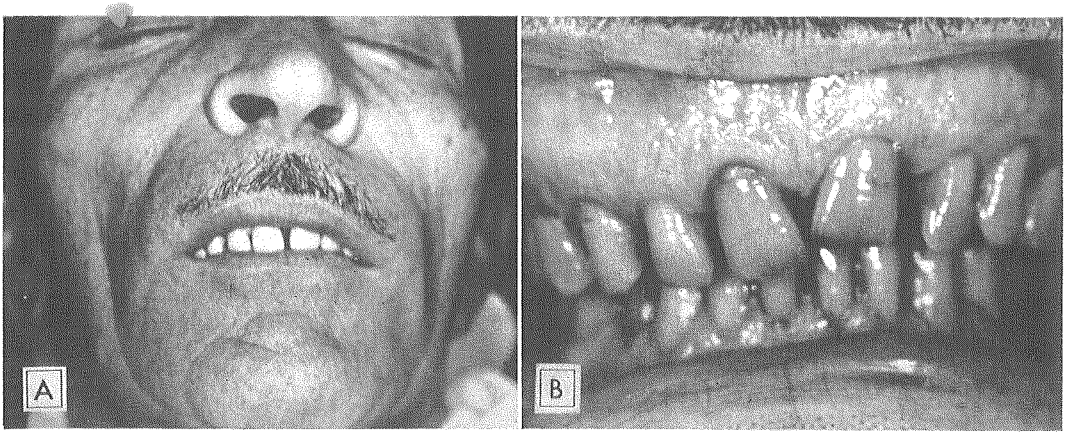


Figure 467. Paget's disease influences the treatment in restorative work in the maxillae. *A*, The cheek bones become enlarged and, with the growth of the skull bones, the maxillae increase in size. *B*, The gingiva becomes taut, red, and painful to touch. The teeth are separated.

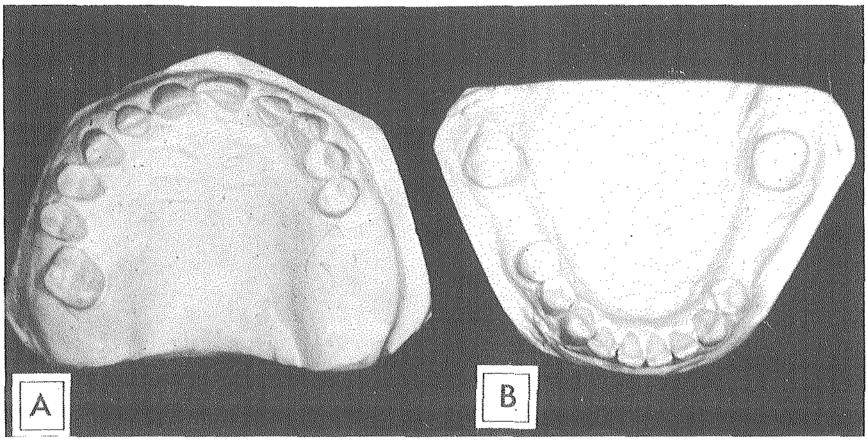


Figure 468. There is marked asymmetry between the jaws. *A*, Occlusal view showing the increased size of the upper jaw and tooth separations. *B*, The normal size mandible.

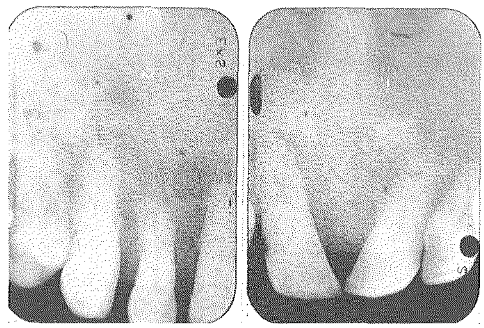


Figure 469. Roentgenograms of the anterior teeth showing the cloudy appearance and loss of trabecular detail.

with a loss of the trabecular detail is seen in the roentgenograms (Fig. 469). To advise surgical removal of the maxillary teeth in a patient with Paget's disease is contraindicated in most cases. The prosthodontist needs to utilize every tooth as abutments for fixed or removable partial dentures, for the oversize maxillae do not permit the construction of a satisfactory complete denture that will meet the requirements of esthetics and function. The mucosa is taut, highly vascular, and extremely sensitive to the touch. This patient is classified in group I class 2, a collapse of the occlusal vertical dimension because of the movement of the maxillary teeth and alveolus, brought about by disease. The occlusion is disorganized because the mandibular teeth function completely lingual to the maxillary ones, making mastication a difficult procedure.

Temporary removable acrylic (or metal) splints are constructed to determine the occlusal vertical dimension that this patient can tolerate (Fig. 470). The dimension is obtained arbitrarily, just as for complete dentures, and the splints are fabricated to be within the confines of the patient's interocclusal distance. After a few days of judicious grinding, the interferences on these splints are removed until comfort is experienced. The teeth are then prepared for crowns and bridges. The splints are used as occlusal rims and the working casts are articulated. Restorations are completed to these rims. Whenever there is such a marked disproportion in size between the mandible and the maxillae, the occlusal surfaces of the restorations on

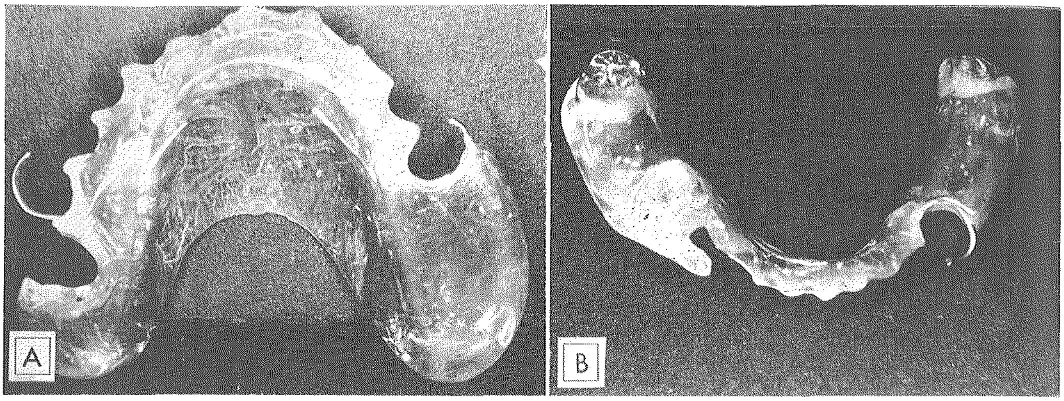


Figure 470. Acrylic resin splints are worn by the patient to determine the degree of restored vertical dimension that can be tolerated in comfort. *A*, The upper, and *B*, Lower acrylic splints.

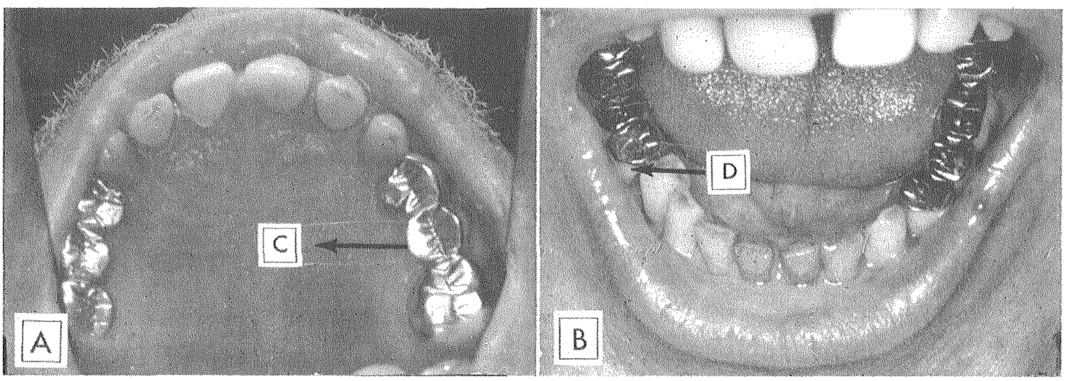


Figure 471. *A*, The occlusal surfaces of the restorations in the maxillae are made a trifle wider toward the lingual (*C*). *B*, The occlusal surfaces of the restorations in the lower jaw are made a trifle wider toward the buccal (*D*). By so doing, occlusal contact is made.

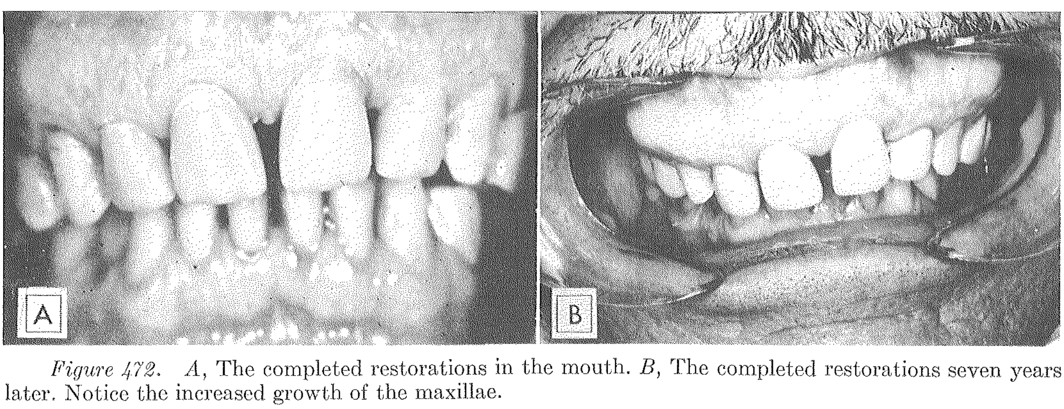


Figure 472. *A*, The completed restorations in the mouth. *B*, The completed restorations seven years later. Notice the increased growth of the maxillae.

the maxillary teeth are widened lingually and the occlusal surfaces of the restorations on the mandibular teeth are widened bucally (Fig. 471). By so doing, the tolerable occlusal contact is brought within the realm of the patient's interocclusal space, and mastication is made possible. The placement of four porcelain jacket crowns on the maxillary incisors improves the esthetics somewhat (Fig. 472*A*).

The success of such a treated case depends upon the progression of the disease. As a result of the continuing growth of the maxillae and its constituents, the restorative work may have to be replaced from time to time over the years, and the patient should be advised of this possibility before treatment is begun. Figure 472*B* illustrates the patient seven years after treatment was completed. Several porcelain crowns had to be replaced because of breakage. Notice the increase in alveolar bone growth and the shifting of the anterior teeth. Fortunately, there is little change as yet in the relation of the restorations in the posterior part of the jaw.

22

MANAGEMENT OF OCCLUSIONS WITH EXCESSIVE HORIZONTAL OR VERTICAL OVERLAPS

The predominant occlusion in man is the one with moderate vertical and horizontal overlaps (Fig. 473*A*). The *vertical overlap* is the vertical distance between the incisal edges of the maxillary and mandibular anterior teeth when the teeth are in centric occlusion. The *horizontal overlap*, or overjet, is the anteroposterior distance between the maxillary and mandibular anterior teeth when the teeth are in centric occlusion. Many excessive overlaps are related to the degree of vertical jaw development or the degree of forward growth of the mandible.[2] Excessive overlaps do not necessarily break down or become periodontally involved, nor do they contribute to facial imbalance (Fig. 474). The degree of overlap varies and it is a moot question just what degree should be considered excessive. For study purposes only, let us say that a vertical overlap over 3 mm. or a horizontal overlap over 4 mm. is excessive. *Excessive overlap, however, does not mean an abnormality nor does it mean that the overlap must be reduced when rehabilitating such an occlusion.*

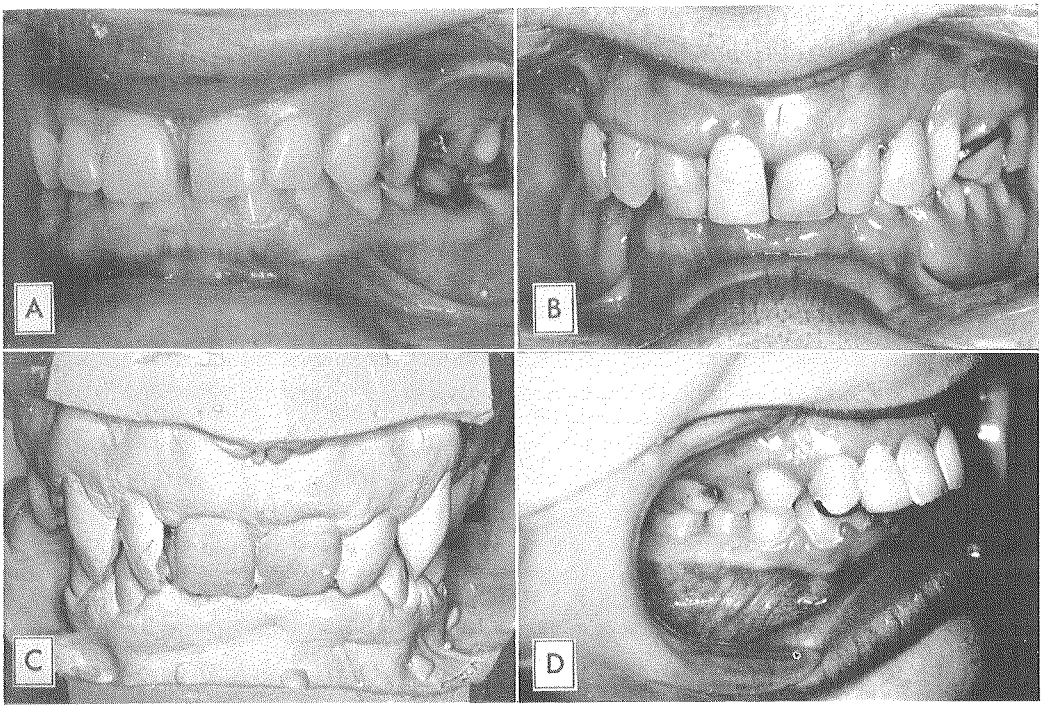


Figure 473. *A,* Common types of vertical and horizontal overlaps. *B,* Excessive vertical overlap. *C,* Scissors-type excessive vertical overlap. *D,* Combined excessive horizontal and vertical overlaps.

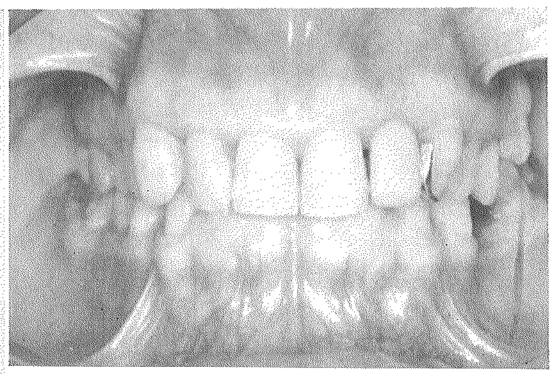


Figure 474. All excessive vertical overlaps do not create a facial imbalance. *Left,* A pretty, normal face with an excessive vertical overlap of the teeth. *Above,* The lips retracted and the teeth in centric occlusion.

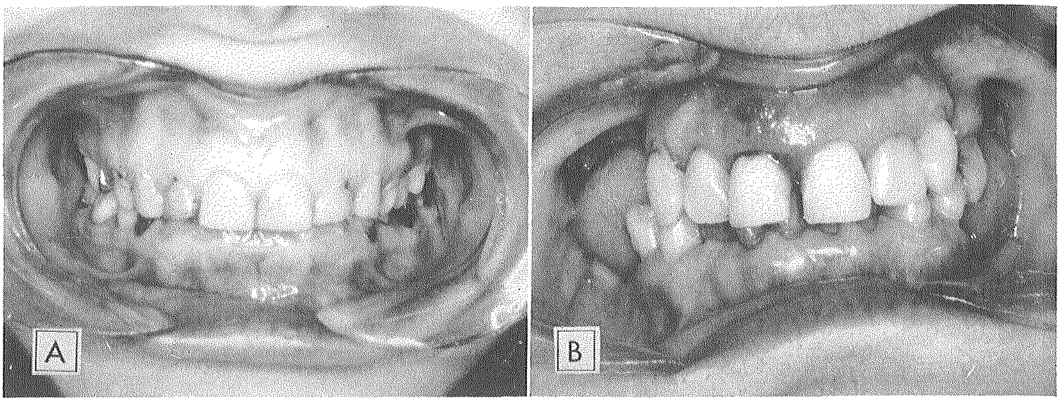


Figure 475. *A*, Excessive vertical overlap brought about by developmental phenomena. *B*, Excessive vertical overlap brought about by loss of the posterior teeth.

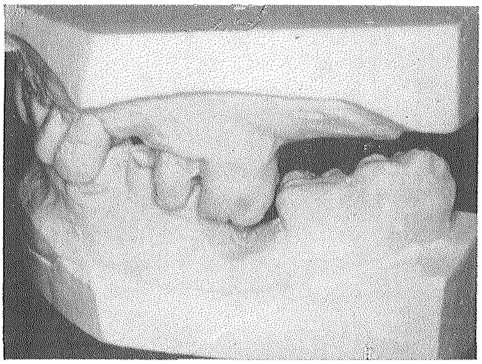


Figure 476. Loss of posterior teeth in one or both jaws often creates an increase in the overlaps.

MANAGEMENT OF EXCESSIVE OVERLAP OCCLUSIONS REQUIRING REHABILITATION

The cardinal rule in the rehabilitation of a dysfunctioning occlusion possessing an excessive overlap is that no attempt should be made to reduce the overlap by increasing the vertical dimension of occlusion beyond the limits of the physiologic rest position or inter-occlusal space, or by orthodontic measures in patients of middle age. In other words, the excessive overlap should not be reduced prosthodontically unless the overlap has been exaggerated because of failure to replace all the posterior missing teeth (Fig. 473). Occlusion is established in functional harmony with the osseous structure, muscles, nerves, ligaments, and temporomandibular joints. Attempts to correct or reduce an excessive overlap by raising the bite will end in failure. We cannot justify bite raising by calling it repositioning the mandible. The neuromuscular system, stretched and displaced by the increase in the vertical dimension and the accompanying strains created, will force the raised teeth back to their original position or out of alignment with bone resorbtion and gingival inflammation.

When function is impaired, excessive overlap cases are difficult to treat. People with teeth that overlap excessively seem to have limited ranges of lateral excursions. Any attempt to rehabilitate such an occlusion by creating the means to function laterally would necessitate reducing the size of the anterior teeth in the maxillae.

This reduction in size will not satisfy the basic requirements of esthetics. By the same token, raising the bite to make room for restorations that will permit these damaging lateral contacting excursions to take place is doomed to failure. With complete dentures, the incisal guide, a factor in the overlap, is under the control of the dentist. Trapozzano[3] writes . . . "if the degree of overbite (vertical overlap) remains constant, the incisal guide angle may be altered by the simple expedient of increasing or decreasing the degree of overjet (horizontal overlap). This may be readily accomplished either by placing the mandibular incisors more lingually or placing the maxillary incisors more labially, or both." But what can be accomplished with complete denture teeth cannot and should not be accomplished when rehabilitating a natural dentition possessing an excessive overlap.

When an excessive overlap associated with a maxillary protrusion requires dental treatment on the maxillary incisors, the operator is cautioned as to what he promises the patient. If esthetic improvement is the patient's wish then all that may be required is the insertion of four or six porcelain jacket crowns without treatment of the occlusion. It is helpful when the operator understands the various types of overlaps so that he knows what to treat, what to duplicate, and what to leave alone.

CLASSIFICATION OF OVERLAP CASES FOR THE PROSTHODONTIST

Despite the claims of many, my clinical experience has been that orthodontic procedures in excessive overlaps in middle-aged patients do not contribute to successful rehabilitation. For a better understanding of the excessive overlaps, I present the following grouping and classification with the hope that they may lead to solving some of the problems when rehabilitating such occlusions:

1. Excessive vertical overlap due to developmental phenomena (Fig. 477).
2. Excessive horizontal overlap due to developmental phenomena (Fig. 477).

Both types are due primarily to an anatomical difference in anteroposterior size between the maxillae and the mandible. These may be classified further as:

a. When the mandibular incisors strike the gingival thirds of the lingual surfaces of the maxillary incisors to protrude and space them (Fig. 477*B*).

b. When the mandibular incisors shear the length of the lingual surfaces of the clinical crowns of the maxillary anterior teeth in appositional contacts (Fig. 477*C*).

c. When the mandibular incisors strike the junction of the cingula and the palatal tissue to irritate and inflame that tissue (Fig. 477*F*).

d. When the mandibular incisors strike the palatal tissue only and may irritate and inflame it (Fig. 477*D*).

3. Increased vertical overlap because of a collapsed or lost occlusion brought about by failure to replace all the missing teeth in one or both jaws (Fig. 476).
4. Deformed excessive overlap brought about by faulty development, maloc-

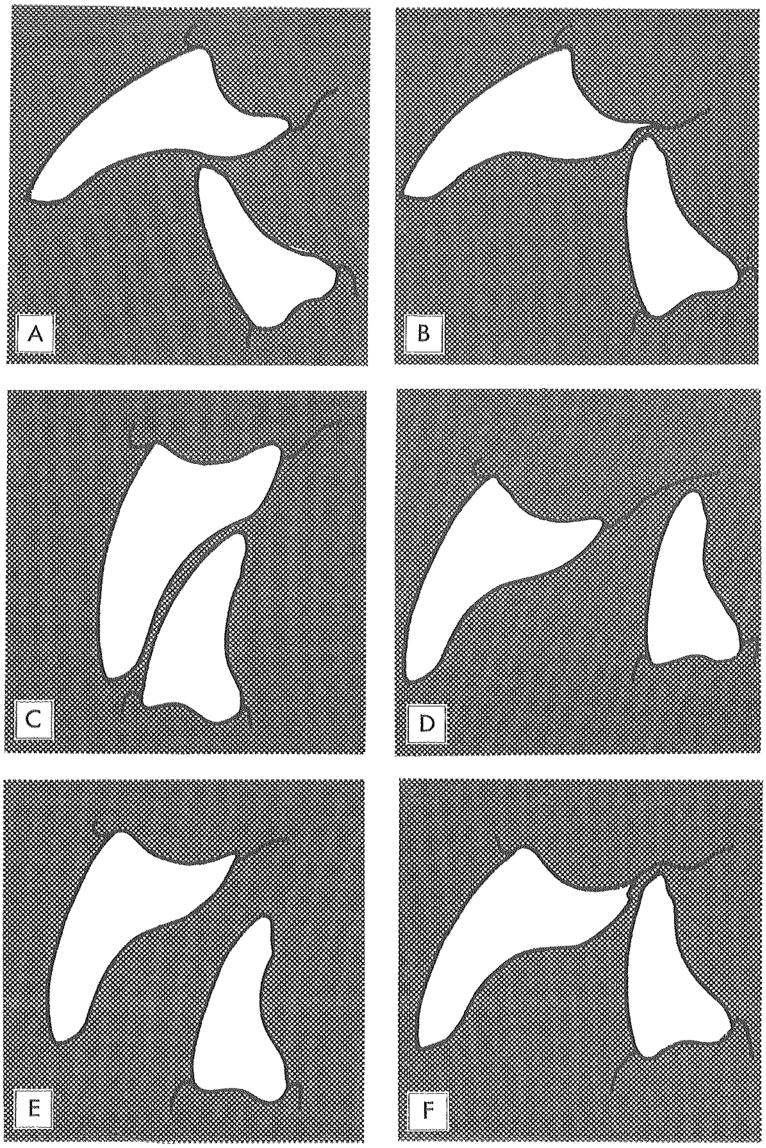


Figure 477. Common though not typical excessive overlaps. *A*, The mandibular incisors strike the middle thirds of the lingual surfaces of the maxillary anterior teeth to protrude and space them. *B*, The mandibular incisors strike the junction of the palatal tissue and the cingula of the upper anterior teeth inflaming the tissue and sometimes creating ledges in the cingula. *C*, Excessive shearing vertical overlap. *D*, Mandibular incisors not touching the teeth or palate. *E*, Excessive horizontal overlap. *F*, Overlap where the mandibular incisors strike and inflame the palatal tissue.

clusion, accidents, or childhood habits of swallowing abnormally and thumbsucking, which distorts the relationship of the arches and the overlap (Fig. 478).

5. Excessive vertical overlap aggravated by abnormal wear and responsible for a decrease in the vertical dimension of occlusion (Fig. 477*B*).

6. Excessive vertical overlap combined with excessive horizontal overlap (Fig. 479).

When patients with overlaps in groups 1, 2, 4, and 6 require occlusal rehabilitation, the overlaps should be duplicated as closely as possible because they are in harmony with the anatomical osseous and neuromuscular differences in size between the mandible and the maxillae.

When the mandibular incisors, emanating from a retruded alveolus, strike the lingual surfaces of the maxillary anterior teeth to protrude and space them, the operator is confronted with a problem (Fig. 479). Such a patient has always objected to the retruded chin and the increased protrusion of the maxillary anterior teeth. So-called repositioning of the mandible by raising the bite and projecting the mandible forward with the restorations to assist in the supposed repositioning is a primary reason for failure. I doubt whether anything in the nature of what is commonly called rehabilitation can be done for such a patient. Some teeth are missing and there is a definite periodontal condition. Frequently, the best procedure to follow is to treat such a dentition as a terminal case. Temporary measures of replacement of the missing teeth at moderate cost are recommended. Furthermore, a thorough explanation of the abnormal uncorrectable conditions, stressing the limitations of treatment, should be presented to the patient and recorded on his chart. In some patients the excessive overlap may not be in harmony with the facial contour that they desire and may contribute to their emotional frustrations. This makes the patients difficult to treat. Construction of complete dentures may be further complicated when terminal teeth are retained too long, with resultant loss of supporting bone and a flat ridge.

Nothing should be done if the patient possesses maxillary anterior teeth in contact that overlap almost the entire length of the clinical crowns of the mandibular teeth (Fig. 477*C*). This anterior relationship should be left intact if there is no loss

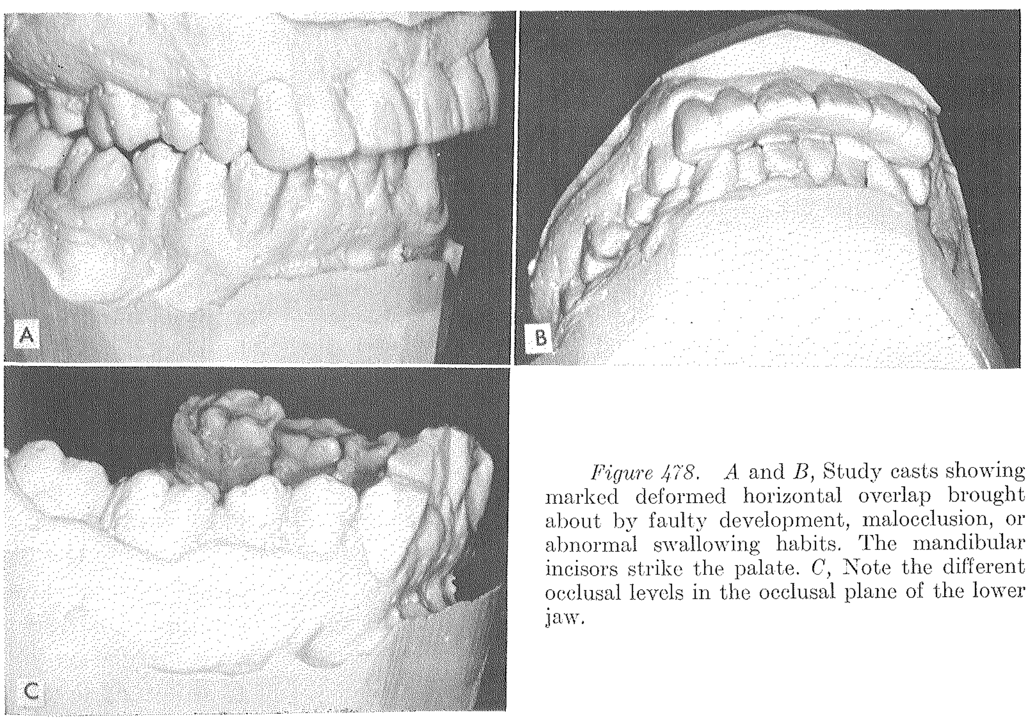


Figure 478. *A* and *B*, Study casts showing marked deformed horizontal overlap brought about by faulty development, malocclusion, or abnormal swallowing habits. The mandibular incisors strike the palate. *C*, Note the different occlusal levels in the occlusal plane of the lower jaw.

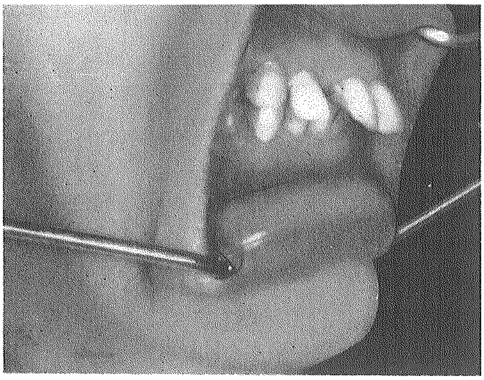


Figure 479. Excessive vertical overlap in a middle-aged patient, aggravated by missing teeth and marked gingival disturbances.

in vertical dimension of occlusion. Crowns of any type on such thin teeth are impossible to construct because of the irreparable damage to the pulps and because the thinness cannot be duplicated in restorations. When the operator has no alternative but to cover such teeth with full coverage restorations the patient should be forewarned that these restorations will have to be bulky and slightly more protrusive.

THE BITE BLOCK IN THE CORRECTION OF EXCESSIVE OVERLAP

An apparent correction of such an excessive vertical overlap by means of the bite plane is the procedure often recommended. This bite plane can be considered a satisfactory adjunct in the treatment of children and young adults when it is scientifically used by orthodontists. However, its value in the therapy of middle-aged patients is questionable. Invariably, such a method is another form of bite raising. The bite plane is so constructed that it creates an opening in the region of the posterior teeth. These teeth, which now do not make contact, are supposed to move of their own volition, without guidance toward each other until they do touch. When the opposing teeth elongate, it is hoped that the resulting space around the roots of the molars and bicuspids will be filled with healthy solid bone. This hoped-for result is most often a biologic impossibility in our older patients.

Once these teeth have moved to touch each other, another appliance is advocated to be used as a retainer to hold these extruded teeth in position. The retainer is worn only at night. During the day, the elongated teeth are pressed back to some extent by mastication and deglutition. The repeated acts of swallowing occur approximately 2000 times a day. At night, the wearing of the retainer permits these posterior teeth to elongate again. This counteracting depression and extrusion of teeth is not conducive to successful rehabilitation. *Depressing the mandibular anterior teeth with a bite block will result in failure because such teeth do not remain depressed.*[1]

Splinting the posterior teeth together will not contribute to correcting the condition either. The fact that an occasional case meets with so-called success should not be taken as an indication that these procedures are to be adopted as recommended methods for the management of the patient with excessive vertical overlap.

Some vertical overlaps are associated with an occlusion of different levels as well as an excessive deep compensating occlusal curve. Clinical experience has proved that leveling the teeth and reducing the deep compensating curve by increasing the vertical dimension of occlusion beyond the limits of tolerance contribute to unsuccessful results. The overlap and deep occlusal curve should be duplicated in occlusal rehabilitation.

In group 3, when the overlap has been increased because of a collapsed occlusion, the vertical dimension may be restored by using the 2.5 to 3 mm. average interocclusal space measurement as a starting point. In group 5, when there has been a decrease in the vertical dimension of occlusion because of excessive wear, the trial method described in Chapter 14 is recommended in rehabilitation.

On occasion, a patient has an excessive vertical and horizontal overlap, with the mandibular incisors striking the gingival and palatal tissues to irritate and inflame them. Ledges may develop in the cingula of the maxillary incisors because of the uncontrollable bruxism (Fig. 491). These grinding movements are sometimes influenced by the patient's swallowing habit. Every time he swallows, the long mandibular incisors contact the cingula of the opposing teeth and engage in a

Figure 480. Roentgenograms of the patient shown in Figure 479.

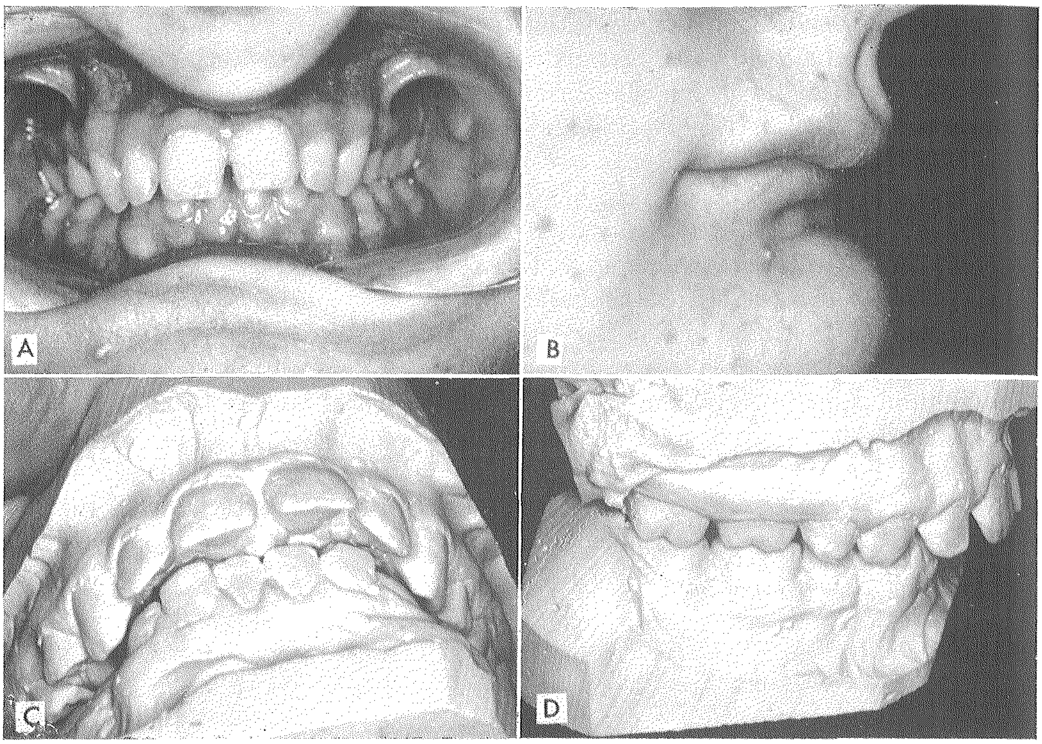


Figure 481. Excessive horizontal overlap due to marked difference in anteroposterior osseous size between the maxillae and the mandible. *A*, Anterior view. *B*, Abnormal lip and swallowing habits contributed to this objectionable appearance. *C*, Study casts showing the mandibular teeth striking the palate. *D*, Casts showing the excessive overlaps. Attempts to correct this by orthodontic measures proved unsuccessful.

grinding, frictional, shimmy-like movement. In due time the mandibular incisors encroach upon the soft tissue. Reducing the incisal edges of the lower incisors and taking them out of contact with the upper teeth is not practical because these incisors will extrude in a short period of time to make contact again. The operator must not be tempted to reconstruct the occlusion by raising the bite. Surgical removal of the inflamed tissue is recommended. Inasmuch as the uncontrollable habit cannot be eliminated, special provisions must be made in cast gold restorations on the maxillary teeth. The ledges should be duplicated in the gold to permit the shimmy-like movements to continue.

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23

MANAGEMENT OF OCCLUSIONS WITH EXCESSIVELY WORN TEETH

What we eat and how we eat are the results of necessity and habit. Man's occlusion is adapted to handling all types of food. A change in the occlusion often takes place in many patients as they get older, and is pronounced in some, insignificant in others. The gradual change may be attributed to the wear of the contacting opposing surfaces brought about by rubbing habits and perhaps by the abrasive action of some foods we eat. Today, the factor of coarse gritty foods plays a small part in creating flatter cusps, peculiar wear patterns, and a change in the original occlusal curve. The rubbing movements can be considered the abnormal symptom that is responsible for any change in the occlusal patterns and in the occlusion. In many instances the rubbing movement removes cuspal inclines and contributes to an edge-to-edge occlusion (Fig. 482). Function is not impaired because low and even flat cusp teeth masticate satisfactorily. True, the patient may not be able to shred his food as well because of the lack of sharp cusps and sharp incisal edges, but he is able to pulverize the bolus more efficiently. This rubbing together of opposing tooth surfaces, frequently referred to as bruxism, should not be confused with abrasion and erosion.

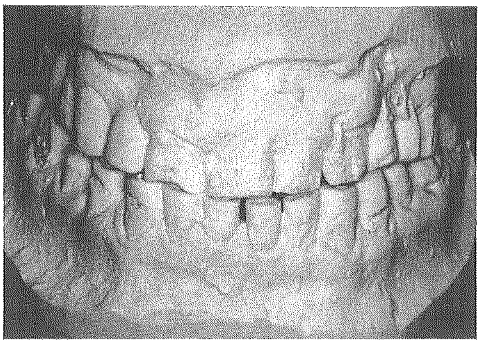

Figure 482. Excessive rubbing movements, in some cases, remove cuspal inclines in later years and contribute to an edge-to-edge occlusion.

ABRASION, ATTRITION, AND EROSION[1]

Abrasion is the abnormal wear that results from rubbing (friction) with a foreign substance such as a coarse gritty food, or improper use of the toothbrush and toothpaste. This type of wear is found in the cervical thirds of the teeth on the buccal and labial surfaces only. *Attrition* is the frictional wear of the teeth brought about by normal and abnormal rubbing together of the contacting opposing surfaces of the teeth. *Erosion* is brought about primarily by a chemical agent aided by abrasion and attrition. The surfaces of teeth affected by erosion are the cervical thirds of all the teeth on the buccal, lingual, labial, and occlusal surfaces.

BRUXISM

One of the most frequently overlooked yet serious conditions that controls the type of restoration in occlusal rehabilitation is the abnormal excessive wear of the teeth by bruxism. Roth and Spasser[4] define bruxism as a symptom which manifests itself in gnashing, grinding, and clamping of the teeth in sleep or while awake. In most instances it is a local manifestation of a psychoneurosis. Bruxism may be an expression of nervous tension, an attempt to overcome irritation or anger, or a way of relieving anxiety or apprehension. In some cases it may be a habit of convenience because of occlusal disharmonies. It is hypothetical reasoning to conclude that bruxism is primarily due to prematurities on teeth and restorations. In many instances, occlusal interferences may be considered the *secondary* cause for gnashing, grinding, and clamping of the teeth. The *primary* cause is still nervous tension. Bruxism does not necessarily occur with either natural or restored dentitions, possessing prematurities. Even if we are certain that the excessive rubbing and clamping is due to interferences in occlusion—a difficult diagnosis to make—by the time it is recognized from the pattern of wear, the symptom frequently has become uncontrollable. Because of this and the fact that fear, anger, or tension is still apparent to the patient, the symptomatic habit is not always eliminated by so-called equilibration procedures. When the operator recommends equilibration as the cure, to what plan of occlusal relationship does he reduce prematurities? Does he apply the philosophy of cross-tooth-contact-in-cross-jaw-excursions to all patients, or is it the protective canine, cusp-to-fossa technique?

Clinical experience by the profession has proven that placing restorations with deep cuspal inclines over excessively worn teeth more often than not fails to eliminate the symptom of bruxism. One school of thought places the blame for rubbing, gnashing, and clamping of the teeth solely upon occlusal disharmonies[3] while another school attributes bruxism solely to the lack of cusps. To state that the only restraint against wear is provided by cusps shows a lack of knowledge of the causes and influences of bruxism with its subsequent abnormal wear.[5] *It is generally conceded that bruxism is a symptom, and we must never lose sight of the fact that the removal of a symptom will not eliminate the cause. A new symptom, more severe in nature, will be manifested elsewhere.* The uncontrollable rubbing movement of the mandible must be considered in the correction or reconstruction of a dentition. Suppose only three or four teeth in a full natural dentition in a patient of middle age show signs of bruxism. Is it feasible to destroy all the healthy teeth by creating an occlusion with restorations on all teeth having arithmetically designed cusps and fossae and believe that such procedures will eliminate bruxism on the three or four teeth?

It is a mistaken belief that because the buccolingual diameters are increased as a result of wear, excessive stresses are applied to the periodontal tissues. Clinical observation has shown that worn teeth are often surrounded by healthy, firm gingiva and embedded in strong, abundant alveolar bone (Fig. 483). Despite the fact that

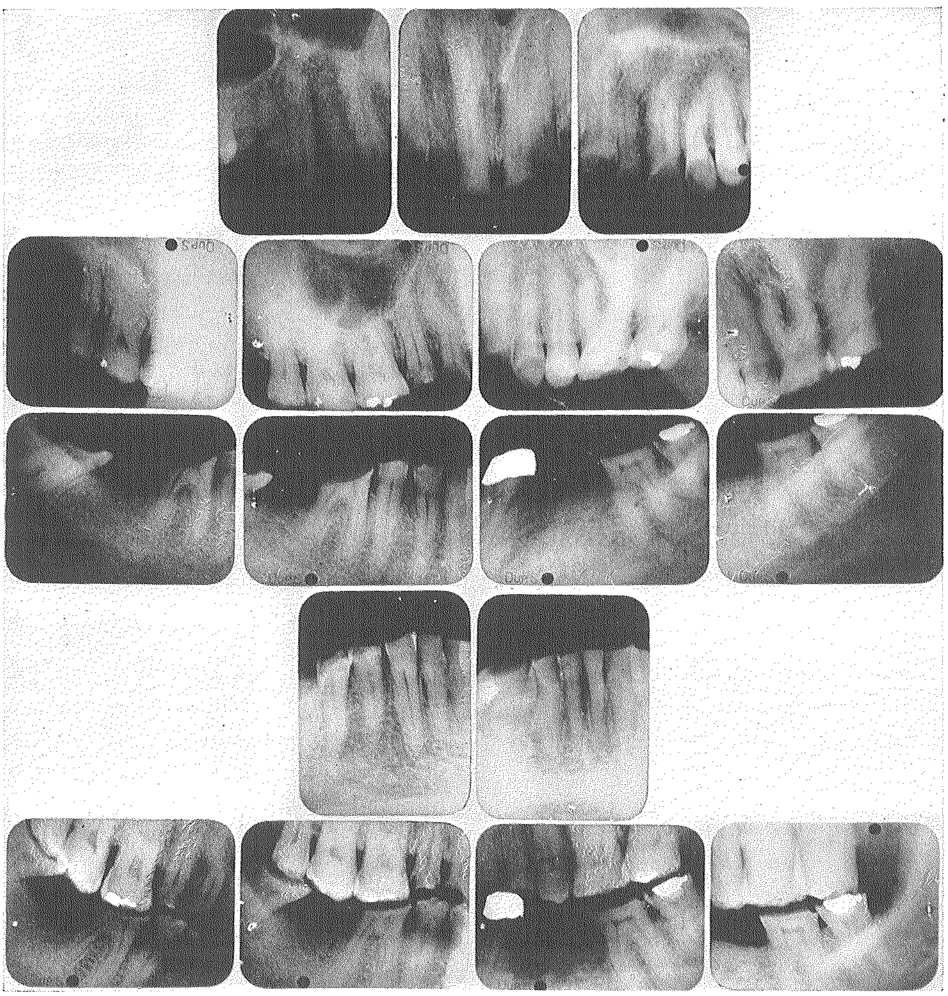

Figure 483. Excessively worn teeth embedded in strong, abundant alveolar bone.

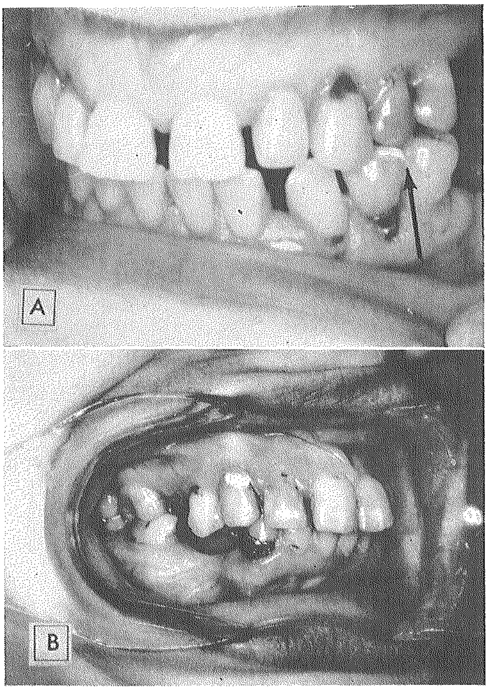

Figure 484. *A*, Teeth that do not wear through bruxism become periodontally involved and loosen. This head-on occlusion is rocking the bicuspids during the grinding. *B*, Movement of the teeth anteriorly caused by bruxism.

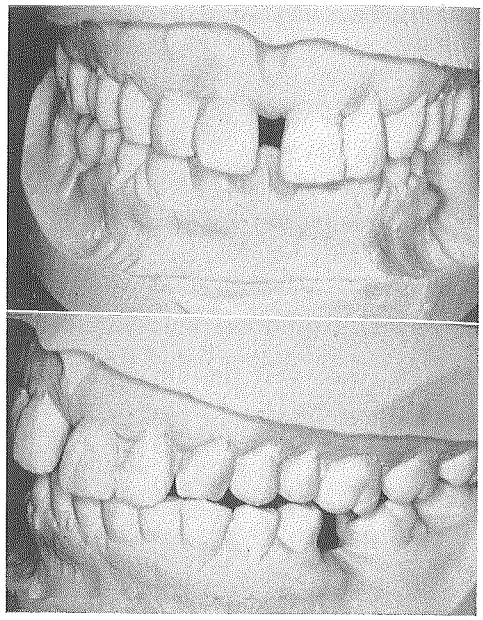

Figure 485. Excessive bruxism to the right forced the left canine and central incisor out of alignment and widened the diastema.

the posterior teeth have little or no cuspal inclines, function is exceedingly satisfactory and the periodontium in many cases is healthy. True, in some instances, markedly worn teeth become loose and the gingivae become diseased. If the habit of rubbing the teeth together brings about wear of the contacting surfaces, usually that wear does not disturb the underlying bone. If the teeth did not become worn by the grinding in the form of frictional wear, they would bear the brunt of the grinding force and thrusts in such a degree that they would loosen and become traumatized. The supporting structures as well as the gingival tissues would suffer.

EFFECTS OF BRUXISM ON THE TEETH AND SUPPORTING AND SURROUNDING STRUCTURES

The rubbing or bruxism habit influences restorative dentistry because it affects the teeth and surrounding structures in any of four ways, or their combination.

Uncontrollable bruxism determines the type of restoration and the occlusal design.

1. The occlusal, incisal, lingual, or labial surfaces are frictionally worn into patterns that are usually compatible with the abnormal rubbing movements. The mandibular teeth rub, glide, and slide over the surfaces of the opposing teeth without trauma. The periodontium usually remains healthy and strong. In most cases, any loss in the vertical dimension of occlusion is compensated for by the growth of alveolar bone and tissue plus the continued eruption of the teeth.

2. If the cuspal inclines of the chewing and incising surfaces do not wear, the teeth rock in appositional lateral, rotary, protrusive, or scissors-like movements and become traumatized and loose. The periodontium is often diseased and the underlying bone resorbs (Fig. 484).

3. Bruxism is responsible for tooth movement that takes place over a long period of time. The periodontium may or may not remain healthy (Figs. 485 and 486).

4. The clenching and clamping may be a contributing factor in creating muscle spasms and pain in the temporomandibular joint areas. The patient usually feels this ache upon arising in the morning.

MANIFESTATIONS OF WEAR CAUSED BY BRUXISM

The nature of the occlusal rehabilitation is controlled by the abnormal grinding habit and consideration must be given to the occlusal patterns of the restorations. Therefore, it is important for the operator to recognize the type of tooth wear. There are seven patterns of occlusal, lingual, labial, and incisal wear that the dentist must recognize in order to plan the restoration that will be in harmony and compatible with habit. They are:

1. *Facet Wear.* The most common type of wear pattern due to abnormal rubbing of opposing teeth is the saucer type of facet wear. It occurs on the occlusal and incisal surfaces of some or all of the teeth, in one or both jaws, on teeth on one side, or even on a single tooth. The facets may be multiple on one tooth, and they are often surrounded by sharp enamel rims (Figs. 487 and 488).

2. *Ledges and Grooves.* These manifestations of excessive wear are noticeable on the lingual surfaces of the maxillary anterior teeth. The groove may develop into a ledge and may exist in the incisal, middle, or cervical thirds of the lingual

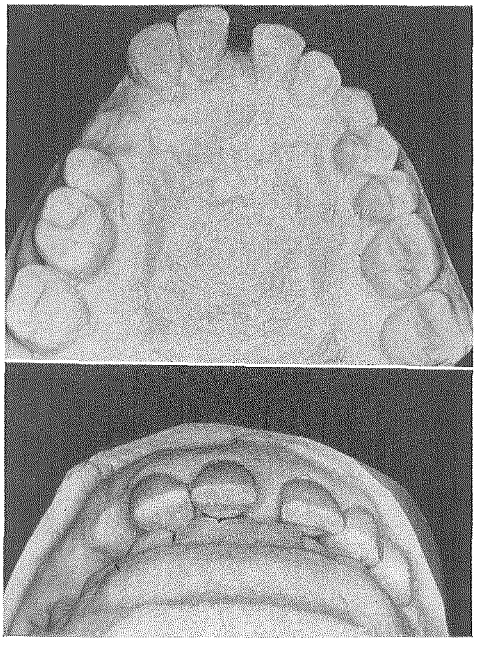

Figure 486. Bruxism forced the right central incisor and lateral out of alignment and increased the diastema.

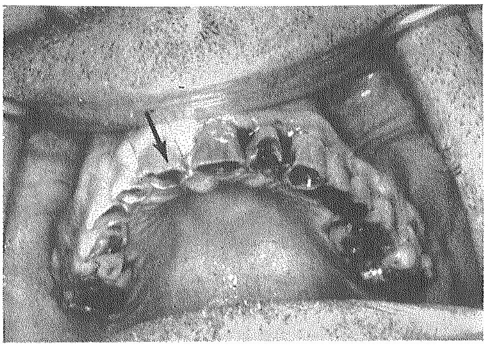

Figure 487. Saucer-shaped excavations, sometimes surrounded by sharp enamel rims, are referred to as "facets."

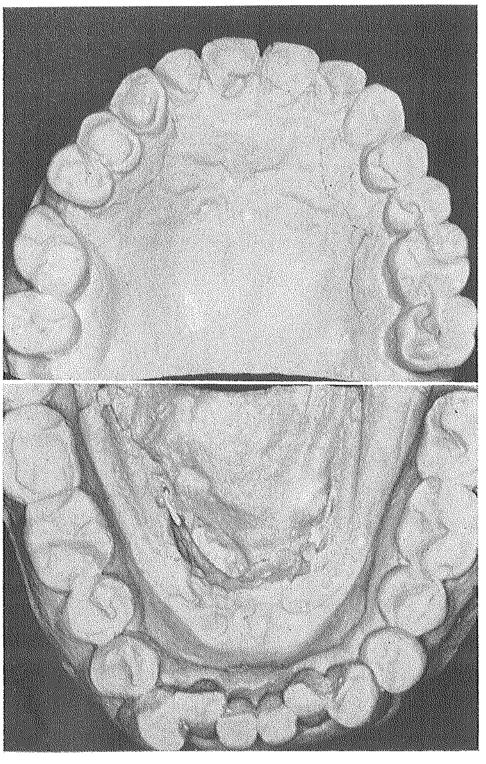

Figure 488. Multiple facets due to uncontrollable bruxism.

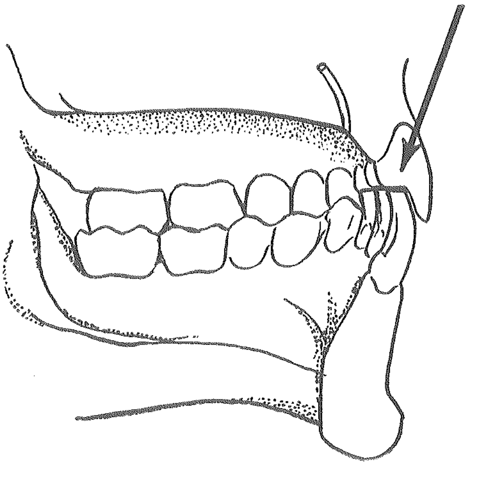

Figure 489. Abnormal attrition may manifest itself in the form of ledges on the middle third of the lingual surfaces of the maxillary anterior teeth.

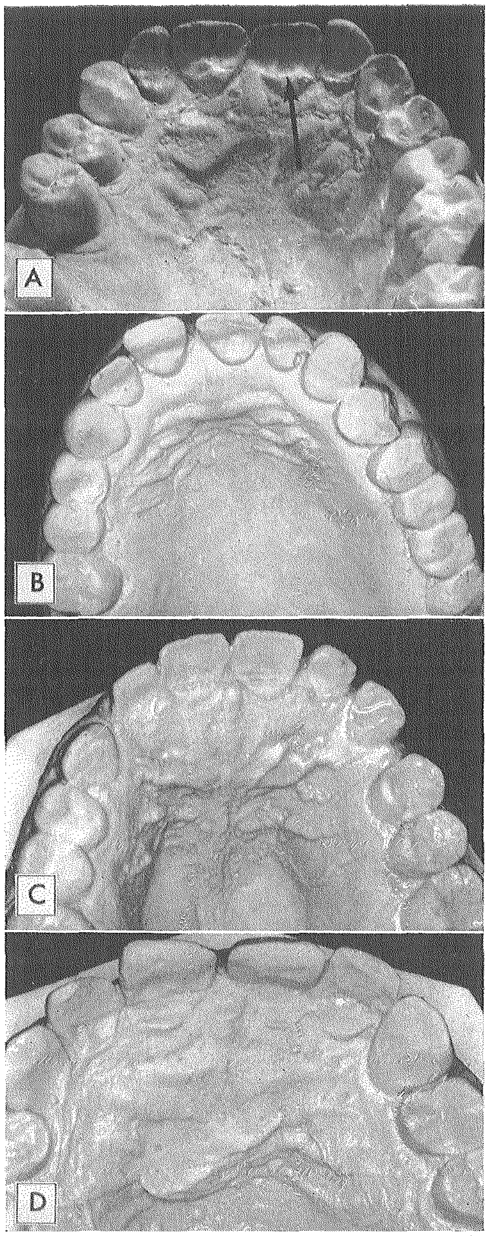

Figure 490. Ledge wear by bruxism. *A*, Linguoincisal wear with pronounced ledges on the cingula. *B*, Ledges in the middle thirds of the teeth. *C*, Irregular ledges. *D*, Mutilated ledges created by criss-cross rubbing and gnashing.

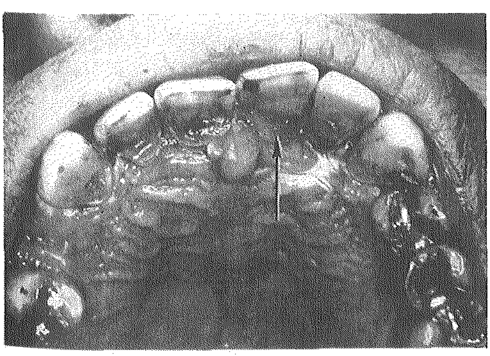

Figure 491. The ledges created by bruxism of the mandibular incisors against the cingula of the maxillary incisors sometimes impinge upon the gingival tissues surrounding the maxillary teeth to inflame them. (Courtesy Dr. Robert C. McKay, New York City.)

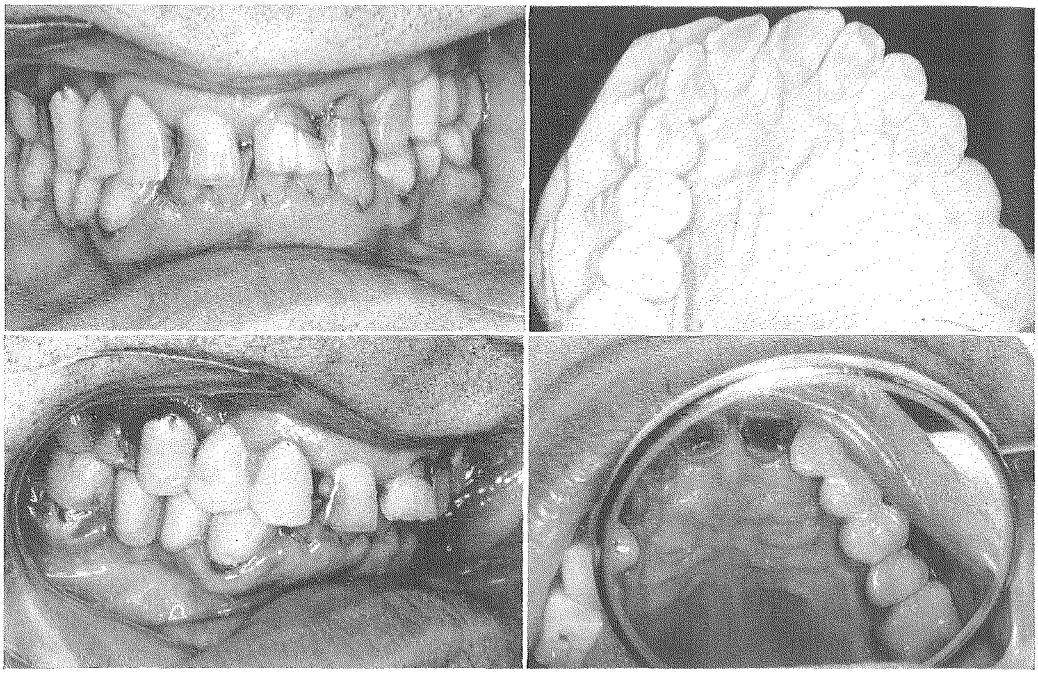

Figure 492. Beveled or shearing wear on the lingual surfaces of the maxillary incisors. Opposing acrylic resin on the posterior teeth did not wear.

surfaces. The ledges may take on an irregular appearance or may be straight, oblique, deep, or shallow. There are times when the palatal tissue becomes inflamed because the ledges in the cervical thirds of the teeth are worn down to that tissue (Figs. 489–491).

3. *Shearing, Scissors-type, or Beveled Wear.* This form of wear affects the labial surfaces of the mandibular anterior teeth and sometimes the lingual surfaces of the maxillary anterior teeth (Fig. 492). Shearing wear on the lingual surfaces of the maxillary incisors frequently causes the teeth to become very thin, and it is almost impossible to restore the tooth or teeth with any type of esthetic crown (Figs. 493 and 494).

4. *Flat, So-called Uniform Wear.* This manifestation of wear takes place on the incisal edges of the mandibular anterior teeth and the occlusal surfaces of the posterior teeth in both jaws. Cuspal inclines are rubbed away by the uncontrollable circular mandibular movements and the occlusal and incisal surfaces are flattened (Fig. 495).

5. *Half-moon Wear.* This arrangement of worn teeth involves the four to six maxillary anterior teeth and usually occurs in an occlusion in which the mandible just escaped being prognathic to the maxillae. It may also be due to a habit of thrusting the mandible forward so that the incisal edges of the mandibular anterior teeth rub vigorously against the linguoincisal surfaces of the maxillary anterior teeth. When bruxism becomes excessive, these linguoincisal areas are worn so thin that they chip away, become ragged, and form a half-moon arc in a line extending from the incisal edge of one canine to the other. It is best to leave such worn teeth alone

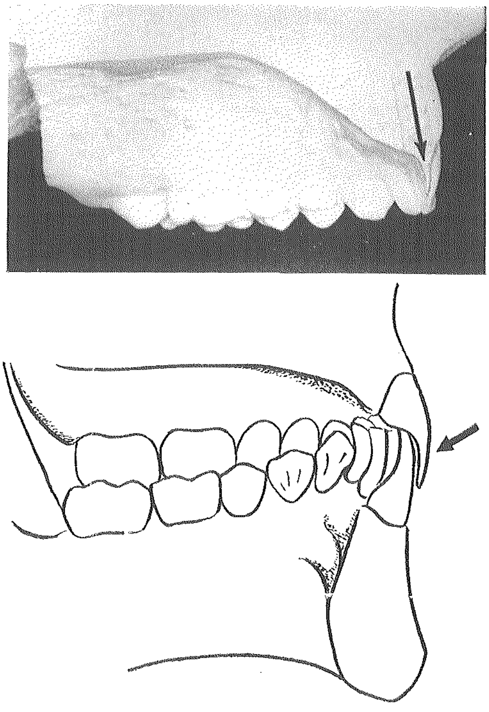

Figure 493. In teeth with a marked vertical over lap, the bruxism habit may be responsible for wearing the lingual surfaces of the maxillary anteriors so thin that complete coverage restorations are impossible to construct. Despite the fact that such a condition will eventually result in destruction of the teeth in the anterior segment, treating the teeth and increasing the vertical dimension is contraindicated.

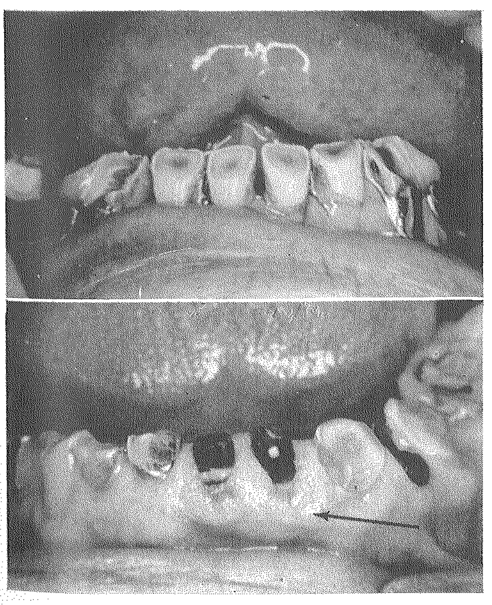

Figure 494. Above, Beveled wear on the labial surfaces of the mandibular incisors. *Below,* Beveled wear down to the gum line. Notice the growth of alveolar bone compensating to some extent for the loss of tooth structure and possible closure of centric occlusion.

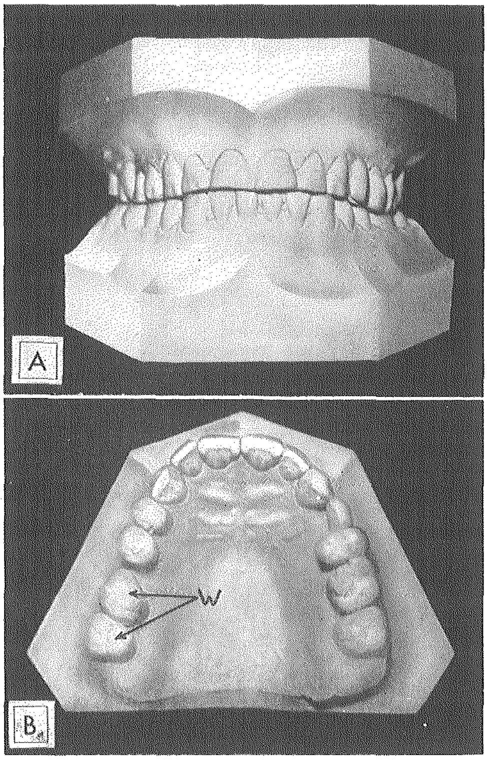

Figure 495. So-called flat uniform wear. *A*, bruxism is responsible for almost uniform wear. The casts in occlusion. *B*, Occlusal view of the upper cast.

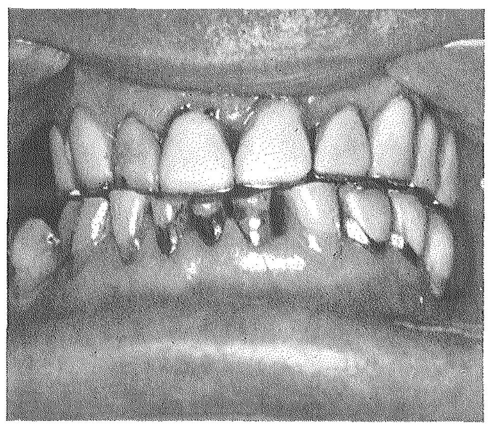

Figure 496. Half-moon wear in the lower anterior teeth.

as long as possible. When restorations are absolutely necessary then acrylic resin cured to fused porcelain copings are recommended (Figs. 496 and 497).

6. *V-shaped Wear.* These designs occur on the posterior teeth in either jaw and occasionally on the incisors. The occlusal surfaces are worn so that they take on the form of a broad V on the posterior teeth and a deep slit on the incisal edge half-way down the labial area on the anterior tooth (Fig. 498). V-shaped wear on the posterior teeth can be reduced and the teeth reshaped to minimize the rocking of the teeth. Anterior teeth with the slits are difficult to restore and the operator

should warn his patient that any crown is apt to be dislodged because of the peculiar force of bruxism.

7. *Staple Design.* A groove caused by attrition manifests itself occasionally on the lingual surface of the canines only. It may start as a shallow groove, only to terminate in a deep staple form. This is not a true type of frictional wear because the opposing tooth frequently does not touch the entire area. Undoubtedly the manifestation is aided by chemical erosion (Fig. 499). Not very much is known as to just how this abnormal design is brought about. It does not necessarily interfere with a restoration.

The texture of the enamel, the type of occlusion, the anatomic forms, the alignment of the teeth, and the manner and pattern of mandibular movements will contribute to the design of wear and its location. Diet and chemical influences also assist in the formation of wear patterns.

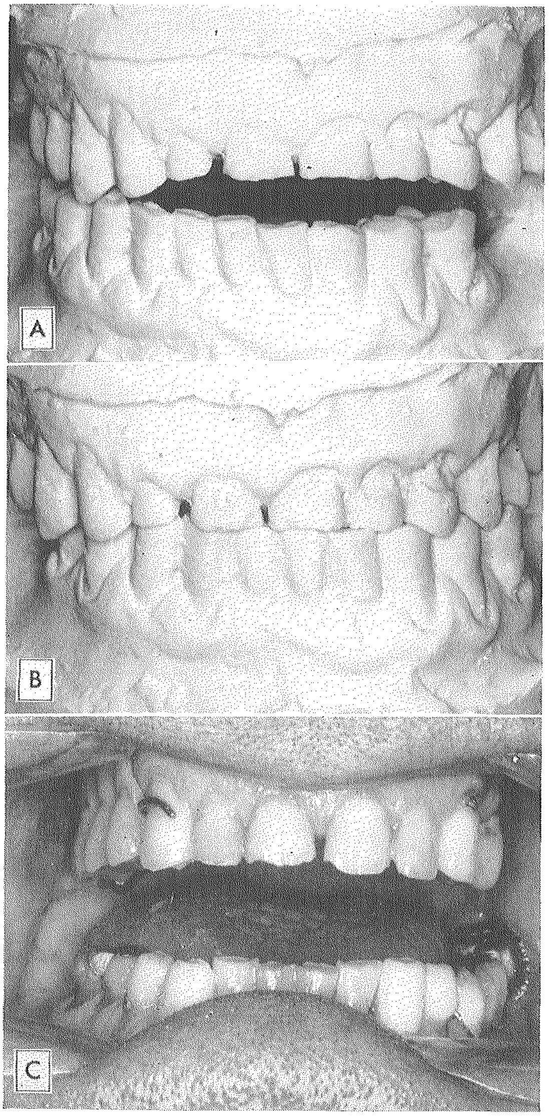

Figure 497. Half-moon wear in the upper anterior teeth. Notice how ragged and thin the incisal edges are in the maxillary anterior teeth. *A*, Study casts open to show the half-moon effect from canine to canine. *B*, Teeth in centric occlusion. *C*, Another patient in the early stage of half-moon design on the teeth.

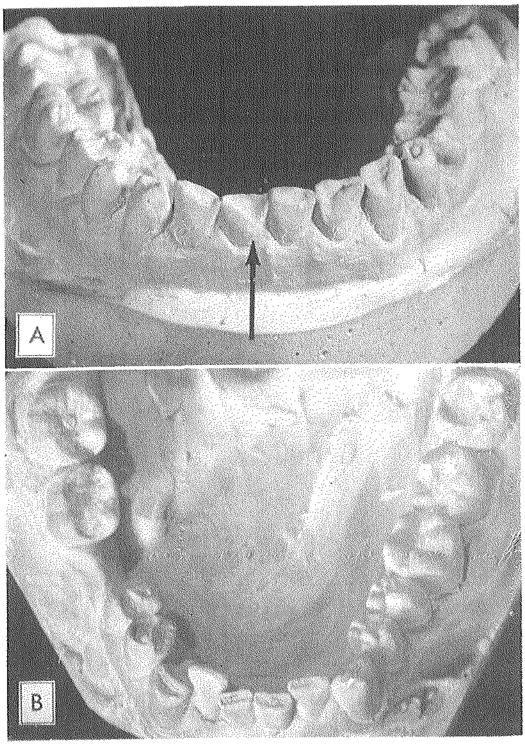

Figure 498. V-shaped wear. *A*, The mand bular incisors on the study cast show distinct V-shaped wear from the incisal edges down the labial arc. *B*, Same type of wear design on the occlusal surfaces of the molars.

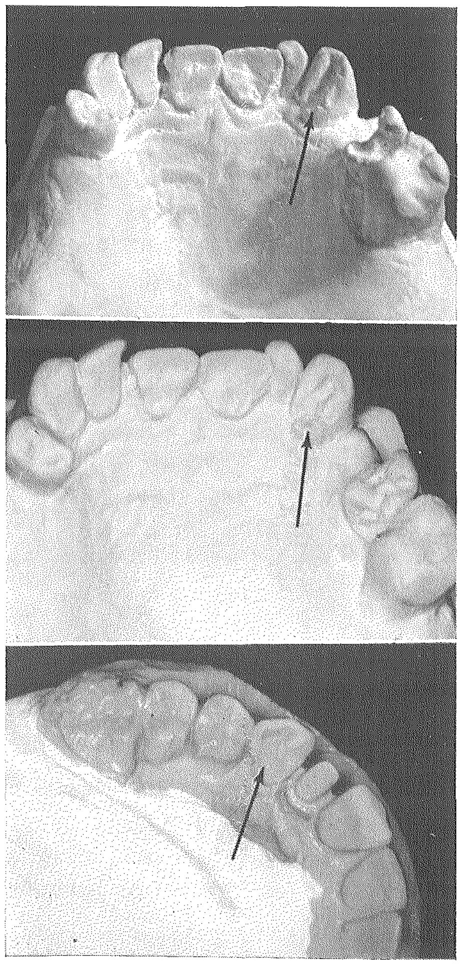

Figure 499. Staple design. Occurs only on the lingual surfaces of the canines, starting as a shallow groove longitudinally and terminating eventually in a deep staple form. Undoubtedly this is not true frictional wear and is aided by chemical erosion. It does not interfere with a restoration.

EFFECT OF BRUXISM IN THE TEMPOROMANDIBULAR JOINT AREAS

In some patients, excessive bruxism that is not satisfied by frictional wear may cause muscle spasms or strained ligaments around the temporomandibular joint areas because of the creation of occlusal disharmonies. Selective grinding and reshaping of the affected teeth sometimes helps those patients having discomfort and pain. When a dentition is rehabilitated without regard for existing bruxism, temporomandibular joint area syndromes may develop.

The patient shown in Figure 500 required rehabilitation primarily because of esthetics. Practically all of the teeth possessed discolored mottled enamel. Notice the wear of the occlusal and incisal areas of all the teeth on the study casts before treatment. When I rehabilitated this mouth, I failed to recognize the strong influence of the rubbing habit. In the treatment, all the posterior teeth in both jaws received veneer or full crowns. Due to the age of the patient (21 years) and the difficulty and danger of preparing such small teeth, the six mandibular incisors were left intact. The treatment procedures were the same as for his brother (Fig. 351), in whom they proved successful because he was not affected by bruxism. In a few years, this patient developed painful manifestations around the temporomandibular joint areas. Because the occlusal surfaces of the posterior teeth were restored in hard gold, bruxism could not take place in comfort as before treatment. To put it another way, the symptom was removed from these posterior teeth. The hard porcelain

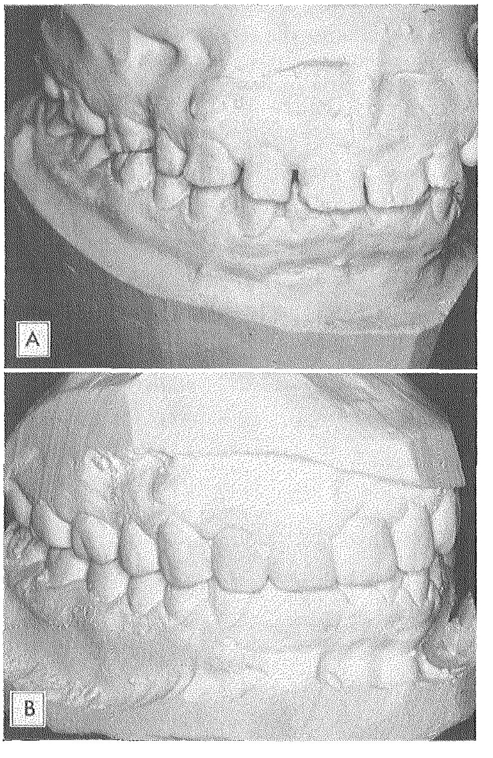

Figure 500. *A*, Study casts of unesthetic worn teeth with mottled enamel. *B*, Casts of same patient four years after rehabilitation.

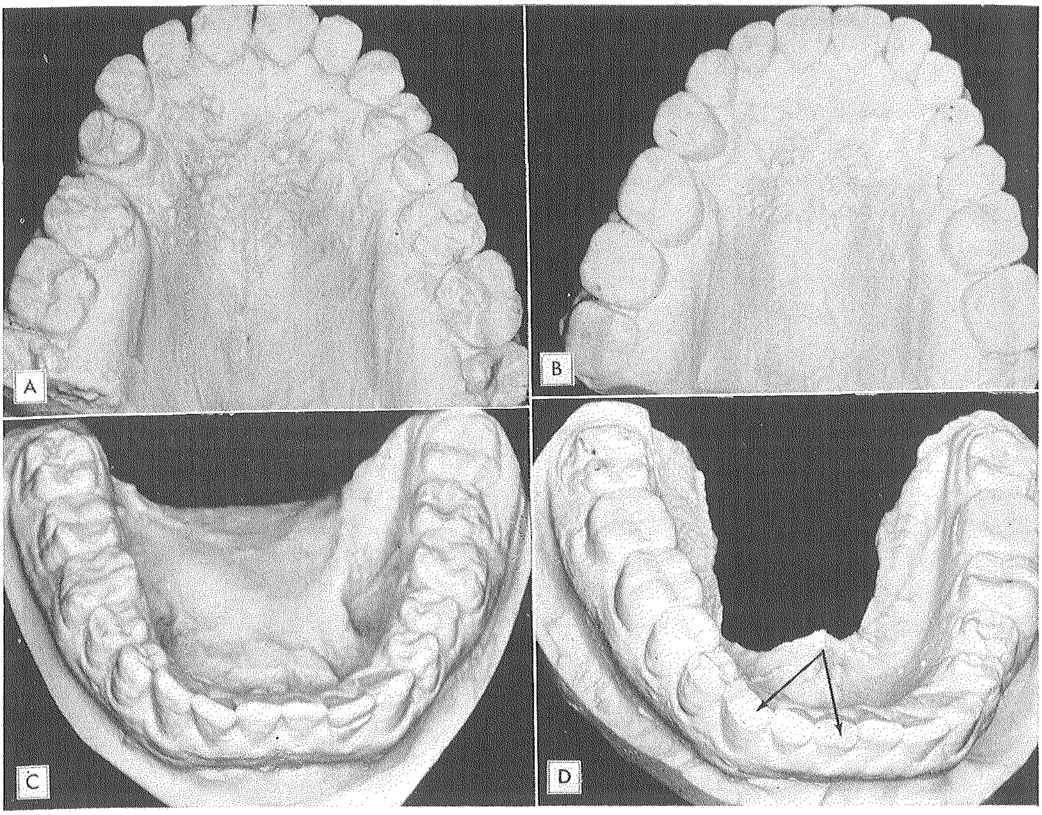

Figure 501. Same patient as shown in Figure 500. *A* and *C*, Occlusal and incisal surfaces show flat wear which was not recognized. *B* and *D*, Cast four years after rehabilitation. A new symptom (arrows) manifested because the uncontrollable habit of circular grinding could not perform in comfort. The unrestored mandibular anterior natural teeth wore excessively. As these incisors and canines became shorter by wear, the more the patient had to force his mandible out of centric relation in order to make contact with the incisors so as to satisfy his uncontrollable habit of grinding. Muscles and ligaments in the temporomandibular joint areas became strained and the patient suffered pain and discomfort (see text).

jacket crowns on the maxillary anterior teeth did wear the incisal surfaces of the six natural mandibular incisors. The symptom was transferred from the posterior teeth to the anterior teeth. The more these small mandibular anterior teeth wore, the shorter they became and the more the patient had to force his mandible out of centric position in order to make contact with the teeth so as to satisfy his uncontrollable habit of grinding. As a result, the ligaments, nerves, and muscles submitted to painful reactions as they were called upon to perform the strained movements.

SPLINTING TEETH THAT PARTICIPATE IN UNCONTROLLABLE BRUXISM

Loose teeth brought about by bruxism *should not be splinted* to adjacent firm ones. The force of the uncontrollable habit is still applied to the same tooth or teeth. In a period of time, the teeth that receive the brunt of the movements of bruxism will pull and loosen the strong teeth which have been splinted. This abnormal pull is responsible for pain and discomfort during the rubbing movements and may loosen a segment of the splint.

Ultra-thin Anterior Teeth As Contraindication to Rehabilitation

Figure 493 is the sectional study cast of a patient whose anterior teeth in the upper jaw were worn very thin by the scissors-like attrition of bruxism. This type of wear takes place usually in cases of excessive vertical overlap. Porcelain jacket crowns are contraindicated, as is any other type of restoration. Despite the fact that this condition may prove disastrous to the anterior segment of the dentition as the years pass, restorative measures to date are not adequate to correct it. It is advisable to leave such thin teeth and occlusions alone.

TREATMENT PLANS IN THE MANAGEMENT OF EXCESSIVELY WORN TEETH

1. Selective but judicious grinding of the teeth and restorations responsible for occlusal disharmonies.

If we accept the belief that bruxism is a symptom, usually the result of anxiety and nervous tension, and the rubbing of the teeth is uncontrollable, then the management of teeth so worn requires a different approach. *Restorations, when necessary, will have to be constructed so that they will permit the abnormal uncontrollable habit to be performed.*

2. Construct the restorations of a material that will wear (to be replaced periodically) such as acrylic resin crowns, bridges, and artificial teeth on removable partial or complete dentures.

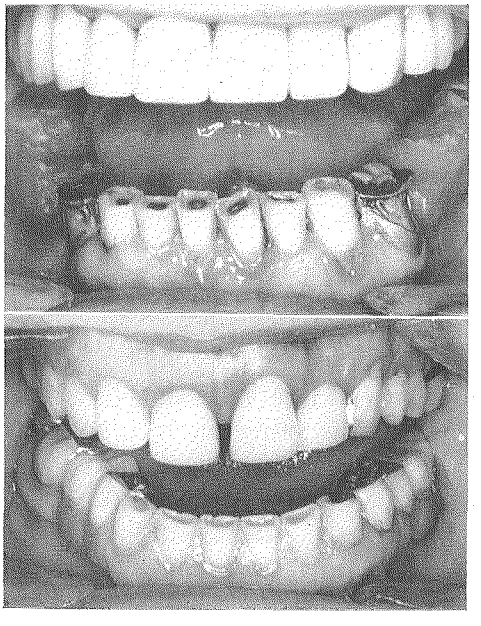

Figure 502. Excessive attrition caused by porcelain jacket crowns on the maxillary anterior teeth. The hard porcelain created facets on the incisal edges of the opposing mandibular teeth.

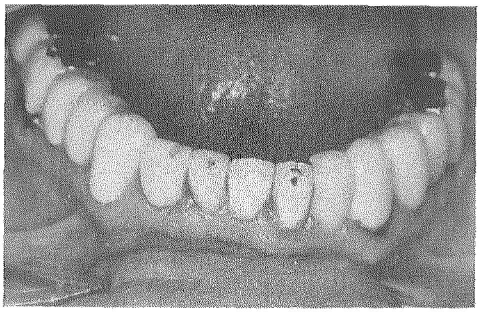

Figure 503. Upper natural anterior teeth caused bruxism on the opposing four mandibular acrylic resin jacket crowns. The posterior restorations are gold and porcelain fused to gold.

3. Duplicate the pattern of wear in gold.
4. Accommodate the pattern of wear by permitting natural or restored teeth in the lower jaw to create new patterns of wear in opposing acrylic resin restorations and then duplicating that new wear design in metal restorations.
5. Control the rubbing movements if possible with a mouth guard.
6. Do nothing drastic with worn teeth except reshape them.

TREATMENT PLAN ONE: SELECTIVE AND JUDICIOUS GRINDING

When the operator recognizes occlusal interferences early enough and before the grinding of the teeth becomes uncontrollable, accurate mounting of good study casts on an anatomical articulator will sometimes assist him in recognizing interferences. On natural teeth, conservative reduction of enamel with a Busch silent and smooth stone is advisable. The operator follows his concept of so-called equilibration, removing sharp interfering cusps, rough restorations, etc. If the bruxism continued after reduction of so-called prematurities then the bruxism is uncontrollable and Plan Two, Three, or Four will have to be introduced. Some operators feel that complete rehabilitation of all the teeth including those which do not participate in bruxism is the only means of eliminating the grinding of the teeth. Furthermore, these operators believe that cuspal arrangements on the affected surfaces of the teeth in accordance with mathematical calculations of a mechanical instrument will solve the problem. These operators lose sight of the fact that once the excessive grinding becomes uncontrollable, deeply carved and geometric forms on restorations will not be tolerated in most instances.

TREATMENT PLAN TWO: CONSTRUCTING RESTORATIONS THAT WILL WEAR

When esthetics is very important and teeth are mutilated because of excessive wear, constructing the restorations of acrylic resin is advisable. The acrylic resin must be cured to a cast gold or fused porcelain coping or a cast gold bridge frame. Acrylic resin alone becomes dislodged when the powerful movements of bruxism twist and turn the restoration so as to break the cementing medium in the resilient acrylic resin restoration. A gold or a fused porcelain coping adheres to the tooth structure with cement, more tenaciously.

Figure 504 illustrates a man of 60 years, with strong teeth. The uncontrollable habit of bruxism was responsible for the wear on the maxillary incisors. The wear plus the drifting of the anterior teeth created an esthetic problem which disturbed this professional man. The diastema widened as the years passed, and a slight mobility of the central incisors soon became evident. An attempt to splint these four incisors with wire, in order to move them closer together to close the space prior to permanent splinting, proved unsuccessful. The patient could not tolerate the pain. During

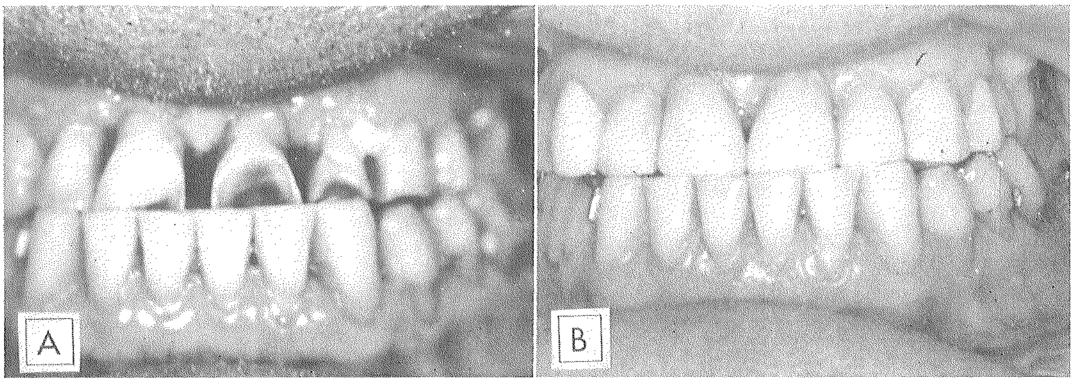

Figure 504. Acrylic resin crowns on teeth worn by abnormal habits will also wear. The opposing teeth and bone will not suffer. *A*, A problem of esthetics; notice the excellent mandibular anterior teeth and gingiva. *B*, Acrylic resin cured over fused porcelain copings (not splinted) satisfies the esthetic requirements. These restorations permit the abnormal wear to continue. The crowns may have to be replaced every two or three years.

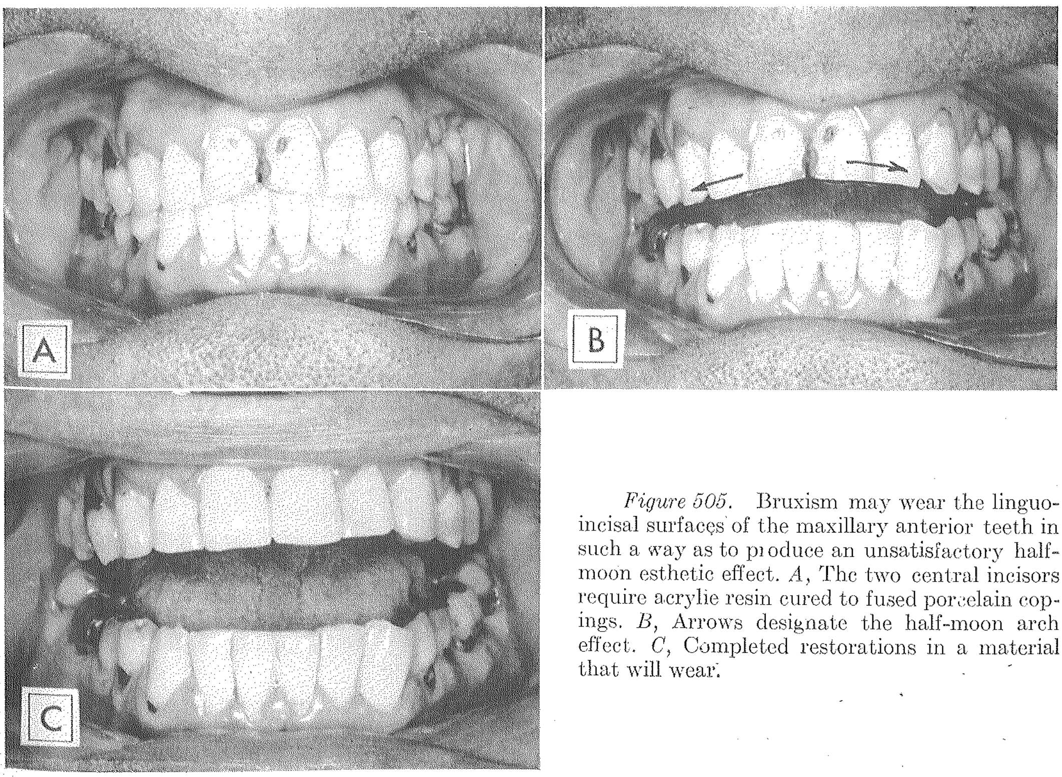

Figure 505. Bruxism may wear the linguo-incisal surfaces of the maxillary anterior teeth in such a way as to produce an unsatisfactory half-moon esthetic effect. *A*, The two central incisors require acrylic resin cured to fused porcelain copings. *B*, Arrows designate the half-moon arch effect. *C*, Completed restorations in a material that will wear.

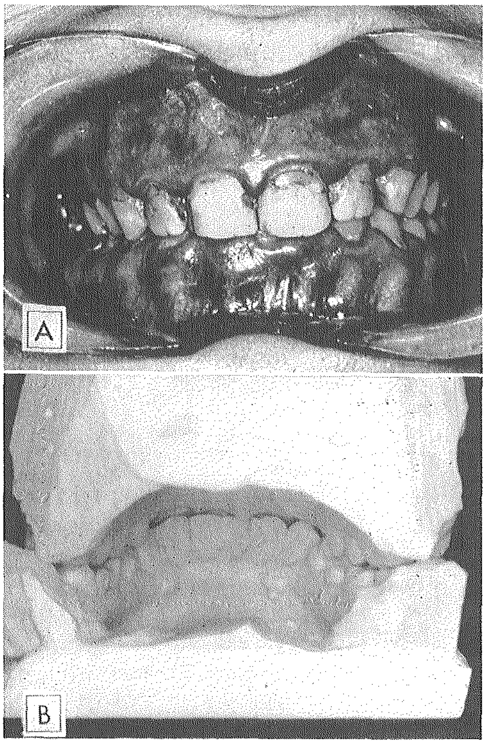

Figure 506. The conventional full coverage restorations for these six maxillary anterior teeth will not be tolerated unless provisions are made for the gliding and sliding maneuvers of bruxism. *A*, Marked vertical overlap and gingival irritation contribute to the problem of poor esthetics. *B*, Looking at the lingual areas of the mandibular incisors as they contact the cingula of the maxillary teeth, creating worn ledges during the abnormal movements of the mandible. In a few more years these mandibular incisors will encroach upon the palatal tissues to inflame them.

the uncontrollable grinding, the less affected tooth was pulled along with the tooth that received the full measure of the bruxism, creating pain. Teeth require individual movement and individual wear during the indulgence of the habit. Restorations of porcelain or gold do not wear, at least not at the same rate as the natural teeth, and the teeth would suffer. Acrylic resin cured to fused porcelain copings improved the esthetics in this patient and permitted the abnormal wear to continue sufficiently to prevent damage. It is frequently necessary to replace these restorations from time to time and the patient must be told about the discoloration and wear of the acrylic.

TREATMENT PLAN THREE: DUPLICATING THE PATTERN OF WEAR IN GOLD

Some teeth possessing wear designs can be treated with restorations having similar designs in cast gold so as not to disturb the uncontrollable bruxism movements. Figure 506 represents a young lady of twenty years who possesses ledges on the linguogingival areas of the maxillary anterior teeth. Other problems are an excessive vertical overlap and gingival tissue irritation and inflammation. The anterior teeth are filled with old acrylic resin and silicate cement restorations that are discolored. Looking behind the study casts at the lingual surfaces of the teeth in both jaws, one can see that the mandibular incisors touch the gingival and palatal tissues (Fig. 506*B*).

Electronic surgery removed the inflamed gingival tissue and the six anterior teeth were prepared for full coverage restorations (Fig. 507). Each preparation has a complete shoulder, with additional widths on the lingual surfaces. Wax copings over swaged Baker's dead soft 0.001 gauge gold matrices (to make for easy handling and accurate castings) were inserted on the prepared teeth to obtain and test nearly accurate imprints in the wax of the ledges. The copings were cast in gold with pronounced ledges upon which the incisal edges of the opposing teeth could ride and

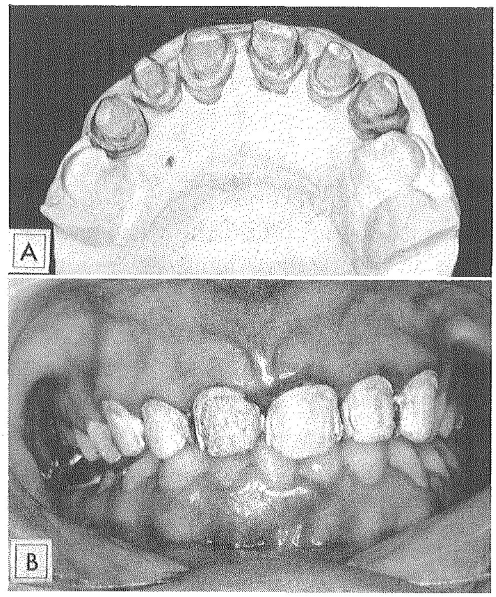

Figure 507. *A*, The teeth in Figure 506 are prepared with complete wide shoulders for full coverage restorations. *B*, Gold copings are cast and acrylic opaque is fused to the labial surfaces of the castings as a mask to accommodate the acrylic resin.

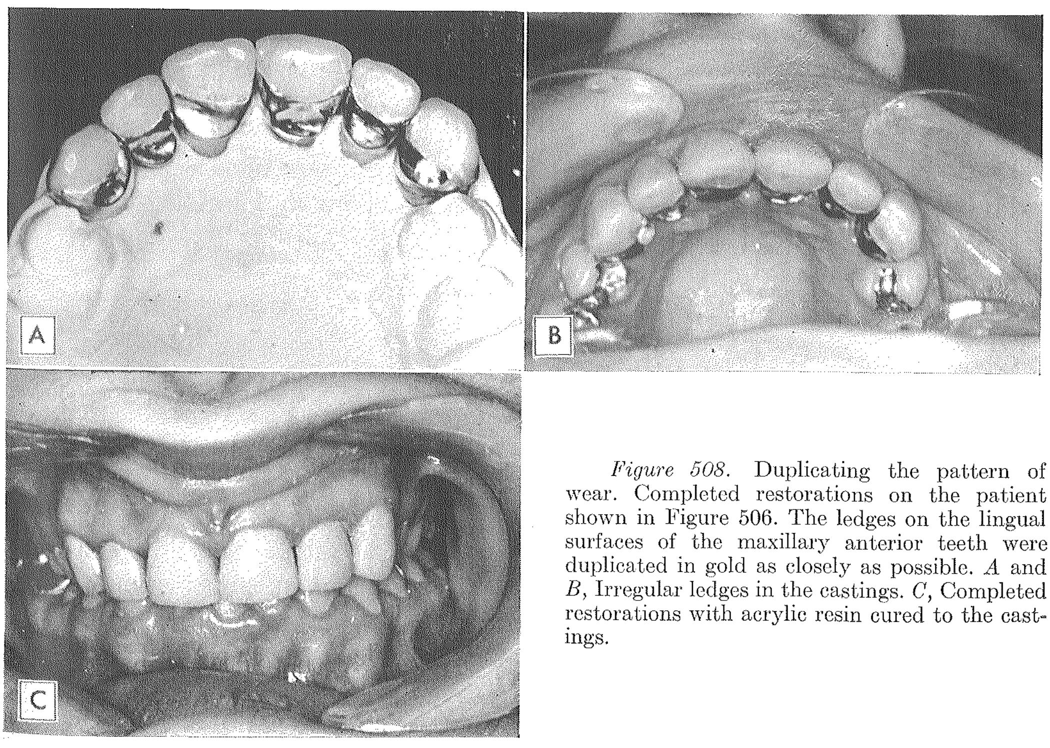

Figure 508. Duplicating the pattern of wear. Completed restorations on the patient shown in Figure 506. The ledges on the lingual surfaces of the maxillary anterior teeth were duplicated in gold as closely as possible. *A* and *B*, Irregular ledges in the castings. *C*, Completed restorations with acrylic resin cured to the castings.

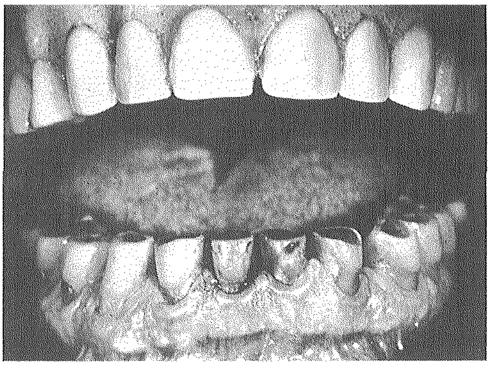

Figure 509. Patient with a complete maxillary denture and attrition on the mandibular teeth brought about by bruxism.

glide as the mandible participated in its abnormal function. The vertical dimension was not increased and the existing excessive vertical overlap was maintained. Acrylic resin was cured to each casting and the occlusion was adjusted further, before cementation. Porcelain fused to gold can also be used. A satisfactory esthetic result is obtained and the restorations will accommodate the bruxism of the mandible (Fig. 508).

Figure 491 illustrates a patient whose mandibular incisors wore the lingual areas of the maxillary ones to such an extent that the gingival tissues became inflamed. This abnormal wear was brought about by the patient's swallowing and grinding habits. Every time he swallowed, the mandibular incisors participated in a contacting grinding "shimmy" on the cingula of the maxillary incisors. Inasmuch as he possessed a pronounced vertical overlap it was not long before the incisal edges of the lower incisors encroached upon the soft tissues and caused a painful inflammation. Removal of the inflamed tissue, preferably by the wire electrodes, is the first step in the treatment of this case. The bruxism cannot be corrected, so provisions must be made in the crowns to permit the shimmy-like movement to continue without interferences. Increasing the vertical dimension beyond the limits of tolerance is not a favorable procedure to follow. For this patient, the teeth should receive restorations with ledges in the lingual areas of the metal castings.

TREATMENT PLAN FOUR: ACCOMMODATING THE HABIT OF BRUXISM

When the excessive attritional wear is severe, the patient is unhappy with the esthetics, the teeth are sensitive, and function is impaired, then rehabilitating both jaws is recommended. Bruxism is accommodated by creating new patterns of wear in a soft material and then duplicating the new wear designs in gold. This method is described fully in Chapter 14.

On occasion, the prosthodontist is called upon to rehabilitate an occlusion in which the biting, rubbing force is powerful and the gliding movements so heavy that an upper denture fractures. Restorations with deep carvings on mandibular teeth are contraindicated. If flat cusps are created the teeth may slip and slide during mastication. A functional occlusion by accommodation is indicated when the possibility of damage is reduced and comfort can be achieved with new restorations.

This can be accomplished by providing the patient with the means to "grind in" his own tolerable and comfortable occlusion.

Figure 509 illustrates a patient with a nearly full complement of mandibular teeth and an edentulous upper jaw. Notice the short, worn mandibular incisors, a disturbing factor in esthetics even to this man of 60 years. His maxillary denture fractured repeatedly, so it was decided to construct one with a metal base. Electronic surgery exposed more tooth structure on the short mandibular incisors (Fig. 510). While healing took place, the posterior teeth were prepared for veneer crowns to occlude with a newly constructed upper denture that possessed *acrylic posterior teeth.* The posterior mandibular restorations were inserted along with the complete denture. The hard factory glaze was removed from the occlusal surfaces of the plastic posterior teeth and a smooth satin finish was created. In the ensuing weeks, the lower carved gold occlusal surfaces actually cut functional gliding paths across and into the acrylic teeth of the maxillary denture. On some patients, this process may take longer. The patient was completely comfortable after the interferences were removed, so the denture was taken from him in order to duplicate in gold the functional ground-in occlusal patterns of the acrylic denture teeth. For this procedure, the Hooper duplicator was used (Fig. 511).

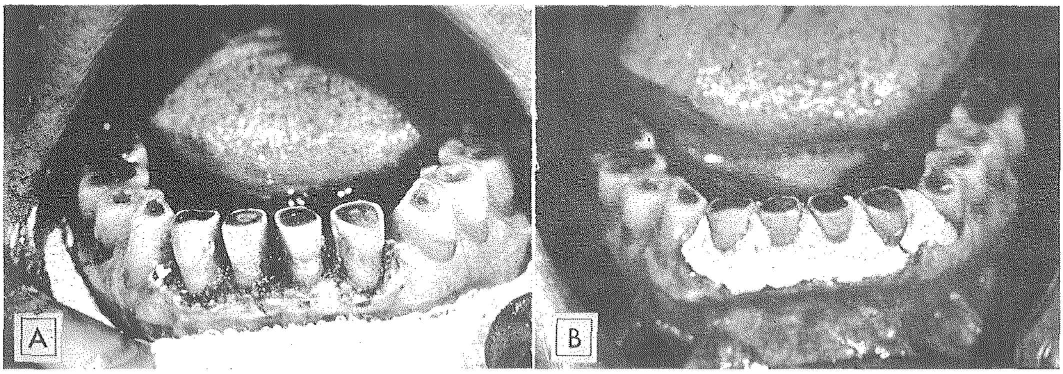

Figure 510. *A*, To obtain a longer clinical crown without increasing the occlusal vertical dimension, some of the gingival tissue from around the neck of each tooth is removed with the wire electrodes. *B*, A pack of Ward's Surgical Cement is applied to protect the cut tissues, allay pain, and promote healing.

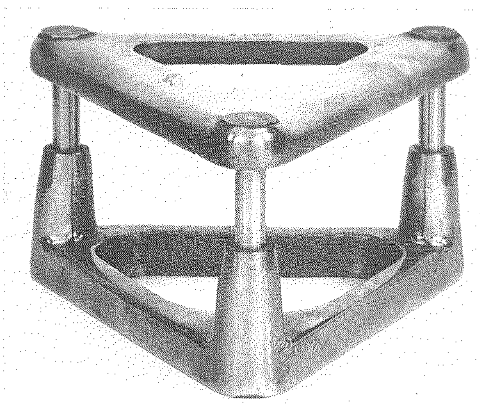

Figure 511. The Hooper duplicator is used to aid in duplicating, with gold, the functionally ground-in patterns of the occlusal surfaces of the acrylic denture teeth.

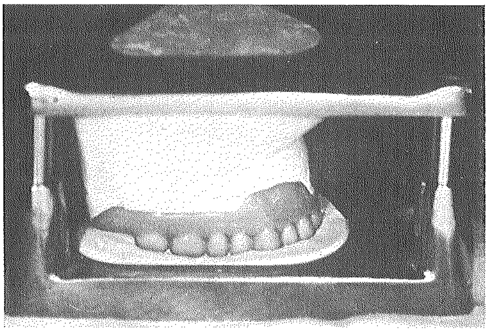

Figure 512. The maxillary denture with the functionally ground-in occlusal areas on the acrylic teeth is inverted in some partially set impression plaster. This leaves an imprint of the occlusal surfaces.

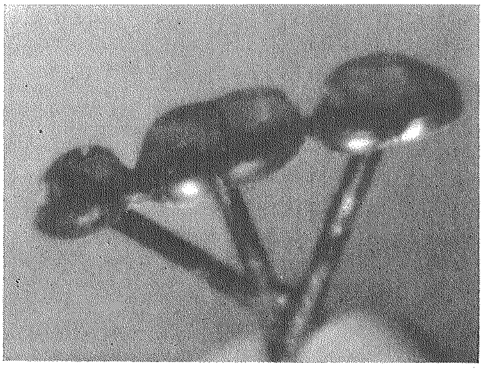

Figure 513. Cast gold onlays (or inlays) are constructed, duplicating the ground-in occlusal surfaces of acrylic denture teeth.

Using the Hooper Duplicator. The steps are as follows: Lubricate the denture on the tissue side and then fill with impression plaster. After setting, trim and score it so that later it can be attached to the upper part of the duplicator. Fill the lower half of the appliance with impression plaster. Lubricate the occlusal surfaces of the plastic denture teeth and place the denture so that the occlusal third of the teeth leaves a good imprint in the partially set plaster (Fig. 512). Close the duplicator and secure the denture to the upper half of the Hooper device with plaster. Trim the excess and, after the plaster has set, separate the halves. Press warmed inlay wax into the carved imprints in the lower half. Trim and carve these wax molds. Remove them carefully and invest and cast them in a not-too-hard gold (Fig. 513). These wax carvings can be individual or connected. Only two molars and one bicuspid on each side were selected in this case.

Cut out the occlusal surface of the acrylic teeth on the denture with a sharp bur. These excavations may be cut to receive occlusal inlays or onlays. Polish the castings and then press them back into the depressions on the lower half of the duplicator. Fill the prepared cavities on the acrylic denture teeth with acrylic resin and press both halves of the Hooper instrument together. The acrylic resin may be self-curing or heat-curing material. When polymerization is complete, polish and smooth the acrylic (Fig. 514). The same technique can be used for a partial denture.

The final phase in the reconstruction of this case is the preparation of the mandibular incisors and the insertion of the jacket crowns (Fig. 515).

TREATMENT PLAN FIVE: ATTEMPTING TO CONTROL THE RUBBING MOVEMENTS

Some operators have success in controlling the damaging, rubbing movements by the use of a bite guard. I do not believe that such a device will eliminate bruxism because it treats the symptom, not the cause. It can prevent the wear patterns from progressing further when the patient rubs his teeth while asleep. The bruxism may be aggravated in some patients because the uncontrollable rubbing and gnashing movements are harnessed and cannot be performed. In selected cases, best judged by the operator, the bite guard may help.

TREATMENT PLAN SIX: DO NOTHING, OR RESHAPE THE TEETH

When excessively worn teeth are sound, are not sensitive, do not impair function, and the esthetics are of no great concern to the patient, such worn teeth are

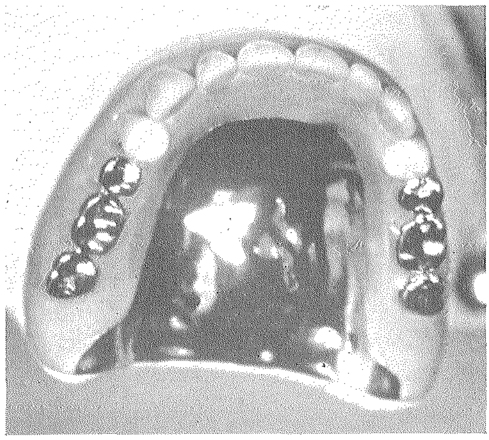

Figure 514. The occlusal surfaces of the acrylic teeth are cut out and the cast gold onlays are inserted with the opposing section of the Hooper duplicator as a guide. These castings are secured to the denture teeth with acrylic resin.

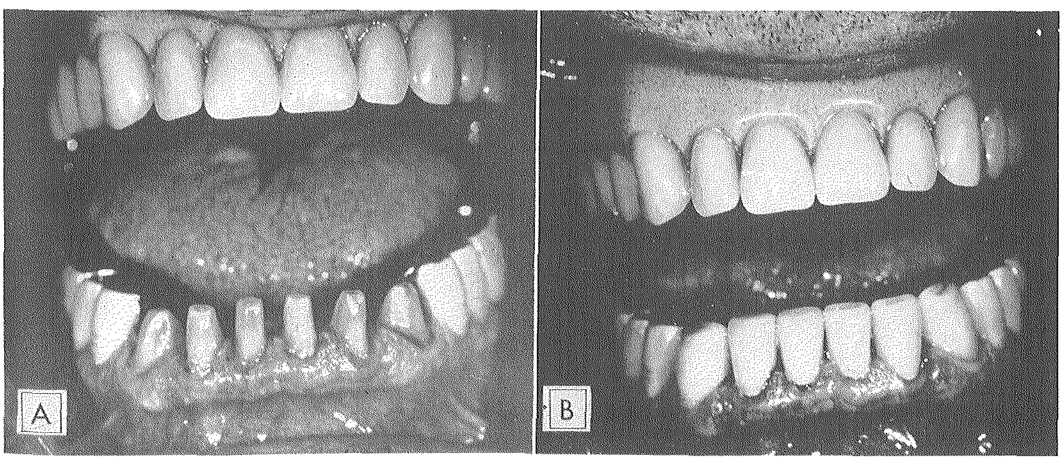

Figure 515. *A*, the anterior mandibular teeth are prepared for jacket crowns. *B*, The completed anterior teeth. (Courtesy Dr. M. Saklad, New York City.)

better left alone. Sometimes it is a good policy to reshape the teeth that participate in the abnormal bruxism. Rough, sharp edges may chip away and split the tooth beyond repair. Rounding and smoothing such edges with sandpaper disks and fine stones preserve worn teeth. Stones can reshape and reduce enamel rims of facets. They can also reduce the V-shaped wear designs to minimize the rocking of such teeth. When teeth migrate or become loose because of bruxism, reshaping and reducing high spots or interference minimizes migration and controls mobility for a time.

BRUXISM IN EDENTULOUS PATIENTS WEARING COMPLETE DENTURES

Does the uncontrollable rubbing habit cease when all the natural teeth are removed? The removal of all the teeth and the construction of complete dentures does not eliminate the symptom of bruxism in most cases. Some authorities[2, 3] claim that there is no wear or bruxism in edentulous cases. They believe that if wear does take place it is due to incorrect occlusion in dentures. What is the correct occlusion for the patient who rubs his teeth uncontrollably, whether they are artificial or natural ones? When the psychologic and neuromuscular influence is great, the only means the patient has to stop the grinding is to take the denture out of his mouth. Rubbing movements tend to trip the denture that possesses teeth which tend to interdigitate in a working-side balancing-side arrangement. The operator invariably is compelled to reduce the cusps of the denture teeth and finds out soon enough that when he has practically flattened the posterior teeth the patient seems to tolerate the denture. Of course it is necessary to recarve such flattened teeth by creating sluiceways in them for better function. In some dentures, there may be a change in the occlusal curve. If the cusps are not reduced on the dentures, the porcelain chips and the acrylic resin wears. The pattern of wear is not exactly the same as on natural teeth because the layers and hardness of tooth structure are not the same as those in glazed porcelain and those in acrylic resin.

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24

MANAGEMENT OF PROBLEMS IN ESTHETICS

No matter how much the dentist stresses the importance of function and retention of the remaining teeth and a healthy periodontium in occlusal rehabilitation, the average patient places more importance on esthetics.

Unsightly teeth undermine poise and self-confidence in some patients and may cause irreparable damage to an individual's personality. No matter how old the patient, or what sex, the demand for improved esthetics in restorative dentistry is great. Sometimes these demands are unreasonable and the operator must explain to the patient what can and what cannot be achieved in restorations. Most crowns and bridges possess a certain amount of artificiality, owing to the color, form, and character of the restorations. The materials the profession uses today are far superior to those used a generation ago and they approach the esthetic qualities of the natural teeth more closely. Nevertheless, artificial pontic teeth and porcelain and acrylic restorations in the form of crowns and bridges contribute in some degree to unnaturalness. When abnormalities exist in the mouth, the factor of unnaturalness is increased. Some anomalies and abnormalities are extremely difficult to correct. These are:

1. Discolored pulpless anterior teeth.
2. Very short anterior teeth.
3. Striated anterior teeth.
4. Crowded and overlapped teeth.
5. Facets in the teeth brought about by bruxism.
6. Extra-wide diastemas.
7. Congenitally missing lateral incisors and canines.
8. Markedly protruding teeth.

9. Prominent anterior alveolar process exposing much gingival tissue when the patient smiles.
10. Marked retrusion of the mandible.
11. Prognathous jaw.
12. Short upper lip.
13. Uneven lip line or gum line.
14. Asymmetries of the face, jaw, etc.
15. Retained deciduous anterior teeth.
16. Teeth with exposed cementum.
17. Previously filled anterior teeth.

The aging process of middle-aged persons is accepted with reluctance. There are times when the patient, aware of a so-called tooth or mouth disfigurement, develops certain psychologic inhibitions which influence his or her behavior. Avoid treating the patient who is under the impression that oral rehabilitation procedures can remove facial folds and wrinkles and that the prosthodontist can reshape or even "grow" a chin by covering teeth with crowns and bridges. The operator must be aware that he can only *improve* upon these difficult conditions.

The remainder of this chapter is devoted to discussions of the nature and solution of common problems in esthetics that confront the prosthodontist.

COLOR

It is impossible to construct porcelain jacket crowns to match every type of tooth without having some difficulty in obtaining color and shade. Porcelain does not have the same absorbing and reflecting qualities that the natural tooth has. Viewed in subdued lights or in rooms where vivid dark walls reflect upon the restorations, the porcelain jacket crown takes on a lifeless hue. This phenomenon is pronounced if the tooth is pulpless or if it receives a gold core or thimble (Fig. 516). The patient should be advised regarding such a condition before the tooth is prepared, to avoid misunderstandings. Painting the darkened stump with a quick-setting white or ivory colored opacifier* will help retain the color somewhat. One porcelain jacket crown is difficult to match with neighboring natural teeth because natural teeth are not all of the same color.

Natural teeth change color because of age and food stains, but fused porcelain does not. Natural teeth that approximate porcelain crowns and bridges take on a different appearance when the porcelain restoration is inserted. As a result, the ceramic crown or bridge seems artificial. Acrylic resin crowns and bridges without any cast gold backings such as a gold coping, a gold veneer casting, or a bridge frame, turn whiter as time goes by. However, when the acrylic resin is cured to gold, the resin material tends to become gray. This objectionable manifestation is primarily due to sulfides in the gold, stain producing foods, and the quality of the acrylic and the masking material. A porcelain fused to gold restoration has a detectably different hue when it approximates all individual porcelain jacket crowns

* George Taub Products, Jersey City, N.J.

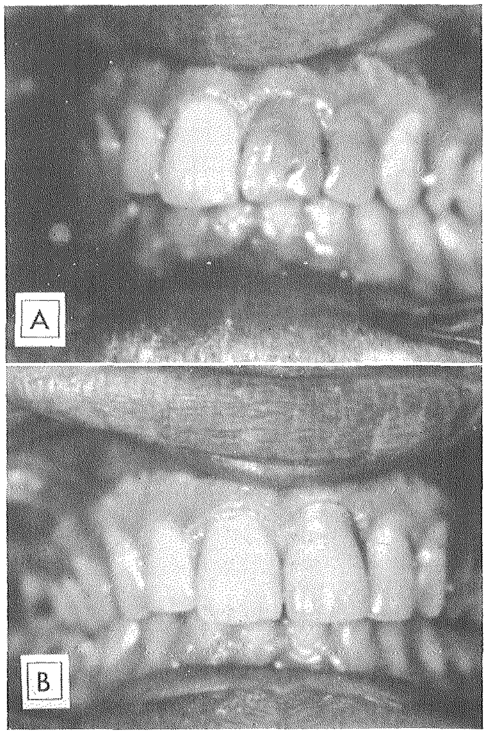


Figure 516. Color difficulty. It is impossible to construct porcelain jacket crowns to match every type of tooth without having some difficulty in obtaining color. *A*, A pulpless darkened tooth prevents the construction of a satisfactory blended porcelain restoration. *B*, The incisal area of the jacket crown almost matches the color of the approximating tooth, but the gingival area is dark because of the influence of the darkened tooth.

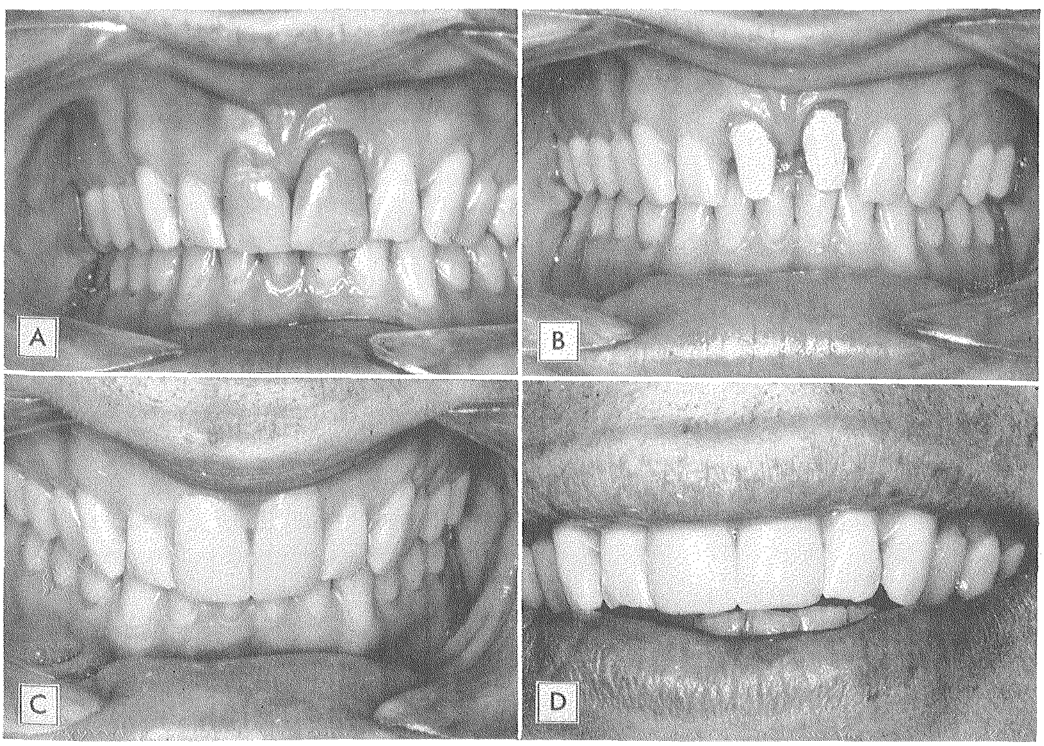


Figure 517. Improving the color on pulpless teeth. *A*, The dark teeth. Notice the different gum level between the central and lateral incisors which should always be called to the patient's attention. *B*, Taub's masking white opacifier applied to the dark preparations before cementation of the completed porcelain jacket crowns. *C* and *D*, The completed crowns with the color improved.

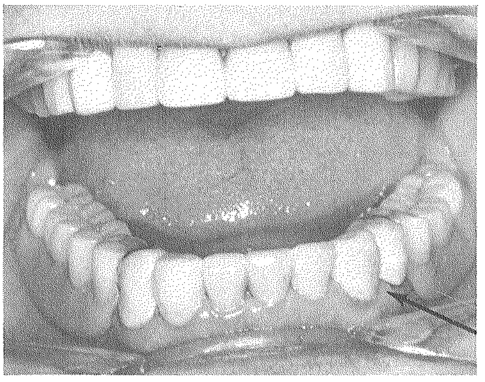


Figure 518. The color of the porcelain fused to gold canines and first premolars (arrow) is not the same as that of the individual porcelain jacket crowns on the mandibular incisors. The metal copings plus the porcelain opaque affect the color despite the fact that the same shade of porcelain was used.

(Fig. 518). Even though the shade of the porcelain used is the same, the metal background and the opaque porcelain plus the not too thick regular porcelain affects the color of the porcelain fused to the metal restoration. Both restorations have different light absorbing and reflecting qualities. *It is always advisable, therefore, to explain the color problems to the patient before dental treatment is begun, because preparing the patient minimizes unpleasant reactions later on.*

COLOR PROBLEMS AFTER THE TEMPORARY RESTORATION

Should the operator plan on constructing a temporary esthetic crown or a temporary fixed or removable partial denture, he should be prepared for an unhappy patient when the permanent crown or bridge is inserted. A beautiful anterior acrylic resin bridge or a temporary removable partial denture with shade 62 Nu Hu translucent teeth thrills the patient as far as esthetics goes. When the permanent restoration is tried on the prepared teeth the color frequently appears less vibrant and actually not the same as the temporary replacement, due no doubt to the underlying metal frame and the difference between the translucency in acrylic resin and artificial Nu Hu porcelain pontics. The possible change should be explained to the patient. Sometimes it is a good policy to construct temporary bridges that are off color and of odd shapes. Cast gold areas on veneer retainers of a fixed bridge in the lower jaw upset many a patient who has grown accustomed to the tooth-like occlusal areas of the temporary restorations. If the abutment retainer is to be porcelain fused to gold or acrylic to gold abutment retainer receiving internal attachments, then the metal female slot must be visible, and the patient should be so advised before treatment.

PROMINENT ALVEOLAR PROCESS

A prominent alveolar process interferes with the esthetic result of any anterior restoration. A person who "shows a lot of gum" does not present a pleasing smile even when he or she possesses a full complement of teeth (Fig. 519). An anterior restoration, such as a crown or a bridge, is often more pronounced and noticeable.

If anterior teeth are missing, the necks of a partial denture will be very conspicuous. The prosthodontist should consult with the oral surgeon on the advisability of reducing the alveolar plate sufficiently to accommodate acrylic on the removable partial denture.

To avoid later unpleasantness, the prosthodontist is advised to point out the pronounced alveolus and gum tissue to the patient requiring occlusal rehabilitation at the time of case presentation. Unless the patient understands the limitations with such conditions and is willing to accept the best that can be done, the prosthodontist is advised not to treat the patient.

STRIATED TEETH

Another phenomenon that causes the operator untold difficulty is the porcelain jacket crown on a tooth approximating teeth that have characteristic striations (Fig. 520). These striations are deeply embedded, and obtaining harmony of color in a restoration is impossible. Ceramists cannot duplicate the striations that nature created, by fusing porcelain jacket crowns. The operator can only improve upon objectionable and difficult manifestations and he should not commit himself re-

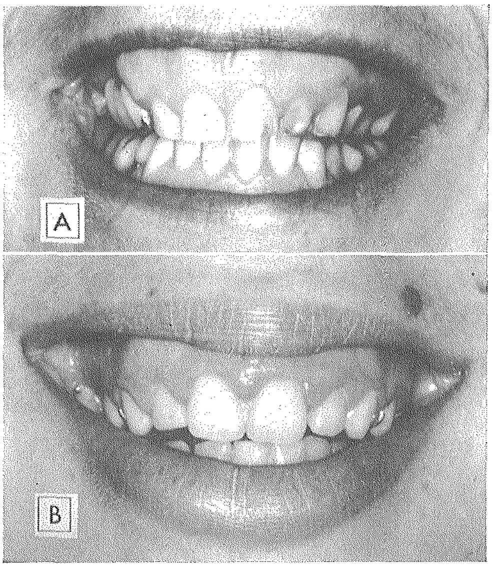


Figure 519. A prominent alveolar process limits the success of a restoration. *A*, A patient who "shows a lot of gum" does not present a pleasing smile even when she has a full complement of teeth. An anterior restoration on such a patient is more pronounced and noticeable. *B*, If the gingival tissue is inflamed, the problem is even greater.

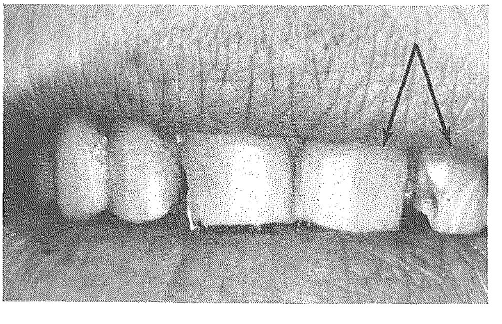


Figure 520. A porcelain jacket crown never matches approximating teeth that have characteristic striations. Ceramists cannot duplicate these thin, deeply embedded striations that nature created.

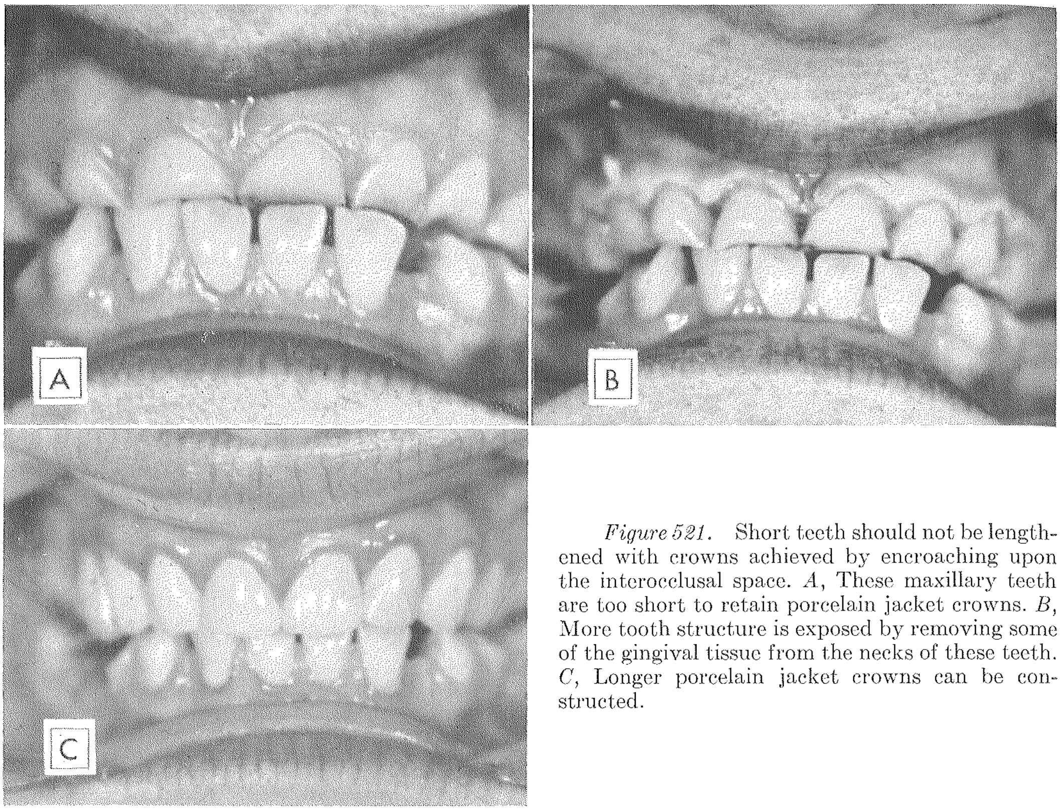


Figure 521. Short teeth should not be lengthened with crowns achieved by encroaching upon the interocclusal space. *A*, These maxillary teeth are too short to retain porcelain jacket crowns. *B*, More tooth structure is exposed by removing some of the gingival tissue from the necks of these teeth. *C*, Longer porcelain jacket crowns can be constructed.

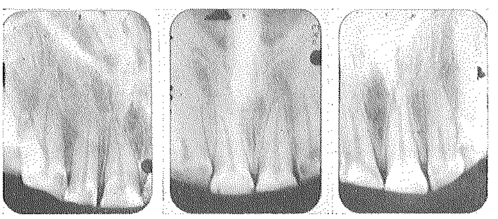


Figure 522. Roentgenograms of the patient shown in Figure 521.

garding such teeth by making rash promises he cannot fulfill. Of course, covering six anterior teeth will eliminate the problem of matching striated teeth, but the patient will object to the crowning of six teeth merely to obtain better color and form.

SHORT ANTERIOR TEETH

Although natural-appearing teeth with beauty and color are important in occlusal rehabilitation, such teeth must not be employed at the expense of the correct occlusal vertical dimension. Short teeth should not be lengthened with crowns achieved by encroaching upon the interocclusal space. Some anterior teeth are too short to retain full coverage restorations and present a serious problem with patients to whom esthetics is essential. Figure 521 illustrates such a patient, a young girl of 21 years. Mottled enamel in the incisal third of her teeth is responsible for the breaking off of the incisal segments, and produces an unattractive condition. The roentgenograms disclose healthy bone (Fig. 522). The teeth are too short to receive porcelain jacket crowns and her entire dentition presents conditions that contraindicate occlusal rehabilitation. Electronic surgery facilitates the success of such a case. Some of the thick plentiful tissue is removed from the necks of eight maxillary anterior teeth, exposing more tooth structure. After healing, which takes place in about six weeks, the eight teeth receive porcelain jacket crowns. To prevent the completed crowns from rotating on the preparations and separating from the cementing medium, a ledge is cut on the lingual surface of each of the six anterior preparations to simulate cingula. Because her occlusion participates primarily in a vertical chopping motion, the porcelain jacket crowns are less apt to fracture.

PREVIOUSLY FILLED ANTERIOR TEETH

Previously filled anterior teeth present quite a problem, particularly in young adults (Fig. 523). The old restorations, usually silicate cement or acrylic resin, are large and in proximity to the pulps. *The patient and the parent should be advised that the life of such a tooth (teeth) is in jeopardy when it is prepared to receive a full coverage restoration of any type to improve upon an unesthetic condition. Despite all precautions, some pulps fail to survive after the permanent esthetic restorations have been inserted.* In a previous carious or filled anterior tooth, there may have been minute exposures that are impossible to detect. In older patients these minute exposures may have existed for a long time without discomfort or warning, only to flare up after the insertion of the restorations. There is no positive and critical method of detecting these small openings. Despite pulp testing, unfavorable reactions to jacket crowns on previously filled teeth take place. The patient should also be advised that should the pulp of a prepared tooth react unfavorably, the tooth can be treated endodontically through the lingual surface of the restoration or by means of root resection with a sterile amalgam seal. In most instances such treatments can be accomplished without removing or remaking the restoration.

Figure 523. Deep-seated silicate cement restorations are often in close proximity to the pulp. The patient should be advised that the life of such a tooth is in jeopardy when it is prepared to receive a full coverage restoration.

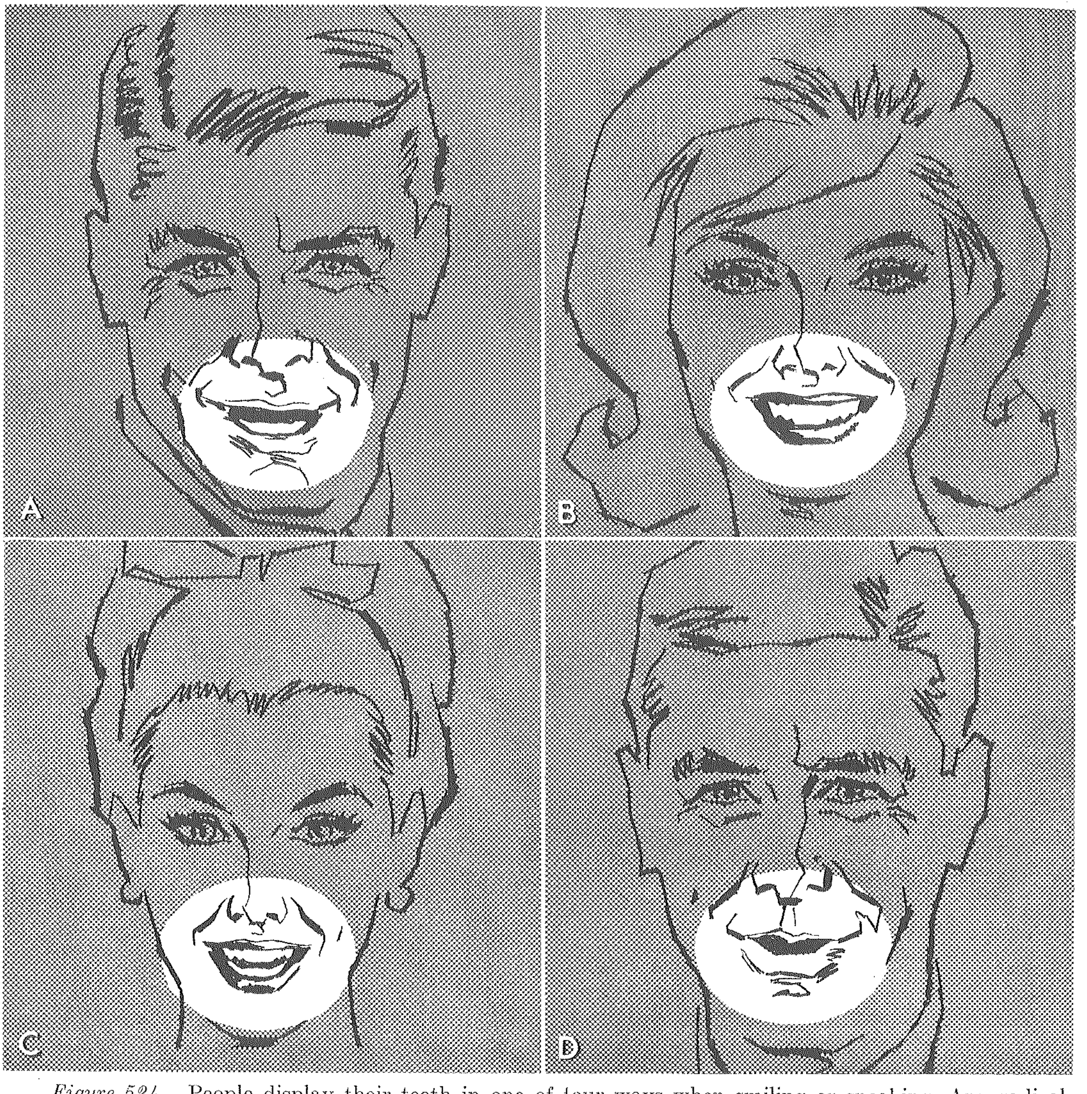


Figure 524. People display their teeth in one of four ways when smiling or speaking. Any radical change in occlusion, such as raising the bite, is apt to change the facial appearance, much to the patient's objection. *A*, Some people show only their lower teeth. *B*, Some show only their upper teeth. *C*, Some show both upper and lower teeth, and *D*, Some people do not display any teeth when speaking or smiling.

IMPORTANCE OF THE LIP LINE WHEN SMILING AND SPEAKING

People normally display their teeth in one of four ways when smiling or speaking. Some show only the maxillary teeth (Fig. 524*A*), while others display only the mandibular ones (Fig. 524*B*). Many individuals exhibit both upper and lower teeth (Fig. 524*C*), while still others do not disclose any teeth and look almost edentulous (Fig. 524*D*). The latter usually have full lips and cheeks and not the sunken facial appearance so typical of patients without teeth. *It is very important, during the examination, for the operator to note and record how the patient smiles and speaks. Any radical change in the occlusion, the type and size and position of the anterior restora-*

tions, and the vertical and horizontal overlaps will change the smile and appearance when the patient speaks. Therefore, every attempt should be made in rehabilitation procedures to duplicate the display of teeth. There are patients, however, who have an acquired abnormal smile and an unnatural manner of speaking because of efforts to hide the objectionable appearance of their teeth. Such unsatisfactory manifestations may be due to a collapsed, lost, or reduced occlusion (Fig. 525), which can be improved by correct occlusal rehabilitation. Abnormal lip habits affect the display of teeth—an abnormality the dentist cannot change any more than he can improve

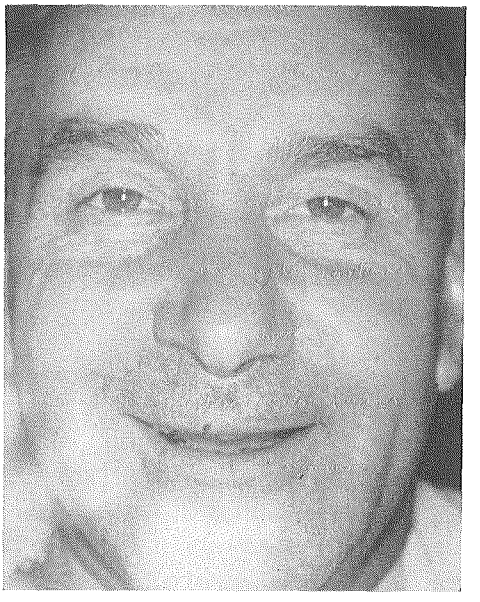


Figure 525. Some patients acquire an abnormal smile and an unnatural manner of speaking due to a collapsed, lost, or reduced occlusion.

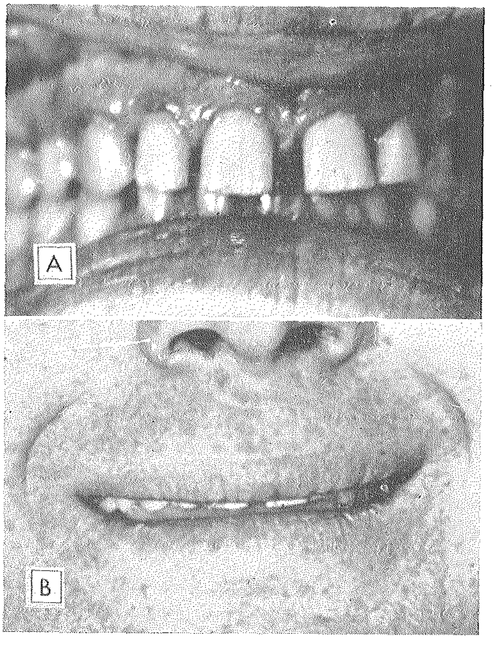


Figure 526. Sometimes the patient with objectionably spaced teeth arranges the lips before smiling in order to hide the abnormality. *A*, Patient with the spaced teeth. *B*, The lip becomes turgid and tense.

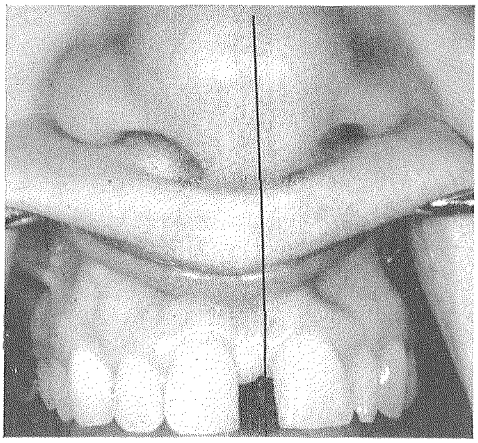


Figure 527. The center of the nose is not always in the same line as the center between the central incisors. Correction of such spaced teeth with porcelain jacket crowns accentuates the off center difference, and the patient should be so advised before treatment is begun. (Courtesy Dr. M. Saklad.)

upon the smile of the individual who displays a lot of gum and alveolus when he speaks or smiles.

SPACED TEETH

Spaces in the anterior part of the jaw are usually developmental diastemas or are caused by the migration of teeth. Some spaces are evident because of congenitally missing lateral incisors or canines. There are occasions when the patient, aware of the dental disfigurement, develops a voluntary immobility of the upper lip. After a few years of this self-protective manifestation, the lips become turgid and tense, resulting in a grimace. These lips are first arranged before smiling in order to hide the spaced teeth. The operator cannot always get a perfect result when correcting spaced teeth. Many times he will find it difficult to obtain the effect the patient has dreamed about. It may be better in these cases not to attempt correction.

POSSIBLE METHODS OF CORRECTING OBJECTIONABLY SPACED TEETH

1. Orthodontic procedures in conjunction with prosthodontic restorations. Usually recommended in young adults.

2. Removal of a tooth (teeth) and insertion of a fixed or removable partial denture with a wider pontic and abutment retainers. Sometimes several anterior teeth are removed and a removable partial denture is constructed with an additional pontic tooth. Usually recommended when protruding, spaced, and periodontally involved terminal anterior teeth have to be removed.

3. Widening a tooth or teeth with full coverage restorations, making each crown a little wider to take up the space. This procedure on sound teeth is recommended only when esthetics is of prime importance, affecting the behavior of the patient.

4. Widening canines and premolars with crowns and bridges to reduce the anterior overall distance between the right and left canine, and constructing four

normal size jacket crowns. Usually recommended in complete occlusal rehabilitation.

5. Fusing two porcelain jacket crowns over one preparation. A conservative approach recommended in young adults and when the lip line is low.

6. Removal of vital pulps and construction of off-center gold cores and porcelain crowns to close the spaces. This is a radical approach not recommended as routine, but only when the esthetics is of extreme importance.

It is often necessary to prepare sound healthy teeth for porcelain jacket crowns in order to close the space or spaces. To obtain nearly equal thickness of porcelain for uniform color and to minimize fracture, it is necessary to prepare the teeth slightly differently from the conventional manner. The mesial surfaces of the teeth are prepared with practically no shoulders while the remaining surfaces receive full shoulders. This procedure enables the ceramist to construct each porcelain jacket crown to nearly equal thickness. Figure 528 represents a patient who requires four porcelain jacket crowns that will close the space. The operator can fill in the spaces with tooth-color wax prior to preparing the teeth, to give himself as well as the patient an idea of how wide the restorations will appear.

Figure 529*A* shows a patient who will undergo occlusal rehabilitation and who presents objectionably spaced maxillary anterior teeth caused by migration and dysfunctioning occlusion. This person will require four porcelain jacket crowns to close the spaces. However, these four crowns will appear too large and too wide to produce a satisfactory result. Inasmuch as the canines are to receive abutment retainers for posterior fixed partial dentures, these canine retainers can be constructed wider toward the median line (Fig. 529*D*). This procedure will reduce the

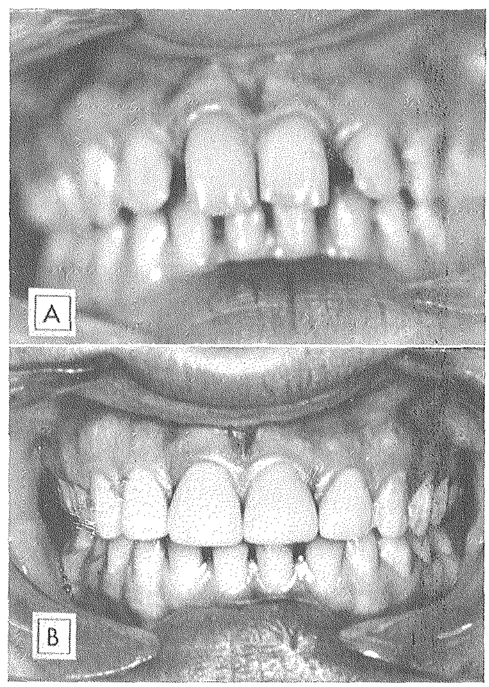


Figure 528. *A*, The spacing exists between the central and lateral incisors. *B*, Four porcelain jacket crowns close the spaces. Before treatment is started, the patient must be told that the restorations will be wider.

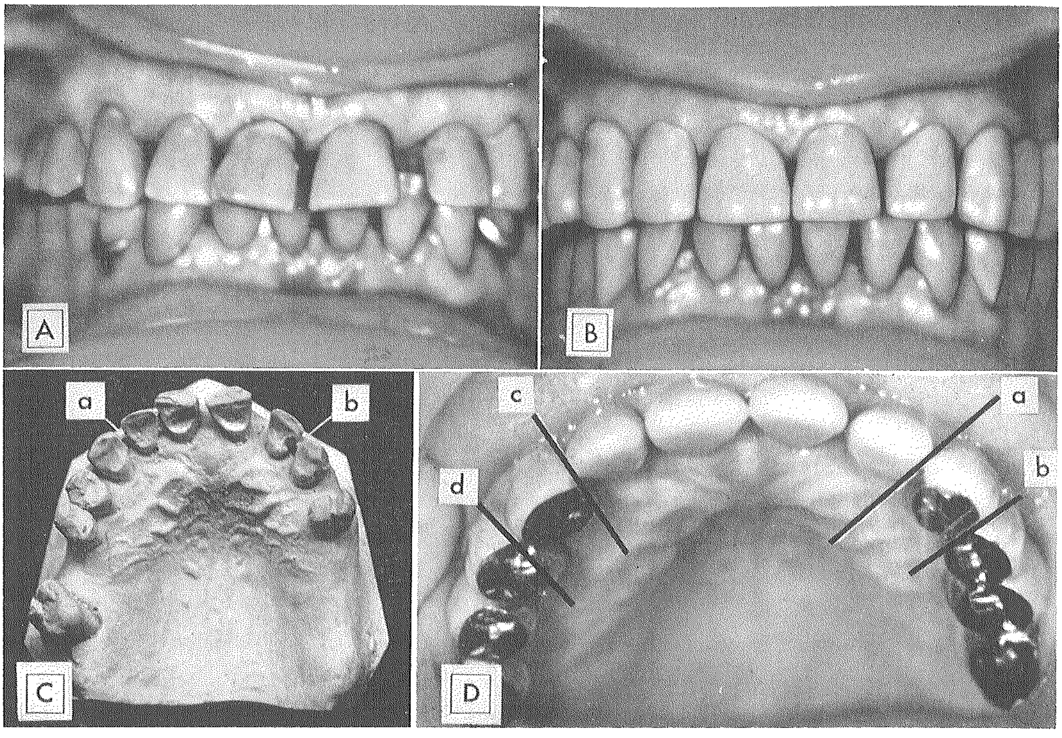


Figure 529. *A*, Patient before treatment. *B*, After correction with porcelain crowns. *C*, Porcelain jacket crowns on the four maxillary incisors will look large and grotesque because the distance between *a* and *b* is too wide to accommodate normal size restorations. *D*, Inasmuch as the canines will receive abutment retainers for posterior fixed partial dentures, these canine castings are constructed wider toward the median line (*a–b*, *c–d*). This procedure reduces the overall space between the canines. Four normal size porcelain jacket crowns satisfy the esthetic requirements.

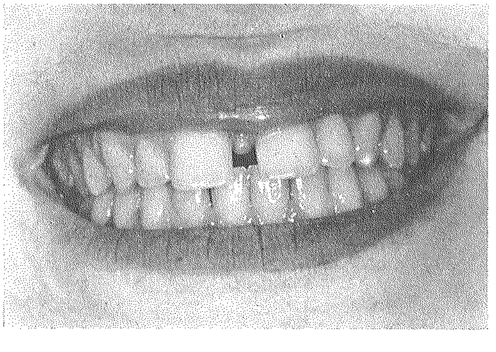


Figure 530. When the diastema is extra wide, the occlusion close, and the teeth beautiful and perfect, correction by prosthodontic means is contraindicated.

overall space for the four anterior teeth, and normal-size porcelain jacket crowns can satisfy the esthetic requirements (Fig. 529*A* and *B*).

When an anterior tooth that participated in the creation of a diastema is removed, the space can usually be eliminated when the fixed partial denture is inserted. The abutment retainers and pontic, however, will have to be a trifle wider. If a frenum prevents proper tissue adaptation of the bridge to the tissue, it can be removed (Fig. 531 and 532). It is sometimes necessary to reduce some of the enamel from the incisal edges and the incisolabial areas of the opposing mandibular teeth.

It is advisable to tell the patient before the teeth are prepared that it may be necessary to reduce the edges of the opposing teeth. Assure the patient that these surfaces can be so treated that no pain will be experienced. Telling the patient beforehand will make him amenable to this procedure.

SHORT TEETH AND MULTIPLE SPACES

Figure 533 illustrates an esthetic problem of short and objectionably spaced anterior teeth. The posterior teeth in the upper jaw have been missing for seven years, since the patient was 23 years of age. The vertical dimension of occlusion was not lost because the opposing premolars on both sides maintained the interdigitating occlusal relationship that was comfortable and functional. The occlusion must not be raised in such a patient to make room for esthetic restorations when rehabilitating the upper dentition and supplying artificial teeth to function better. This patient can be considered in group II class 2, described in the chapter on treatment plans. A preliminary occlusal rim was used in conjunction with the few remaining guide teeth (Fig. 534).

Gingival tissue was removed from around the necks of all remaining maxillary teeth and some exposed alveolus was chipped away, to improve upon the esthetics

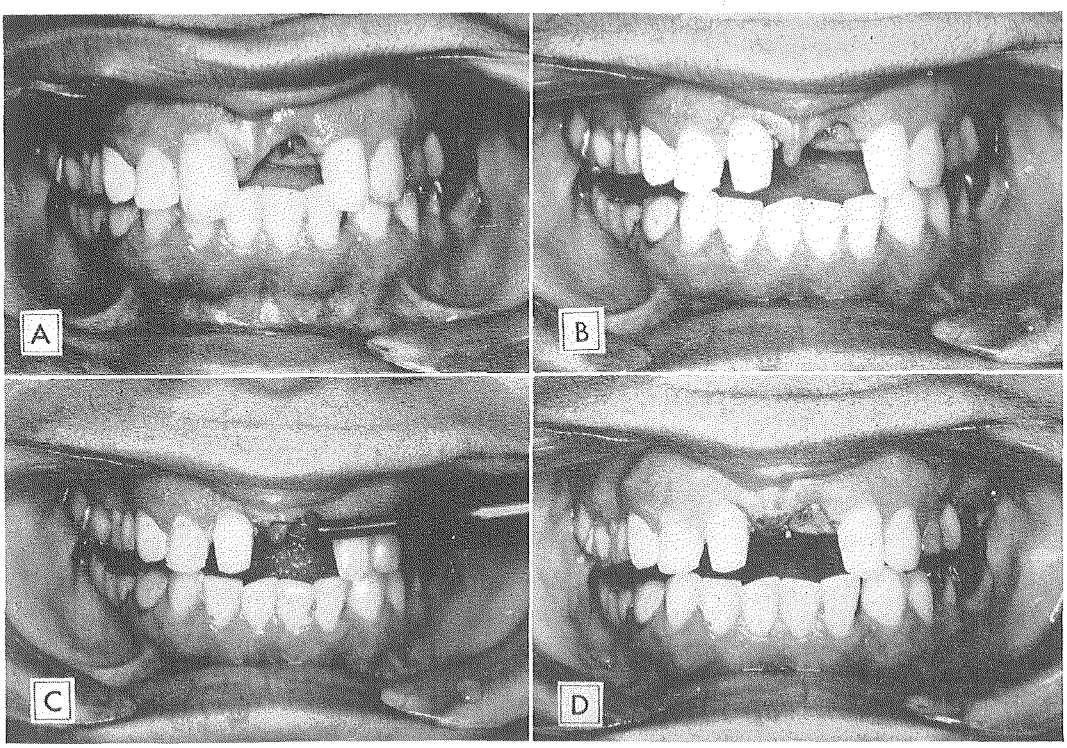


Figure 531. When an anterior tooth that participated in the creation of a diastema is removed, the space is eliminated when the fixed partial denture is inserted. *A,* The space between the abutment teeth is too wide to receive a normal size central incisor. *B,* The central and lateral incisors are prepared for veneer crowns. *C, D,* The interfering frenum is removed with the wire electrode.

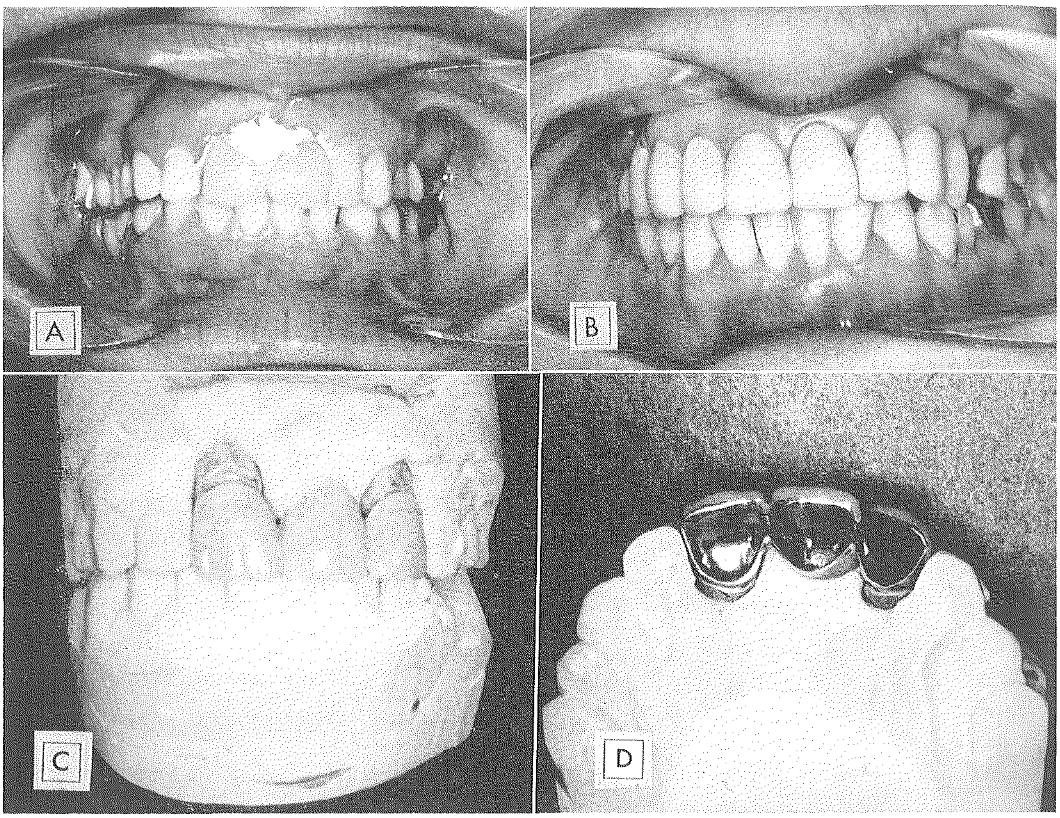


Figure 532. The same patient as shown in Figure 531. *A*, The temporary bridge is cemented on the teeth with Ward's Surgical Cement. *B*, *C*, The completed bridge. *D*, The lingual view.

while rehabilitating the upper jaw only. These preliminary procedures created longer anterior teeth without increasing the vertical dimension of occlusion and improved upon the periodontal condition and level of the gingiva (Fig. 533*D*). The additional length of the teeth was tissueward. Splinting the entire remaining maxillary teeth and cantilevering one or two posterior pontics would not give this patient the esthetics she desired because the underlying metal framework would affect the color. Experience has proved, in most cases, that large splints with additional free-end pontics usually loosen up in one section.

The two premolars and canine on the right side were splinted with acrylic resin veneer crowns and the premolar and canine on the left side received the same type of restorations. These splinted abutment retainers supported a removable partial denture with internal attachments. The canines and premolar on each side were constructed a little wider toward the mesial areas. This reduced the overall distance between the right and left canines. Four porcelain jacket crowns were constructed on the four incisors and the occlusion was adjusted after a few weeks. Unfortunately this patient refused to accept a removable partial denture. The steps in the management of this dentition are described graphically in Figures 535 and 536.

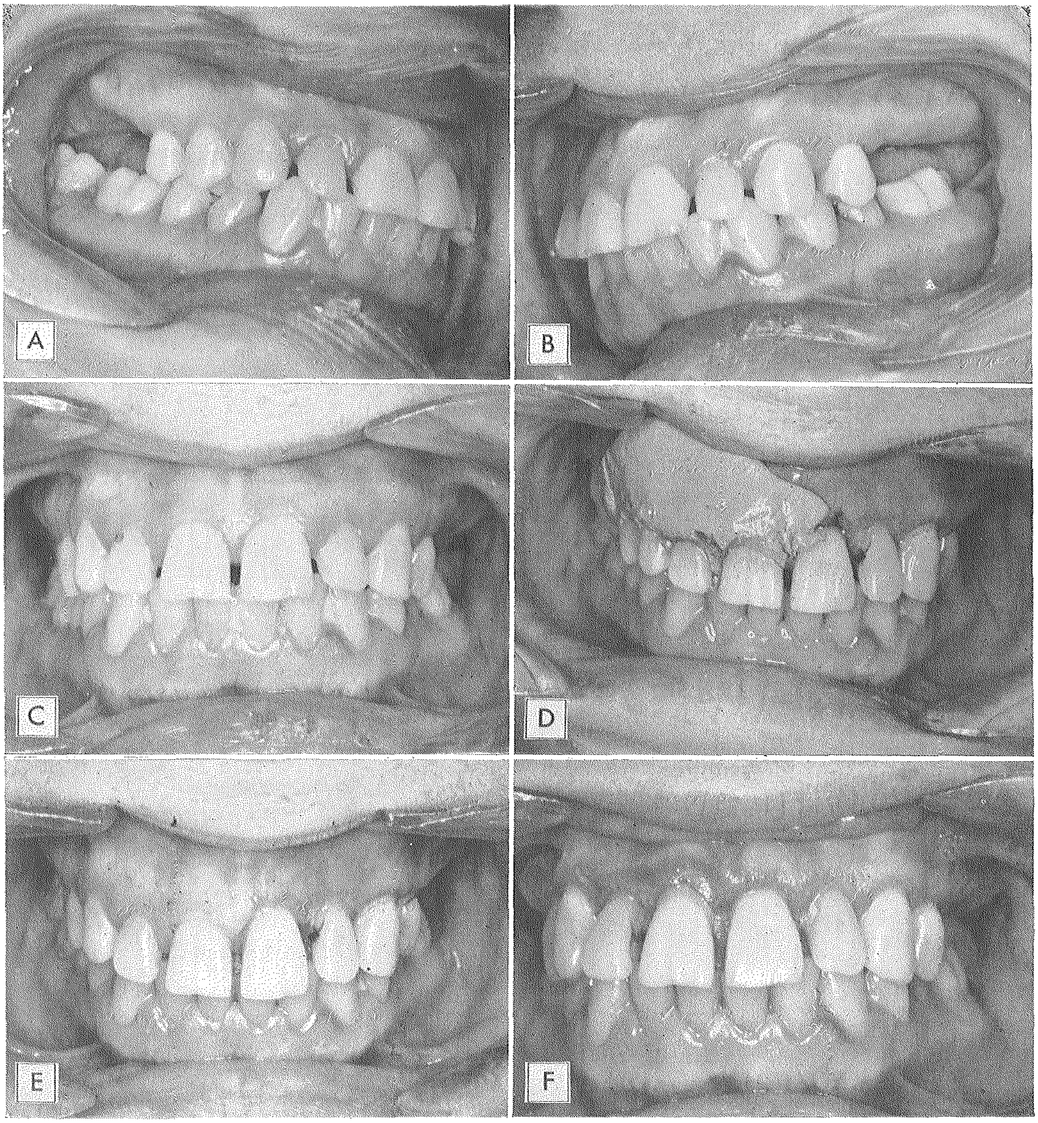


Figure 533. Improving short and spaced teeth in the upper jaw requiring rehabilitation without raising the bite. *A, B, C,* Anterior and lateral views before treatment. *D,* Electronic surgery removed gingival tissue from around the necks of the remaining teeth. Some alveolar bone was also chipped away. *E,* The tissue removed from the teeth on the left side. Notice the additional length of the teeth on this side as compared with the teeth on the right side. *F,* After healing.

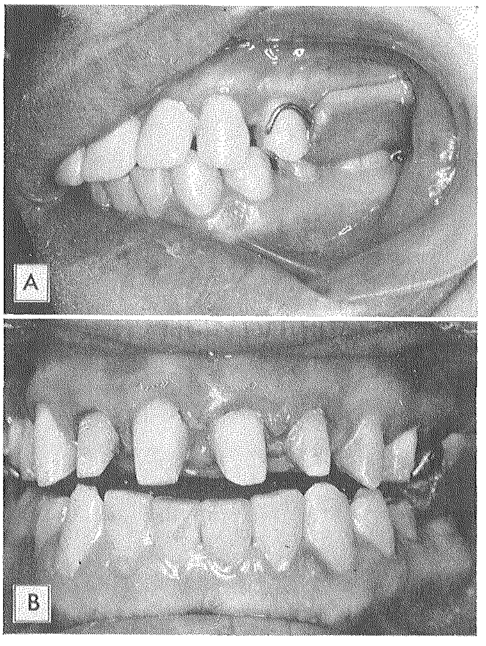


Figure 534. Same patient as shown in Figure 533. *A*, Preliminary occlusal rim before preparation of the premolar guide teeth. *B*, Preliminary occlusal rim in the mouth after all the teeth in the upper jaw have been prepared. The rim helps maintain the patient's tolerant vertical dimension of occlusion.

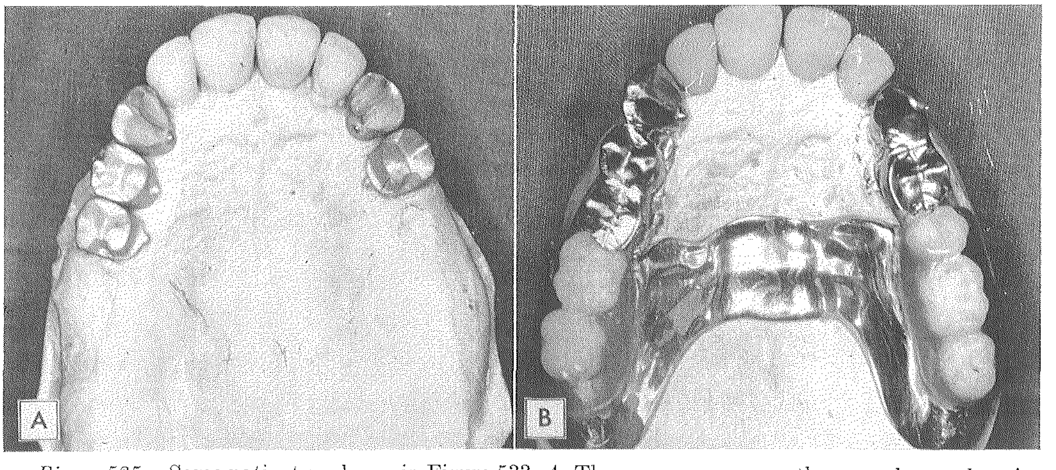


Figure 535. Same patient as shown in Figure 533. *A*, The veneer crowns on the premolars and canines were constructed to be a little wider toward the mesial area to reduce the overall space between the canines. Four biscuit bake porcelain jacket crowns were constructed on the four maxillary incisors. The last premolar veneer casting on each side has a cutout for the reception of an internal attachment. *B*, The completed case on the working cast consisting of four porcelain jacket crowns, three splinted veneer crowns on the right side, and two splinted veneer crowns on the left side, supporting a removable partial denture with internal attachments.

THE WIDE DIASTEMA ON THE PATIENT WITH THE BRUXISM HABIT

Figures 537*A* and *B* illustrate a patient of about 50 years of age who had her occlusion rehabilitated about 10 years before this photograph was taken. Bruxism was excessive even prior to rehabilitation. This uncontrollable phenomenon was either not recognized or no means was known to accommodate the damaging rubbing movement. As a result, the brunt of the bruxism shifted from the restored posterior gold and porcelain restorations to the porcelain jacket crowns on the upper anterior teeth and the natural mandibular anterior teeth. These porcelain jacket crowns fractured repeatedly. The preparations were continuously reprepared for new porcelain crowns until the four incisors became pulpless. Silver points were inserted as the final root canal fillings through the openings on the lingual surfaces of the crowns. The diastema widened. The left lateral incisor did not respond favorably to endodontic treatment and that tooth was removed. A cantilever fixed partial denture was inserted, a three-quarter crown on the canine carrying a porcelain pontic. When this porcelain pontic fractured away from the retainer (because of excessive bruxism) the patient appeared for treatment. By this time she was aware of the difficulty with her anterior teeth. The extra wide space, the short canines, and the powerful uncontrollable rubbing habit were pointed out to her.

Rather than place a full coverage restoration on the short left canine, a pitledge

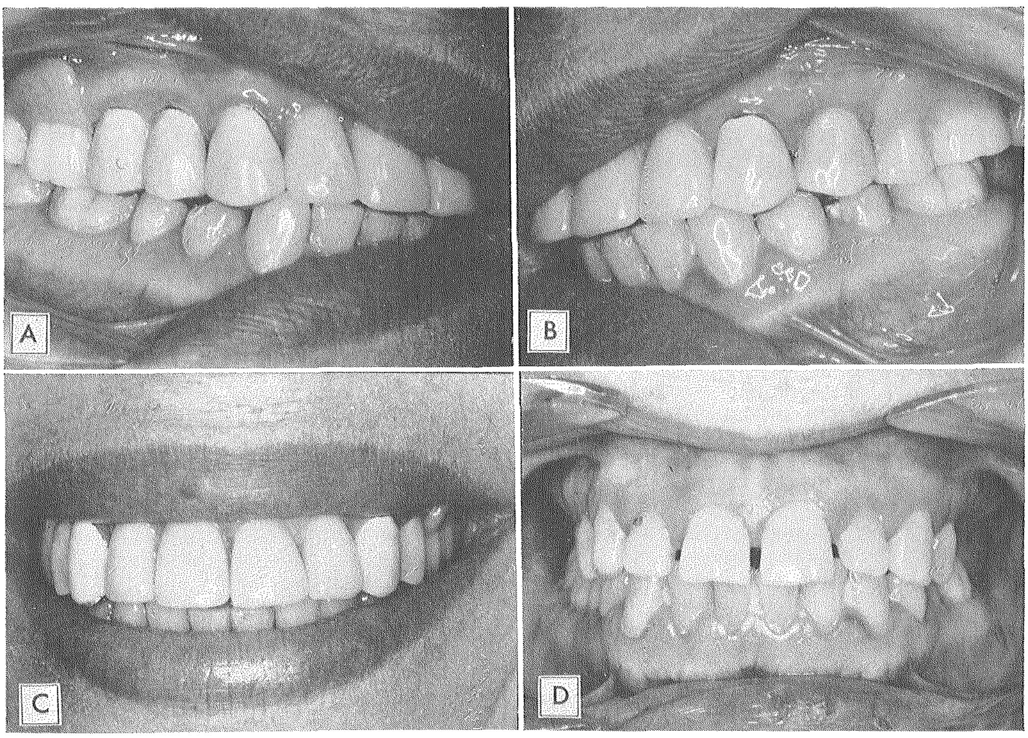


Figure 536. Same patient as shown in Figure 533. *A*, *B*, *C*, The completed restorations in the mouth. The esthetics was improved without increasing the vertical dimension of occlusion. Slight gold collars on the veneer crowns are visible to avoid overextension into the crevices. *D*, The dentition before treatment.

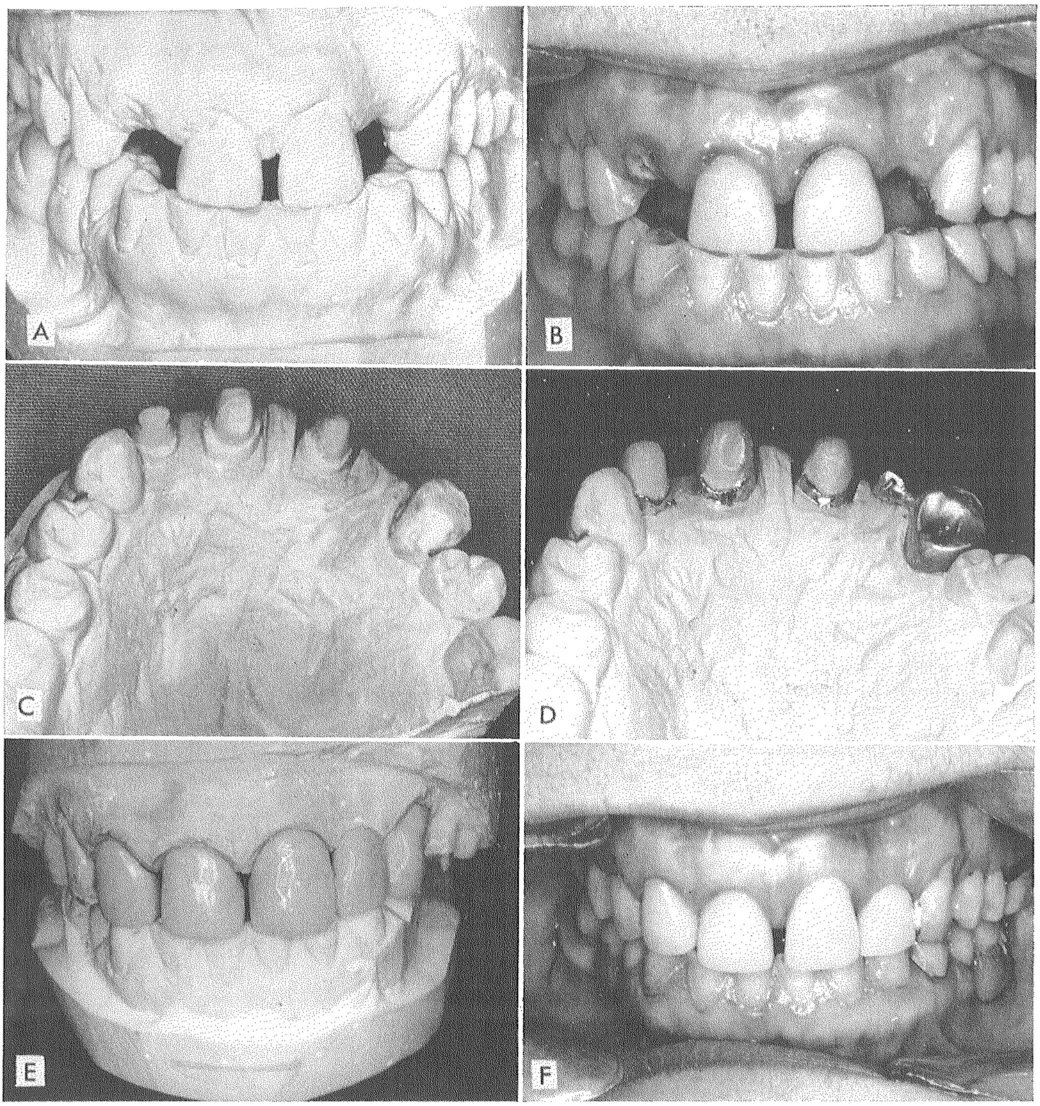


Figure 537. Esthetic improvement of a difficult case (see text). *A*, Study casts. *B*, Anterior view showing wide diastema, retained right lateral root, marked attritional wear on the mandibular incisors, and short maxillary canines. *C*, A gold core was inserted on the right lateral root. The old central incisor porcelain crowns were removed and the teeth re-prepared. A pinledge preparation was created on the short broad left canine. *D*, Opaque fused porcelain copings on the three anterior teeth. The pinledge casting on the left canine has a cantilever bar for a lateral incisor pontic. *E*, Waxed crowns on the working cast. *F*, The completed restorations of acrylic resin cured to fused porcelain copings and the cantilever bridge.

three-quarter crown was constructed. Because of the rubbing movements, porcelain restorations were out of the question. This canine casting supported an acrylic resin pontic. The right lateral incisor received a gold core after the silver point was tediously removed. It was too precarious to attempt to remove the points from the two central incisors. This was called to the patient's attention and she was instructed not to incise hard foods with her anterior restored teeth in order to lessen the possibility of fracture of the coronal portions of the teeth at the necks. Acrylic resin cured to fused porcelain copings were fabricated for the two central and remaining lateral incisors. The patient was advised that these restorations would have to be replaced within three to four years because the acrylic would wear and change color. The large space could not be closed completely without making restorations much too large and wide. Although not ideal, this result is an improvement in esthetics, considering the many limitations involved. The patient was very cooperative because all the troublesome limitations were repeatedly called to her attention, before and during treatment.

CORRECTION OF AN EXTRA WIDE SPACE BY FUSING TWO CROWNS OVER ONE PREPARATION

If the upper lip is low and the patient does not expose the gingival tissue when he speaks or smiles, *improvement* of a very wide diastema may be brought about by the introduction of an additional tooth. Figure 539 depicts such a patient. This young lady of nineteen years was very conscious of the wide diastema. It would not be prudent to prepare six healthy anterior teeth for so young a patient and cover them with six extra wide porcelain jacket crowns. The esthetics would not be improved much. At the expense of only one tooth, the left central incisor, an acceptable result was obtained. This tooth was prepared for a porcelain jacket crown with a complete shoulder and received two joined crowns over one preparation. This created an extra tooth and the median line was shifted—factors that were called to the patient's attention prior to treatment. The upper lip did not expose the junction of the two fused crowns at the cervical border. Figure 530 illustrates an extra wide diastema that is not amenable to such treatment, and such a condition should be left alone.

CORRECTION OF SPACES BY WIDENING ANTERIOR TEETH WITH PORCELAIN JACKET CROWNS

Figure 528 illustrates a young patient with a wide diastema in whom it was necessary to prepare four healthy teeth to receive porcelain jacket crowns, each wider, to obtain the esthetic result the patient desired. Inasmuch as equal thickness

Figure 538. Roentgenograms of the patient shown in Figure 537. The roots have been filled with silver points. No attempt was made to remove these points, lest the important roots would be jeopardized.

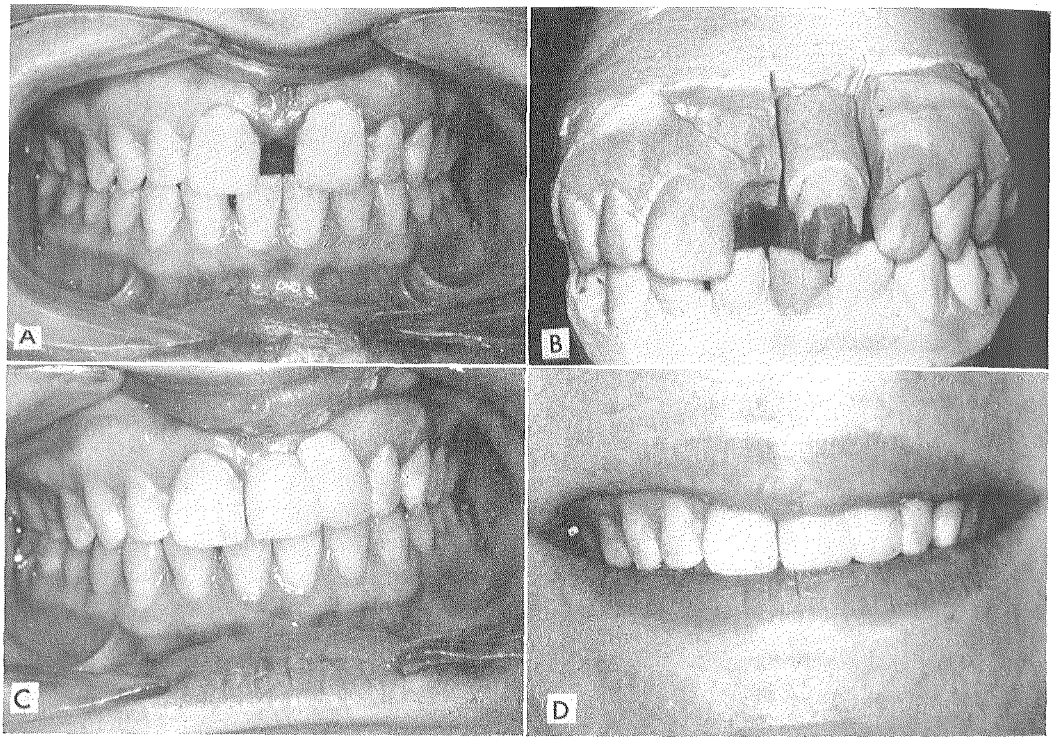


Figure 539. Correction of a very wide diastema in a young lady by fusing two porcelain jacket crowns over one preparation. *A*, Space is too large to close with two porcelain jacket crowns or even four, because they would appear much too wide. *B*, The left central prepared for a porcelain jacket crown. *C*, The fused jackets on the one prepared central incisor. *D*, The patient has a low lip line and the extra tooth is not noticeable. This is an improvement of an unesthetic condition at the expense of only one tooth.

of porcelain minimizes fracture and contributes to better color, the preparation of such spaced teeth differs somewhat from the conventional. *The shoulders will not be uniform because more proximal tooth structure will have to be removed from the distal areas than the mesial areas in order to be able to construct porcelain crowns of near equal thickness*. Frequently, it is a good policy to melt and apply white wax to the proximal surfaces of spaced teeth prior to preparing them so that the patient can visualize how wide the restored teeth will appear.

CORRECTING SPACED TEETH WITH OFF-CENTER CORES AND PORCELAIN CROWNS

A radical method of eliminating objectionably spaced teeth is to remove the vital pulps of some of the teeth creating the space. This procedure enables the operator to construct off-center gold cores and porcelain jacket crowns in alignment that will eliminate the spaces (Fig. 540). Although there are occasions when *only* such a method can bring about a satisfactory result, removal of vital pulps is not recommended as routine procedure to correct objectionably spaced teeth. Actresses and career girls usually are in the category of patients in whom this radical treatment may be applied.

CROWDED MANDIBULAR INCISORS

Mandibular incisors are sometimes overlapped, malturned, or in lingual or labial position. I believe that such crowded teeth should be left alone if the bone and gingiva are in a healthy state. These teeth prevent a successful esthetic result in occlusal rehabilitation. The patient should be given to understand that the life of these small incisors, and of the entire restorative dentistry, is apt to be jeopardized if the crowded teeth are straightened by crowns in a patient in middle age. Human hands cannot always reproduce small, delicate mandibular incisors accurately by full coverage restorations to give satisfactory esthetic results and maintain healthy pulps. Attempting to cover crowded mandibular anterior teeth makes the procedure

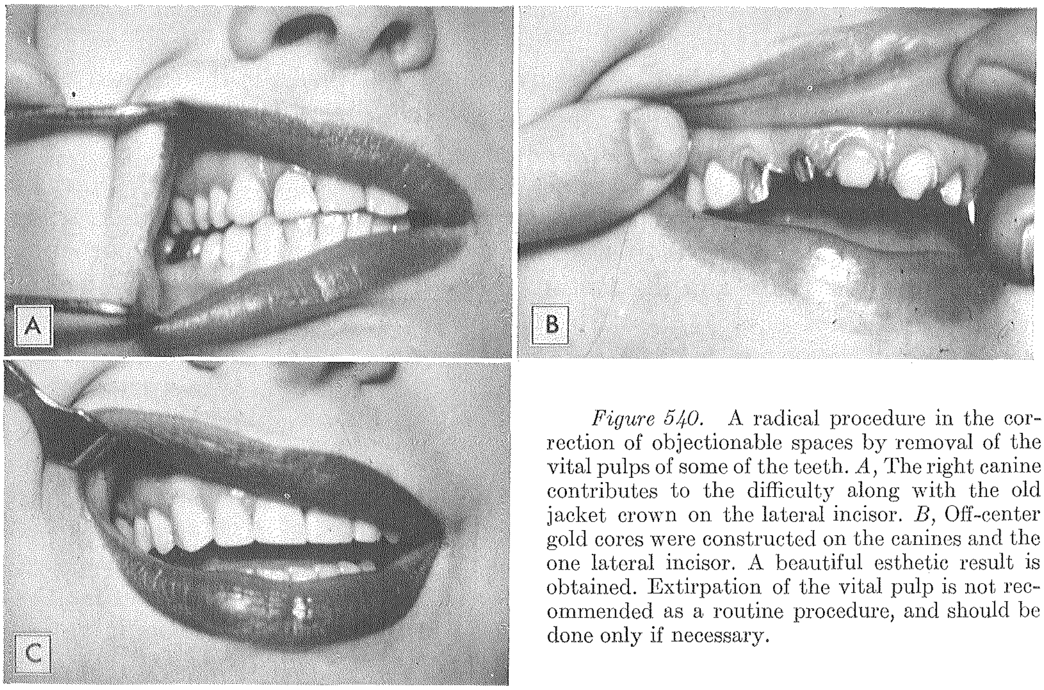


Figure 540. A radical procedure in the correction of objectionable spaces by removal of the vital pulps of some of the teeth. *A*, The right canine contributes to the difficulty along with the old jacket crown on the lateral incisor. *B*, Off-center gold cores were constructed on the canines and the one lateral incisor. A beautiful esthetic result is obtained. Extirpation of the vital pulp is not recommended as a routine procedure, and should be done only if necessary.

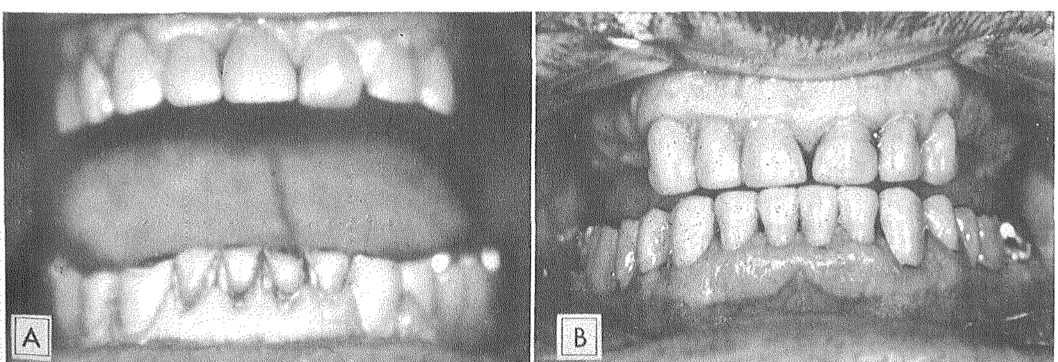


Figure 541. Sometimes mandibular incisors have to be used for multiple abutments to support a precision partial denture. *A*, The short mandibular incisors. *B*, After tissue has been removed from around the necks of the teeth and jacket crowns inserted.

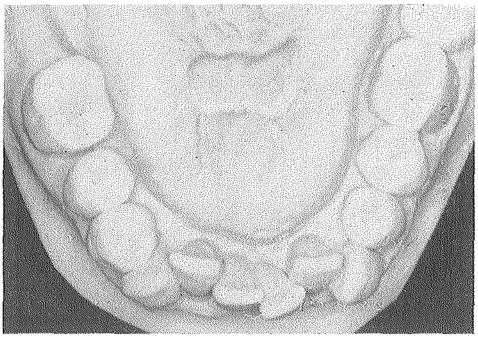


Figure 542. Crowded mandibular incisors are best left alone in patients of middle age.

doubly hazardous. To recommend grinding the proximal surfaces on small, crowded mandibular incisors in a patient of middle age to make room so that they can be brought into alignment by ligatures or orthodontic methods, is theoretically good, but in most cases it is practically unsound. If the cementum is exposed on such crowded teeth, silicate cement restorations will improve the esthetics.

Sometimes wear on the incisal edges of these mandibular teeth exposes the dentin, which may become stained. There usually is no loss in vertical dimension because the decrease in tooth structure has been compensated for by the growth of bone and gingival tissue and the continued eruption of the teeth. It is best, in the majority of such cases, not to disturb these teeth. If, however, there is a reduction in the vertical dimension of occlusion or if the esthetics is of extreme importance, then the operator is compelled to cover them with jacket crowns.

On occasion, worn incisors must be utilized as aids in stabilizing a mandibular removable partial denture by supporting multiple retainers. Figure 541 illustrates such a patient. More tooth structure is exposed from the necks of these small teeth by removing some of the gingival tissue. The vertical dimension is not increased and longer esthetic clinical crowns are the result. The prognosis for such treated teeth depends upon the patient's tolerance to the hard, nonwearable restorations. As a routine procedure, covering firmly embedded worn mandibular incisors in patients of middle age is not recommended.

PORCELAIN JACKET CROWNS ON MANDIBULAR INCISORS: THE BASTIAN METHOD

The preparation of a shoulder on small mandibular incisors necessitates the reduction of much protective tooth structure. Sometimes, the shoulderless preparation is feasible. This type of preparation, however, is not recommended to take the place of the shoulder type or to take the place of good dentistry. Bastian[1] introduced the cast gold shoulder technique over the shoulderless preparation. The small tooth is prepared without a shoulder, but with a definite finishing line. The operator is advised to remove sufficient tooth structure from the mesial and distal areas of these small teeth. The copper band and compound impression is taken and the die constructed with a false shoulder. This false shoulder is apparent when the compound impression is removed from the amalgam die, formed by the border of the copper band. The technique for the construction of the gold shoulder is described in Figure 543.

MALPOSED AND MALALIGNED TEETH

The scientific and correct means of treating malposed teeth and those out of alignment is by orthodontic measures. Such methods, however, do not always succeed without continued orthodontic retainers. The average patient who presents himself to the prosthodontist for correction of overlapped or malaligned teeth is usually at an age when orthodontic treatment is either contraindicated or not acceptable by the patient. Is it good practice to reduce tooth structure on a sound healthy tooth to receive a full coverage restoration just because the patient is concerned with the appearance of the tooth? Landa[2] expressed a logical view in this regard, "The dental profession must realize the important bearing esthetic standards have upon mental health and it should strive toward higher achievement in this field." The appearance of the teeth is important from a psychological point of view. Abnormally positioned teeth should receive consideration for crowns *only* when they disturb and affect the behavior and social life of the individual.

TEETH WITH EXPOSED CEMENTUM OR A LARGE RESTORATION IN THE CERVICAL THIRD

Sometimes, a canine or other anterior tooth possesses an extensive silicate cement or metal restoration in the cervical area. A tooth may display the cementum because of periodontal surgery or the aging process of the teeth and periodontium and otherwise be healthy without restorations of any sort. The patient should be forewarned that the completed restoration will be long tissue-ward. When an old restoration has to be removed from the cervical area, the operator should place cement in the prepared cavity and contour it to the form of the tooth. Prepare this

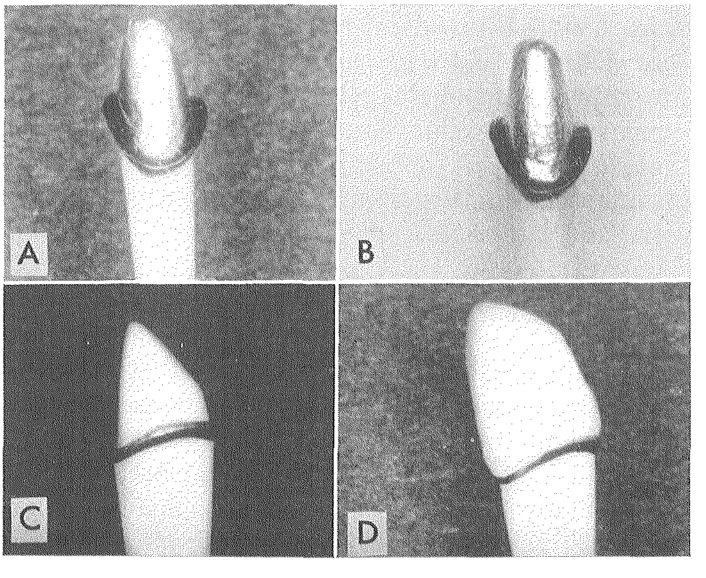


Figure 543. The Bastian porcelain jacket crown for a shoulderless preparation. *A*, Platinum foil matrix is formed around the shoulder of the die, about 2 mm. above and 2 mm. below the shoulder or finishing line. *B*, A wax shoulder is carved and cast in inlay gold. *C*, This gold shoulder is finished on the die and then tried on the prepared tooth for corrections. It is placed back on the die and a full platinum matrix is fabricated over the entire die and gold shoulder. *D*, The porcelain jacket crown is constructed and fused over the matrix. After glazing, the matrix is removed and the porcelain crown and cast gold shoulder are cemented on the tooth with the same mix of cement.

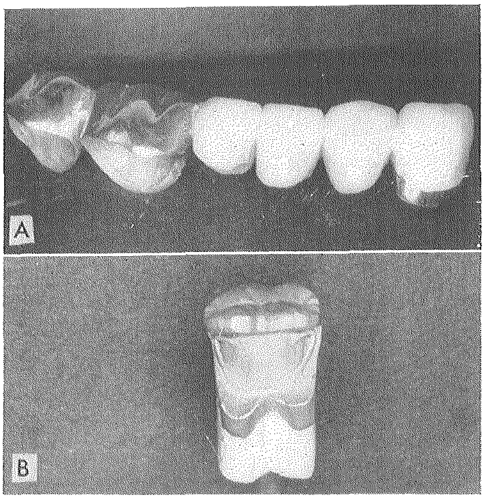


Figure 544. *A*, The gold collar is visible in a restoration over a shoulderless preparation where the cementum is exposed. *B*, On a molar, where the bifurcation is exposed, the gold collar follows the contour of the roots. A definite finishing line in the preparation is imperative.

tooth for a full coverage restoration, creating just a butt finishing line in the root region but a shoulder around the rest of the tooth if the restoration is to be a porcelain jacket crown. It is usually not possible to cut a shoulder in the cement or the cementum without damaging the pulp sooner or later. To give the impression of a shorter porcelain jacket crown, constrict the neck of the porcelain and carve it in the biscuit bake to give the appearance that the cementum is exposed. The patient, however, should be consulted as to whether he prefers it that way. All this should be agreed upon before the tooth is prepared and the patient must be made aware of the limitations.

If the tooth with exposed cementum is to receive a veneer or a porcelain fused to metal crown, then a gold collar should be visible to prevent overcontouring the restoration and to maintain a healthy gingiva (Fig. 544*A*). The gold collar is advisable because the tissue will not tolerate overcontour and manifests this intolerance by becoming red and inflamed a short time after insertion. Overcontouring of veneer and porcelain fused to metal crowns is a common practice because of the unreasonable demands of the patient for no display of metal. Compromising the correct design of the restoration because of such demands is not good dentistry. An apron-like fit of the gold casting is the only logical goal if the thinness of the cementum or dentin makes it impractical to create a shoulder. If the operator feels that esthetics is of such importance, then the patient must share the responsibility of gingival irritation because of overcontouring as well as exposure of the gold collar at a later date.

FIRST MOLAR WITH THE BIFURCATION EXPOSED

An upper first molar presents an esthetic problem in many mouths. Here, too, the patient should be advised of the importance of a gold collar in the veneer or the porcelain fused to metal restoration. It is impossible to prepare a shoulder of sufficient width on the maxillary first molar because of the anatomy of such a tooth to construct a veneer or porcelain fused to metal crown that will not be overcontoured. Inasmuch as the bifurcation is significant of a previous periodontal condition, a drifted tooth, or the aging process, overcontouring should be avoided. The partially exposed bifurcation forms a V-shaped depression and it is best not to eradicate this undercut lest the pulp be permanently damaged. The depression can be extended all the way toward the occlusal area with a tapering cylinder diamond stone so as to appear as a continuous buccal shallow groove. The casting should possess a metal collar resembling a "short pair of pants" (Fig. 544*B*).

THE PROTRUDING TOOTH

Correction of this type of tooth by ceramic means is a difficult undertaking, requiring careful examination, planning, and explanation of the problem to the patient. A protruding tooth can be brought back lingually, within limits, by a porcelain jacket crown. The operator must be careful in the reduction of the labial tooth structure in order to avoid a shortened preparation. The labial surface is reduced more than elsewhere and as much as the pulp will permit. It is advisable to use a handpiece with moderate speed. A large tapering diamond cylinder stone is held in such a position that more tooth structure is removed from the labioincisal area than elsewhere (Fig. 545). Hardly any tooth structure is removed from the linguoincisal region. *Do not reduce the incisal edge at all until the preparation is practically completed and you find it necessary to do so.* This precaution will minimize a short preparation. Because of the protrusion, the tooth will have a short lingual height and incisal reduction may not be necessary. If the tooth protrudes to the degree that pulp involvement may take place, then pulp extirpation may be resorted to but only in selected cases in which esthetics is of extreme importance.

TOOTH IN LINGUAL POSITION

A tooth in lingual position is brought about by overcrowding or the partial closing of the space from premature loss or too long retention of a deciduous tooth. Realignment of such a tooth by means of a porcelain jacket crown frequently necessitates reduction and reshaping of the opposite tooth (teeth) to make room for clearance of the newly covered opposing tooth in its various paths of function. A thorough study of the pulp will be a deciding factor in determining the steps to follow in the preparation. *Always tell the patient that the opposing teeth will have to be reduced somewhat, to avoid misunderstanding.* The first step in accommodating the jacket is the reduction of the labioincisal or bucco-occlusal area of the opposing tooth (teeth)

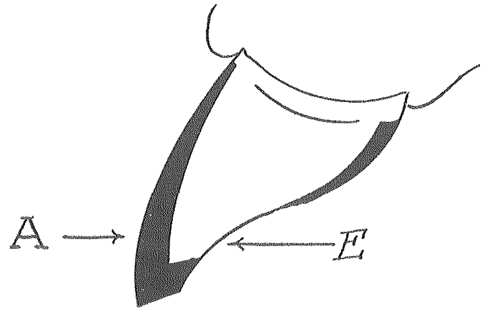


Figure 545. Preparation of a protruding tooth. More tooth structure is removed from the labioincisal region than elsewhere, as much as the pulp will permit (*A*). Hardly any tooth structure is removed from the linguoincisal region (*E*).

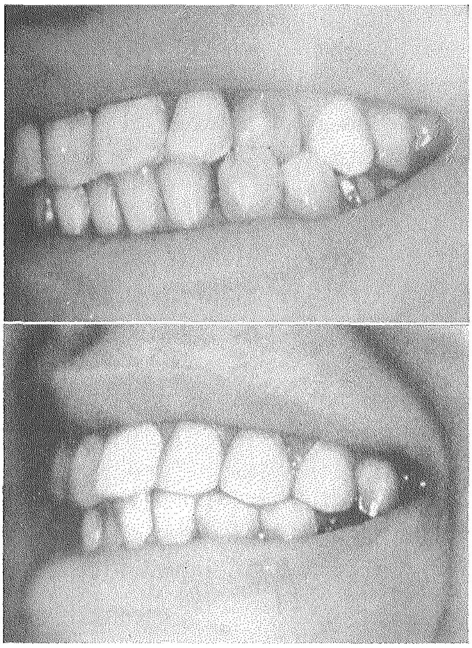


Figure 546. Correction of a tooth or teeth in lingual position by means of porcelain jacket crowns or porcelain fused to gold restorations (see text).

with a stone of your choice. Repolish this ground surface and treat any sensitivity with an accepted preparation that will reduce the painful sensations of a ground surface. Inasmuch as the completed preparation must approach parallelism to the normal approximating teeth, more tooth structure will have to be removed linguo-incisally or linguo-occlusally than elsewhere. Grind the labiogingival or buccogingival area until the entire labial or buccal surface is in a line, parallel with the normal neighboring teeth, without endangering the pulp. Hold the cylinder diamond stone in such a manner that no tooth structure in the incisal or occlusal third is touched. This contributes to the preparation a condition in which enamel remains in this area. How much to be removed will be dependent on how far in lingual relation the tooth is. Create the shoulder in the same manner as for a normal tooth. An esthetic result with porcelain jackets can be accomplished (Fig. 546).

LINGUALLY LOCKED, PARTIALLY ERUPTED CANINE

If the tooth is short and in marked lingual position, even pulp extirpation and the construction of an off-center gold core is impractical. Porcelain fused to a metal casting may prove more successful. Figure 547 illustrates the management of such a tooth. For retention of the metal casting, a lingual pit and proximal grooves were created in the preparation. No tooth structure was removed from the labial surface of this lingually-locked canine which failed to right itself after orthodontic treatment. Porcelain was fused to the casting with the porcelain butted up against the labial gingiva. The incisal edge was a broad bicuspid-like surface in metal to accommodate the opposing mandibular canine.

THE TOOTH WITH A LARGE RESTORATION IN THE CERVICAL AREA OF A MANDIBULAR PREMOLAR

A large cavity or old restoration in the cervical third of a bell-shaped mandibular first premolar that is to receive a full coverage restoration may contribute to pulp exposure during the preparation (Fig. 548). The operator is cautioned about

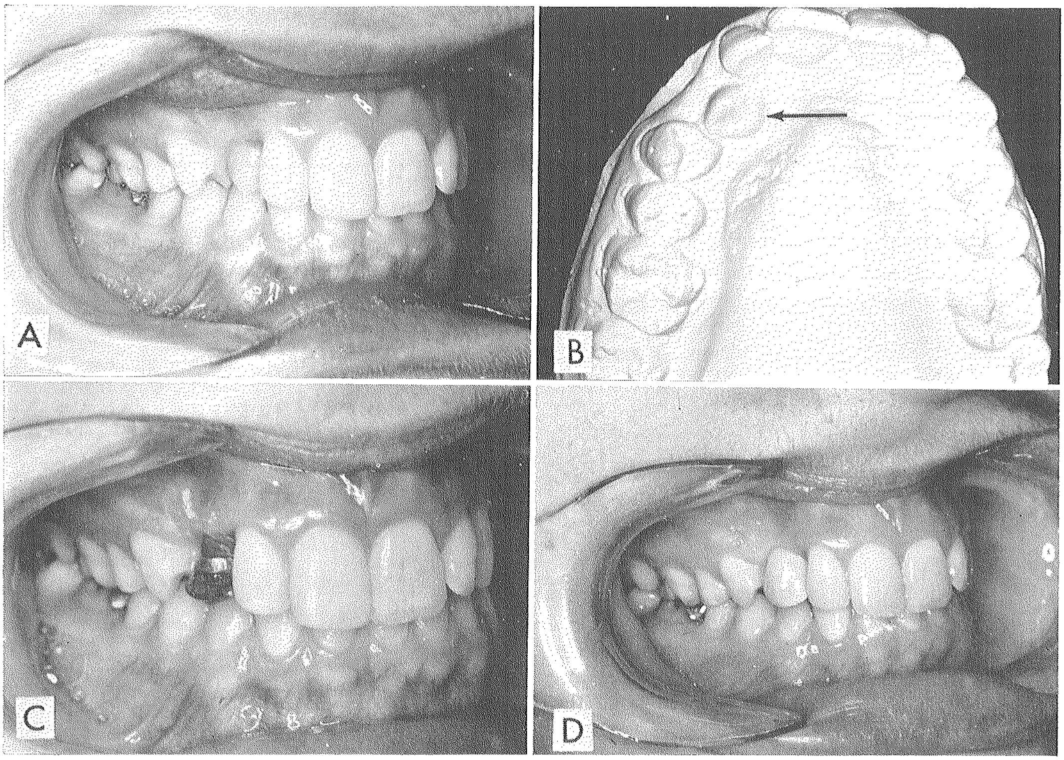


Figure 547. Porcelain fused to gold crown to improve the esthetics in a lingually positioned canine. *A*, Before treatment. *B*, Study cast; note the shortness and marked lingual position of the right canine that did not respond to orthodontic treatment. *C*, Gold casting over a preparation with proximal grooves. *D*, Completed porcelain fused to gold veneer crown.

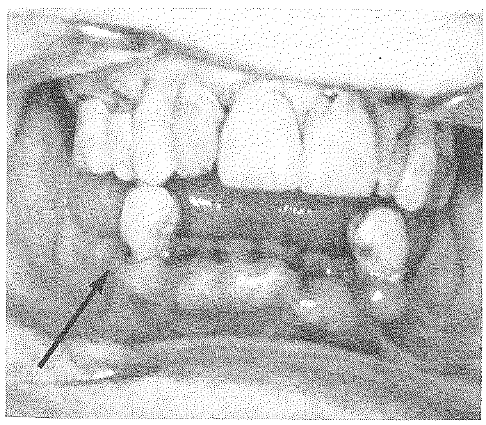


Figure 548. A large cavity or an old restoration in the cervical region may contribute to pulp exposure during the preparation.

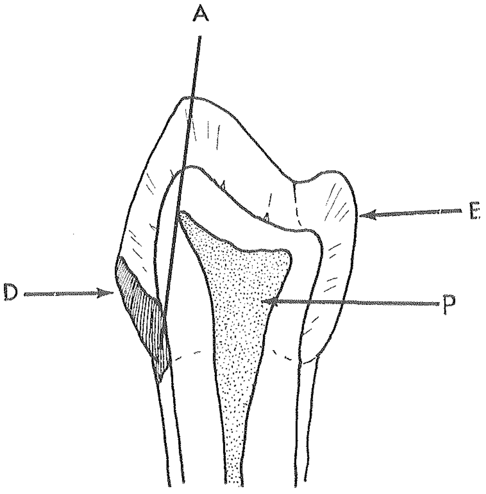


Figure 549. The operator is cautioned about reducing the buccal surface in a line with the decayed area (*D*). In a mandibular first bicuspid, for example, the pulp horn (*P*) extends close to the bulbous portion of the tooth. Holding the stone so that it reduces the tooth structure in a line with the old restoration or decay (*A*) often exposes the pulp. *E* denotes enamel.

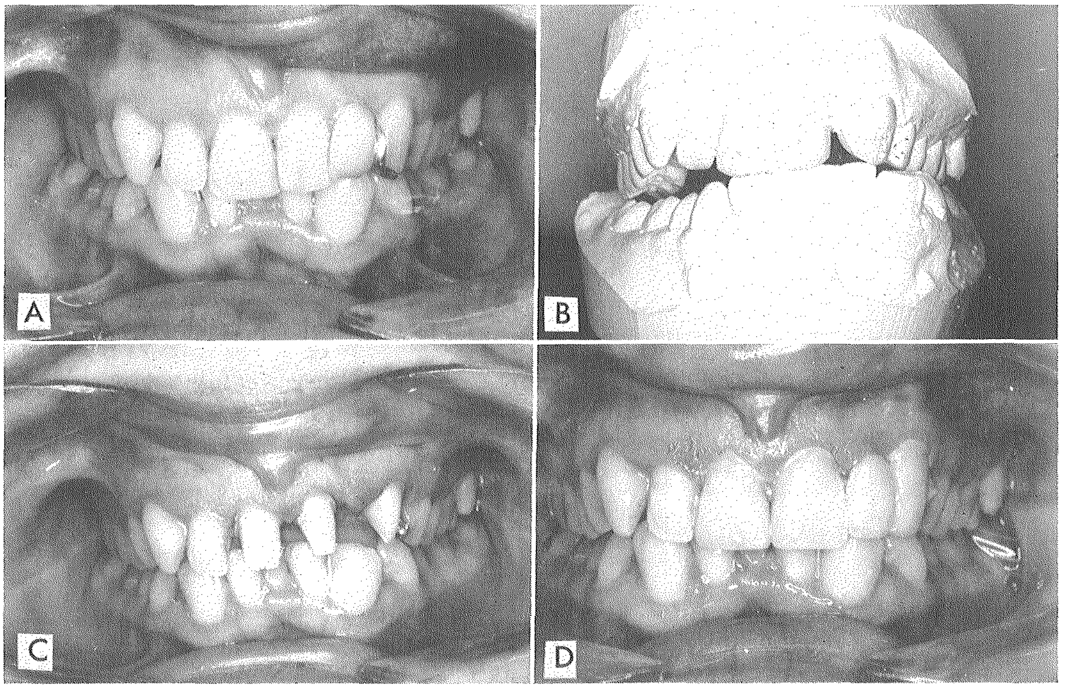


Figure 550. Improving esthetics with porcelain jacket crowns. *A*, Overlapping cantilever lateral from the three-quarter crown; narrow left central incisor. *B*, Casts after the cantilever was removed; note the narrow space for the lateral incisor pontic. *C*, The three prepared teeth. *D*, Two porcelain jacket crowns on the central incisors and a cantilever all porcelain bridge from the canine.

reducing the remaining buccal surface. In the mandibular first premolar, the pulp horn frequently extends close to the bulbous portion of the tooth (Fig. 549). Holding the stone so that it reduces this tooth structure in a line with the old restoration often exposes the pulp. It is a good procedure to excavate the decay or remove the old restoration first and fill the cavity with cement or amalgam. The tooth is then prepared without a shoulder in the buccal region.

INSUFFICIENT ROOM FOR THE CORRECTION OF AN UNESTHETIC CONDITION

Sometimes a space or a malposed tooth prevents the construction of a restoration that will improve upon the appearance. It is frequently necessary to prepare and cover more teeth in order to improve upon the esthetics. Figure 550 illustrates such a condition. The previous dentist was compelled to utilize only the left central and canine to support a missing lateral incisor and as a result the esthetics is not satisfactory. By including the maxillary right central with the left central and canine an improved appearance was created. The median line is slightly to the right.

CONGENITALLY MISSING LATERAL INCISORS

Some spaces are the result of congenitally missing lateral incisors. The diagnosis and treatment plan regarding the abutment retainer selection for the replacement of such incisors in teen-age and young adult patients has always been a serious problem. When the replacements are necessary in middle-aged patients, the problem is even greater. We are frequently advised to move the canines orthodontically to approximate the central incisors and then to reshape these bulky cuspids to look like delicate lateral incisors. This procedure seldom proves satisfactory from an esthetic point of view. Figure 551 illustrates the study cast of a young man with congenitally missing lateral incisors. The spaces are such that nothing in the nature of prosthodontics can improve upon the esthetics and it is better to leave such a mouth alone. When the operator undertakes the replacement of congenitally missing anterior teeth he should not make any promises that the completed result will be perfect in all respects. Quite often, the young patient's mother sets up in her mind the kind of ideal anterior teeth she would like her daughter to have, regardless of the shortcomings of porcelain and acrylic resin and of the limitations in and around the mouth. In such a situation, misunderstandings are prone to arise during the treatment. Unless the parent and the patient are convinced that the appearance can only be improved but not made perfect, the operator should not treat the patient.

Persons whose lateral incisors are congenitally missing often present pointed canines without cingula. Also, there are many patients who expose a lot of gingiva when they smile. Still others possess short wide anterior teeth with a strong, promi-

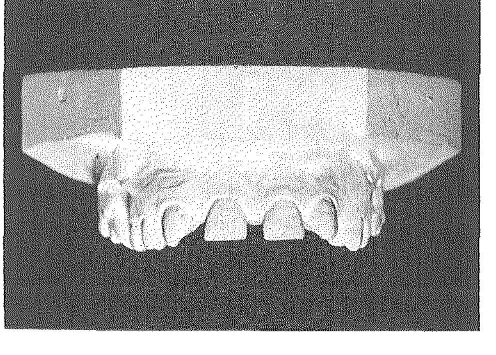


Figure 551. Congenitally missing lateral incisors cannot be replaced, nor can the spacing be corrected by prosthodontic means.

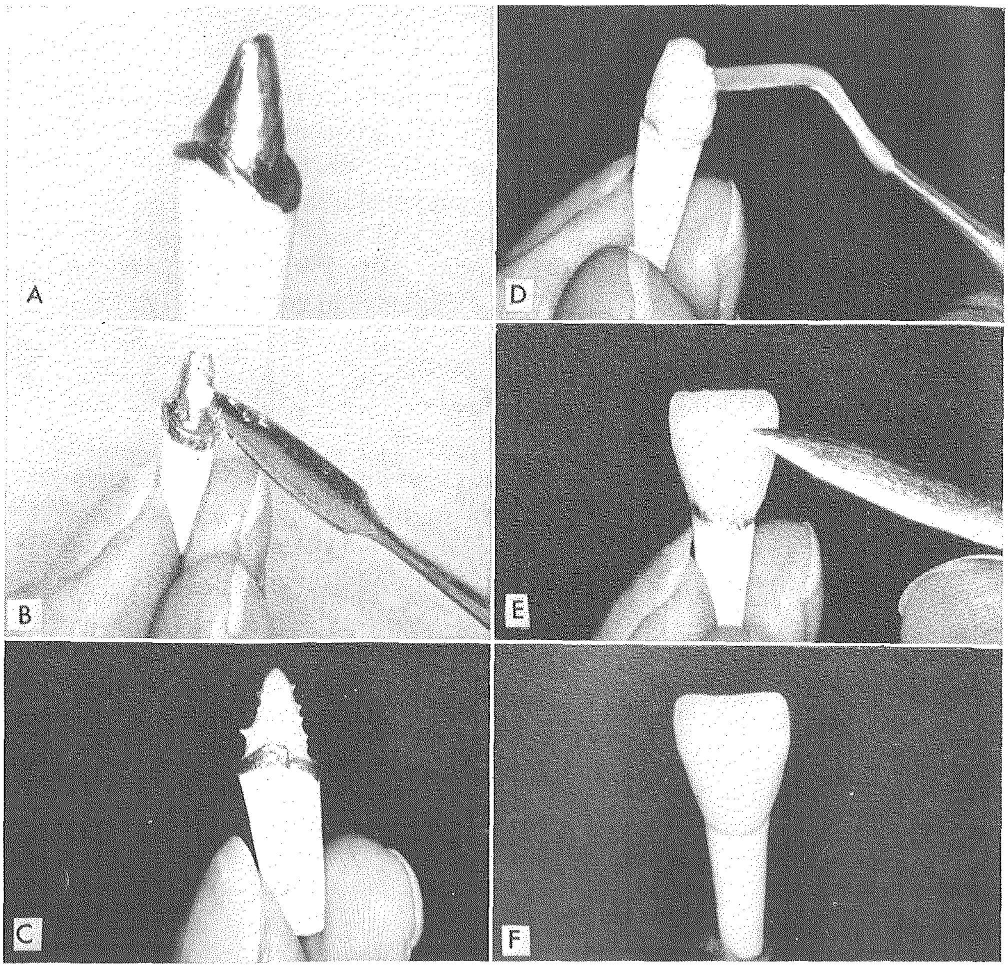


Figure 552. Acrylic resin cured to fused porcelain coping. Steps in construction. *A*, The platinum matrix 0.001 gauge is cut and folded, burnished, and swaged into a matrix. *B*, Opaque porcelain is mixed and applied to the matrix. *C*, The porcelain coping is fused in the furnace. Notice the rough surface. *D*, Tooth color wax is melted and applied to the porcelain coping. *E*, The waxed crown is shaped and carved to full contour and tried on the tooth in the mouth. The waxed crown is invested, wax is boiled out, and acrylic resin is cured to the rough porcelain coping. The platinum matrix is peeled off before cementation.

nent frenum between the central incisors. These conditions make esthetic improvement extremely difficult. Acrylic cured over fused porcelain copings as abutment retainers for cantilever bridges are satisfactory restorations for the replacement of such teeth in selected cases. Sometimes, just individual crowns of these materials will close the spaces. The color is more stable than acrylic alone and fracture rarely takes place.

ACRYLIC RESIN CURED TO FUSED PORCELAIN

An all acrylic resin crown or bridge possesses resiliency. When such a restoration is under torque, it rotates on the preparation and breaks the cementing medium to become dislodged. When the acrylic resin is cured to a fused porcelain coping it not only resists discoloration but the cementing medium is rigidly attached to the porcelain and tooth structure. The dentin-like color of the underlying opaque porcelain contributes to improved color, and because there is no gold underneath, no black sulfides penetrate the restoration. The acrylic, however, has a tendency to become whiter. This type of restoration is indicated when esthetics is important and the occlusion is too close to permit fused porcelain restorations.

TECHNIQUE OF CONSTRUCTING AN ACRYLIC CURED TO FUSED PORCELAIN RESTORATION FOR CONGENITALLY MISSING LATERALS

A piece of 0.001 gauge platinum foil is constructed over the die to form a matrix, in the same manner as for the construction of a porcelain jacket crown. Some light-colored opaque porcelain is applied over the matrix, *except on the shoulder*, and fused. Wax up the required type of restoration. It is a good policy to try the waxed crown or bridge on the tooth or teeth for adjustments, form, and alignment. Invest, pack, and cure in acrylic resin. The platinum matrix is removed prior to cementation (Fig. 552).

In Figure 554 the canines are pointed and offer no retention for an esthetic retainer. The central incisors have been filled previously with silicate cement restorations. The spaces for the lateral incisors are extremely narrow and contribute to the difficulties in constructing an esthetic and durable replacement. The treatment for this patient, a young girl of eighteen years, is as follows:

More tooth structure is exposed by cutting away some of the gingival tissue from the necks of the central incisors and canines. This is recommended in order to

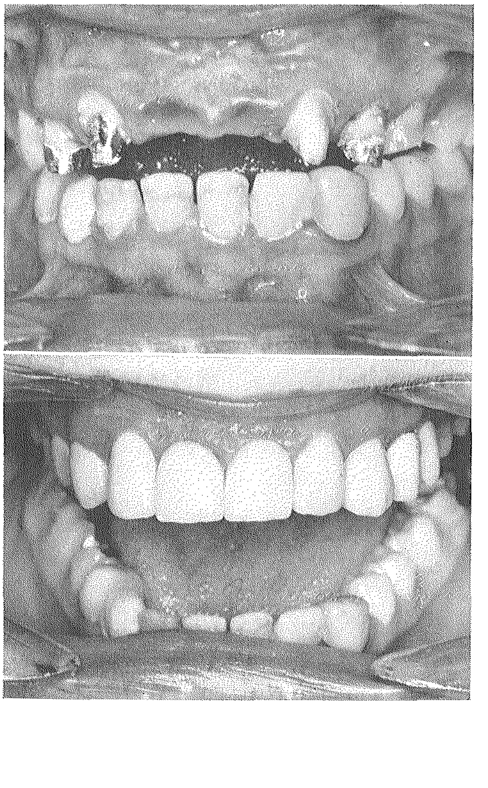


Figure 553. A six unit acrylic cured to porcelain fixed bridge on a teen-age girl.

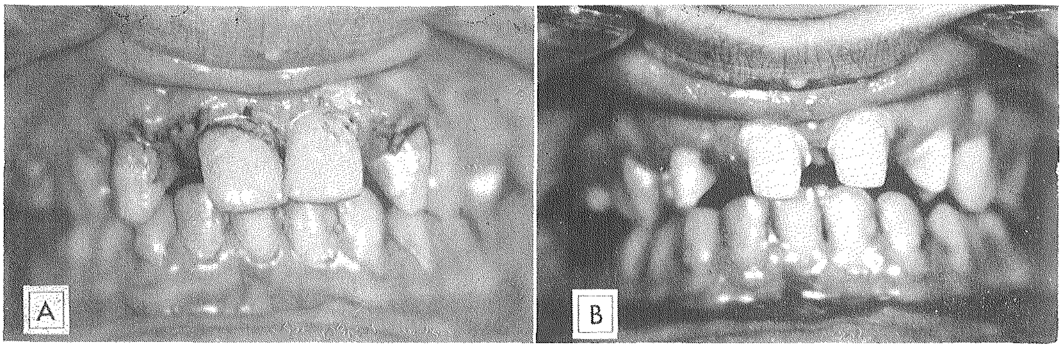


Figure 554. *A*, Congenitally missing lateral incisors in a young adult. *B*, The teeth are prepared as for jacket crowns.

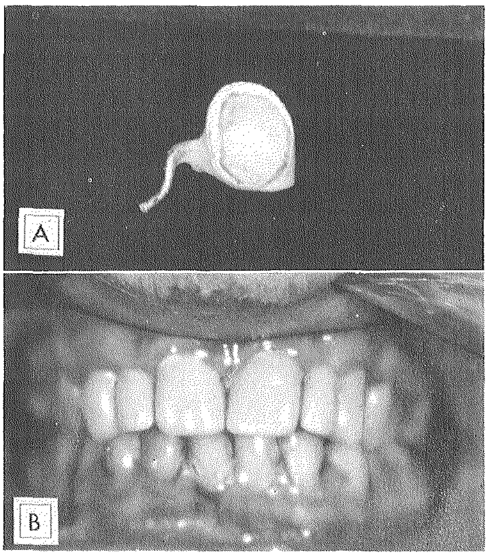


Figure 555. *A*, Porcelain copings are baked for each canine and carry a piece of iridioplatinum wire (17 gauge). White wax is melted and shaped over two cantilever bridges and the two porcelain copings on the central incisors. These are tried on the teeth for corrections. *B*, Acrylic resin is cured to the fused porcelain copings.

raise the lip line with the completed restorations, and is conveniently accomplished with the wire electrode, described in Chapter Eight. After healing, the four anterior teeth are prepared for full coverage restorations. Porcelain copings are baked over platinum matrices and carry an iridioplatinum wire for cantilever support (Fig. 555). White wax is melted over these porcelain copings, shaped and carved, then tried in the mouth. After correcting the occlusion, contact areas, etc., acrylic resin is cured over the porcelain copings and cantilever extensions. For this patient, the canines carry lateral incisors and the central incisors receive individual crowns of the same material. The incisors are made narrower and smaller than the original teeth (Fig. 556).

When the canines are healthy and strong and do not possess any previous restorations, both patient and prosthodontist are apprehensive of cutting such healthy prominent and important teeth, particularly in a young person. Conservation of the canines in young adults should receive consideration when planning the replacement of the congenitally missing lateral incisors. The restorative work we do does not last indefinitely. If the prosthodontist can construct cantilever bridges from the central incisors to last for a few years he can preserve the canines for a much later time when the restorations need replacement. Figure 557 illustrates the management of such a condition. There is not sufficient room for lateral incisor pontics. The two central incisors are prepared to receive full coverage restorations of acrylic resin cured to fused porcelain copings, each supporting a cantilever pontic. The lateral incisor slightly overlaps each canine and an improvement in esthetics is created (Fig. 558).

REPLACING MULTIPLE CONGENITALLY MISSING TEETH

In most instances, the cantilever all porcelain bridge is indicated for the replacement of the lateral incisor. Although this form of replacement is often considered a fragile restoration, there are occasions when the operator is compelled to sacrifice longevity of the replacement for esthetics, particularly in young adults. In this type of bridge, the abutment retainer is a porcelain jacket crown fused to a porcelain pontic. There is no metal frame, merely a piece of 17 gauge iridioplatinum wire joined to the swaged platinum matrix of the retainer. An excellent esthetic result can be obtained because no metal struts are used to influence the color of baked porcelain. No other restoration approaches the natural esthetic qualities of such all porcelain bridges.

On occasion, multiple bridges of this sort may be used if the esthetics is of great importance and the occlusion permits. Figure 560 illustrates a young lady of twenty years. The permanent lateral incisors and both canines are congenitally missing, presenting a difficult esthetic problem of replacement. A fixed bridge with a metal framework will always look like a bridge. Esthetics is very important to a young woman, particularly to her mental health and to her social life. Any res-

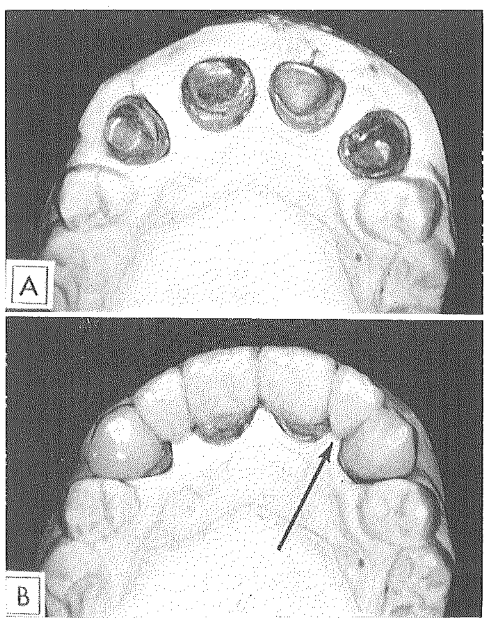


Figure 556. *A*, The dies of the patient shown in Figure 555. *B*, Lingual view of the completed case. Notice the narrow space for the lateral incisors.

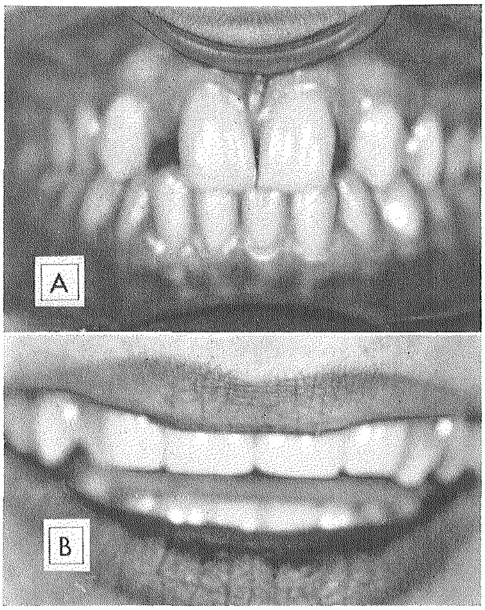


Figure 557. *A*, Another patient with congenitally missing lateral incisors. She is only 17 years of age, and because of her youth, the canines are left intact. *B*, The two central incisors are prepared to receive acrylic resin cured to fused porcelain copings, to carry cantilever lateral incisors. The esthetics is improved despite the use of only two abutment teeth.

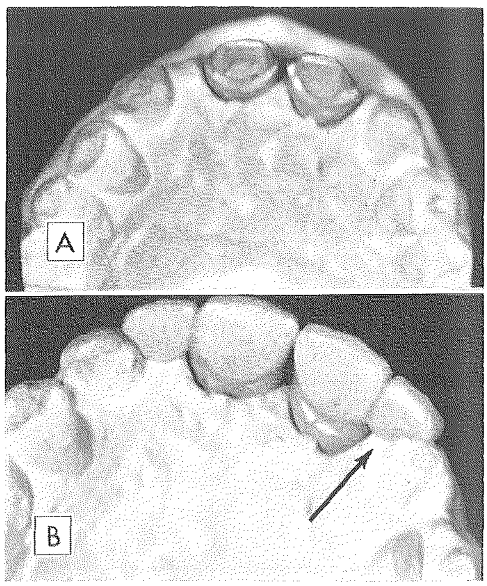


Figure 558. The same patient as shown in Figure 557. *A*, The central incisor dies. *B*, The cantilever lateral incisors slightly overlap the canines.

toration which would tend to be obvious by virtue of a display of gold, directly or indirectly under lights, would make this young woman self-conscious. Four all porcelain cantilever bridges are constructed with instructions to the patient to be careful in her eating habits.

The remaining loose deciduous lateral incisor and canines are removed. The two central incisors and first premolar on each side are prepared for porcelain jacket crowns with complete shoulders. Be sure there is sufficient incisal and occlusal clearance to accommodate thickness of porcelain. Take individual band impressions and a plaster impression of the upper jaw with transfer copings in place. A counter-impression of the mandibular teeth is taken in alginate, and a wax centric occlusion

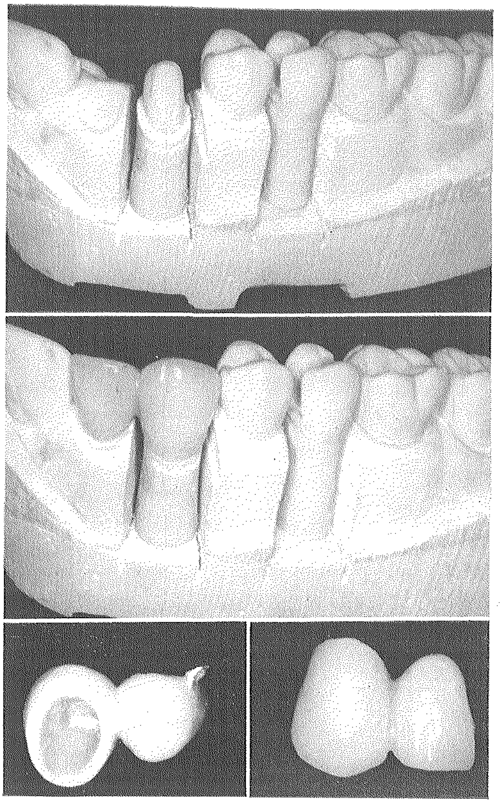


Figure 559. The all porcelain standard cantilever bridge.

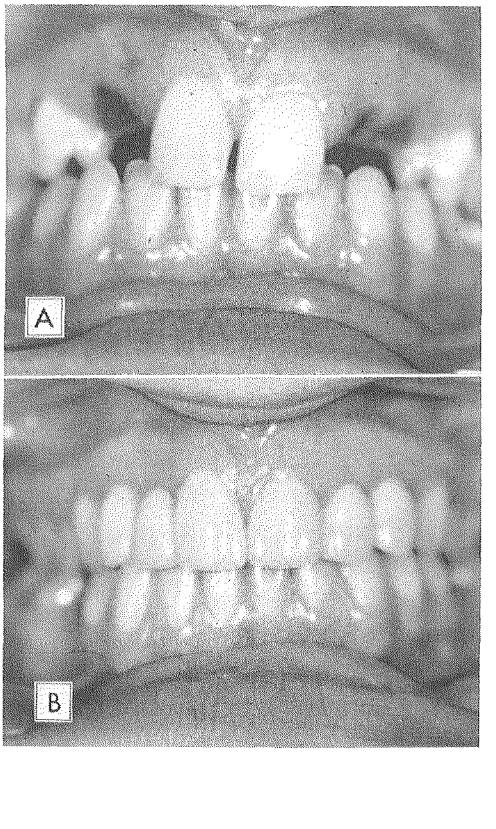


Figure 560. The cantilever all porcelain bridge. *A*, The canines and lateral incisors on both sides are congenitally missing. *B*, A beautiful esthetic result is obtained by constructing four cantilever all porcelain bridges. Instruct the patient to be careful in her eating habits.

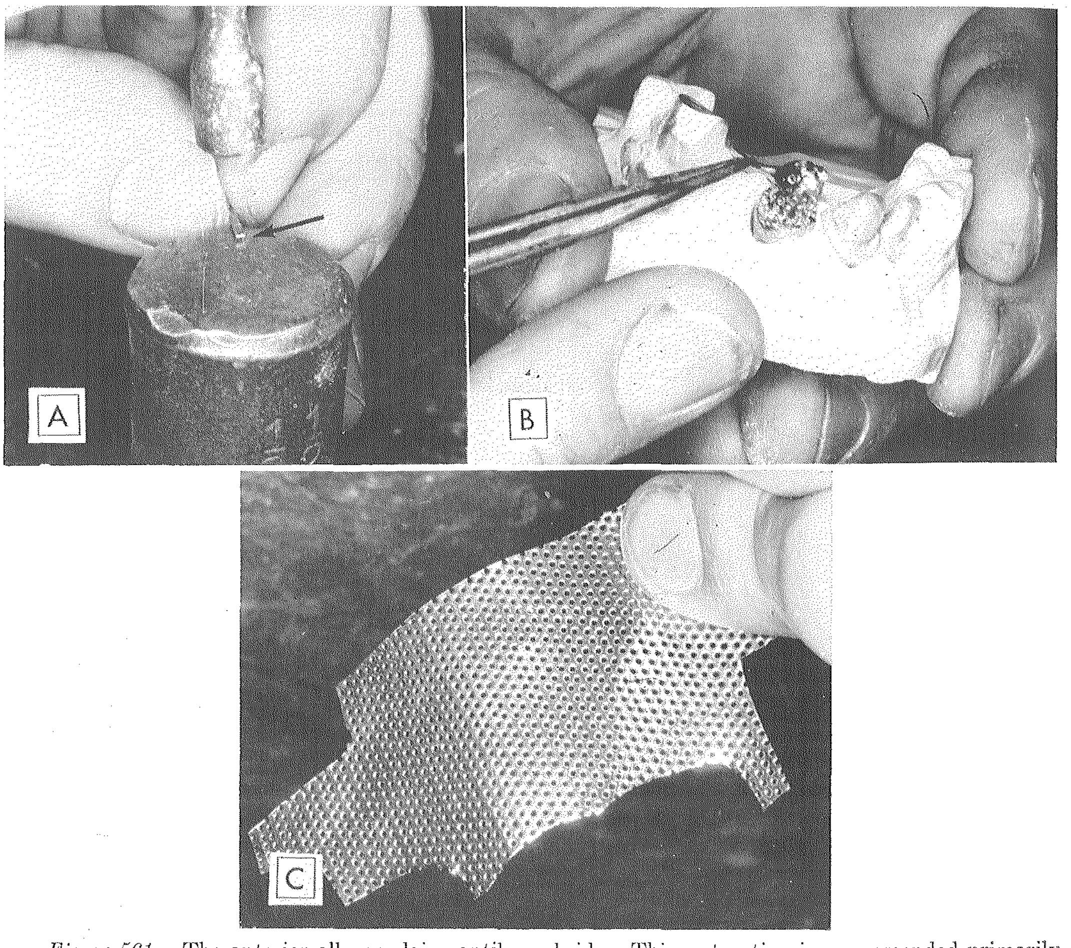


Figure 561. The anterior all porcelain cantilever bridge. This restoration is recommended primarily for the replacement of the lateral incisor. *A*, A 17 gauge iridioplatinum wire is hammered thin on one end. *B*, This wire is then waxed to a swaged, mesh platinum matrix and soldered. Porcelain is fused to the abutment platinum matrix and joined wire. *C*, A piece of mesh platinum matrix.

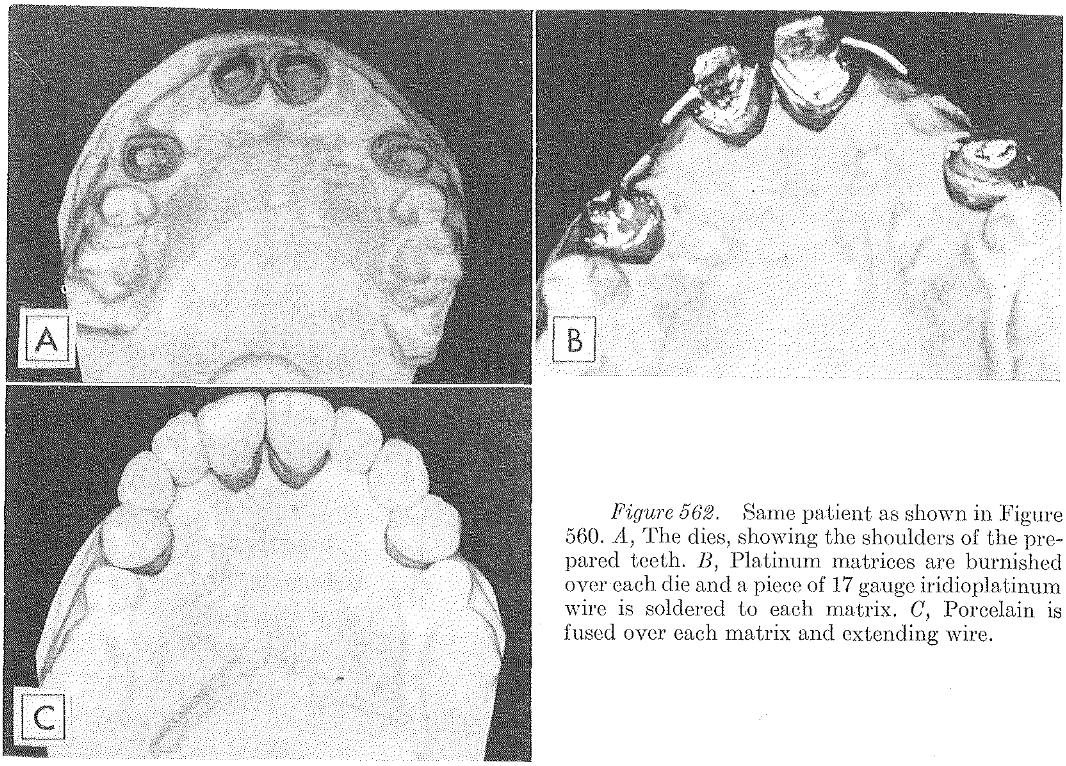


Figure 562. Same patient as shown in Figure 560. *A*, The dies, showing the shoulders of the prepared teeth. *B*, Platinum matrices are burnished over each die and a piece of 17 gauge iridioplatinum wire is soldered to each matrix. *C*, Porcelain is fused over each matrix and extending wire.

registration will assist in articulating the poured casts. Platinum matrices are burnished and swaged over each die and a piece of 17 gauge iridioplatinum wire is soldered to each matrix (Fig. 562). Porcelain is baked over each matrix and extending wire. Try the biscuit bake bridges on the teeth and test for contact areas, alignment, occlusion, and form. Glaze the porcelain and then cement the bridges separately.

DIFFERENT GINGIVAL LEVELS

The gingival line around the necks of the teeth is not always at the same level. Sometimes this phenomenon is normal and the patient is not aware of it until restorations on the teeth are constructed. The jacket crown appears longer tissueward. Another such situation occurs when the tooth is long because of gingival recession (Fig. 563). These abnormal manifestations should be called to the patient's attention before the tooth or teeth are prepared to receive esthetic restorations.

Figure 564 represents a patient who requires esthetic improvement because of her profession. The left maxillary lateral incisor is congenitally missing and a bulky canine has migrated to contact the central incisor. The anterior teeth are filled with restorations that have discolored. The level of the gingiva is not the same. Porcelain jacket crowns alone would bring out the irregular level of tissue by appearing like long teeth when the patient smiled. Somehow, the irregular level of tissue is not noticeable by the patient until restorations are inserted on the teeth. Electronic

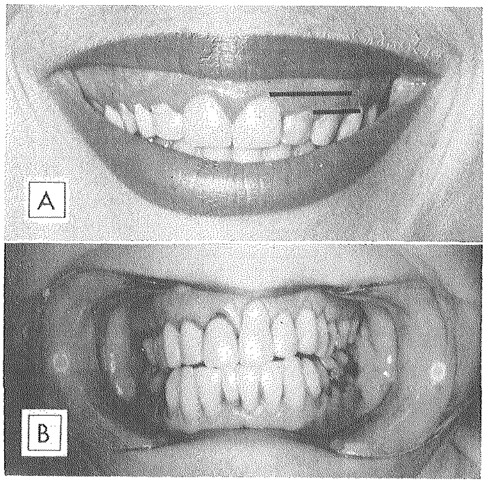


Figure 563. Different levels of the gingiva. *A*, The gingival line around the necks of the teeth is not always at the same level. This phenomenon is normal but the patient is not aware of it until restorations are placed on the anterior teeth. The jacket crowns appear longer tissue-ward. *B*, A tooth that is long because of gingival recession.

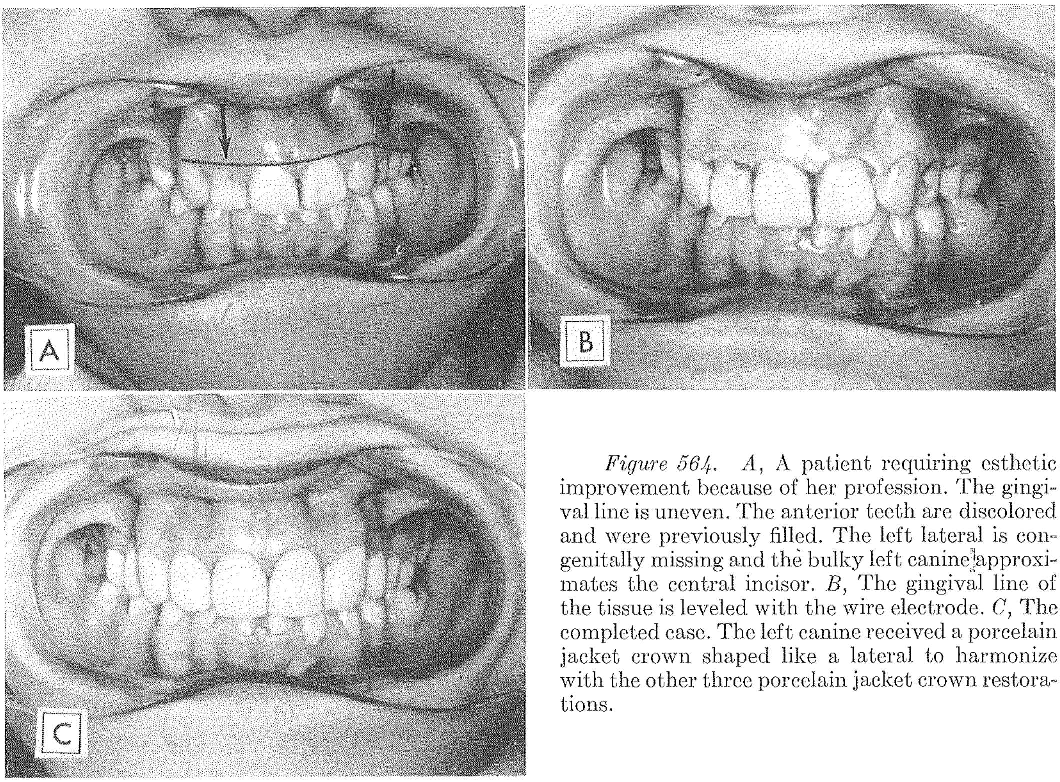


Figure 564. *A*, A patient requiring esthetic improvement because of her profession. The gingival line is uneven. The anterior teeth are discolored and were previously filled. The left lateral is congenitally missing and the bulky left canine approximates the central incisor. *B*, The gingival line of the tissue is leveled with the wire electrode. *C*, The completed case. The left canine received a porcelain jacket crown shaped like a lateral to harmonize with the other three porcelain jacket crown restorations.

surgery levels the gingival line and four porcelain jacket crowns complete the esthetic result. The left canine is shaped like a lateral incisor after provisions are made in the preparation of this tooth to make it possible for the ceramist to make the change.

MISCELLANEOUS PROCEDURES TO IMPROVE ESTHETICS ON RESTORATIONS

There are certain procedures the operator can resort to, should he desire to alter the anterior restorations in order to break away from the symmetry and artificial appearance. The operator can make his restorations approach natural teeth by the following changes: changes in the anatomic form; positioning the restoration; color variance; and stain.

Changing the anatomic form of a tooth from a canine to a lateral incisor is a common procedure. Figure 565 represents a young lady who has a serious problem of esthetics. The left canine is in position where the lateral incisor should be. The right canine inclines lingually and the mandibular left central incisor is missing. Porcelain jacket crowns correct the anatomic form of the canines and a cantilever all porcelain

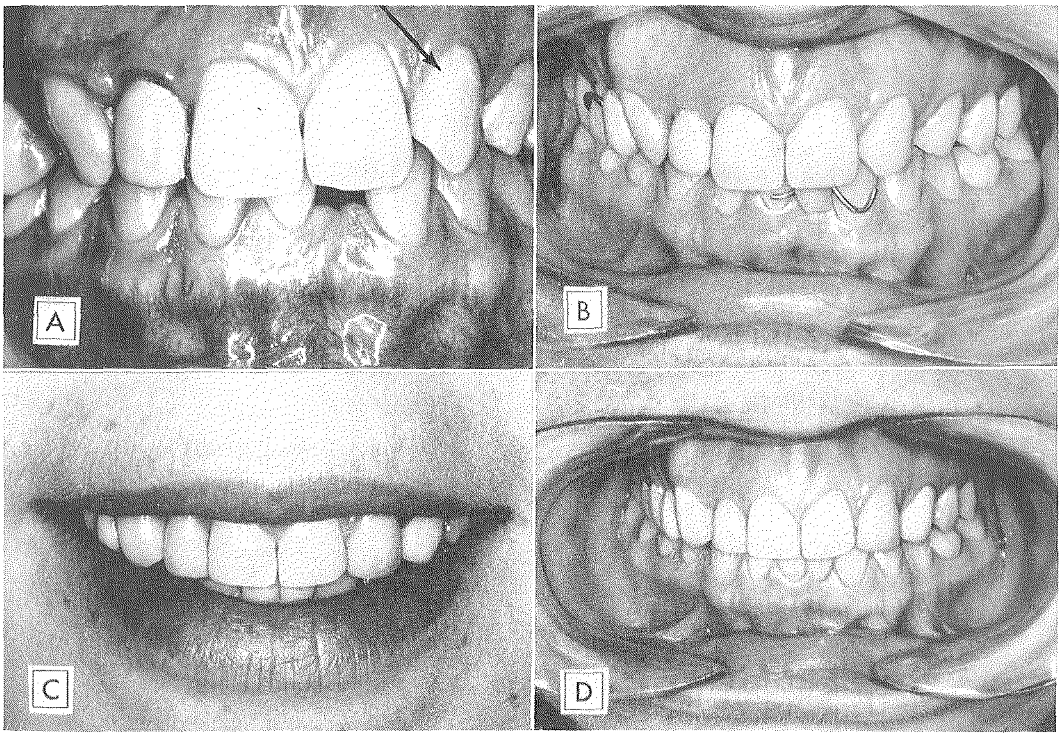


Figure 565. Changing the anatomic form to improve the esthetics. *A*, Patient with the left lateral incisor congenitally missing, and the bulky canine approximating the central incisor. The right maxillary canine inclines lingually, accentuating the bulk. The right maxillary first bicuspid is congenitally missing, as is the mandibular left central incisor. *B*, Small removable restorations with objectionable wire clasps that the patient did not approve of. *C*, *D*, The right canine in proper alignment by receiving a porcelain jacket crown. The left canine received a porcelain crown shaped like a lateral incisor. A cantilever all porcelain bridge replaced the missing mandibular lateral incisor.

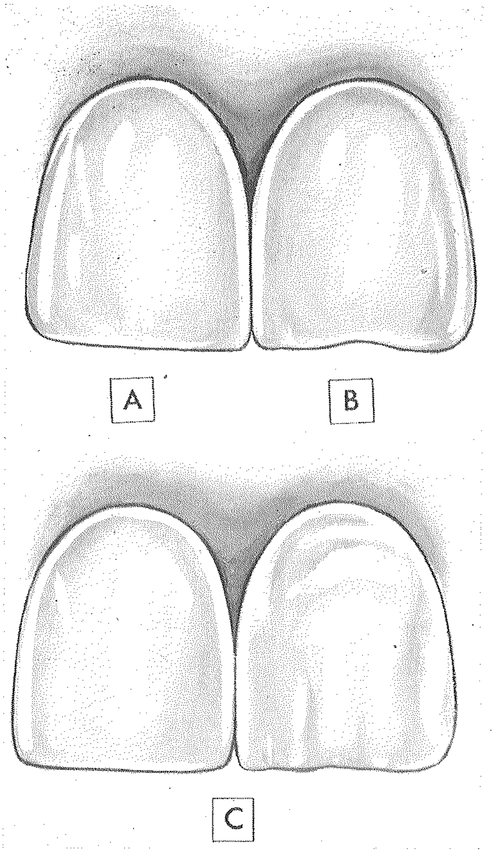


Figure 566. Changing the anatomic form to improve the esthetics of a restoration. *A*, Unnatural effect of a full coverage jacket restoration. *B*, Uneven incisal edge improves the esthetics of the restoration in a middle-aged patient and breaks away from the artificial appearance. *C*, Faint carvings on the labial surface will diffuse a light striking this surface and produce highlights, more natural than a flat smooth area.

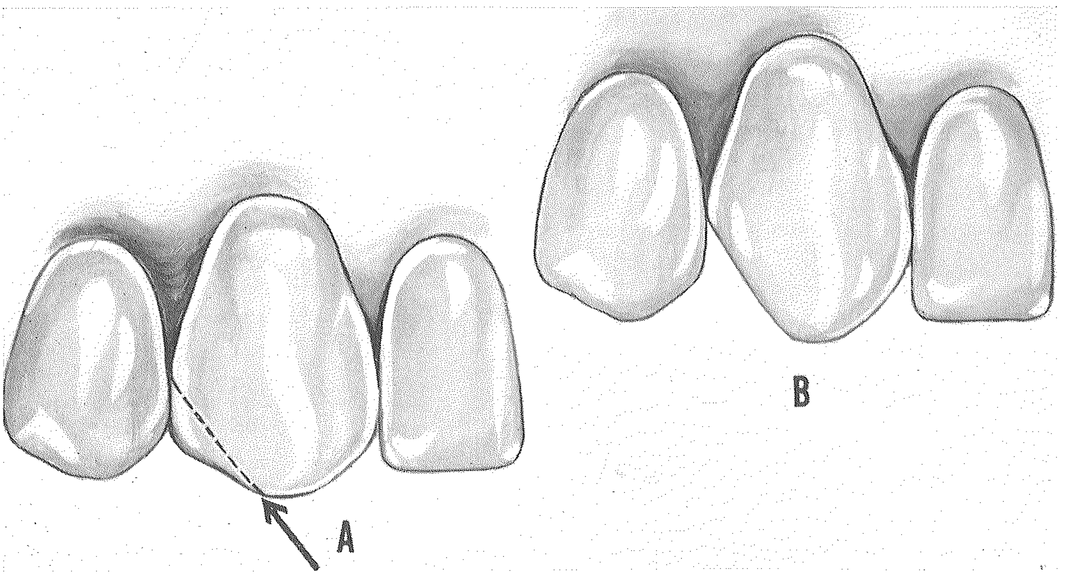


Figure 567. If a maxillary canine or bicuspid is too wide because of the space it has to fill, increasing the distal angle (*A*) with a stone gives the illusion of a narrower tooth (*B*).

bridge replaces the mandibular central incisor. Characterization of jacket crowns (porcelain or veneers) with a stone will contribute to natural-appearing teeth. In Figure 566 the incisal edge of an anterior crown can be characterized by creating an irregular edge with a Cratex wheel. Evenness of the incisors in middle-aged patients makes them appear unnatural. Of course, some patients prefer straight and even teeth possessing white, startling hues.

If a maxillary canine or premolar is too wide because of the unusually large space it must fill, increasing the distal angle with stones and disks often gives the illusion of a narrower tooth (Fig. 567). By the same token, a long, thin canine can be made to appear shorter by constricting the cervical portion (Fig. 568). This procedure presents the effect of exposed cementum, and a surface that is divided into two segments gives the illusion of being shorter. If the patient cooperates, artificiality in anterior restorations can be reduced by malturning one tooth slightly, usually the

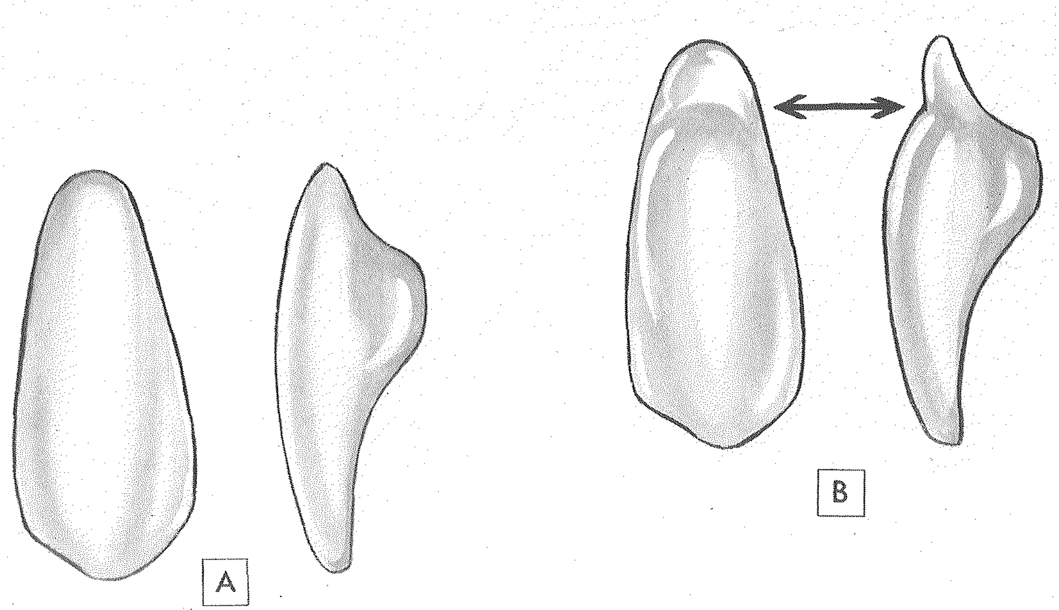
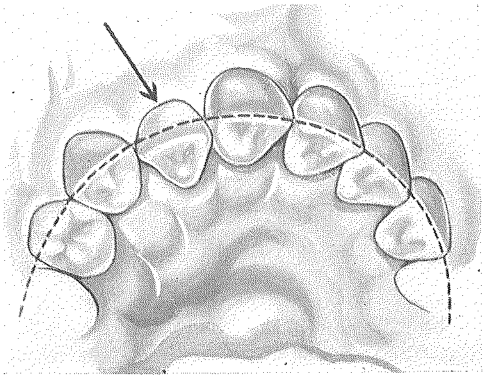


Figure 568. A long thin tooth (*A*) can be made to appear shorter by constricting the cervical portion (*B*). This gives the effect of exposed cementum. A surface that is divided into two segments gives the illusion of being shorter.

Figure 569. A lateral incisor crown, if constructed to be slightly lingual to the approximating teeth, usually improves the esthetics by breaking up the symmetry.



canine. A lateral incisor crown, if constructed to be *slightly* lingual to the canine and central incisor, often improves the esthetics (Fig. 569).

Translucent incisal edges in porcelain restorations break up the artificial porcelain look. Today, with so much improvement in translucent porcelain, there is no need for a porcelain crown to appear devoid of character and natural color. Very faint check lines will add to naturalness. In some patients, particularly men, a cigaret line or tobacco stain interproximally will help the esthetics.

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2. Landa, J.: Some psychosomatic aspects of medicine. Dent. Items Interest, *69*:336, April, 1947.

25

PRIMARY REASONS FOR FAILURES IN OCCLUSAL REHABILITATION

The operator must never lose sight of the fact that he is qualified to remedy, not create, an occlusion. The type, design, and arrangement of the restored teeth are dictated, not by man, not by the articulating device, nor by the patient's wishes but only by the neuromuscular system and the physiologic comfort peculiar to that individual. Therefore, with some exceptions and whenever possible, the closer the operator duplicates the patient's original, satisfactory occlusal relationship, the greater the chances for success. *He must take into consideration the patient's osseous and neuromuscular asymmetries, the vertical and horizontal overlaps, individual chewing and rubbing habits, muscle memories, etc., and success in treatment depends upon compatibility with these factors.*

Teeth can be rehabilitated without destroying an existing functional occlusion because once the satisfactory relationship has been tampered with it is almost impossible to find it again except by guesswork. There are many reasons for failures in occlusal rehabilitation. The primary ones that usually get the operator and the patient into difficulties are:

1. Altering the existing, comfortable, and functioning occlusion by increasing the vertical dimension of occlusion beyond the limits of tolerance (raising the bite).
2. Altering satisfactory functioning occlusions to one predetermined plan called ideal, the same for all patients.
3. Insistence upon a 2 to 3 mm. interocclusal (freeway) space in every case.

4. Failure to reproduce the normal horizontal and vertical overlaps.
5. Changing the functional occlusal planes by means of a template or its equivalent, the same plane on both sides of the jaw.
6. Disregard for the limitations in and around the mouth and in the materials used in the restorations.
7. Changing a tolerant, acceptable incisal guide angle on teeth with restorations.
8. Accommodating the unreasonable demands for esthetic improvement.
9. Incorrect design of the crown, fixed or removable partial denture, or complete denture.
10. Unpreparedness of the patient for extensive restorations because of misunderstood case presentation.
11. The patient's unwillingness or inability to accept all or part of the restorations.
12. Extensive and expensive restorations in a terminal case.

ALTERING THE EXISTING COMFORTABLE AND FUNCTIONING OCCLUSION (RAISING THE BITE)

We frequently hear the phrase, "I do not raise a bite, I restore it." How misleading, because there is a difference. Increasing the vertical dimension of occlusion (raising the bite) is a deliberate increase beyond the limits of the physiologic rest position and the tolerant interocclusal (freeway) space. This procedure is often resorted to so that certain esthetic or supposedly improved restorations can be constructed. To the technician it means making room for prescribed restorations. It is also recommended by those who believe in the denture type of arrangement of restored teeth to contact in right and left lateral and in protrusive crossjaw excursions. Sometimes, orthodontic measures, bite planes, and around the arch splinting of restorations are introduced to maintain the raised occlusion. *Harnessing teeth in a rigid state, to be held in a position and alignment of discomfort to the muscles and nerves, usually contributes to unsatisfactory results in reconstruction.* The emotional pattern of behavior of the patient is apt to become more disturbed—the beginning of trouble between the patient and the dentist. Raising the bite beyond the limits of tolerance is a major cause for failure.

Figure 570 illustrates the study casts of a woman about 60 years of age. She became emotionally upset when rehabilitation of her occlusion was nearly completed. From her description of her problems, it was obvious that she was primarily concerned with esthetic improvement and no doubt prevailed upon her dentist to improve upon the appearance of her teeth. To meet the esthetic demands, the vertical dimension of occlusion was increased beyond the limits of tolerance. The maxillary unesthetically spaced and protruding teeth were brought back by orthodontic measures where the patient wanted them. The operator splinted these moved teeth to hold them in their new position. Maxillary and mandibular restorations were inserted and a new occlusal relationship was created by the increased occlusion. The splint extended from the left maxillary canine all around to the right second premolar. The mechanical restorative work was good; however, the patient complained of tightness—to use her word—and a pulling sensation in the upper teeth. She further claimed that her speech was affected, and she was extremely unhappy with the esthetic result. The large splint compelled the technician to construct wide restorations. To make matters more difficult, the patient displayed a prominent alveolus when she smiled. In addition, she had the habit of bruxism, a habit which helped force her natural anterior teeth out of alignment. One can conclude from this case that the following factors contributed to apparent failure:

1. The vertical dimension of occlusion was inadvertently increased beyond the limits of the physiologic rest position.

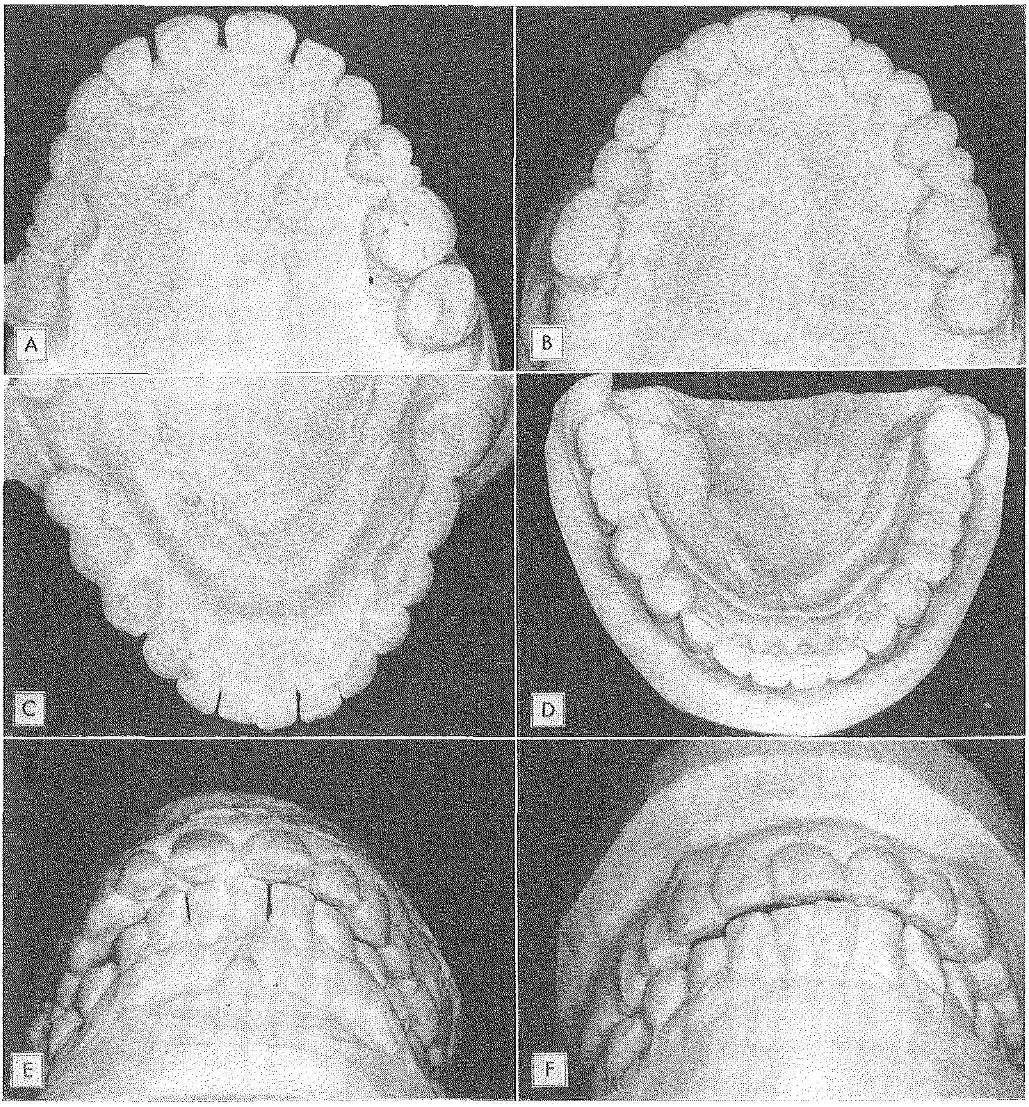

Figure 570. Unsuccessful rehabilitation because of increasing the vertical dimension of occlusion beyond the limits of the physiologic rest position. *A, C, E,* Study casts before treatment. *B, D, F,* Casts after treatment. Notice the position of the mandibular teeth in the lower cast in *E* as compared to the relationship in *F* after the bite was raised.

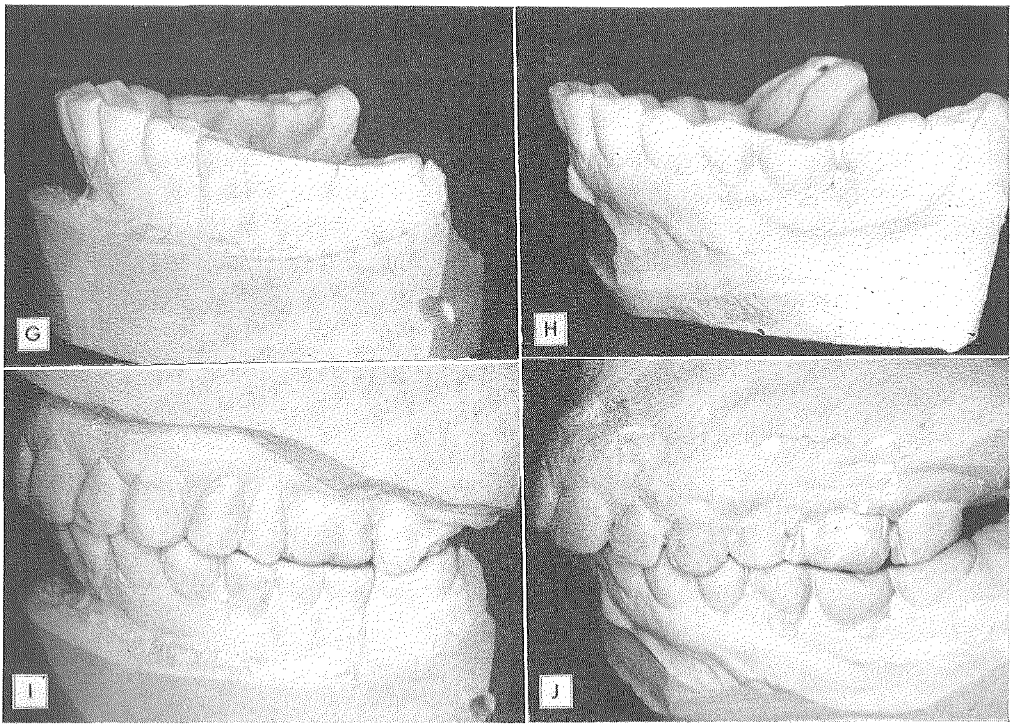

Figure 571. Same patient as shown in Figure 570. *G* and *I*, Marked changes in occlusal and compensating planes as compared with original casts *H* and *J*. Due to the raised bite, the horizontal and vertical overlaps have been altered. Compare *I* with *J*.

2. The patient did not understand the limitations in treatment such as the prominent alveolus, the uncontrollable bruxism, and the wide space problem of the upper anterior teeth.

3. The radical change in the horizontal overlap (overjet) which is responsible for discomfort and speech defects.

4. The patient claims she was not informed that splinting of anterior teeth with a metal frame necessitates making square-shaped teeth, unnatural in color because of the underlying metal.

5. Splinting teeth that participate in uncontrollable bruxism creates tightness and pain in eccentric movements.

Figure 571 shows the different relationship in the overlap as compared with the original study casts.

Restoring the bite, on the other hand, *may* bring about an increase in the vertical dimension of occlusion within the limits of the individual's physiologic rest position, centric occlusion, and interocclusal space. This procedure is resorted to when there is a collapse, a loss, or a reduction in the vertical dimension. It is also recommended when existing old restorations have outlived their usefulness and function is not at its optimum. Occlusions may be restored when there is pain because of extruded teeth or when there is a marked periodontal condition attributed to the existing occlusion. The satisfactory change in occlusion, however, is accomplished by trial methods after the restorations have been constructed in accordance with the average 3 mm. interocclusal space *as a guide.* These restorations can be reduced and reshaped, the plane of occlusion can be altered, but all are governed by the individual's mandibular movements and uncontrollable habits, function, comfort, tolerance, speech, and esthetics.

INSISTENCE UPON A 2 TO 3 MM. INTEROCCLUSAL (FREEWAY) SPACE IN EVERY CASE

Some operators and teachers fail to realize that the frequently recommended 2 to 3 mm. interocclusal space measurement is an average and hence does not apply to all individuals. An interocclusal space of 9 mm. or more may be normal for one patient, whereas a space of 1 mm. or even less may be normal for another. Nevertheless, it is recommended:[8, 9] "In altering vertical dimensions, approximately 3 millimeters of interocclusal distance always should remain after restorations." To

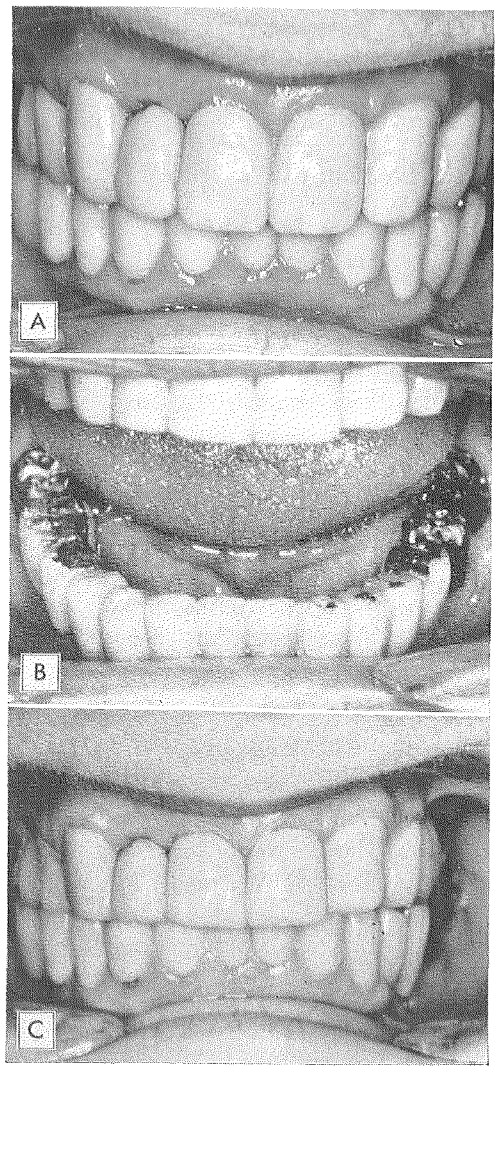

Figure 572. To insist that 3 mm. of interocclusal distance should always remain after restorations will frequently cause difficulty for the operator and the patient. *A*, Crowns and bridges with increased vertical dimension. The patient suffered pain and discomfort even though the interocclusal distance measured 3 mm. *B*, Restorations were reduced in length until pain was eliminated. *C*, Patient's interocclusal distance measured about 6 mm. after reduction of the heights of the restorations.

follow this dogmatic and rigid rule in crown and bridge prosthesis when rehabilitating an occlusion will get the operator into trouble. Just because the patient's interocclusal space is greater than the average 2 to 3 mm. measurement does not give us the right to bring it to that average by increasing the vertical dimension beyond the limits of tolerance. Figure 572 illustrates a dentition that was rehabilitated by increasing the vertical dimension of occlusion, using the 3 mm. average space measurement *only* as the formula. The patient suffered severe pain and discomfort in the temporomandibular joint areas. The dentist claimed that the occlusion was not raised and offered proof by the fact that the interocclusal space after rehabilitation measured 3 mm. This procedure followed the recommended concept that the average space measurement must be present in every case—a policy that is bound to result in failure of many cases. Temporary measures were introduced, reducing the heights of all crowns and bridges, and freedom from pain was experienced in a short period of time. The patient's interocclusal space was then measured and it was found to be approximately 6 mm.

ALTERING SATISFACTORY, FUNCTIONING OCCLUSIONS TO ONE PREDETERMINED PLAN CALLED IDEAL, THE SAME FOR ALL PATIENTS, A REASON FOR FAILURE

Belief in only one plan of occlusion for all patients encourages the operator to destroy an otherwise normal, functioning occlusion just because the relationship does not follow the pattern the operator has adopted as ideal. The cross-tooth contacts in cross-jaw excursions philosophy, labeled a "balanced" occlusion for every dentition, is a philosophy that can result in failure. The protective canine, cusp to fossa technique, the same for all dentitions, is academic and can be considered another reason for unsatisfactory results in many cases. A hinge axis recording must be considered only as a means for registering the hinge opening for orienting the working cast in close relation to the maxillae by means of a face-bow in accordance with certain anatomical landmarks. Strong believers in the importance of the hinge axis theorize that centric relation and centric occlusion are identical in location. Kurth[7] expounded a sensible reasoning in this regard when he wrote, "Various groups of men, however, have accepted the assumption that the point of relative non-movement that they find in the region of the condyle is the hinge axis. According to them this location determines centric maxillomandibular relation. Casts of natural teeth are mounted on an articulator of their choice by means of various tracings using a kinematic face-bow. If centric occlusion is not congruent with centric relation, a malocclusion is the diagnosis. Grinding the occlusion or a complete mouth reconstruction may be necessary to rebuild the mouth to this idealized concept. In the absence of pathosis, this may be a tragedy. Success gained in some cases does not mean that such procedures can be applied indiscriminately to all patients, for some of these patients will not and cannot adjust to these extreme boundary positions. Some of these complete mouth reconstructions have even worn through the gold restorations and are functioning anterior to the hinge position in possibly the original location of centric occlusion."

Webster's dictionary defines *balance* as *a state of equilibrium* and *equilibrate* as *to balance equally*. These definitions are practically synonymous. There are many conflicting and not quite understandable opinions of what a balanced occlusion is and when and how teeth and restorations should be equilibrated. The term, balance, is used too loosely. The presumably correct occlusal balance in one patient might disturb the harmony of the masticatory machine in another. Many of us have been influenced to believe that a normal occlusion is one that resembles the so-called ideal. This ideal is based upon what is known as a balanced occlusion, with definite patterns and arrangements of natural or restored teeth, participating in cross-tooth contacts in three cross-jaw excursions, right and left lateral and protrusive. Many well-known prosthodontists, periodontists, and equilibrationists admit that these contacts in three prescribed jaw movements rarely occur in natural dentitions. What is puzzling is why they still call this a balanced and ideal occlusion, and restore or reduce teeth in attempts to reach this ideal. Perhaps we can understand the necessity for this type of arrangement of teeth in complete dentures, for stability of the dentures, let us say, which slide over a moist mucosa. Should such an arrangement be recommended for the patient who functions satisfactorily in an up and down motion only, or with limited lateral excursions? Is not function the important phase we strive for? We should not follow the denture concept of a working-side balancing-side arrangement of teeth in occlusal rehabilitation, nor refer to a single plan to reproduce this ideal, picture-book arrangement of restored teeth, in the same way for all patients.[1] Restoring, replacing, and altering the anatomical forms of teeth, the same way for all patients, may not be functionally acceptable by the neuromuscular system, no matter how beautifully the carved restorations appear nor how well they intercuspate on an articulating device.

ASSUMED LAWS OF OCCLUSION

In a natural dentition, the predominant occlusion is the one without excessive overlaps. These overlaps, horizontal and vertical, prevent or limit cross-tooth contacts in cross-jaw excursions. *There is no biologic or physiologic law in nature that states that teeth must touch in three prescribed jaw excursions. There is no law in nature that insists that no diastema exist between the maxillary central incisors. There is no law in nature that states that uniformity in arrangement of the teeth be present. There is no law in nature that states that the incisal guide angle, and the angle of the cusps of the posterior teeth, and the angle of the articular eminence are the same. There is no law in nature that insists upon geometric occlusal carvings which are the same for all teeth. All these are man's laws which do not necessarily apply to the individual.* Wheeler[11] writes, "Nothing anatomic may be reduced to the mathematical exactitude of geometrical terms."

Belief in one plan of occlusion, which is the same for all patients, encourages the operator to destroy a normal functioning occlusion just because the relationship does not follow the concept he has adopted as ideal. Figure 573 illustrates a woman 62 years of age. She possesses practically all of her teeth. Her dentist constructed three satisfactory bridges in harmony with her occlusion. She has an uncontrollable habit of bruxism, hence the occlusal surfaces of the bridges were of acrylic resin.

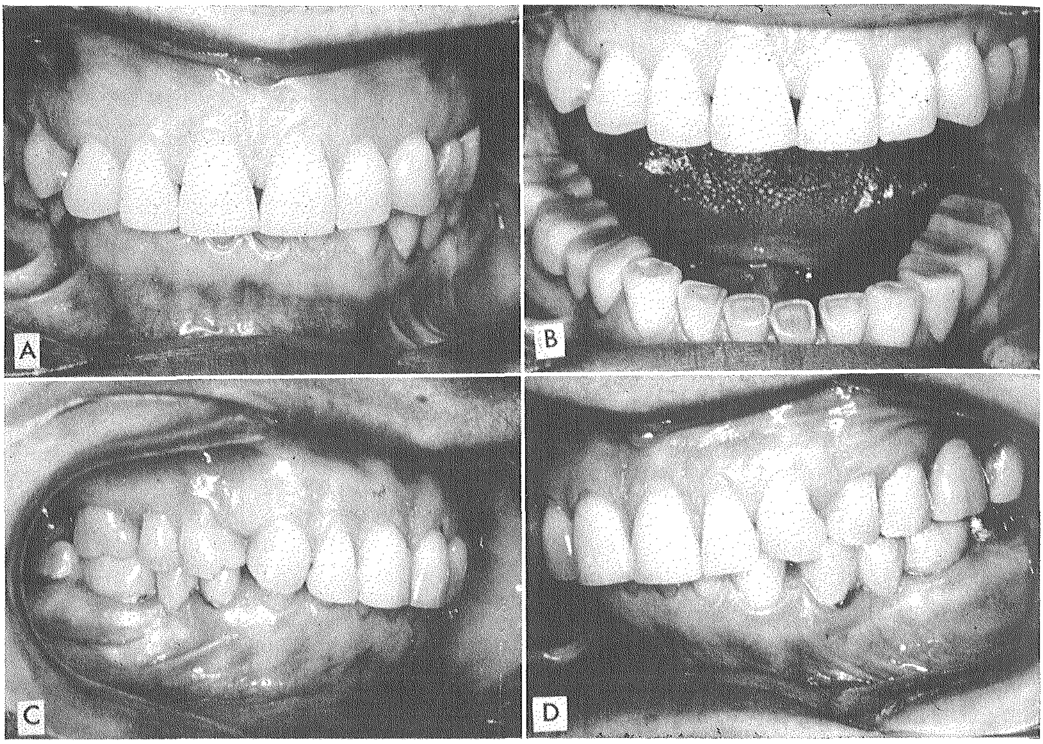

Figure 573. Patient of 62 years, with marked bruxism. Teeth did not make contact in cross-tooth cross-jaw excursions. A set philosophy encourages a dentist to destroy a satisfactory dentition only because the teeth either do not contact in protrusive and right and left lateral excursions or because the cusps of the posterior teeth do not fit congruently into the opposing fossa. The teeth are in excellent condition, although the mandibular incisors are worn.

A short time later, the patient for some unknown reason sought the services of a new dentist. He in turn referred her to an equilibrationist who ground and reduced the surfaces in accordance with his adopted philosophy that teeth must touch in three prescribed jaw excursions called balance. After a series of such treatments, she claimed that her teeth didn't set right (to use her own words). The operator then advised her that all her teeth should be rehabilitated, and raised the occlusion arbitrarily on the straight line articulator (Fig. 574) to indicate how much of an increase she required. Distraught and confused, she sought new help. The new operator believed in the protective canine, cusp to fossa philosophy. He took excellent study casts and recorded them on an anatomical articulator. He advised her that all the upper and lower teeth should be covered with porcelain fused to gold veneer crowns to create a cusp to fossa relationship.

The age of the patient, function, plus excessive bruxism movements caused wear of some surfaces of the teeth and slight bone loss. The fact that the patient was 62 years old, the fact that she had an uncontrollable habit, the fact that she functioned satisfactorily, and the fact that she retained beautiful teeth for her age (Fig. 573) made little difference. This case illustrates what I mean: a set philosophy encourages a dentist to destroy a satisfactory dentition only because the teeth either do not contact in protrusive and right and left lateral excursions or because the cusps of the posterior teeth do not fit congruently into opposing fossae.

FACTORS THAT INFLUENCE REHABILITATING AN OCCLUSION

Jaw movements become an individual phenomenon. Some occlusions function in a rotary motion, some in a chopping motion, and many in lateral motions. We cannot ignore developmental osseous and neuromuscular asymmetries, individual occlusal designs, patterns of chewing, muscle memories, and varying occlusal planes and horizontal and vertical overlaps. We cannot set down rules that will apply to all patients regarding their mandibular movements. From his student days, the dentist is compelled to follow the dictates of cross-tooth contacts in cross-jaw excursion philosophy rather than the guidelines of logic, of physiology, of individuality, of developmental traits and anatomical variations, to name a few.

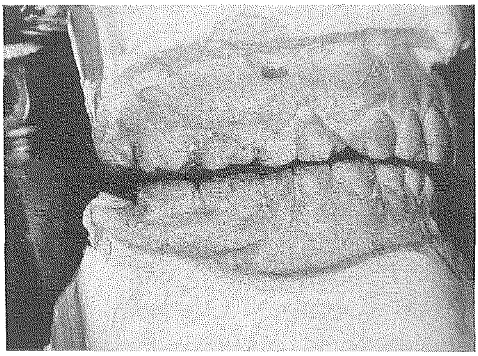

Figure 574. After equilibrating these teeth in an attempt to have them make contact in three jaw movements, the equilibrationist decided that the entire dentition should be restored in accordance with the amount indicated on the straight line articulator. The patient sought the services of another dentist.

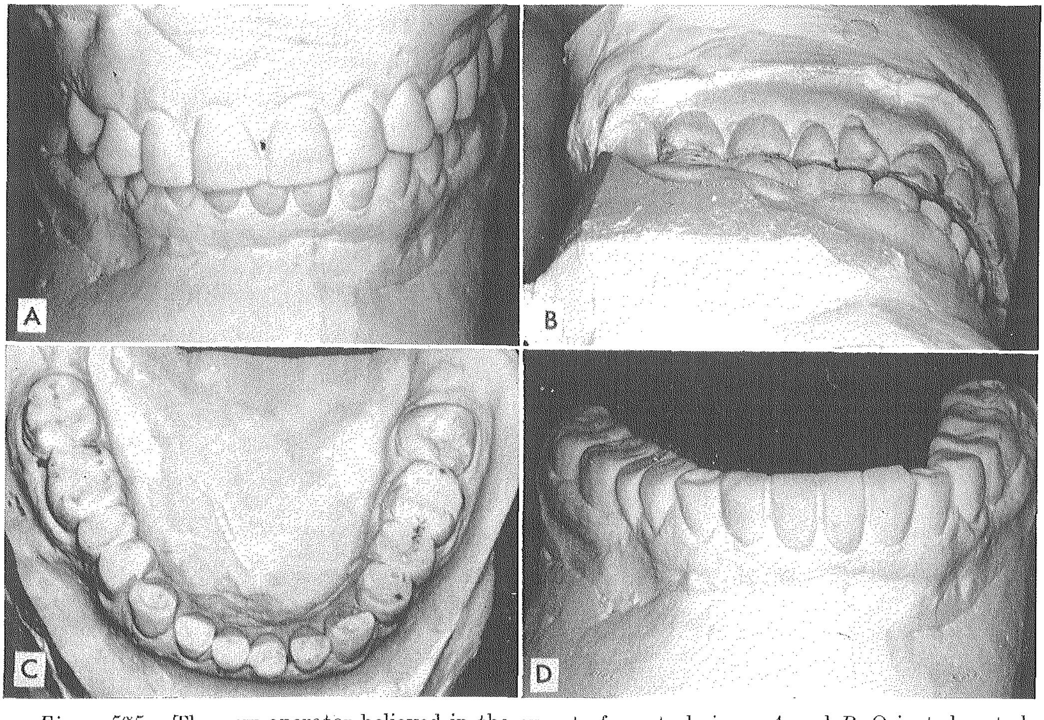

Figure 575. The new operator believed in the cusp to fossa technique. *A* and *B*, Oriented casts by means of the hinge axis philosophy. *C* and *D*, Casts showing marked attrition, and types of occlusal planes. The new operator advised preparing all the teeth, even the beautiful maxillary anteriors, and covering them with porcelain fused to gold veneers, thereby creating a cusp to fossa relationship (see text).

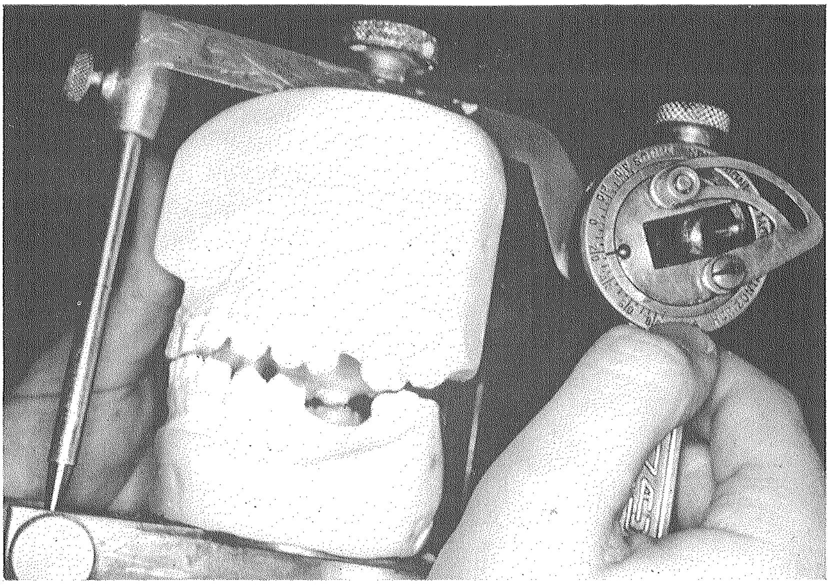

Figure 576. Moving the condyle balls of the articulator with the fingers does not duplicate the exact movements of the mandible.

Harmony in occlusion means comfort in function. Harmony can be obtained by duplicating or maintaining the accepted functioning vertical dimension of occlusion, the varying occlusal planes except those distorted by extruded teeth, maintaining the incisal guide whenever possible, and all the other factors previously mentioned. To obtain harmony in occlusion with restorations it is frequently necessary to disregard uniform carvings, to compromise on narrow buccolingual occlusal widths, and to have extra regard for the periodontium and the correct type of restorations.

When the dentist writes the word, balance, in his article or book, or when he speaks the word, balance, in his lecture, without giving his meaning of the word, we have found it suitably convenient to assume that he means balance as defined in parts 2 and 3 of the words, balanced occlusion, in *Current Clinical Dental Terminology:*[5] "The simultaneous contacting of the upper and lower teeth on the right and left and in the anterior and posterior occlusal areas. It is thought of primarily in the mouth, but may be arranged and observed on articulators. This occlusion is developed to prevent a tipping or rotating of the denture bases in relation to the supporting structures. . . ." I believe that it is wrong to restore all occlusions with a denture type of arrangement because, to paraphrase Dr. Trapozzano,[10] we make the patient fit the occlusion, instead of the occlusion fitting the patient. Cross-tooth contacts should not be thought of in the mouth despite the fact that such an arrangement can be obtained and observed on articulators. The articulator must not be considered the criterion in establishing the absolutely correct occlusal relationship for an individual. *Inasmuch as the articulator cannot do exactly what the mouth can, the mouth should be the determining factor in what is correct for the mouth—not the articulator. It is ludicrous to assume that moving the condyle balls of the articulator with the fingers can reproduce the exact movements of the mandible* (Fig. 576).[2]

THE ARTICULATOR AND THE MOUTH

Dentistry has been incredibly naive with regard to the articulator, expecting it to perform beyond its limited mechanical capabilities. There is no need to become profoundly enthusiastic over articulators. There are a great many such instruments, some simple, some complex. It is difficult to concede that a mechanical contrivance can imitate, with any degree of accuracy, the manifold, functional, and eccentric movements of the individual's mandible. All interferences cannot be accurately located on an articulating device because the interference may be brought about by a particular mandibular movement peculiar to that individual alone and which the mechanical instrument cannot duplicate. Does the articulator have muscles? Does it have nerves? Does it have the ability to form and change habits? Most important: can it function physiologically; can it chew? Of course not. *The articulator, any one, can only be considered a device upon which dental restorations can be constructed on the bench in the laboratory. It is more often necessary to make final adjustments in the mouth when the restorations are fitted on the teeth because it is only in the mouth that the patient's preferred, convenient, comfortable, habitual, functional, and eccentric movements, voluntary and involuntary, are performed.*[3]

I do not wish to convey that an articulator is not necessary. In fact, orientation of the working cast by means of a face-bow and mounting it on an anatomical articulator is recommended because the procedure facilitates construction of the restorations and minimizes the amount and degree of adjustments. How the operator obtains the opening axis for registration is his choice. We should not have any illusions that such registrations can be exactly duplicated or even repeated on the same patient. To believe that an articulator can imitate the opening and closing, rubbing and chewing movements of the natural teeth so well that whatever restoration is constructed on the articulator will fit exactly the same in the mouth, will disappoint the operator. The jaw does not close in a fixed vertical direction when participating in grinding movements. It closes from a slight right and slightly left position, whereas an articulator closes in a fixed vertical direction.

D'Amico[4] concluded from his clinical research that the denture type of so-called balanced occlusion rarely exists in a natural dentition. Granger,[6] despite the fact that he calls such a denture type of occlusion ideal, writes, ". . . in practice it is seldom possible to achieve this relationship completely." We can conclude that rehabilitating all occlusions to the denture type of tooth relationship is another reason for failure.

GEOMETRIC DESIGNS AND ACCENTUATED OCCLUSAL CARVINGS A SOURCE FOR UNSATISFACTORY RESULTS IN SOME CASES

Overcarved restorations also contribute to failure in rehabilitation. I do not recommend flat occlusal surfaces on all restored teeth nor deep carvings on all restorations. Insistence upon well-formed geometric carvings in all restorations and in every case can prove disastrous. Cusps of natural teeth in patients of middle age and over are not all sharp, well-defined angles of the kind we see in line drawings

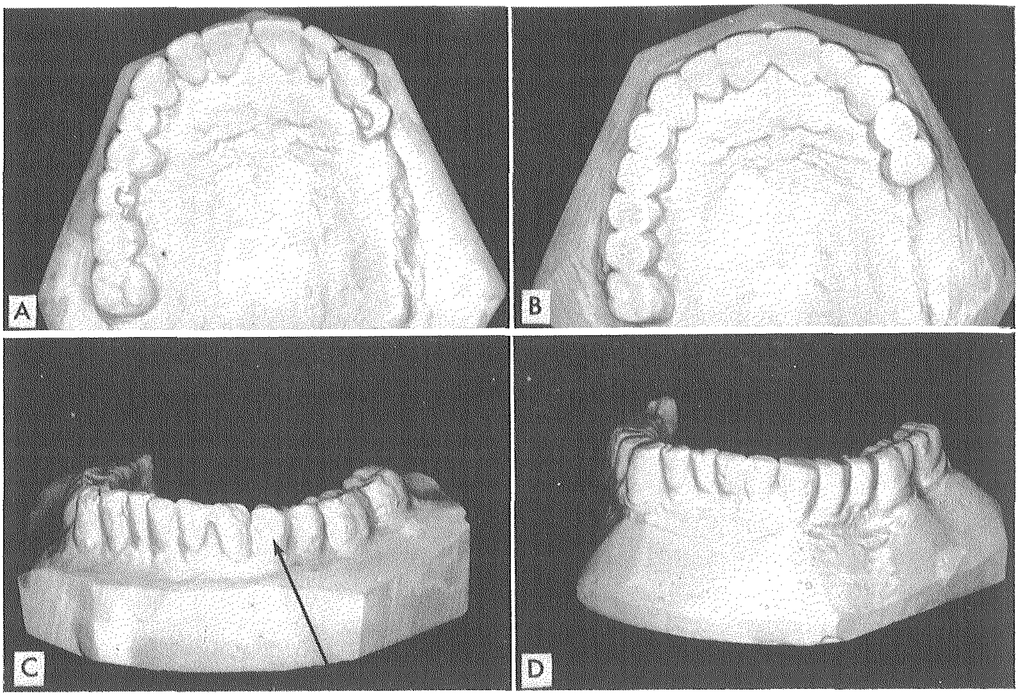

Figure 577. Original study casts *A* and *C*, compared with rehabilitated casts *B* and *D*. Arrow points to worn acrylic on veneer due to bruxism. Note extra cantilever tooth, a premolar in *B* (see text).

of teeth for teaching purposes. For the most part, they are gnarled, irregular, sometimes rounded, sometimes deep, and sometimes flat protuberances. The individual's chewing and rubbing movements have a direct bearing upon the angulation of the occlusal patterns, their sharpness or dullness. The marginal ridges of natural and restored teeth in the opposing jaw and the approximating teeth will also influence the lobes, the inclines, the depth, and the forms of the cusps. These manifestations are not exactly the same in all mouths nor on teeth in both sides of the jaw nor in the same side of the jaw. Some restorations and artificial teeth will be deeply carved, the forms of others non-anatomical, and still others irregular, even shallow cuspal designs. Whenever most of us have created theoretically carved cusps that interdigitate perfectly on the articulator, invariably we have had to stone down these carvings because the patient complained of discomfort. Furthermore, accentuated marginal ridges on the lingual gold surfaces on maxillary anterior restorations serve no purpose whatsoever. These ridge-like carvings look pretty, but feel decidedly uncomfortable to the patient.

UNSUCCESSFUL REHABILITATION BECAUSE OF FAILURE TO REPRODUCE THE HORIZONTAL OR VERTICAL OVERLAPS

Figure 577 illustrates the original study casts and those of the rehabilitation that failed. This patient's dentition was rehabilitated ten to twelve years prior to the second treatment. Although a maxillary removable partial denture was constructed, the patient never accepted it. Nevertheless, he functioned satisfactorily until a breakdown of the old restorations caused by decay compelled him to seek a new operator. There are other factors besides that of the overlap that contributed to failure in rehabilitating this dentition a second time. All the old occluding restorations were removed. This was the first procedure responsible for difficulties, because the operator failed to measure and record the patient's acceptable and tolerable interocclusal space so that he could duplicate it. As a result, he inadvertently raised the bite when he reconstructed the occlusion. It has been stated that once the tolerant vertical dimension of occlusion has been destroyed, it is practically impossible to find the correct occlusal relationship again. To correct the slight intolerable increase, the cemented restorations as well as the incisal edges of the mandibular incisors were reduced. Broad, incisal edges were created and an unsatisfactory change in the incisal guide angle resulted. Furthermore, there is a marked difference in the horizontal overlap, which is now quite unlike the one with which he functioned so favorably, for ten or twelve years (Fig. 578).

Adding an additional cantilever pontic on the upper left side, to satisfy the patient's unreasonable demands for only a fixed partial denture, increased the pull of the pump handle effect. Note the wear due to bruxism on the occlusal third of the buccal surfaces of the old acrylic resin veneer crown in Figure 579 which was not taken into consideration. The patient complained about difficulty incising food and his inability to become accustomed to the overall change. The lower left canine was covered with a veneer crown possessing a broad occlusal table, and the anterior

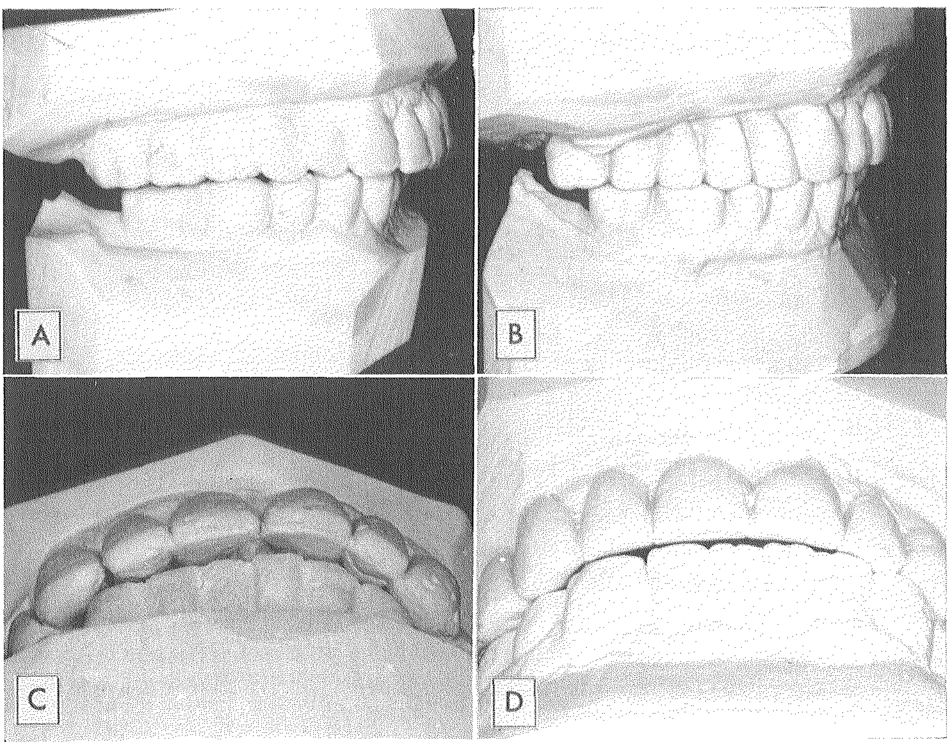

Figure 578. Occlusion was raised. *A* and *C* are original study casts. *B* and *D* are casts of completed treatment. Notice change in the overlaps.

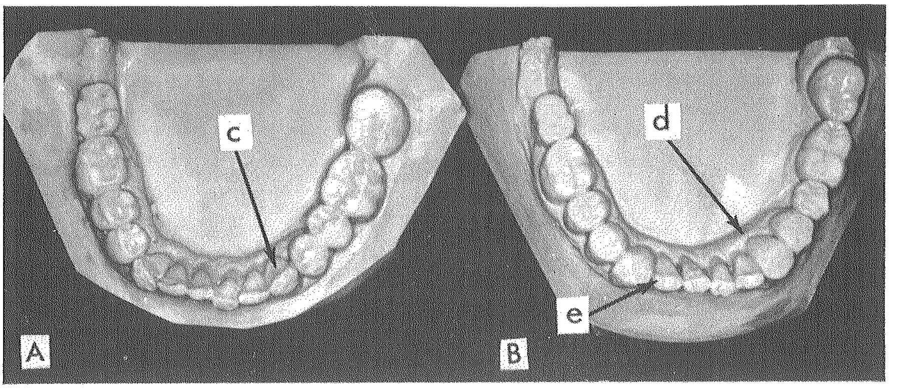

Figure 579. Same patient as shown in Figures 577 and 578. *A*, Original lower study cast. *B*, Rehabilitated lower jaw. *c*, Narrow and normal size canine compared to broad rehabilitated canine. *d*, Mandibular incisors were ground in an effort to close the occlusion, *e* (see text).

maxillary restorations were constructed much thicker than the previous ones. After so many years of satisfactory function with the old restorations, the neuromuscular system, muscle memories, the feel of the tongue, incising and chewing, as well as speech habits—all were unable to adjust to the radical changes. This case illustrates the importance of duplicating satisfactory functioning conditions, as previously stated.

ACCOMMODATING THE UNREASONABLE DEMANDS FOR ESTHETIC IMPROVEMENT

There are some patients who believe that dentists can beautify any objectionable esthetic condition of the teeth. No attempt should be made to improve upon the esthetics unless the patient is made aware and understands the limitations. Esthetics is very important. Nevertheless, the dentist is not a cosmetician. He should firmly fix in his mind just what he can accomplish along the lines of esthetic improvement, and must not extend himself to attempt the impossible. (See Chapter 24.)

DISREGARD FOR LIMITATIONS IN THE MOUTH AND IN THE MATERIALS USED IN RESTORATIONS, ANOTHER REASON FOR FAILURE

Figure 580 illustrates failure in the restorations because the operator did not take into consideration the uncontrollable rubbing or bruxism. Furthermore, the type of restoration was definitely not indicated. This woman over 60 years of age had two porcelain fused to gold crowns inserted on the maxillary central incisors to close the objectionable space. The ceramic to gold crowns were too hard to be tolerated. Because of the powerful uncontrollable bruxism, the periodontium suffered, the bone resorbed, the restored teeth were forced farther apart, and one tooth became hopelessly mobile. Trying to relieve the damaging condition, first the porcelain on the lingual surface of the crown on one tooth was ground, exposing the underlying gold, then the gold was reduced, exposing the tooth structure. Disregard for the bruxism resulted in failure. Acrylic cured to fused porcelain are the restorations indicated, with instructions to the patient regarding the shortcomings of acrylic and the necessity for replacing the crowns every three or four years depending upon the rapidity of the wear.

THE CANTILEVER SPLINT, A FACTOR IN FAILURE OF THE RESTORATION

It has been stated that a fixed splint is primarily indicated when teeth are reasonably mobile or when multiple abutments in fixed partial dentures are necessary for support of the pontics. To cantilever a free-end pontic in a fixed splint is often a precarious procedure which frequently contributes to unsuccessful results. When the occlusion is satisfactory, the condition of the teeth and underlying bone good, and bruxism is not a problem, a single cantilever pontic at the end of the splint may prove satisfactory. It is not recommended that more than one free-end pontic be attempted. We must be aware that all cantilever restorations have a pump handle effect on the last tooth. This lever action tends to break the cementing

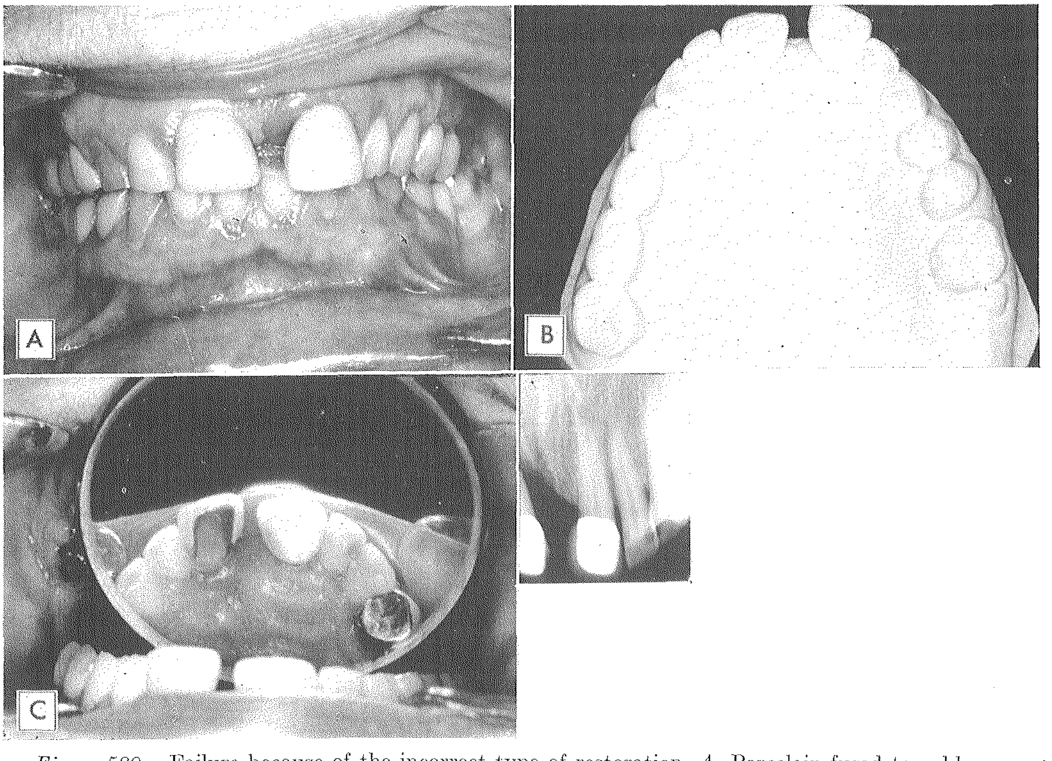

Figure 580. Failure because of the incorrect type of restoration. *A*, Porcelain fused to gold crowns; bruxism has been disregarded. The gingiva is inflamed and the central incisors are mobile. *B*, Left central, receiving the brunt of bruxism, is forced out of alignment. *C*, Lingual surface of left central restorations was ground repeatedly, exposing the gold and then the tooth, in attempts to prevent further damage. Roentgenogram shows marked loss of bone.

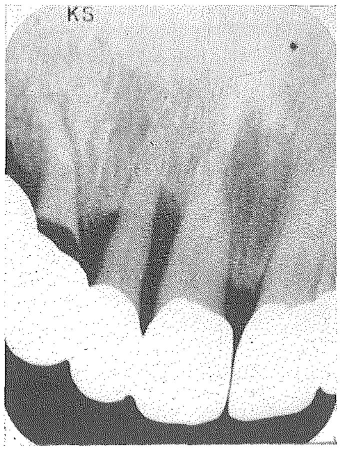

Figure 581. Pump handle effect on a cantilevered splint tends to break the cementing medium, resulting in caries and eventual death of the pulp.

medium around the tooth supporting the cantilever pontic and caries results (Fig. 581). All cantilever splints should be carefully checked at frequent intervals. The patient should be advised that the splint may loosen or that decay may set in. Usually, this procedure of cantilevering a fixed splint is resorted to, to satisfy the unreasonable demands by the patient for esthetics or to avoid a removable partial denture.

When a canine abutment tooth is to receive an internal attachment, that retainer will have to be wider than the normal canine, thereby limiting satisfactory esthetics. When the patient objects to the wider canine, that patient must assume some responsibility for constructing a cantilever pontic which will receive the attachment, and the canine of the splint will then be of normal size. Compromising for esthetic improvement has its disadvantages.

ALTERING OCCLUSAL PLANES, FACTORS IN FAILURE

The occlusal plane is an imaginary plane commonly accepted to run from the incisal edges and the cusp summit of the upper cusps of the teeth. The occlusal planes in both jaws are individual phenomena and each side may be different from the other. There is no need to destroy an existing comfortable plane in order to substitute an arbitrary one created from some mathematical device or theory. Radical changes in the occlusal curves may prove detrimental in a rehabilitated occlusion. It is fallacious reasoning to state that the occlusal curve is not an important factor. The curves represent the arrangement of the teeth that contribute to that part of the masticatory mechanism which is physiologic. Restorations are apt to be tolerated when they closely follow the normal original curves and planes, except those which have become distorted because of exfoliation of teeth.

Figure 582 illustrates a patient with a marked vertical overlap and a deep mandibular occlusal curve with the posterior teeth in the premolar region much lower than the anterior ones. On three occasions in her experiences with three dentists, her occlusion was raised to bring about a theoretical type of occlusal cant with new restorations, eliminating the different levels. Each time the operator was compelled to revert to the original curve and the different levels of occlusion. This patient lost confidence in dentists and prefers to function comfortably with the present state of her occlusion despite the fact that the dentition requires rehabilitation and esthetic improvement. Should new and improved restorations be attempted, the step-down lower occlusal plane must be duplicated, the marked overlap maintained, and the occlusal relationship not raised. A dentition with different occlusal levels, developmental in origin, cannot participate in the usual prescribed mandibular movements with the teeth making contact in three cross-jaw excursions. As a result, such satisfactory occlusions are often destroyed and submitted to extensive, unnecessary rehabilitation by the wanton destruction of perfectly good teeth, which then receive full coverage restorations, all because the dentition lacks the type of occlusal planes desired by the operator and his technician.

TREATING A TERMINAL DENTITION WITH EXTENSIVE RESTORATIONS, A REASON FOR FAILURE

To insist upon insertion of extensive restorations in a terminal dentition is another reason for unsuccessful results, in many instances. Usually these loose terminal teeth are not strong enough to withstand the rigors of grinding and reducing plus the many complicated procedures necessary for complete rehabilitation. Unless the patient can afford the high cost of extensive dentistry in a problematic dentition and is willing to gamble because he understands that the completed treatment may last one or two years, or perhaps longer, the operator is advised not to rehabilitate such a dentition.

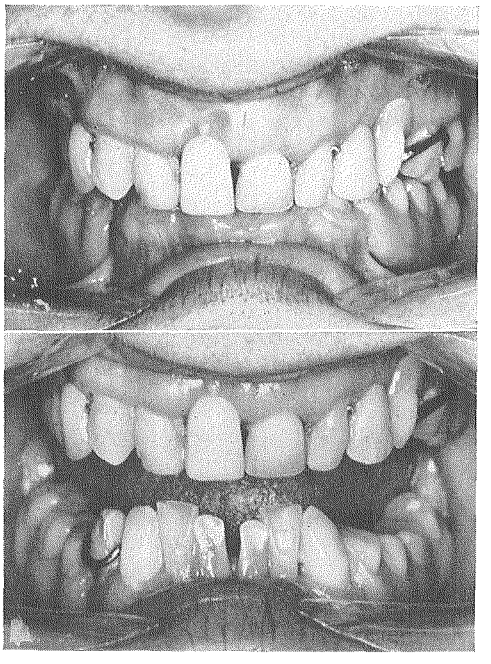

Figure 582. Patient with excessive vertical overlap and a deep mandibular occlusal plane. On three occasions with three operators, her occlusion was raised to bring about a theoretical type of ideal occlusion. Each time the operator was compelled to revert to the original curve and different levels of occlusion as well as the marked overlap.

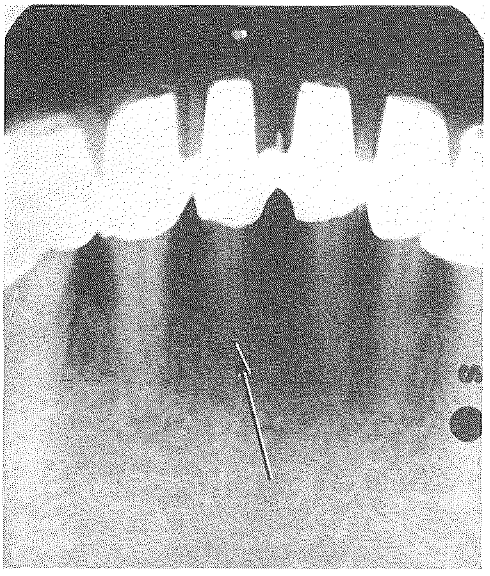

Figure 583. Roentgenogram showing the overbuilt crowns on a splint.

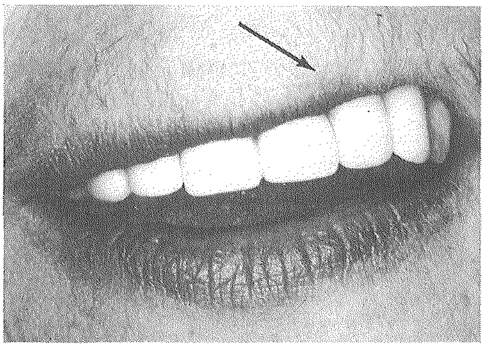

Figure 584. Overcontoured restorations are not in harmony with the lips. In this case, the lip clung to the teeth when the patient smiled and had to be released by hand at the termination of the smile.

INCORRECT DESIGN OR CHOICE OF MATERIALS USED IN CROWNS, SPLINTS, FIXED AND REMOVABLE PARTIAL DENTURES, REASONS FOR FAILURES IN REHABILITATION

The introduction of a new appliance or a change in the shape and design of the restoration may not prove successful in some mouths. Patients become accustomed to the "old feel" of the surfaces of the teeth. When the tongue has accommodated itself to marked concave lingual surfaces of natural maxillary anterior teeth, that tongue will often rebel when these surfaces are convex or straight in crowns and bridges. When the restorations are too thick labiolingually to obtain better esthetics, speech may be affected. The natural anatomical forms of the teeth should be duplicated as closely as possible. Splints and fixed partial dentures possessing overhanging gold collars (Fig. 583) irritate and inflame the tissue and may be considered a reason for failure in restorative dentistry.

The faulty shape and contour of a restoration may cause a patient unhappy moments. Figure 584 illustrates a patient in whom the labial contours on the an-

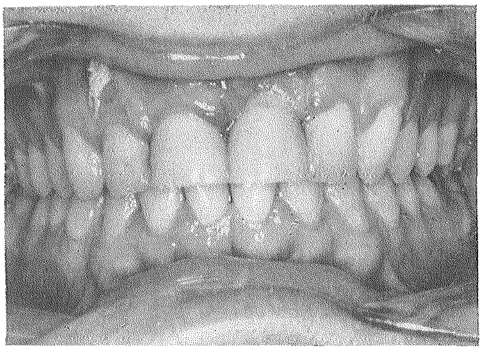

Figure 585. Failure of a restoration because of overcontour at the gingival third of the upper right central incisor restoration.

terior restorations are not in harmony with her lips. Every time she smiled or laughed, the upper lip did not slide gracefully over the restorations to assume its normal position at the termination of the smile. As a result, the lip clung to the restorations and the patient was compelled to release it with her fingers. Overcontouring a restoration also contributes to gingival irritation and ultimate periodontal disturbance (Fig. 585). The deflecting contours of the restoration must be in harmony with the deflecting contours of the gingiva.

UNWILLINGNESS OR INABILITY TO ACCEPT PART OR ALL OF OCCLUSAL REHABILITATION

There are some patients who cannot or will not accept part or even the entire reconstruction after it has been completed. The color of the restored teeth may not meet with their approval or the shape of restored teeth dissatisfies them or the result is not what they expected. A removable partial denture often becomes an obstacle which some patients cannot overcome. Perhaps the patient failed to understand the limitations of the materials. Proper presentation of all conditions—what can and what cannot be accomplished—is very important.

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26

CEMENTATION AND MAINTENANCE

CEMENTATION

Immediately after the tooth has been prepared for the full coverage restoration, the operator is advised to apply an aqueous solution of a prednisolone preparation to the exposed dentin. Inasmuch as the injured cells liberate histamine thereby setting up an inflammatory condition, the application of prednisolone prevents the liberation of histamine and hypersensitivity of the dentin is practically eliminated. The eugenol present in the temporary cement which holds the temporary crown in position helps in the formation of secondary dentin. Eugenol possesses antiseptic, stimulating, and local anesthetic properties.

PREPARING THE TOOTH FOR CEMENTATION

When the operator is convinced that the prepared teeth are ready for permanent cementation he is advised to wash the preparation with warm water containing some hydrogen peroxide and follow with sprays of clear warm water. The tooth or teeth are then isolated with cotton rolls and the preparation is dried with small cotton pellets and several gentle blasts of warm air. Some operators recommend an application of a calcium hydroxide preparation as a protection to the pulp. Avoid irritating medicaments such as phenol, alcohol, and silver nitrate.

CEMENTING A SINGLE PORCELAIN JACKET CROWN

Practically all types of restorations such as crowns, veneers, and fixed partial dentures can be cemented with a temporary cement, with the exception of the porcelain jacket crown. This restoration depends upon the retentive properties of the cementing medium that will not affect the color. A temporary medium will not retain the ceramic restoration and it is apt to move in such a manner as to be fractured by the opposing tooth.

The color and type of cement for permanent cementation frequently influence the esthetic value of the completed porcelain jacket crown. It is the usual practice to mix different colors of oxyphosphate of zinc cement powder with water or glycerin, place some of it into the porcelain jacket crown, and then insert the crown over the preparation until a proper selection of shaded cement is made. Unfortunately, this type of mix will not create the same color effect when the cement powder blend is mixed with the acid. During these tests, the sensitive tooth is exposed to air and the fluids of the mouth, thus making the dentin all the more sensitive. If the dentist prefers to use these time-consuming trial tests he must consider the effect of the permanent mix which will be darker and grayer.

If the porcelain jacket crown is sufficiently thick, then Mizzy's Ceramic Blend oxyphosphate of zinc cement is recommended. This cement gives a warm natural shade to the porcelain with little possibility of affecting its color. However, if the jacket crown is on the thin side, particularly on the labial or buccal surface, any oxyphosphate of zinc cement will leave an outline of the preparation which will be different in color from the solid section of fused porcelain toward the incisal or occlusal region. The use of a translucent cementing medium such as Caulk's Lucent cement, shade 20, for all thin porcelain jacket crowns in which color is of prime importance, is recommended. The operator may select S. S. White's Kryptex. Although these media are not oxyphosphate of zinc cements (they are silico-phosphate), they have proved successful over the years. How much influence the shade of cement will have upon the porcelain jacket crown depends upon the thickness and the translucency of the porcelain. It is difficult to bring about a more desirable color in a completed porcelain crown by the use of the cementing medium, but the wrong color of cement can readily destroy the shade of a beautiful finished crown. The zinc phosphate cements are opaque and more retentive. The opacity is a disadvantage. The silicate cements are translucent but less retentive.

PROCEDURE OF CEMENTATION

Use a non-corrodible clean spatula and a clean glass slab that is not too chilled. Dispense a few drops of the liquid in the center of the slab and the powder at the end. Incorporate small amounts of powder into the liquid, and spatulate slowly over a large area. Do not add more powder until the previous batch is completely incorporated. Mixing should be completed in one or two minutes. Line the inside of the clean, dry porcelain crown with the tacky mix and seat it gently but firmly over the dried prepared tooth. Keep the isolated area dry until the cement is set, and then carefully remove the excess with a sharp explorer. Johnston, Phillips, and Dykema[3] write, "The most common cause for difficulty in use of zinc phosphate cement can be attributed to the use of liquid which has changed either through exposure to the atmosphere or by contamination or improper mixing technique. The probable causes of cement *setting too slowly* are (1) a mix which is too thin (that is, not enough powder incorporated); (2) a mix which is spatulated too long (increased spatulation time increases setting time); or (3) a mix using liquid which has lost water because of improper care."

ZINC OXIDE AND EUGENOL CEMENT

For permanent cementation of an individual gold crown, a thin mix of a zinc oxide and eugenol preparation is recommended if the prepared tooth is extremely sensitive. Despite the fact that this mixture does not possess the retentive properties of the phosphate cements, it does condition the dentin and heals the injured pulp. Its property of hardening seems to retain the gold restorations. Thermal shock is practically eliminated. On short preparations, however, or on fixed partial dentures, it is contraindicated. There is no such thing as an ideal temporary cement unless sufficient quantity of petrolatum is incorporated with the zinc oxide and eugenol preparation to prevent hardening of the mix. Crowns inserted with a temporary cement must be carefully checked periodically.

MAINTENANCE

The fact that the patient's dentition has been rehabilitated does not mean that future dental care and treatment will not be necessary. The practice of dentistry is a series of continual operations. The frequency depends upon the individual patient. It has been stated that material things are not exempt from the process of wear and age. Natural teeth and soft tissues do not remain the same indefinitely and it is not unreasonable to assume that these manifestations of deterioration take place in restored dentitions. As a result, maintenance and constant repair are necessary measures. In some patients the deterioration of restorations and teeth may take place in a short period of time after completion of rehabilitation, while in others, breakdown of restorations and tissues may take place after ten or more years. No one can predict how long restorations will last, but early recognition of possible problems may preserve a completed case for a much longer period.

WHAT HAPPENS TO THE DENTITION AFTER REHABILITATION

1. Acrylic resin veneer crowns and bridges become discolored.
2. Acrylic resin restorations wear and abrade.
3. Acrylic resin crowns without a metal strut or gold casting turn whiter.
4. Porcelain restorations may fracture.
5. Complete dentures become loose.
6. Free-end saddles in removable partial dentures require rebasing.

7. Pink color of the resin denture base changes.

8. Untouched natural teeth develop permanent stains different from those in restorations.

9. Acrylic restorations lose their gloss.

10. The gingivae may become inflamed due to lack of oral hygiene.

11. The pulps of some prepared teeth may die and a tooth may develop an abscess.

12. Alveolar bone resorbs and exposes the cementum of the roots.

13. Decay may set in at the necks of some restored teeth.

14. Male internal attachments may spread too much when continuously adjusted, and may break, requiring a new male attachment.

15. The female attachment may become wider from frictional wear, causing the male attachment to become loose.

16. A hole may arise in a thin gold occlusal surface of a restoration.

17. Silicate cement restorations discolor, wash out, and have to be replaced.

18. Pain may arise in any tooth that has been restored.

19. The patient may develop the habit of bruxism.

20. Some restored teeth may become mobile.

Figure 586. The Water Pik, an extremely helpful device in maintaining restorative work in rehabilitation. Brushing, even after every meal, cleans only the exposed surfaces of the teeth and restorations that can be reached. The brush cannot clean between the teeth, under bridges, and in spaces between the gums and teeth. Through the use of a searching, pulsating jet of water it removes virtually all of the residual debris from the mouth. At the same time, the action of the stream of hot water on the gums affects circulation and contributes to the maintenance of firm and healthy gums.

Instruct the patient in the correct use of the toothbrush, Stimudents, the Water Pik, and other oral hygiene measures. Brushes with hard nylon bristles will cut grooves in acrylic resin restorations and it is better to recommend a soft brush with natural bristles. At intervals, roentgenographic recordings are taken to detect any possible abnormalities in the periodontium and restorations.

WHY PORCELAIN JACKET CROWNS FRACTURE

Actually, as Felcher[2] puts it, "A porcelain jacket crown breaks because directional forces during mastication pass through the porcelain before the underlying tooth structure can react to cushion and absorb the shock." Primary reasons for fracture are:[1]

1. Incorrect preparation.
2. Faulty condensation of the porcelain during the construction by the ceramist.
3. Improper fusing of the crown.
4. Carelessness in fitting and cementing the porcelain jacket crown.
5. Insertion on teeth that participate in excessive uncontrollable bruxism.
6. Torque and eating habits with certain hard foods.

The fracture of a porcelain jacket crown usually takes the shape of a half-moon or a vertical form. The force or stress is the primary cause for breakage and the contributing factors may be considered the friability of the material itself or incorrect preparations such as preparation of insufficient length, preparation of insufficient width, preparation with sharp angles and corners, marked tapered preparation, or any preparation that does not permit the ceramist to construct a porcelain jacket crown of nearly equal thickness.

A porcelain jacket crown that breaks soon after insertion is more apt to break again until the reason for the fracture is ascertained and corrected. When fracture takes place in a preparation of insufficient length it is because the force applied is at right angles to the large bulk of porcelain lingually in the incisal third. Inasmuch as there is not enough tooth structure in this area to absorb the stresses, they pass through the porcelain and create a half-moon break in the cervical third, labially or lingually. In a preparation of insufficient width, a vertical fracture takes place when a force is applied that tends to produce rotation or torsion. The force striking the oversized unequally constructed part of porcelain brings about a twisting motion to the crown and a vertical break occurs in the thinner areas. Unequal as well as not enough removal of tooth structure of any surface of a normal tooth helps to bring about fracture.

The patient who has porcelain jacket crowns should be made aware of the fragility of such restorations and cautioned regarding eating habits. Eating the meat off a lamb chop, corn on the cob, hard crusts of bread, and the like must be avoided.

DISLODGEMENT OF A PORCELAIN JACKET CROWN

A jacket crown constructed to cover a marked tapering preparation depends solely upon the cementing medium for retention. When torque is applied to such a restoration, it is likely to rotate on this conical form, the cementing medium breaks, and the jacket crown is dislodged. Recementing the jacket as a maintenance procedure will prove of no avail unless the preparation is altered. The creation of a ledge on the lingual surface in the form of a cingulum will prevent dislodgement.

MANAGEMENT OF A DISCOLORED OR PARTIALLY ABRADED OR LOST ACRYLIC FACING IN A VENEER CROWN

When the acrylic resin of a veneer crown is badly discolored or has worn through to disclose some of the underlying metal or has to be completely replaced, it is not necessary to remake the entire veneer.

REPLACING THE ENTIRE ACRYLIC RESIN VENEER FACING (FIG. 587)

Remove all of the old discolored remaining pieces of acrylic with a bur and level off all undercuts in the veneer casting. It is necessary to remove the deep undercut in the incisal or occlusal flare of the gold and a smooth flaring surface is created. With a ½ round bur in the ultra high-speed handpiece, held at an angle that is parallel to the incisal or occlusal flare, cut into the gold in the middle third, mesially

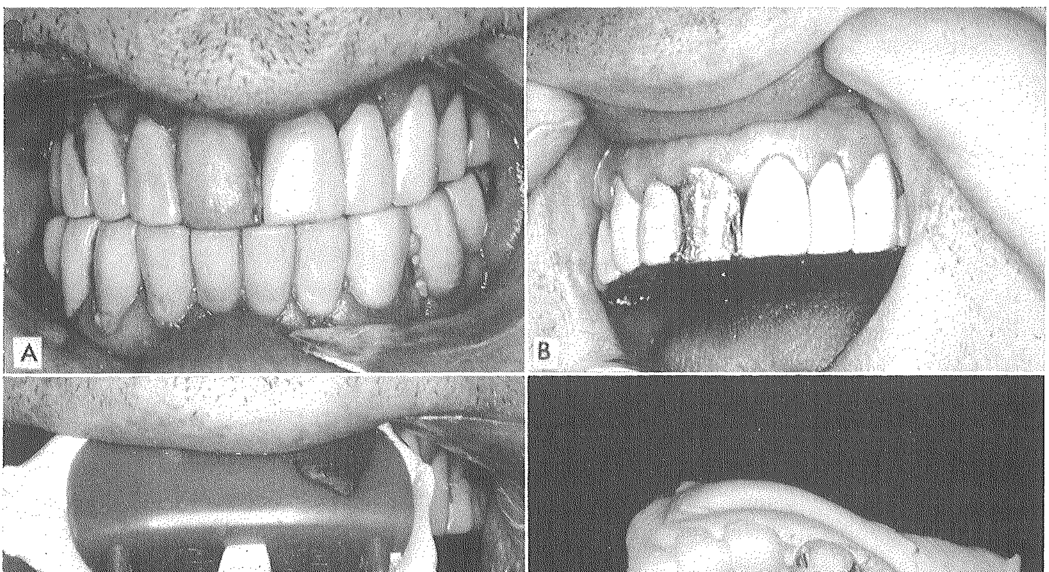

Figure 587. Replacing a discolored acrylic resin veneer facing. *A*, The discolored facing. *B*, The prepared boxing and reamed holes holding two pieces of dressmaker pins (see text). *C*, Elastic impression with pins in position. *D*, The impression removed showing the pieces of pins.

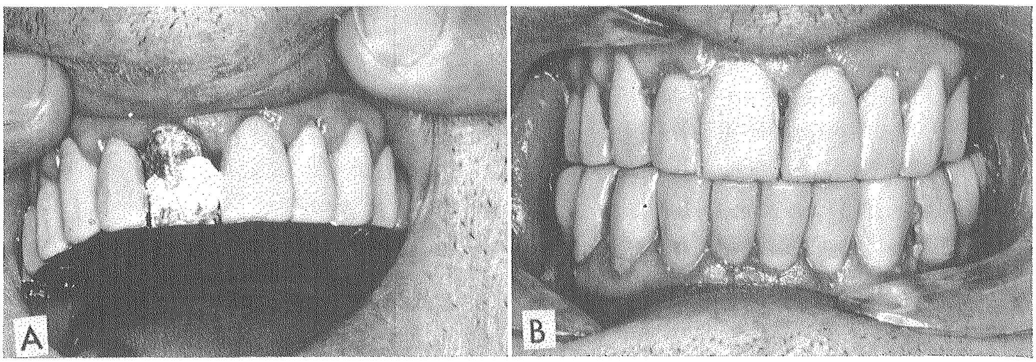

Figure 588. Temporary replacement. *A*, Fill the prepared holes with gutta percha. *B*, Place and carve a facing in silicate cement. When ready for the try in of the waxed replacement, the silicate cement s split apart.

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and distally. Try to create these holes as parallel as possible. Drill them slowly and carefully, stopping every so often to be sure that the head of the bur does not break or perforate into tooth structure. The replacement will be a new acrylic resin facing with pins that will be cemented into the mesial and distal holes.

Cut a thin dressmaker pin, of similar gauge to the hole, and place a piece in each hole with the heads of the pins protruding about 1/16 inch (Fig. 587*B*). Take an elastic impression in a suitable tray of the labial or buccal areas. The pinhead will become locked into the impression (Fig. 587*C* and *D*). The patient cannot be dismissed without some means of covering the exposed gold veneer temporarily. Plug the holes with a little gutta percha and then mix, place, and carve a mixture of silicate cement over the entire front of the veneer. Dip the blunt end of a cement carrier in some petrolatum and pat and carve the silicate facing (Fig. 588). To remove this silicate facing, cut a longitudinal groove in the center of the labial surface with a cross-cut fissure bur and pry the facing apart with a blunt instrument.

Pour up the elastic impression in hard stone. It is advisable to paint a thin layer of melted wax on the exposed pins before pouring the stone mix. This makes for easy removal of the pins. Cut a piece of 0.001 gauge tin or platinum foil and burnish it well into the facing of the stone cast. Puncture the platinum or tin foil with a straight or bent piece of dressmaker pin. Melt some tooth color wax over the foil and around the exposed pins until you are able to carve a facing that will be in alignment with the approximating teeth on the cast (Fig. 589*B*). Remove the waxed facing from the cast and try it in the gold veneer in the mouth. Add more wax where necessary, particularly in the cervical third of the facing (Fig. 589*C*). Take the shade. Invest, boil out the wax, pack, and cure acrylic resin. Cement the new pin acrylic facing into the cast veneer with Acralite or Justi resin cement (Fig. 589*D*). Keep the cast for future replacement.

REPAIRING THE OLD ACRYLIC WITH QUICK CURE RESIN MATERIAL (FIG. 590)

When the acrylic veneer has worn so thin that the underlying gold is visible, the use of Sevitron acrylic resin filling material may be made. Figure 590*A* illustrates an old acrylic veneer with the gold partially exposed. Use a small round or inverted cone bur in the ultra high-speed handpiece and roughen the exposed gold and part of the old acrylic resin (Fig. 590*B*). Place a small amount of correct shade Sevitron powder in a dappen dish. It may be necessary to use some blender or mixtures of shades. Dispense a few drops of Sevitron liquid in another glass dappen dish. The liquid evaporates very readily, so keep the dish covered. Moisten the end of a small sable brush with the liquid and lightly dip it into the surface of the powder in the other dish. Deposit this on the veneer casting and on the serrated old acrylic resin (Fig. 590*C*). This material cures and hardens rapidly. Be careful not to permit any of the new acrylic resin to work itself under the gingival tissue. A blunt-end instrument moistened with the liquid can remove any semi-hardened acrylic that tends to creep interproximally and under the tissue. The liquid and powder are applied until full contour is reached. When completely hard, the surface can be ground and smoothed with fine stones, sandpaper disks, etc. Polish the surface with fine pumice and a soft bristle brush (Fig. 590*D*).

MAINTAINING THE LUSTER OF ACRYLIC RESIN IN VENEER CROWNS

Inasmuch as the gloss of the acrylic veneer crown or bridge is created by fric-

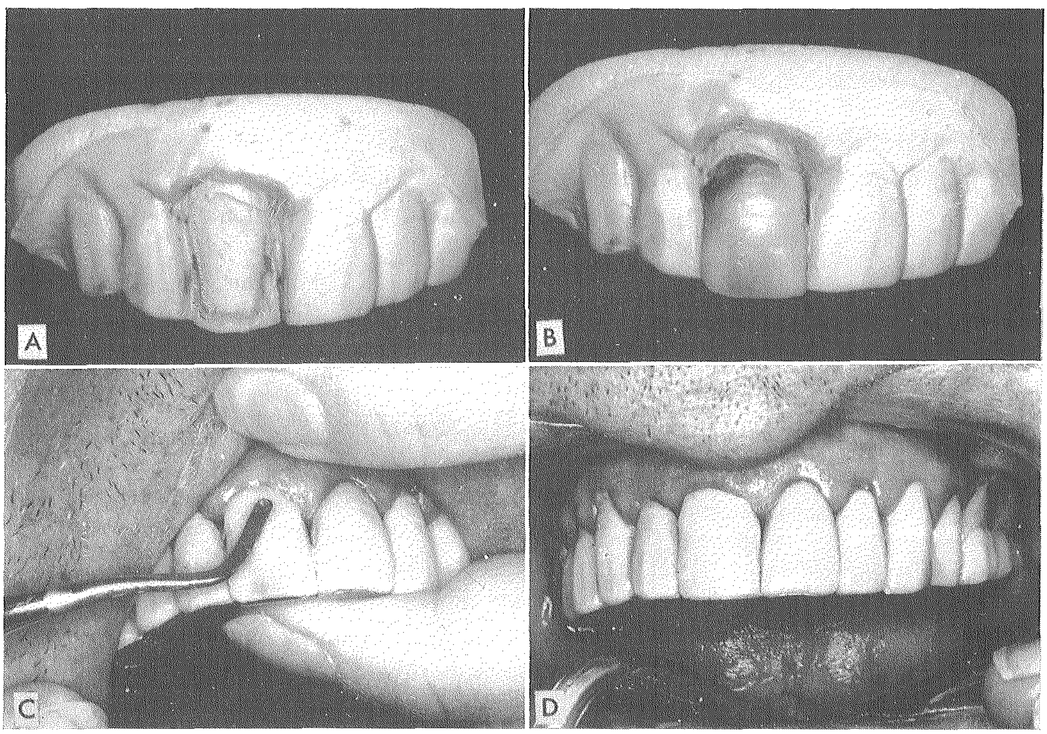

Figure 589. Construction of the new facing. *A*, Stone cast showing holes. *B*, Replace dressmaker pin pieces and burnish tin foil over the entire labial surface; add tooth color wax and carve a new facing. *C*, Try the waxed facing in the mouth. Wax usually must be added in the cervical area. *D*, The waxed facing is invested, packed, and cured with acrylic; after the foil is remove the restoration is cemented with an epoxy or acrylic resin cement.

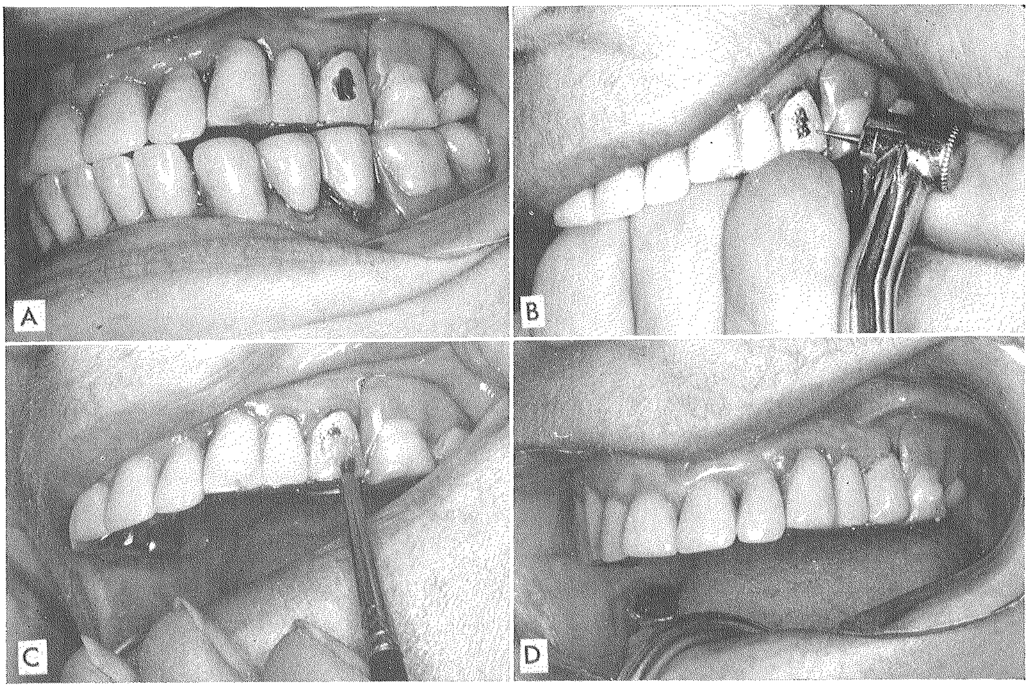

Figure 590. Repairing an old worn acrylic facing of a veneer crown. *A*, The exposed gold on the second premolar crown and the thin worn incisal third of the acrylic in the canine veneer. *B*, Roughen the gold with a small round bur in the high speed handpiece and remove or roughen remaining old acrylic resin. *C*, Apply Sevitron quick-cure acrylic over the prepared surface and fill to contour. *D*, When the Sevitron is set, finish and polish; glaze with Healy's Luster-Bright cream and a soft, cup-shaped, Robinson bristle brush.

tional heat polish with a soft rag wheel and fine pumice, the sheen tends to disappear shortly after cementation of the restoration. This is so because the bolus plus the type of food the patient eats tend to remove and dull the gloss. Never use coarse pumice to clean the teeth when giving a prophylaxis on the patient who has acrylic resin restorations in the mouth. This will also dull the gloss and abrade the resin material. Polish the veneer at each prophylaxis with Healy's Lustre Bright paste. Use a very soft cup-shaped Robinson brush and create a new gloss without danger of wearing away the material in the veneer.

CARIES IN THE CERVICAL THIRD OF RESTORED TEETH

Resorption of the alveolus and gingival recession are parts of the normal aging process. These manifestations are accelerated in a mouth rehabilitated with full coverage restorations and fixed partial dentures. A radical change in occlusion with such restorations is a contributing factor. A crater is often formed between the border of the crown and the receded gingival tissue. Food debris collects in this depression and caries occurs in the cementum of the roots. If this decay is not recognized and taken care of in the early stage, the decay will spread underneath the crown to attack the pulp. Regular periodic examination will enable the operator to prevent some failures in occlusal rehabilitation. When the caries is removed, silver amalgam, gold foil, or gold inlays can be inserted in the posterior teeth. Silicate cement, acrylic resin, porcelain inlays, or gold foil can be inserted in the anterior restorations (Fig. 591).

MANAGEMENT OF THE ABSCESSED RESTORED TOOTH

It has been stated that a restored tooth does not mean that no further dental treatment is necessary. Pulps may die with or without warning to the patient. Endodontic procedures and treatment are usually instituted through the lingual surface of the anterior restoration and through the occlusal surface of the posterior

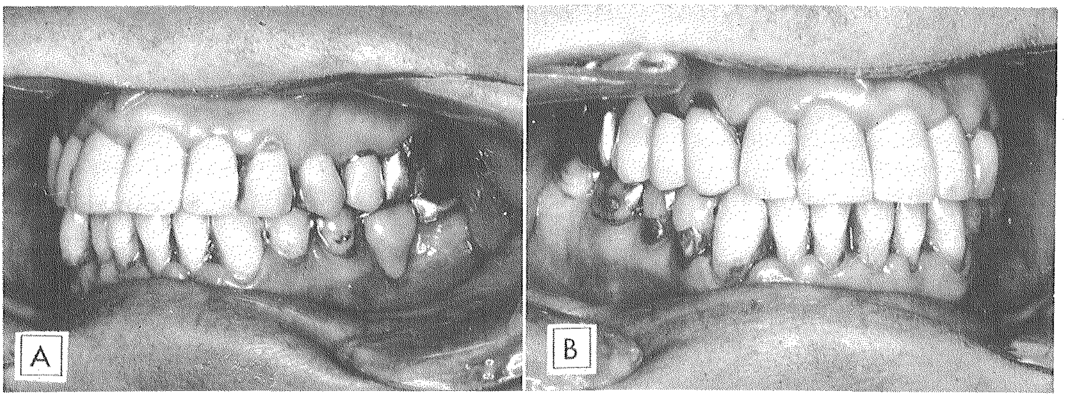

Figure 591. After ten years a dentition that has been rehabilitated shows the exposed cementum, decay in the gingival third of some of the teeth, and gingival inflammation from lack of maintenance. *A*, Cervical erosion around the three-quater crowns. *B*, Alloy restorations in the cervical third of some of the teeth.

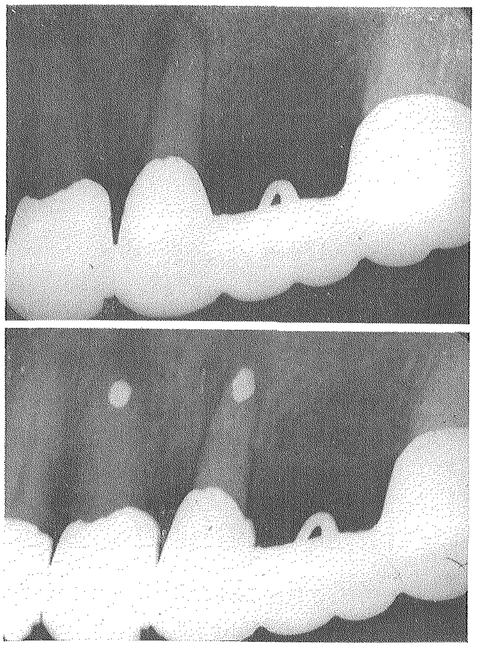

Figure 592. On some periapically involved teeth, root resection and sterile amalgam seals can be accomplished.

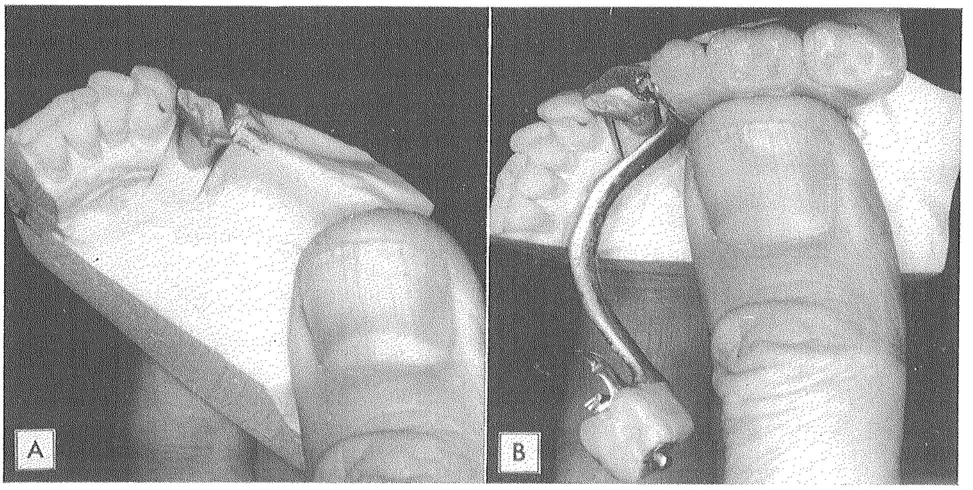

Figure 593. Replacing a worn female attachment. Remove the old retainer containing the worn female attachment. Reprepare the tooth and construct a new veneer crown with a wide and deep enough boxing to receive a new female attachment. *A*, Take an impression of the tooth, fabricate the new veneer, and try in the mouth for occlusal adjustment. *B*, Take an impression of the new veneer with the removable partial denture in position and pour the working cast.

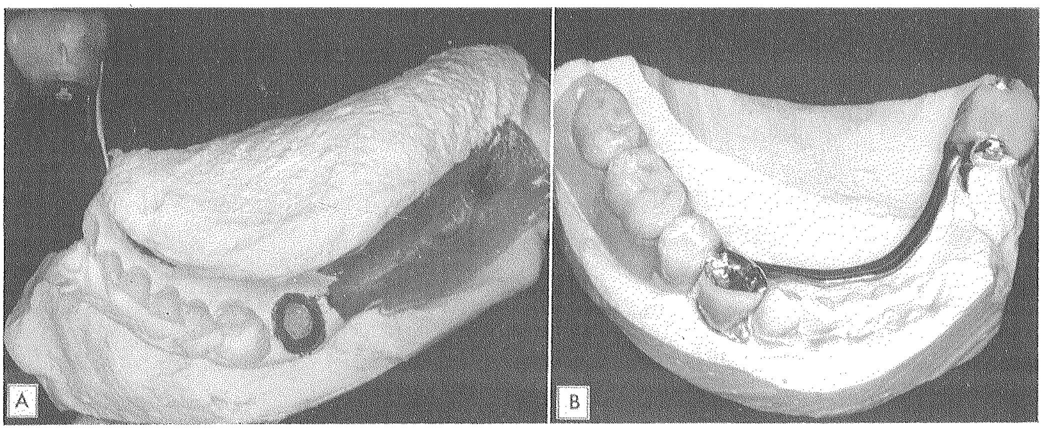

Figure 594. *A*, The master impression with the male attachment waxed to the new veneer crown. *B*, The new crown and female attachment on the cast (see text).

restoration. On some periapically involved anterior teeth, root resection and sterile amalgam seals can be accomplished (Fig. 592). At the time of periodic prophylaxis, bite wing roentgenographs are advisable at least once a year. When the patient complains of fullness or a throbbing pain, or classifies her pain as neuralgia, it is advisable to resort to endodontic treatment of the involved tooth before complications set in.

CLINICAL PROCEDURES FOR REPLACING A WORN FEMALE ATTACHMENT

Remove the old abutment retainer containing the worn female attachment and construct a new veneer crown with a boxing wide and deep enough to receive the new female attachment without friction. Place the new retainer on the tooth and seat the partial denture. Flow some sticky wax over the male attachment and the boxing in the new veneer. Take a plaster impression. When the cast is poured and the wax flushed away the technician can select, seat, and solder a new female to the recessed abutment retainer. Construct the veneer facing before cementation (Figs. 593 and 594).

REPLACING A NEW ABUTMENT TOOTH AND ATTACHMENTS

When the abutment tooth and its retainer carrying the female attachment is removed, a new retainer on the approximating tooth and a new tooth with a new male attachment will have to be constructed on the denture. The new retainer will house a new female attachment. The approximating tooth is prepared and a veneer crown with a cutout in the distal region is constructed. The old male attachment is disked off the partial denture. With the new cast retainer on the prepared tooth and the removable partial denture in the mouth, a full plaster impression is taken. The technician will replace the missing tooth on the partial denture and a new male attachment in the repaired denture will fit into a new female attachment soldered in the boxing of the new veneer crown. A full jaw impression is necessary because the technician can line up the new attachments on one side with the old attachments on the other side of the partial denture. Each technician has his own method of repairing such a case.

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QUESTIONS AND ANSWERS

WHAT IS RESPONSIBLE FOR SPEECH DEFECTS AFTER SOME REHABILITATED DENTITIONS?

Speech defects are brought about by the following: (1) Closure of spaces between anterior teeth with jacket crowns or fixed bridges. The tongue has become accustomed to fitting into these spaces over the many years when pronouncing certain words. When restorations close the spaces, the tongue has difficulty adjusting itself to the new environment and speech difficulty is often encountered. This defect, however, is more often of a temporary nature and can be eliminated by practice in reading aloud and by speaking slowly. (2) Failure to restore the previous lingual contour on the anterior tooth or teeth contributes to speech problems. The absence or presence of a cingulum or wear patterns should exist in the restorations. (3) Speech defects are also brought about when the bite has been raised, thereby reducing the interocclusal space. A thickness when pronouncing certain words is often the result. Correcting the occlusal relationship so that it is within the patient's physiologic rest position will overcome such speaking abnormalities. (4) Spaces between pontics (interproximal spaces without interdental papillae) on an anterior fixed bridge are responsible for a "shushing" sound when pronouncing words that start with letter S or letters CH. Saliva collects in these clear spaces and is forced through, creating the speech impediment. (5) Inadequate tongue room in a distal extension removable partial denture is another reason. (6) Any maxillary removable partial denture with a wide palatal bar or a full acrylic palate as well as a lingual bar in a mandibular removable partial denture contributes to speech difficulties. (7) Failure to duplicate the satisfactory vertical and horizontal overlaps will cause problems in speaking.

DOES A SO-CALLED EQUILIBRATION PROCEDURE ELIMINATE BRUXISM?

Removal of occlusal interferences responsible for excessive bruxism sometimes eliminates the rubbing symptom when diagnosed in time. When the habit is uncontrollable or when it is primarily due to neurotic tendencies, equilibration of the teeth will help the occlusion but will not stop the uncontrollable bruxism.

HOW FAR BENEATH THE GINGIVA SHOULD THE PREPARATION FOR A FULL COVERAGE RESTORATION TERMINATE?

The cervical border of the preparation should extend very slightly beneath the gingiva. Overextension of any restoration will not be tolerated by the tissue and this intolerance is manifested by inflammation of the gum. It is fallacious reasoning to insist that the preparation of a tooth for any crown should extend up to the epithelial attachment. The attachment can be seen only under the microscope, and not by the naked eye. Furthermore, the attachment is not at the same level around the tooth, thus making it impossible to cut a shoulder or a finishing line that will be regular in outline.

AFTER A FIXED BRIDGE HAS BEEN CEMENTED AND THE OCCLUSION ADJUSTED, WHY IS PAIN SOMETIMES EXPERIENCED ONLY UPON PRESSURE WHEN THE BOLUS IS STRUCK IN A PARTICULAR WAY?

Even when the occlusion of the bridge is in harmony with the occlusion of the rest of the teeth, this type of pain still may take place. Orban writes,[1] "Should a tooth that has been without an antagonist for a long time be called upon to take part in the work of chewing again, the periodontal membrane faces structural unpreparedness. This is the reason that at times, when fillings and fixed or removable partial appliances are placed, the patient complains of pain. A tooth may feel lame and weak for many weeks or months if the new functional requirements are different from those present before the restoration was made. In time, however, if the tissue reaction is favorable, we can expect complete functional rearrangement of the periodontal membrane, cementum and bone according to the new requirements."

WHICH MANDIBULAR MOVEMENTS ARE THE MOST DAMAGING TO THE TOOTH AND PERIODONTIUM?

The individual's chewing, rotary movements and excessive uncontrollable rubbing or bruxism in some cases because they rock and twist the teeth in normal and abnormal movements.

WHAT ARE THE REASONS FOR BITING THE CHEEK AND TONGUE AFTER REHABILITATING SOME OCCLUSIONS?

Reduction of the interocclusal space by raising the bite is the primary reason for biting the cheek or tongue. Broad occlusal tables and sharp buccal and lingual cusps are other factors. Reducing the vertical or horizontal overlaps also compels the patient to nip the tongue. Replacing missing teeth which have been lost for a long time usually is responsible for cheek biting.

WHY IS IT NECESSARY TO USE A NEW CRUCIBLE WHEN MELTING HIGH MELTING RANGE GOLD TO BE USED FOR A PORCELAIN FUSED TO GOLD RESTORATION?

The old crucible, used for casting golds for inlays, etc., contains residue metal and oxides of copper, silver, and other base metals in large percentages that would contaminate the high melting range casting, thereby affecting the strength of the casting and the color of the porcelain fused to it.

WHY DO SO MANY PULPS FAIL TO SURVIVE UNDER FULL COVERAGE RESTORATIONS?

With the introduction of higher speeds with stones and burs that remove tooth structure so rapidly, the pulps of many teeth deteriorate. High speed does not mean haste. Removal of too much tooth structure in the preparation to accommodate thickness of gold and esthetic materials is a contributing factor to pulp damage. Deep-seated caries or old restorations, existing minute and undetectable pulp exposures prior to preparing the tooth, overheating, dehydrating the dentin, use of irritating drugs, damaging occlusion, and the action of the cement when permanent cementation is done before the injured dentin has laid down some protective secondary dentin are many other reasons for failure of the pulp to survive.

IS A THICKENED PERIODONTAL LIGAMENT INDICATIVE OF PAIN AND PULP INVOLVEMENT? (Fig. 595)

Sometimes such a condition indicates pulp involvement. Figure 595 illustrates the roentgenogram of a tooth that caused constant pain. Electric pulp tests on the premolars gave a vital response. The molar gold crown prevented such a test. There was no pain upon percussion. Notice the thickened periodontal ligament on the mesial root of the molar. Upon entrance into the pulp chamber through the gold crown, no pain was experienced and further excavation proved the pulp to be necrotic. (Courtesy J. Englander, New York City.)

Figure 595. Pain and pulp involvement caused by thickening of the periodontal ligament on the mesial root of the molar.

WHAT IS MEANT BY A BISCUIT BAKE RESTORATION?

It is the first fusing of the porcelain mix on the platinum matrix of the porcelain jacket, bridge, fused to gold, or porcelain inlay restorations. It is sometimes called the shrinkage bake because the first firing creates the greatest amount of shrinkage. It is always advisable to try the biscuit bake restoration on the tooth or teeth for adjustments in alignment, shape, contour, and occlusal relationship before glazing the restoration. If additional porcelain has to be added, it can only be done in the biscuit bake with the platinum in place or in the unglazed state.

WHAT CAUSES REDNESS AND INFLAMMATION IN A PALATAL OR LINGUAL BAR OF A REMOVABLE PARTIAL DENTURE WITH INTERNAL ATTACHMENTS?

(1) Incorrect occlusion, (2) scraping the working cast before waxing the bar, (3) lack of oral hygiene, (4) excessive gnashing and grinding, (5) failure to permit the saliva to bathe the area (neglecting to take the appliance out of the mouth when sleeping), (6) incorrect design and construction of the restoration, and (7) tightening the male attachments too much.

WHY IS A PORCELAIN PIN VENEER CONTRAINDICATED AS AN ABUTMENT RETAINER WITH INTERNAL ATTACHMENT?

Torque—the force or stress created by many chewing movements—tends to break the cementing medium around the pins of the porcelain veneer, causing dislodgement or fracture of the porcelain.

WHY DO ANTERIOR FIXED BRIDGES LOOK ARTIFICIAL, PARTICULARLY UNDER CERTAIN LIGHTS AND IN DARK OR DIMLY LIT ROOMS?

The metal framework of a fixed bridge affects the color of the porcelain to make the restoration conspicuous. Furthermore, the porcelain or acrylic resin attached to the metal does not possess the same resorbing and reflecting qualities as the natural teeth or those on an artificial removable or complete denture without metal struts or frames.

IS A FACE-BOW REGISTRATION NECESSARY IN OCCLUSAL REHABILITATION?

No. However, it is advisable to use a face-bow as well as an anatomical articulator plus registrations for transfer because such procedures will orient the working cast closer to the position of the jaws in relation to the skull. This makes for minimum adjustments in the completed restorations.

WHAT ARE THE AVAILABLE PORCELAIN FUSED TO METAL MATERIALS, THE MELTING RANGES OF THE METAL, AND THE FUSING POINTS OF THE PORCELAIN?

	Melting Range	*Porcelain Fuses*
Ceramco SR 165	2100°–2150° F.	1800° F.
Ceratex (NuDent)	2150°–2240° F.	1800° F.
Ney P-16	2020°–2170° F.	1650° F.
Micro-Bond Gold	2150°–2200° F.	1800° F.
Stern MF-Y Gold	2150°–2200° F.	1800° F.
Noble Metals 1732	2150°–2240° F.	1800° F.
Noble Metals J (extra hard)	2130°–2220° F.	1800° F.

WHEN DOES A CLASP REMOVABLE PARTIAL DENTURE RECEIVE PREFERENCE OVER ONE WITH INTERNAL PRECISION ATTACHMENTS?

(1) When the abutment teeth are intact, and there are no caries or restorations, (2) when the abutment teeth are very short, and (3) when the cost is an important factor to the patient.

WHEN THERE ARE A FEW REMAINING TEETH IN THE UPPER JAW, WHAT WOULD BE THE PRACTICAL DESIGN FOR THE REMOVABLE PARTIAL DENTURE?

A full palate acrylic (or metal) partial denture is the design indicated. With such a design, the partial gets maximum tissue support and there is less strain upon the few teeth. Other advantages of the full palate are these: (1) a tooth can be added to the partial should the patient lose a tooth, (2) the patient becomes accustomed to the full palate for an eventual complete denture, and (3) if the palate of the restoration is acrylic resin, the cost is low—a benefit to the patient with few remaining teeth.

WHAT ARE THE FACTORS TO BE CONSIDERED WHEN TAKING THE SHADE FOR ANY ESTHETIC RESTORATION?

1. The kind and intensity of light under which the shade is taken.
2. The type and kind of restoration.
3. The color of the walls which affect the color of the teeth. The natural tooth picks up some of these outside colors and the true shade of the tooth cannot be taken. (The walls should be a flat ivory color with a touch of red or pink.)
4. Lip rouge on the patient's lips.
5. The position of the patient so that no shadows are cast upon the teeth.
6. The condition of the shade guides. Sometimes sterilization of shade guide teeth and stems alters the original colors. Wash the shade guide teeth with soap and water and then sterilize them in cold germicidal solution that will not affect the aluminum stems such as Benz-All or Cetylcide.
7. The approximating and opposing teeth. All natural teeth in one mouth are not of the same color and variance in shades of teeth contributes to difficulties in obtaining an acceptable shade for the patient.
8. The color and condition of the surrounding gingiva.
9. Whether the restoration is to be one unit or several adjacent restorations. A single porcelain crown is difficult to construct so as to match both approximating teeth of different hue.
10. Whether the tooth is pulpless or possesses a gold core.
11. Age of the patient.
12. Eye fatigue. After minutes of trying to obtain an acceptable shade, the eyes become strained and color matching becomes extremely difficult. The operator is advised to rest his eyes, away from the patient, for five or ten minutes before resuming attempts to take the shade.
13. The wishes of the patient.

DOES THE SHORTENING OF THE NATURAL CLINICAL CROWN BY EXCESSIVE WEAR REDUCE THE VERTICAL DIMENSION OF OCCLUSION?

In most instances, any reduction in the heights of natural teeth by bruxism is compensated for by the stimulated growth of alveolar bone and tissue plus the continual eruption of the teeth. However, when the reduction by wear is so rapid as not to keep pace with the growth of bone and continual eruption of the teeth, the vertical dimension of occlusion is reduced (Fig. 289).

OF WHAT SIGNIFICANCE IS THE 2 TO 3 MM. AVERAGE INTEROCCLUSAL SPACE?

The 2 to 3 mm. interocclusal (freeway) space measurement is an average space which does not necessarily apply to the individual. This average measurement may be used as a starting point when restoring a lost, collapsed, or reduced occlusion or when complete dentures are required. The interocclusal space varies in most cases between 0 and 10 mm. It may be even more. Tolerance, function, comfort, swallowing, esthetics, and speech are the final indications for obtaining the individual's nearly correct interocclusal (freeway) space.

WHEN CEMENTING FIVE OR MORE APPROXIMATING PORCELAIN JACKET CROWNS WHY DOES THE LAST CROWN FREQUENTLY FAIL TO BE SEATED PROPERLY?

When the platinum matrix is removed from a completed porcelain jacket crown, that crown is 1/1000 inch shy of the preparation because the platinum matrix is that thickness. The completed restoration can be moved that distance mesially or distally. When two or three crowns are cemented, one at a time, the discrepancy is overcome by holding the three inserted crowns in place with the fingers. But when many porcelain crowns are cemented, one or two at a time, there is the possibility that each crown is pushed 1/1000 inch in the same direction. The last crown will not have sufficient room to slip over the preparation. To prevent this occurrence, dry all the preparations and put all the crowns in place. Have the assistant mix cement for one or two jacket crowns and cement them in place while the other approximating jackets are held in position. When the cement is set, remove all the excess and proceed with the next crown or two, still with the remaining uncemented restorations in place on the teeth. Repeat the procedure until all the crowns are cemented. With this method, each porcelain jacket finds its correct position and alignment.

WHAT ARE THE CONTRAINDICATIONS FOR FIXED PARTIAL DENTURES?

According to Steiger and Boitel the contraindications are these: (1) Excessive width of the edentulous area in connection with an insufficient number of healthy abutment teeth. (2) Too large a span. (3) Periodontal disturbances due to poor oral hygiene habits or inaccessibility of the soft tissues surrounding the abutment teeth. (4) Excessive bone loss and tissue loss from operations, extractions, or various forms of atrophy. (5) Doubtful prognosis for certain abutment teeth in connection with the periodontal condition or devitalized status of the roots. (6) Esthetics.

WHAT ARE THE PRIMARY REASONS FOR GINGIVAL INFLAMMATION IN A REHABILITATED DENTITION HAVING FULL COVERAGE AND FIXED PARTIAL DENTURE RESTORATIONS?

(1) Mutilation of gingival tissues and severance or peeling of the epithelial attachment during the preparation. (2) Mutilation by careless band technique when taking the impression. (3) Overextension of the cervical margins of the crowns into

the gingival crevices. (4) Overcontour of the esthetic facing of the veneer or porcelain fused to gold crowns. (5) Incorrect occlusion. (6) Poor oral hygiene habits. (7) Ill-fitting crowns and temporary restorations. (8) Restorations not compatible with uncontrollable bruxism. (9) Retention in the gingival crevices of hard materials, such as zinc oxide and eugenol paste or regular cement which has hardened.

WHAT IS THE PROCEDURE FOR REHABILITATING A DENTITION IN A PATIENT OF TEEN AGE? (Fig. 596)

It is advisable to limit full coverage restorations in such a young patient. All the old unsatisfactory alloy restorations should be removed and restored with either gold inlays or new amalgam restorations, meticulously inserted. If possible, this should be accomplished under the rubber dam. The occlusal relationship should not be disturbed. If esthetics is of paramount importance, four jacket crowns on the maxillary incisors are recommended.

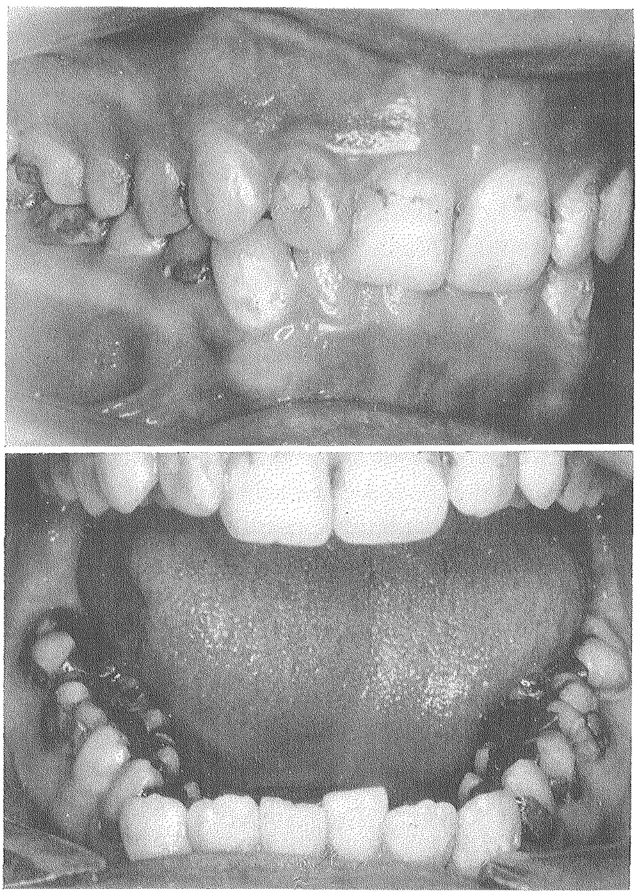

Figure 596.

HOW CAN THE DENTIST RECOGNIZE AN INTERFERENCE IN OCCLUSION?

Interferences are responsible for certain manifestations which the operator can recognize. The patient may complain of pain in the tooth or gingival tissue around a tooth. The surrounding tissue may appear red and inflamed. The roentgenogram may disclose bone loss. There may be pain and discomfort in the temporomandibular joint areas because of an abnormal shift of the mandible, creating a muscle spasm or a strained ligament. Sometimes the cementum of the tooth is unusually exposed or the tooth may be mobile.

WHAT IS RESPONSIBLE FOR THE SPREADING OF THE FEMALE ATTACHMENT?

Repeatedly biting the removable partial denture into position will distort the female boxing. The patient should be instructed to insert the denture with the fingers and never by the opposing teeth. Incorrect occlusion is another reason for spreading the female attachment because excessive force upon the male attachment will exert a lateral force in the boxing.

WHAT IS RESPONSIBLE FOR LOOSENING OF A MALE ATTACHMENT?

Frictional wear of the attachment during mastication and the constant removal and insertion of the partial denture are the main reasons for loosening of the male attachment. When the female attachment spreads, obviously the male attachment becomes loose.

WHY ARE SILVER POINTS CONTRAINDICATED IN PULPLESS TEETH TO BE USED FOR CROWNS?

Most pulpless teeth have a tendency to fracture at the cervical border when full coverage restorations are inserted over prepared pulpless teeth. A gold post or core is recommended in order to brace the coronal and root portions of the restored tooth. A silver point inserted by the endodontist is difficult to remove in part. The canals should be wide and filled with gutta percha points so that a portion of the filled canals can be removed for the reception of the post or gold core. However, a small segment of a silver point can be cemented at the end of the treated canal and the remainder filled with gutta percha, or even left free.

WHAT FACTORS DETERMINE, IN THE FINAL ANALYSIS, THE OCCLUSAL DESIGNS OF RESTORATIONS?

1. The occlusal forms of the opposing teeth.
2. The chewing contact movements.

3. The rubbing or contacting movements of bruxism.
4. The degree of the horizontal overlap.
5. The incisal guide angle.
6. The marginal ridges of the opposing and approximating teeth.
7. The material the restoration is made of (fused porcelain limits occlusal carvings).

WHAT ARE THE OBJECTIVES IN OCCLUSAL REHABILITATION?

The primary objectives should be these: (1) optimum function, (2) compatibility with the osseous and neuromuscular asymmetries, uncontrollable rubbing habits, muscle memories, (3) improved esthetics, (4) no impediment in speech, (5) elimination of pain and discomfort, (6) retention of the remaining teeth and restorations for as long a time as possible under the conditions, (7) comfort and tolerance of the restorations, and (8) a healthy periodontium.

IN THE PREPARATION OF A PROXIMAL SHOULDER OR FINISHING LINE, HOW DOES ONE PREVENT LACERATION OF THE INTERDENTAL PAPILLA WHEN USING A DISK?

Direct the disk in such a manner that the shoulder or finishing line follows the natural contour of the interproximal gingiva, not the labial gum. The interproximal tissue is not at the same level as the labial or buccal tissues.

WHAT ARE ADVANTAGES AND DISADVANTAGES OF FULL COVERAGE RESTORATIONS IN OCCLUSAL REHABILITATION?

Some advantages are the following: (1) they are more retentive than any other type of restoration, (2) they are very esthetic when porcelain or acrylic resin is used, (3) they improve occlusal function and the anatomic contour of some teeth, (4) they minimize the possibility of loss of many teeth (badly broken down), and (5) they are excellent as abutment retainers in large span fixed partial dentures, splints, and abutment retainers housing internal attachments for removable partial dentures.

Some disadvantages are these: (1) the possibility of damage to the pulpal tissue during the preparation because too much of the protective tooth structure has to be sacrificed, (2) the opportunity for gingival irritation and inflammation if the cervical margins are overextended, (3) leakage at the margins permitting the invasion of harmful bacteria, causing caries, (4) the objectionable display of metal in full cast and in veneer crowns, and, (5) acrylic resin tends to discolor and abrade readily and porcelain is prone to fracture.

IN A TOOTH PREPARED FOR A FULL COVERAGE RESTORATION, WHY IS THE SHOULDER OR FINISHING LINE SOMETIMES CONCEALED BY GINGIVAL TISSUE WHICH APPEARS TO HAVE GROWN OVER THE MARGIN BY THE TIME THE COMPLETED CROWN IS READY FOR CEMENTATION?

Ill-fitting and border-shy temporary crowns are responsible for the exacerbation of inflamed gum tissue. The gum is inflamed because food debris collects in the trough created between the shy temporary crown and the once healthy gum. The operator should cut, festoon, and fit the temporary crown up to the border of the preparation and be sure to remove all hardened acrylic and temporary cement.

BY THE SAME TOKEN, WHY DOES SOME GINGIVAL TISSUE RECEDE, EXPOSING UNPREPARED TOOTH STRUCTURE OR ROOT PORTION, A WEEK OR SO AFTER PREPARATION AND JUST BEFORE THE RESTORATION IS TO BE CEMENTED?

Stripping the epithelial attachment with the disk during the preparation as well as overextension of the temporary crown is the primary reason for exposure of tooth structure beyond the shoulder or finishing line in the preparation. Severing the attachment with caustic drugs or with electronic loops is another reason because the gingival tissue heals at a different level. Stripping the attachment may take place by improper copper band technique when taking the impression by pushing the band far beyond the shoulder or finishing line. Hardened temporary cement left in the gingival trough is responsible for tissue damage beyond normal repair, resulting in exposure of unprepared tooth structure.

WHAT PROCEDURES ARE RECOMMENDED FOR THE INSERTION OF A REMOVABLE PARTIAL DENTURE HAVING INTERNAL ATTACHMENTS AND ABUTMENT RETAINERS? WHEN AND HOW ARE THE RETAINERS CEMENTED WITH OXYPHOSPHATE OF ZINC CEMENT?

When all the restorations are completed, the abutment retainers are inserted with a small amount of a zinc oxide and eugenol mixture in which some petrolatum or oil has been incorporated to prevent hardening of the mix. The patient is then dismissed, with instructions to appear the next day. All adjustments are made during the next few days until the occlusion is correct and the denture bases do not impinge upon the tissues. Discomfort in the sensitive prepared teeth is allayed by the eugenol present in the zinc oxide vehicle. During this period the patient must not remove the partial denture. When permanent cementation is indicated, the operator dries the prepared teeth and decides which abutment retainers are to be cemented first. It is recommended that those retainers diagonally opposite be cemented first while the remaining ones are merely seated on the prepared teeth without any medium. Place the partial denture in position immediately and hold in occlusion until the cement in the two retainers is completely set. It is a good procedure to put a drop of thin lubricant around the male and female attachments (be sure not to get any oil in the retainer or on the prepared tooth) to prevent cement from adhering to the attachments and making it difficult to remove the partial denture. After the cement is set, remove the denture and uncemented retainers. Clean off all excess cement around the cemented crowns, prepare the remaining abutment teeth for cementation, and cement these in the same manner. Never attempt to cement all the retainers at one time and do not cement the retainers without the partial denture in position in the mouth. At the next appointment, the patient is instructed in the removal and insertion of the partial denture.

WHEN DOES ONE CHANGE THE EXISTING OCCLUSION IN REHABILITATION OF THE DENTITION?

When function is impaired and when periodontal involvement is the result of the incorrect occlusal relationship; when pain in the temporomandibular joint areas exists because of the occlusion; when esthetics is necessary for the psychologic welfare of the patient.

CAN REHABILITATION PROCEDURES AND ALTERING THE OCCLUSION IMPROVE UPON A RETRUDED MANDIBLE?

Rehabilitation procedures with crowns and bridges cannot grow or reduce a chin. Increasing the vertical dimension of occlusion beyond the physiologic rest position and projecting the retruded chin forward by raising the bite will end in failure.

WHAT TYPE OF FIXED PARTIAL DENTURE IS INDICATED FOR THE REPLACEMENT OF FOUR INCISOR TEETH?

If the occlusion permits, porcelain fused to gold bridge is the restoration of choice. Esthetically it is acceptable and durability is its outstanding feature. When the occlusion does not permit this type of restoration, then the acrylic veneer retainers and gold lingual areas on the pontics are recommended. The span is too great for three-quarter crown retainers. In some dentitions, the use of double abutment retainers, the canines, and the first premolars is advisable.

WHY DO SOME REHABILITATED OCCLUSIONS MAKE CLICKING SOUNDS WHEN THE PATIENT SPEAKS?

Clicking noises are primarily due to a decrease in the patient's original inter-occlusal (freeway) space brought about by raising the bite.

DOES THE REMOVAL OF ALL REMAINING NATURAL TEETH ELIMINATE BRUXISM?

Everyone rubs his teeth together; some do this more than others. The symptom of bruxism more often than not is due to apprehension and nervous tension or anger and is frequently uncontrollable. If the bruxism is begun in an edentulous mouth with dentures, the symptom is no doubt due to the wrong occlusion and the interferences on some artificial teeth. Correcting the occlusion usually eliminates the bruxism. However, uncontrollable bruxism because of neurotic tendencies will remain with the patient after the loss of the natural teeth and the insertion of complete dentures.

SHOULD SILVER NITRATE BE USED ON PREPARED TEETH?

Silver nitrate is not a self-limiting drug and persists in its action even after the application of eugenol. The dentinal tubules of the prepared tooth or the ones with deep-seated caries are wide open after radical reduction of tooth structure or deep excavation of decay. Application of an irritating caustic drug does more harm than good. Englander, James, and Massler subjected 26 carious human teeth to a standard series of applications with silver nitrate, ammoniacal, and plain. Histologic examination revealed that silver nitrate frequently damaged the pulp. The odontoblasts were disrupted with increasing degrees of inflammation and edema of the pulp as the silver nitrate came closer to the pulp.

IN LONG ANTEROPOSTERIOR FREE-END SADDLES SUPPLYING ALL THE POSTERIOR TEETH, WHAT TYPES OF INTERNAL ATTACHMENTS ARE INDICATED FOR THE REMOVABLE PARTIAL DENTURE?

An extra-long Baker internal attachment on the premolar or canine abutment teeth, coupled with a lingual arm and accessory lock-in devices in the retainer. On occasion, multiple abutments joined in the form of a splint of the anterior teeth may be indicated. Lock-in devices from the lingual or palatal bar can fit into corresponding receptacles on the lingual surfaces of the splint. I do not recommend a cantilever pontic of each end of an anterior splint. The bases of the free-end saddles should cover as much of the saddle areas as possible and extend up onto the retromolar pads if the occlusion permits.

WHAT IS A CHECKBITE AND WHAT IS ITS PURPOSE?

In occlusal rehabilitation, the restorations are constructed on an articulating instrument with or without a face-bow recording. Due to many variables in any procedure of transferring working casts to the articulator, centric and protrusive records may be inaccurate. A checkbite is a new recording of centric relation using wax, plaster, zinc oxide and eugenol paste, or acrylic resin or even silicone with the unfinished restorations on the teeth. Centric relation and centric occlusion with the trial restorations in the mouth should occlude almost the same as they do on the articulating instrument. The new checkbite is then transferred to the articulator on which gross corrections can be made. Final occlusal discrepancies can be corrected directly in the mouth.

WHAT ARE THE SKIN ERUPTIONS AT THE CORNERS OF THE MOUTH AFTER SOME REHABILITATED DENTITIONS AND HOW ARE THEY TREATED?

Perlèche is a mild, superficial, sometimes red, inflamed fissure-like eruption that occurs at the angles of the mouth. It is very annoying to the patient. It sometimes occurs after prolonged dental treatment when the mouth is stretched wide and instruments and trays are inserted. Mouth breathing during sleep and lack of vitamin B contribute to this condition. Application of the following ointment, as frequently as is possible, is of value:

Acid salicylic	2.0 parts
Lanolin	7.5 parts
Petrol. Alb.	7.5 parts
Ungt. aqu. rosae	15.0 parts

SHOULD ALL FIXED RESTORATIONS SUCH AS CROWNS, BRIDGES, AND SPLINTS BE CEMENTED WITH A TEMPORARY CEMENT INDEFINITELY AND THE RESTORATIONS REMOVED PERIODICALLY FOR EXAMINATION OF THE TISSUES AND PREPARED TEETH?

Inasmuch as there isn't any positive temporary zinc oxide and eugenol cement unless petrolatum or its equivalent is added to prevent hardening of the mix, the restorations are prone to become loose and even dislodge or disturb the occlusion. Furthermore, to check the restorations on all rehabilitated cases periodically, let us say every three months, is a time-consuming burden for the operator. The abutment retainer of a fixed bridge may loosen in the intervening period, without the patient becoming aware of the condition. The prepared tooth may become exceedingly sensitive and food debris collects so that the tissues become inflamed. Furthermore, constantly removing and replacing restorations as a routine procedure is detrimental to the teeth. Depending upon the individual case and the condition of the prepared teeth, restorations should be cemented permanently as soon as possible.

SHOULD AN OLD INCOMPLETE ROOT CANAL FILLING BE RETREATED WHEN THE PULPLESS TOOTH IS TO REMAIN IN THE MOUTH AND PRESENTS NO RECOGNIZABLE ADVERSE CONDITION?

Incomplete root canal filling does not necessarily signify a pathologic condition. Usually attempts to remove such canal restorations stir up an irritation, possible perforation of a canal, or even fracture of a root or root canal instrument. When the tooth must be removed after such attempts at correction, the patient becomes upset because the particular tooth presented no discomfort prior to attempts to remove the filling material. Some operators believe that no pulpless teeth incompletely filled should remain in a mouth that is to be rehabilitated. It should be up to the operator to make that decision after explaining to the patient what may happen.

WHAT ARE THE CARDINAL STEPS IN EXAMINING A DENTITION REQUIRING OCCLUSAL REHABILITATION?

1. Full series of roentgenograms.
2. Full mouth impressions with alginate material for study casts.
3. Measure and record the existing interocclusal (freeway) space if possible.
4. Face-bow registration and mounting the study casts on an anatomical articulator.
5. Chart all existing old restorations and conditions.
6. Pulp test all teeth when possible.
7. Record existing abnormalities.
8. Examine and record periodontal conditions.
9. History of physical health and previous dental treatment.
10. Evaluation of behavior.
11. Chart missing teeth.
12. Record surfaces worn by bruxism.
13. Note swallowing habit which may cause forward movement of anterior teeth.
14. Chart different gum levels.
15. Chart degree of the vertical and horizontal overlaps.
16. Chart incisal guide angle.
17. History of any pain or discomfort.

WHY IS A CANTILEVER PONTIC AT THE END OF A LARGE SPLINT OR FIXED BRIDGE IMPRACTICAL TO SUPPORT A REMOVABLE PARTIAL DENTURE WITH INTERNAL ATTACHMENTS?

Any cantilever pontic at the end of a fixed splint is contraindicated in most instances. Clinical observation indicates that the last abutment retainers, attached to the free-end pontic, loosen sooner or later. Torque, the force created in chewing, breaks the cementing medium in the retainer. The entire restoration posterior to the last retainer seems to pivot at the ends where the cantilever pontics are soldered. Once the cementing medium breaks away, food debris collects and caries sets in.

WHY SHOULD PERIODONTAL TREATMENT BE COMPLETED BEFORE REHABILITATING A DENTITION?

Unless the gingival tissues have been put in a healthy state prior to rehabilitation, the gingivae will not react favorably to the restorations and will become increasingly inflamed. Once the dentition has been treated it is impractical to attempt to treat the worsened condition around the crowns and bridges. New periodontal problems appear because of the type and contour of the restorations, splints, and the lack of oral hygiene.

WHEN A FIXED SPLINT IS PLANNED, WHICH TYPE AND OF WHAT MATERIAL IS ADVISABLE?

The splint which has the solder connections near the incisal and occlusal areas is the type of splint preferred. The interproximal spaces are free and can be kept clean because of accessibility. The interdental papillae can be stimulated with the toothbrush or Stimudents. This limits the splint to either one constructed of veneer crowns with acrylic or porcelain facings or three-quarter crowns. Large splints should be broken up into sections and connected with precision rests or lock-in devices.

WHAT COMPONENTS MAKE UP A HARMONIOUS OCCLUSION?

1. Centric occlusion and centric relation of the teeth and jaws.
2. Physiologic rest position.
3. Interocclusal (freeway) distance, an individual phenomenon.
4. Individual mandibular movements, rubbing, chewing, swallowing, speaking, smiling, protrusive, side protrusive, lateral, vertical and circular.
5. Function.
6. Esthetics.
7. Neuromuscular system.

8. Occlusal planes, maxillary and mandibular.
9. Incisal guidance.
10. Occlusal table and occlusal carvings.
11. Periodontium.
12. Temporomandibular joints and their components.
13. Compatibility with uncontrollable habits, asymmetries, and muscle memories.

WHAT HIGH SPEED EQUIPMENT IS AVAILABLE?

1. Air-turbine and Air-bearing types.
2. Motor driven standard engine, convertible to high speed by belt drives.
3. Electronically controlled, miniature motor type (Fig. 597).

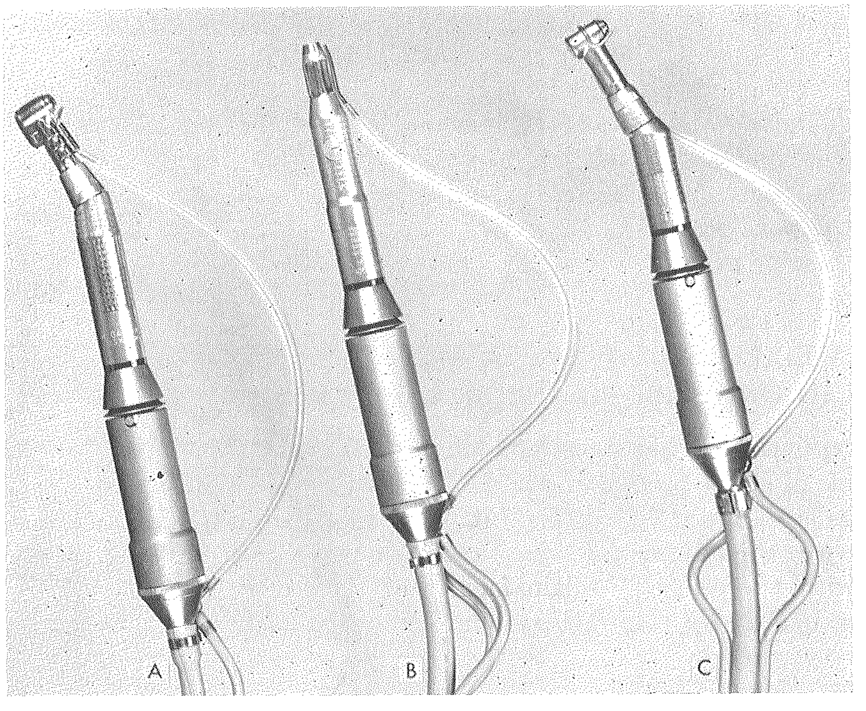

Figure 597. The S. S. White Electronic Handpiece System. *A*, Contra-angle, 4000 to 40,000 r.p.m. *B*, Straight handpiece, up to 40,000 r.p.m. *C*, High speed, up to 120,000 r.p.m. At a speed of 120,000 r.p.m. the instrument stops instantly when the foot releases the switch—an important safty factor. All air turbines coast after the foot switch shuts off. There is better control at this speed and the operator can apply pressure because of the high torque, resulting in a better preparation.

Reference

1. Orban, B.: Biologic consideration in dentistry. J.A.D.A., *28*:1079, 1941.

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Page numbers in *italics* refer to illustrations