Partial Dentures

A Textbook for the Practitioner by
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Prof. Dr. med. Dr. med. dent. François Ackermann, Emeritus Director of the University of Geneva Dental Institute, Past President of the International College of Dentists

I am particularly pleased to write the foreword to this new work on "Partial Dentures".

Prof. Schön and Prof. Singer are both well known for their publications in the field of prosthetic dentistry. One has only to remember their remarkable book "Aesthetics and Rehabilitation in Dentistry". Prof. Singer is also the author of the book "La ricostruzione del combaciamento in protesi" (The Prosthetic Rehabilitation of the Occlusion). Those of our colleagues who attended the lectures on prosthetics during the Milan Dentistry Congress in December 1961 will remember Prof. Singer's classical films and the excellent lecture by Prof. Schön, two presentations based on long experience and careful research.

As esteemed prosthetists who speak several languages, are well travelled, and who have experience in lecturing and in further education, these two colleagues are well qualified to present the results of their scientific observations and practical experiences to the dental profession.

In this book the authors discuss the biomechanic, biostatic, aesthetic, phonetic and functional requirements for a partial denture. They emphasize the importance of quality and precision in clinical and laboratory work; they describe diagnosis, impression taking, the choice of articulator, the indications for a fixed denture, the choice of clasps, attachments and the modern prosthetic and paraprosthetic elements.

Everyone who is aware of the complicated nature of this subject and the difficulties and requirements involved in a biofunctional, aesthetic prosthesis can only congratulate the authors on their accomplishment. This book will be of interest to the student as well as the practitioner, because it discusses and critically reviews topical, controversial, and basic problems. For this reason it deserves the attention of the dental world.

Geneva, February 1964

The success of "Aesthetics and Rehabilitation in Dentistry", the authors' first joint book, has induced them to write a textbook on modern prosthetic dentistry. The writers have pooled their many years of experience and their considerable knowledge. In this way they hope to guide the practitioner and help him improve his clinical results.

Oral procedures and important laboratory techniques are clearly demonstrated by numerous pictures. These illustrations are designed to emphasize principles of treatment planning, which are more important than pureley technical matters.

Since a denture rests on living tissues, biological considerations are stressed in later chapters.

1. The Concept of the "Maxillofacial Unit"

HÄUPL feels that a partial denture requires support from teeth and periodontal tissues, together with support from the alveolar tissues. BOITEL takes a wider view in that partial prosthetic dentistry includes everything which does not belong to the realms of complete denture prosthetics.

Substitution of artificial teeth presents both technical and biological problems. The prosthetist faces the problem of fitting an inactive mechanical structure into a dynamic system. The denture has to replace lost functions and blend with the whole maxillofacial unit.

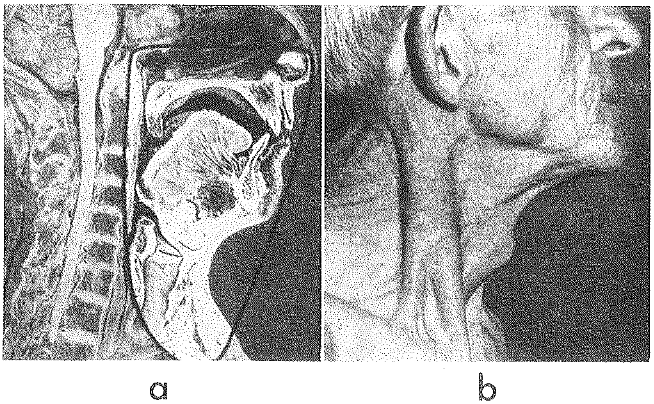


Fig. 1. The "maxillofacial system" in the form of a pyramid. (a) The lines of the pyramid drawn on an anatomical section; (b) The surface anatomy of a living person.
(From "Anatomy of the Mouth and Related Structures" by Alexander L. Martone, Norfolk (Va.) and Columbus (Ohio); Journal of Prosthetic Dentistry, Vol. XII, Jan.-Feb. 1962, No. 1.

The oral cavity lies in a pyramidal-shaped area. The base of the pyramid joins both ears and the nose, while the apex touches the sternum (Fig. 1).

Within this area are the tissues and organs responsible for chewing, swallowing, breathing, talking and facial expressions. This multitude of interrelated functions has persuaded us to go further than the usual conception of the "organ of mastication", and to introduce the wider conception of the maxillofacial system (SCHÖN).

This maxillofacial system contains many units. It contains the teeth, periodontal tissues, oral musculature and the temporomandibular joints. Jaw relationships, occlusal relationships and facial musculature must be considered as well. Even the denture must be regarded as an element of equal value. These components are so closely interrelated that the failure of one unit will effect the whole system. We have therefore extended the idea of the "organ of mastication".

A denture may improve or spoil a patient's appearance. A poorly retentive complete denture will cramp the muscles of facial expression, as will defects in the region of the upper anterior teeth. The facial harmony depends on the vertical relations. The prosthetist can improve a patient's appearance, a most important factor in the patient's life.

A large tongue can influence the form of the jaws, affect the position of the teeth, interfere with the stability of complete dentures, and hinder speech. Developmental maxillary defects (cleft palate, harelip), loss of teeth and prosthetic measures will also affect the speech. Maxillary deformities, if not treated, may cause psychological disturbances.

It can now be seen that an understanding of the anatomy and physiology of this pyramidal-shaped area represents a basis for treatment planning.

2. The Dentist and the Dental Technician

A prosthetist needs more than mere technical skill. He also requires a considerable knowledge and an understanding of the materials he uses. Experience, skill and self-criticism contribute to success.

The dentist and the dental technician must work as a team. The planning is left to the dentist, because he alone can evaluate the condition of the oral structures. A highly polished casting is useless if it cannot be fitted into the dynamic system of the oral cavity.

McCRACKEN recently carried out an interesting experiment. He sent the same casts of a partially edentulous mandible (KENNEDY Class II, modification 1) to 38 different industrial laboratories. A design of a unilateral free-end saddle was requested and he analysed the designs or the finished work.

He found considerable differences in thickness, form and position of the lingual bar. The relations of the lingual bar to the mucosa differed and there were numerous variations of clasp design.

The design of each partial denture must therefore be based on an exact knowledge of oral conditions. The dentist should be responsible for the construction of a denture with which he hopes to restore the patient's occlusion.

Important factors such as age, tissue reaction, face form, skin colour, chewing, etc. must be considered. The technician is in no position to appreciate these factors. The denture will be covered by soft oral tissues whose contour will be influenced by the artificial teeth; this may affect the whole facial appearance. For example, it is well known how anterior teeth affect the labial fullness.

Ideally, the dentist should have his own technician nearby, so that they can discuss the treatment while the patient is there. Different arrangements of teeth should be tried in, to study the effect of lip movement, and the appearance under artificial as well as natural light. The relation of the shape and size of the teeth to the patient should be considered as well.

3. Classification of Spaces

CUMMER has calculated that more than 113,000 variations of spaces are possible. A classification is therefore required for systematic diagnosis and planning of treatment. However, a simple classification cannot be suggested to take the opposing occlusion or jaw relationships into account. These must be considered before a diagnosis is made.

The KENNEDY classification is simple and effective. The four main classes cover all types of spaces. The most distal gap determines the class. Further possible gaps are registered as modifications.

CLASS I

Bilateral free-end gaps.

CLASS II

Unilateral free-end gaps.

CLASS III

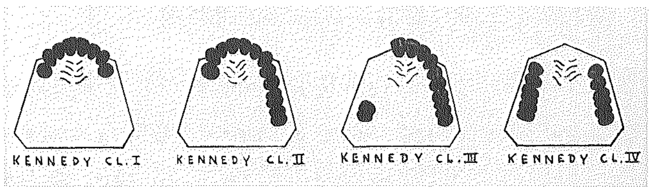
Bounded gaps.

CLASS IV

Anterior bounded gaps. There are no modifications in this class. A modification would alter the class.

Missing wisdom teeth are not taken into account for classification purposes; neither are missing unopposed second molars. This classification does

Fig. 2. Diagram.



not imply a standardization of prosthetic treatment. The correct method is only decided by consideration and analysis of the occusal, periodontal, bone, and mucosal conditions. In other words, all the tissues of the mouth must be considered together.

For example, take a KENNEDY Class II situation where only the molars are missing. If oral conditions are good, a unilateral denture can be made. However, if there is a gap on the other side, it must be used to stabilize the denture. Let us take another case in which there has been bilateral distal loss of teeth (Class I). There may be a small anterior gap as well. In this situation, firm splinting of the remaining teeth is the only solution. Attaching the anterior bounded saddle to the bilateral free-end saddle denture would lead to loosening of the abutment teeth.

4. Evaluation of the Transitional Mucosal-borne Partial Denture

The requirements of a partial denture are as follows:

1. Function (movement, chewing and speaking).
2. Aesthetics (natural appearance, no visible metal).
3. Durability (preservation of remaining teeth, maintenance of the alveolar ridge).

A denture which contains all these properties may be considered to be of good quality, while a denture lacking these properties is of poor value.

The majority of work carried out in practice lies between these two extremes.

For these reasons, the entirely mucosal - borne partial denture can only be used as a temporary

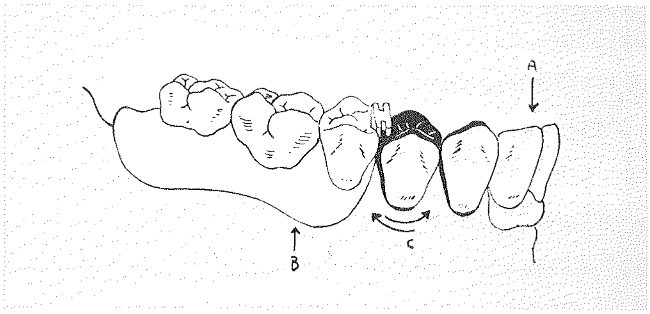


Fig. 3. Remaining teeth 44, 43, 33, 34; wrong construction, since the incisors are in the removable part of the denture. The leverage leads to loss of abutment teeth and breakages of the attachments.

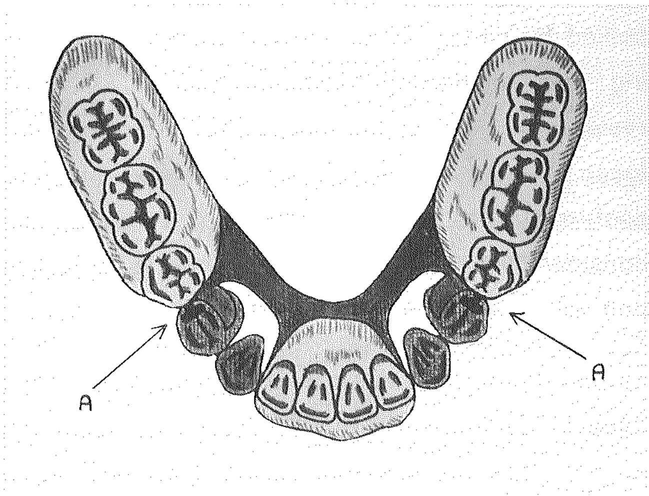


Fig. 4. The occlusal view of same case. A = attachment.

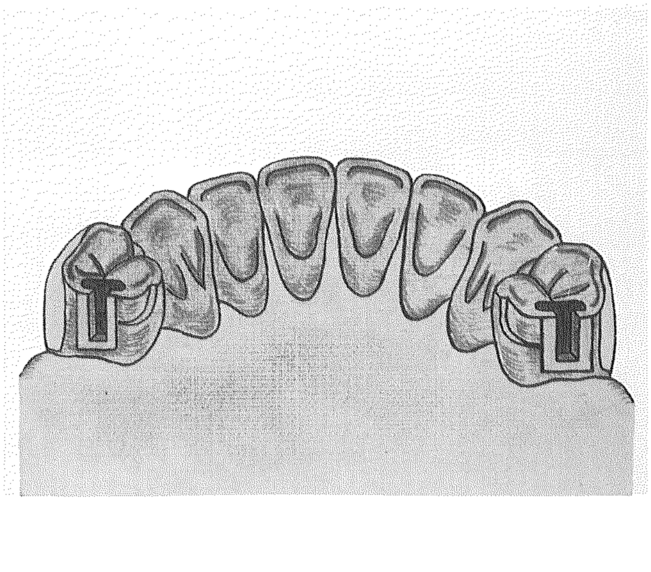


Fig. 5. Correct method: firm splinting from 44 to 34.

replacement. Its functional and aesthetic values are poor, while destruction of the remaining teeth and alveolar ridge commonly occur.

In 1952 REICHENBACH re-examined approximately five hundred partial denture wearers. These dentures had been constructed by students at the University Hospital in Halle following certain standard principles, and had been in the mouth for an average of three years. 39 % of all the dentures had sunk, and a distinct spacing in the row of teeth was evident. 10 % of all clasped teeth were attacked by caries, 40 % showed changes in retaining and supporting elements (clasps, occlusal rests), and 11 % of the clasped teeth had become loose. This rather depressing result does, in fact, confirm our practical experiences, therefore we will consider the tissue-borne partial denture no further and will proceed to more satisfactory methods.

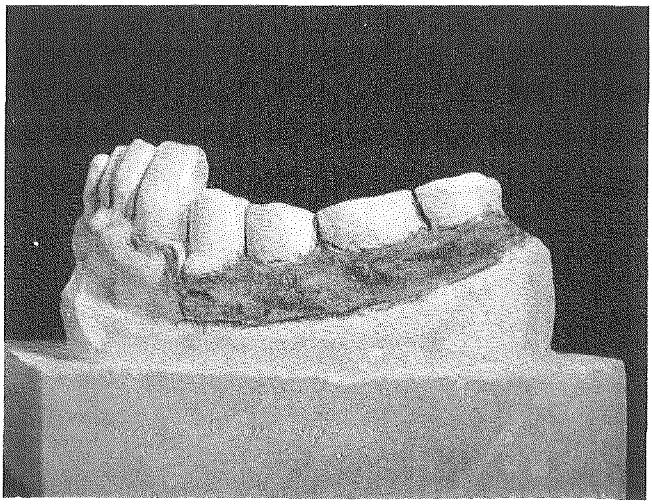
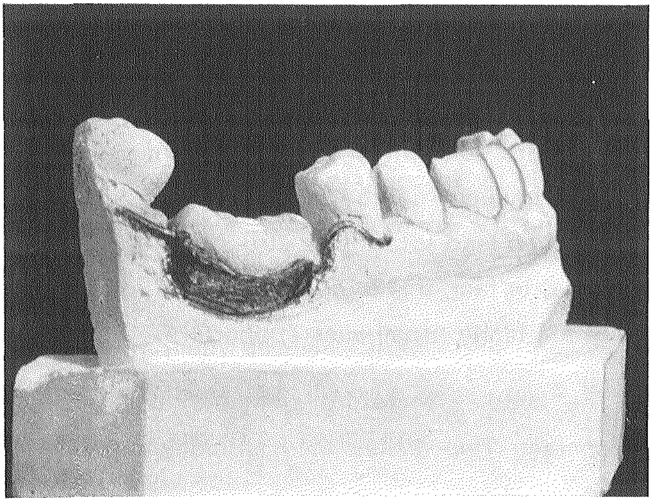


Fig. 6. Lower denture, entirely mucosal-borne.

Fig. 7. The same case, opposite side. It has sunk after two years of functioning.



5. Paradontally Supported Partial Dentures

These appliances preserve the remaining teeth and alveolar tissues, rather than merely replace lost teeth.

Occlusal pressure has different effects on the periodontal ligament of the remaining teeth and on the mucosal covering of the edentulous alveolar ridge. The teeth hardly move at all, while the alveolar tissues may be considerably displaced. In order to equalize chewing pressures, an experiment was carried out in which a hinge was fitted between the abutment teeth and the mucosal-borne saddle. However, clinical experience with joint prostheses has revealed that this construction is based on an error of thought. The results would be as follows:

1. Functional movements overstrees both periodontal tissues and alveolar ridge. This results from the binary division of the unit.

2. The free-end saddles possess a certain degree of horizontal and vertical freedom of movement. HÄUPL feels that excessive functional stimulations are started, which lead to local circulatory disturbances of the alveolar tissues. These changes lead to a faster atrophy of the alveolar bone. In fact, this is opposite to the hypotheses of the hinge prostheses supporters.
3. The saddles therefore sink and lose occlusal contact. This makes them virtually useless.

At the Dental Hospital of Milan University, two groups of 80 patients were fitted with free-end saddle dentures. One group had dentures with joint connectors, while the other group had rigidly constructed dentures. Both groups were examined after a year. Those with rigid connectors showed marked abrasion of the occlusal surfaces of the plastic teeth, a sign of use; those with joints showed

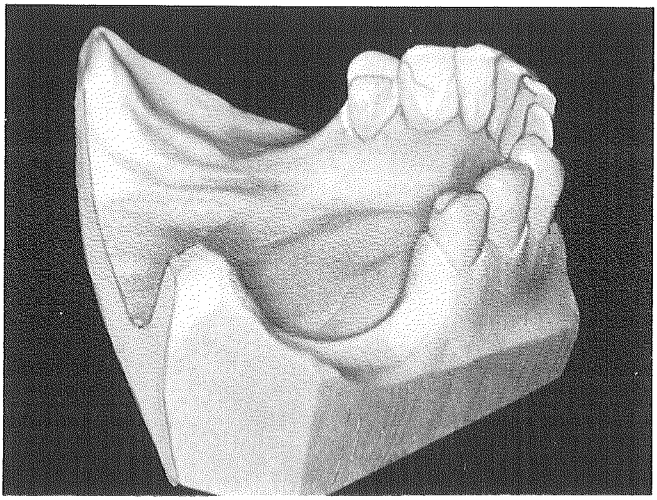


Fig. 8. Lower cast of a 48 year-old patient, who had worn a bilateral free-end denture with joints for seven years. The atrophy of the edentulous ridge has gone so far that the jaw bone is about as strong as a pencil.

heardly any wear, since the saddles had sunk and were out of occlusion. Relief of the remaining teeth had been only a pious hope.

We must remind our readers of SCHUYLER'S statements in this respect. "There are no indications for joints because:

1. Through them occlusal pressure is constantly transferred to the denture base, from which pressure should be kept away.
2. They allow the denture base excessive movement. Tissues of the alveolar ridge are overstressed and result in atrophy of alveolar bone."

Let us now analyse the above concepts. First of all a comment on the idea of resiliency — the capability of a tissue to yield to pressure. Resiliency is the degree of reaction; pressure is the action causing this reaction. It is sufficient to reduce the action to a level which does not cause a noticeable reaction.

This is the solution to the free-end saddle problem. The masticatory pressure should be correctly spread over the periodontal ligaments of the remaining teeth and the edentulous alveolar bone.

This leads to the conclusion that the old concept of resiliency is outdated. In fact, this conception has not recently appeared in American literature. In this connection HÄUPL has written:

"It is unnecessary to pay special attention to resiliency in the construction of the dentures, provided that the impression method has been correctly chosen. The problem centres around retarding the effect of denture pressure on the mucosa." Excessive functional irritations are caused when the denture saddle has freedom of movement and is therefore unprotected. This allows uncontrollable forces to be applied to the oral tissues. These excessive irritations are transferred indirectly by the denture to the alveolar base and are responsible for hastening bone atrophy.

On the other hand, rigid anchoring firmly connects the denture with the remaining teeth. The saddles are allowed no freedom of movement, which decreases their vertical displacement to a physiological level. Within this rigid system the masticatory pressure will spread evenly over the whole unit, no matter at which point pressure is applied.

The works of FRECHETTE, KAIRES and FRANCIS FISH have shown that the following rules can be applied to the free-end saddle denture: -

1. The more rigid the construction, the better the distribution of pressure and the less the deformation of the supporting tissues.

2. The remaining teeth should be splinted and the edentulous area covered as widely as possible. The larger the area covered by the saddle, the lower will be the pressure.

3. The occlusal surfaces of the artificial teeth should be reduced to a minimum. Commonly used standard types are too large. It is also

advisable not to place artificial teeth too far distally. It is suggested that in some situations the second molar be replaced by a metal wedge. The upper edge of the wedge forms a linear continuation of the occlusal surface.

ACKERMANN compares the free-end saddle with a boat. If the oarsman stands in the middle of the boat, it will remain balanced. If, however, he stands at the distal end, the boat will rock. The functional load centre of a saddle is in the 45, 35 area. ACKERMANN recommends saddle design according to the principle: "Hétéromorphie", "Hétéronombre", "Hétérotopie".

"Hétéromorphie". The form of the second lower molar is reduced by grinding off of the buccal cusps. This creates favourable subocclusal gaps.

"Hétéronombre". The last molars on the saddle are either much smaller or left out altogether.

"Hétérotopie". The artificial teeth 44, 34 are replaced by 45, 35 the cusps of which can take a higher lingual pressure; or the 44, 34 are left out altogether and the order of the artificial teeth is changed to 45, 46, 45, 43, 42, 41, 31, 32, 33, 35, 36, 35.

To summarize the advantages of rigid anchoring:

1. Simple construction, which eliminates the danger of the patient bending it.

2. Physiologically correct distribution of pressure between remaining teeth and alveolar ridges.

3. There is therefore no bone atrophy and no necessity for rebasing the saddles for four to five years, since the saddles do not have any freedom of movement.

Firm splinting of all the remaining teeth should be considered the method of choice. If the remaining teeth are periodontally weak, they should be splinted together. If the remaining teeth are strong, excessive use will have led to marked abrasion. Increasing the vertical relation can only be accomplished by a firmly fitted splint. Thus even the sound teeth can be protected.

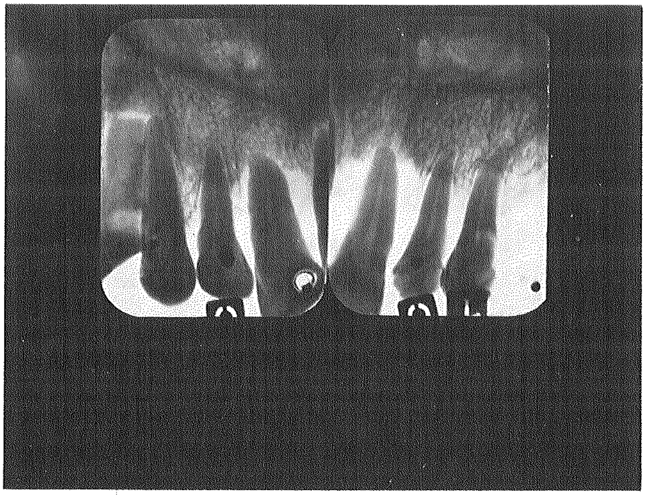


Fig. 9. Radiograph of severely damaged teeth, 13, 12, 11, 21, 22, 23. After extraction of the two central incisors, the two canines had to be devitalized because of deep caries.

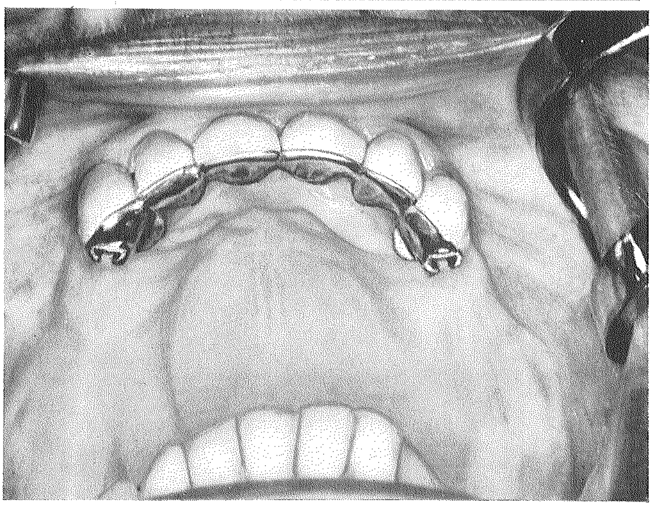


Fig. 10. Splinting of the anterior teeth with veneer crowns.

Fig. 11. Premolars and molars are replaced by a rigidly anchored (internal attachment) bilateral free-end denture.

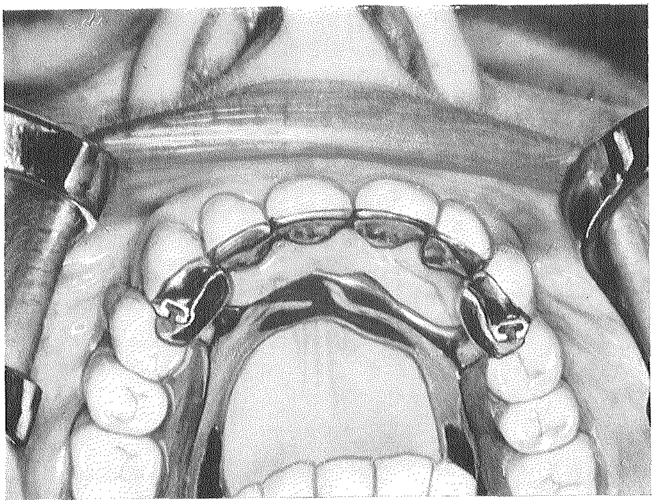


Fig. 12. Labial view of the whole construction.

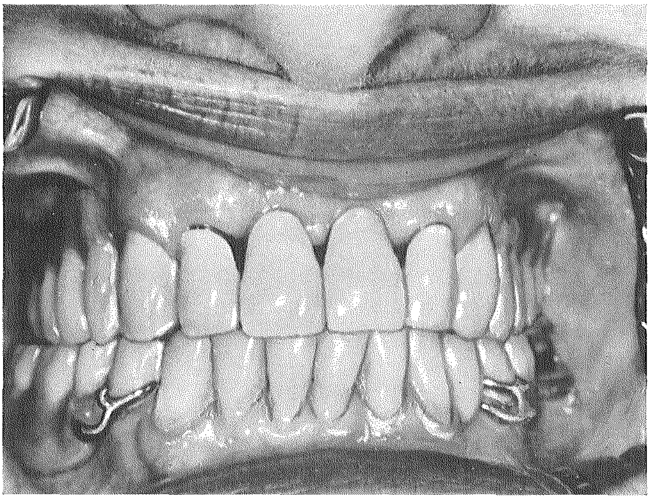
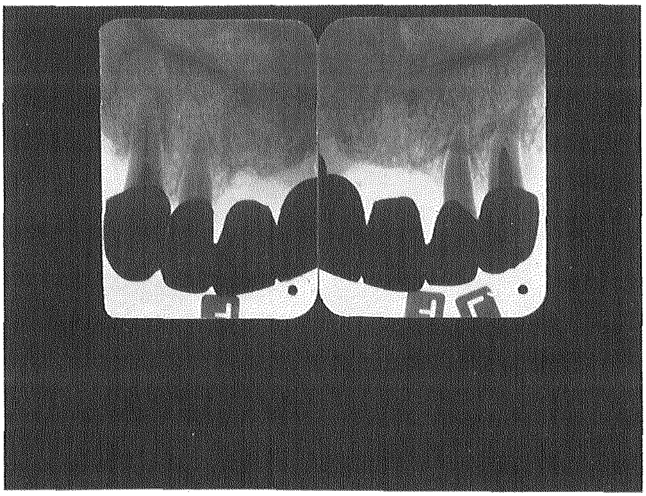


Fig. 13. Radiographic examination after four years. Nothing was found wrong with the periodontal condition of the abutment teeth. No rebasing of the saddles was necessary.



1. Examination and Diagnosis

A treatment plan, regardless of whether it concerns a fixed bridge, a removable partial denture or an occlusal rehabilitation, has to be based on an examination. This should include the following points:

1. Study of the face.
2. Clinical examination of the teeth.
3. Radiographic examination.
4. Preparation of diagnostic casts (documentation).
5. Examination of the oral mucous membrane.
6. Photographs before treatment and after completion.

1) Study of the Face

The diagnosis should not be started with mirror and probe, but with a study of the patient's face. As we have already explained in Part I, the muscles of facial expression form a unit of the maxillofacial system. They can be considerably affected by prosthetic measures. When the patient is talking, laughing or unconsciously relaxing his face, this leads to a functional fluctuation, which MARTONE calls "anatomy in action". Even for forming one single syllable, 72 muscles are put into action. This fact proves the dynamics of the maxillofacial system very well.

Measurements or face masks only produce a static result. The prosthetist should always remember the fourth dimension — the "vitality factor".

Muscle tone, tissue resilience and the oral structures are all interrelated. This must be remembered if prosthetic failures are to be reduced or avoided.

2) Clinical Examination of the Teeth.
This point includes:

a) Vitality tests (electric current or carbon dioxide snow).

b) Tests for caries.

c) Evalution of the periodontal condition.

3) Radiographic Examination

The radiographic examination must include an examination of all teeth and edentulous areas. FRÖHLICH reports that among five hundred complete radiograph results only 6.6 per cent were without pathological changes. Even in the case of vital teeth with healthy marginal gingivae, pathological processes such as root resorption or internal granuloma can appear. In 25 per cent of clinically normal jaws, radiographic examination has shown up conditions such as:

a) Residual cysts.

b) Healed-over remains of fractured roots.

c) Foreign bodies (e.g. amalgams), which had fallen into the tooth socket after extraction.

d) Surplus root filling material, which had remained at the base of the alveolus after root extraction.

e) Retained teeth with dentigerous cysts.

f) Cysts of the nasopalatine duct.

As soon as the edentulous areas are stimulated by the denture saddles, these pathological structures may give trouble. The patient considers treatment to be completed when the dentures are delivered, and he will rightly blame any ensuing trouble on inadequate examination. Gutta-percha points may be used to aid the radiographic evaluation of periodontal pockets (Fig. 15a, b).

Radiographic examination of the temporomandibular joints can usually be dispensed with, unless obvious disturbances are present.

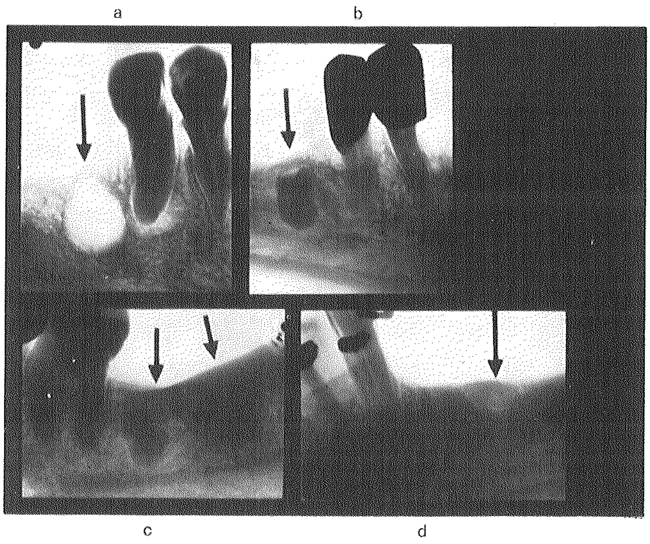
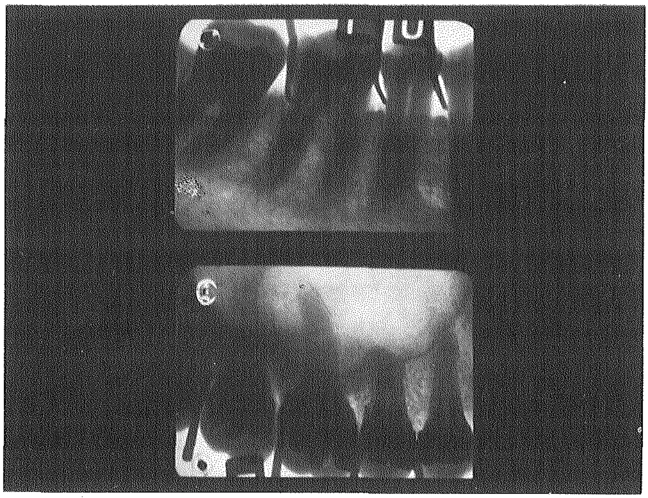


Fig. 14 a—d. Accidental findings.
Fig. 14 a. Cysts in the edentulous mandible.
Fig. 14 b. Residual root.
Fig. 14 c. Residual roots.
Fig. 14 d. Residual root.

Fig. 15 a, b. Severe periodontitis: Gutta-percha points placed in the pockets.



4) Preparation of Diagnostic Casts

Only a detailed analysis of diagnostic casts will give accurate information about:

a) The occlusion.

b) The depth of overbite (vertical overlap).

c) The distribution of the occlusal load.

d) Premature contacts.

e) Eccentric movements.

f) Parafunctions (grinding, etc.).
(Figs. 16—20).

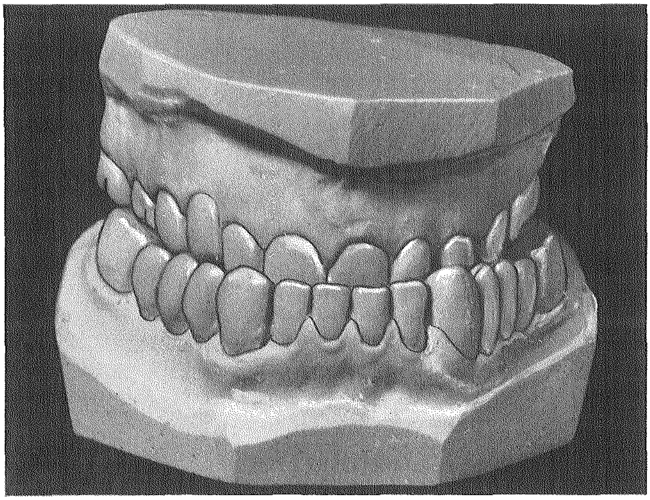


Fig. 16. Vertical relation reduced, note prognathism. Caused by faulty mandibular bridge.

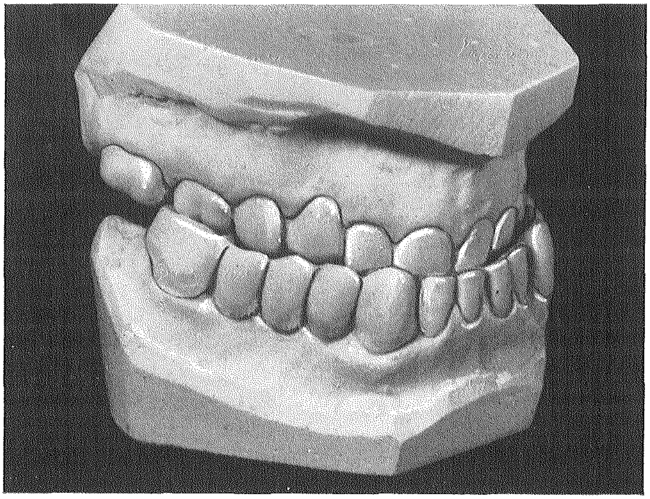


Fig. 17. The same case seen from the right side.

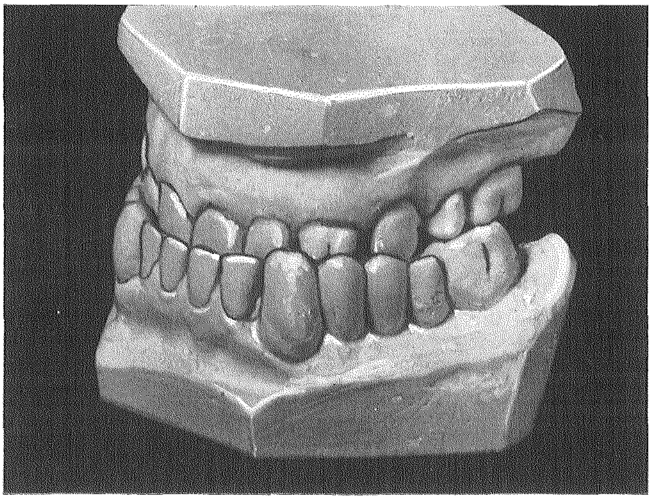


Fig. 18. The same case seen from the left side.

Fig. 19. Vertical relation of occlusion restored with wax plate.

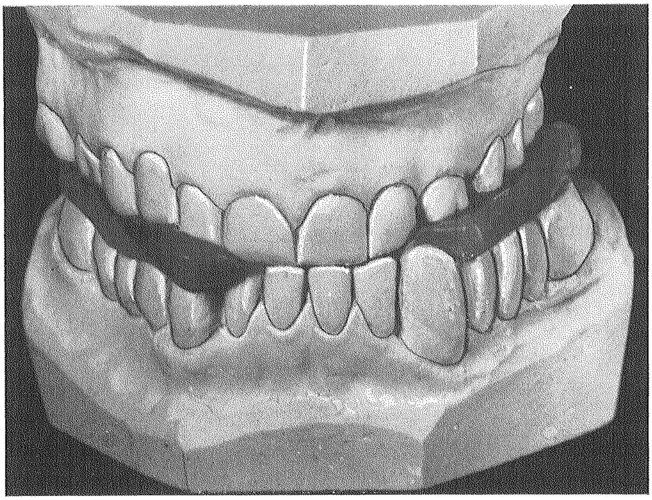


Fig. 20. View from right.

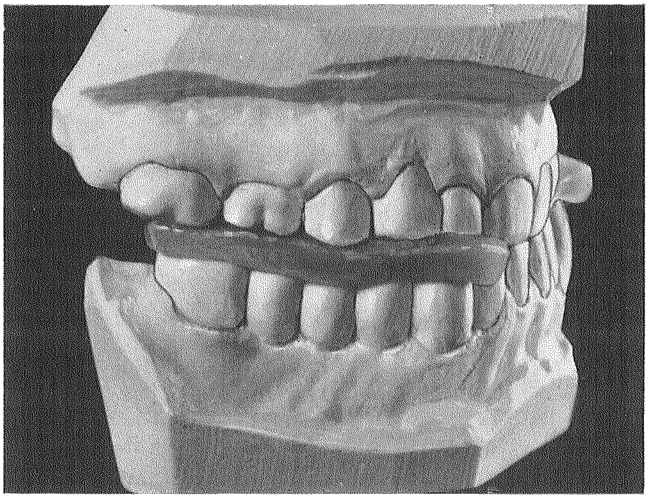
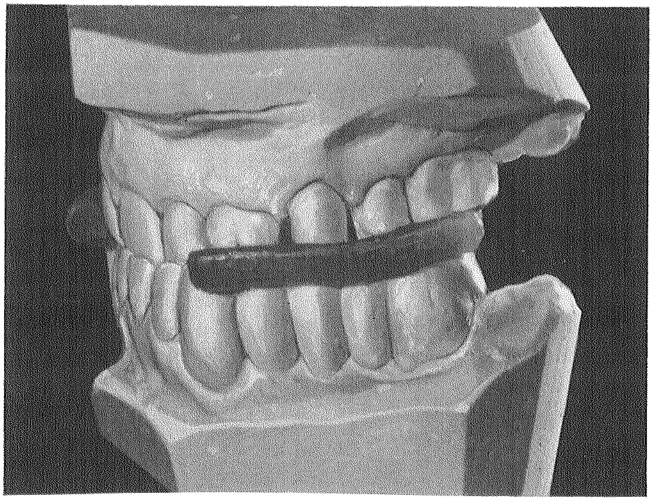


Fig. 21. View from left.



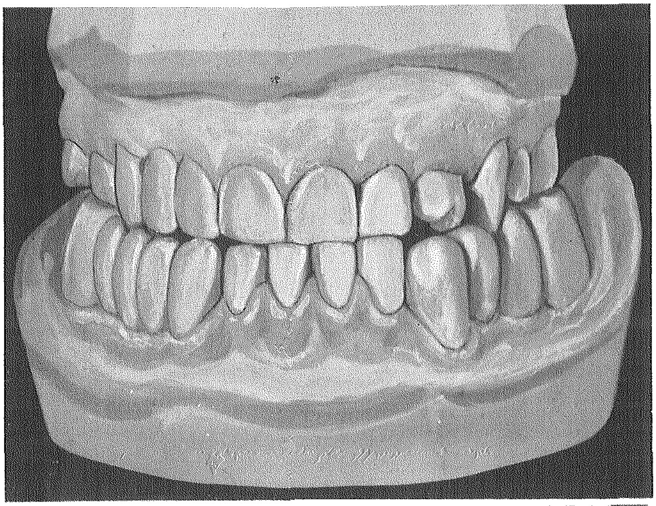


Fig. 22. Vertical relation increased with temporary side bridges (for four to six weeks).

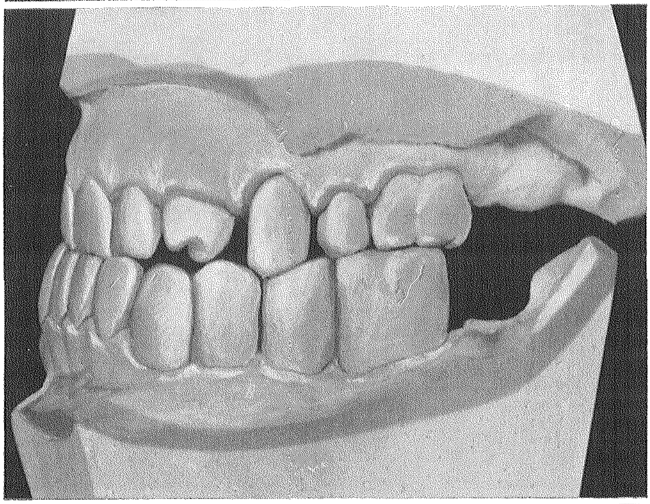


Fig. 23. View from left.

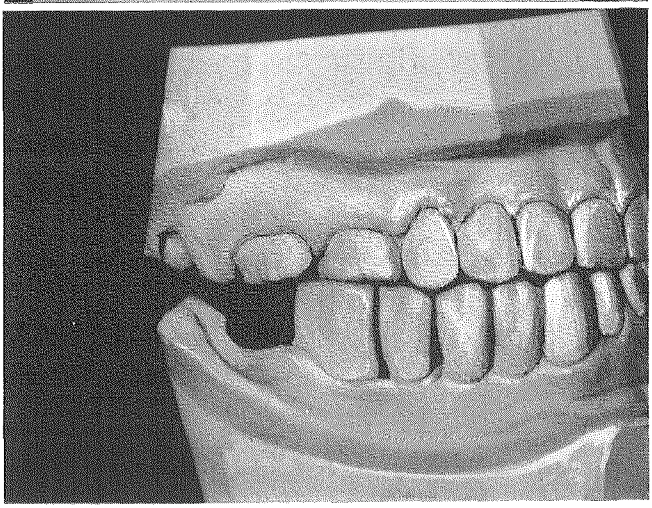


Fig. 24. View from right.

5) Examination of the Oral Mucous Membrane. Mucosal affectations such as lichen planus or leukoplakia contraindicate additional irritations by denture saddles.

6) Photographs Before Treatment and After Completion.

Photographs (front and profile) before and after completion of the treatment represent a valuable addition to the clinical documentation. Hardly any patient will ever remember his former looks. If a great improvement in the patient's appearance has been achieved, it is important to impress those changes upon him by means of pictures. Coloured photographs, or, even better, coloured slides are especially valuable. These slides can easily be taken in the surgery or laboratory. When projected they show details which would not heve been apparent on a black and white print. Colour differences between natural and artificial and inflammatory conditions of the mucosa, especially around gingival margins, can clearly be seen. Colour photographs are not only valuable material for collecting and documentation purposes; they also serve as unprejudiced judges of our work.

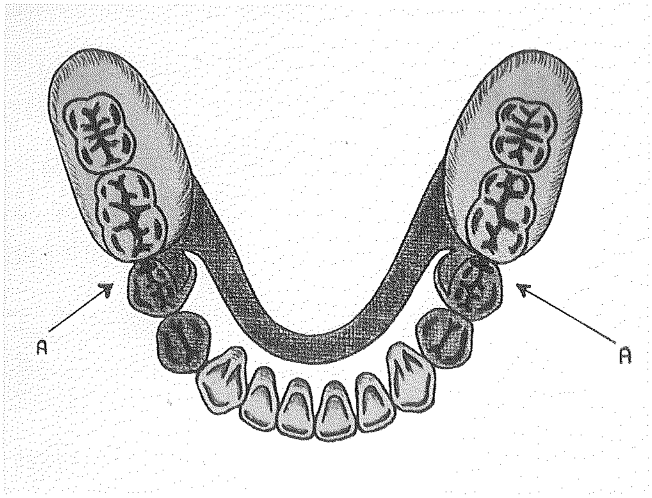


Fig. 25. Splinting the abutment teeth.

2. Planning

All remaining abutment teeth should be splinted together, if possible. This rule applies to both periodontally weak and strong teeth. The latter may well have to carry the additional burden of a removable partial denture. If occlusal conditions are good and the periodontal condition normal, it may be sufficient to splint the two most distal teeth on each side (Fig. 25).

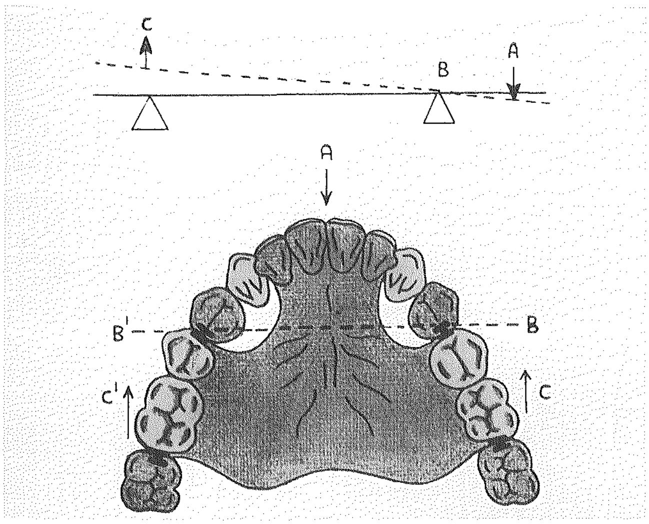


Fig. 26. Incorrect planning; denture rotates round the axis B—B 1.

Fig. 27. Clinical case; 17, 12, 11, 21, 22, 27 standing.

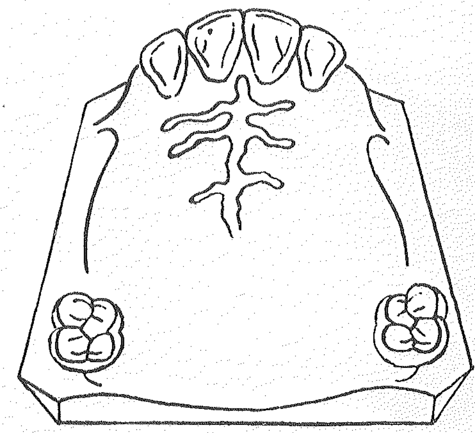


Fig. 28. The incisors are firmly splinted. Attachments are fitted into the adjacent pontics and into the molars.

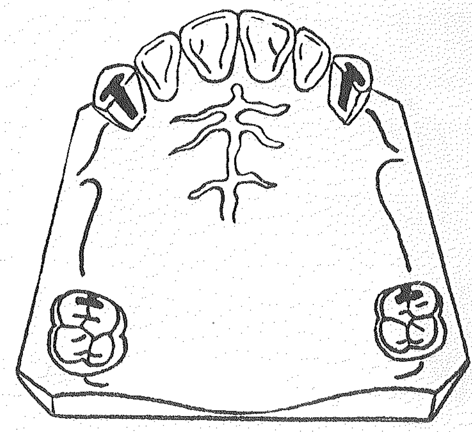
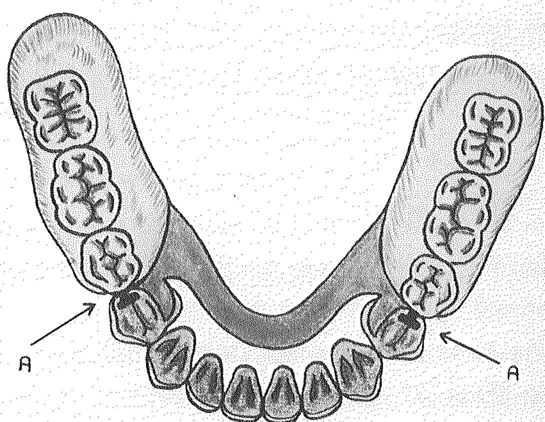


Fig. 29. Lingual connector; attachment at point A.



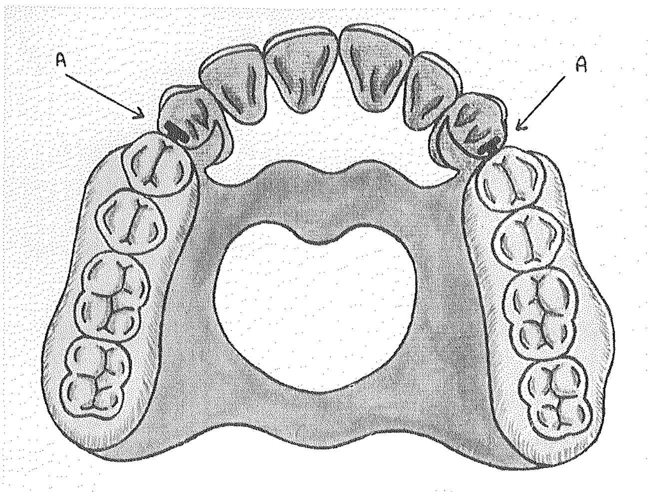


Fig. 30. Standard forms of the palatal connector.

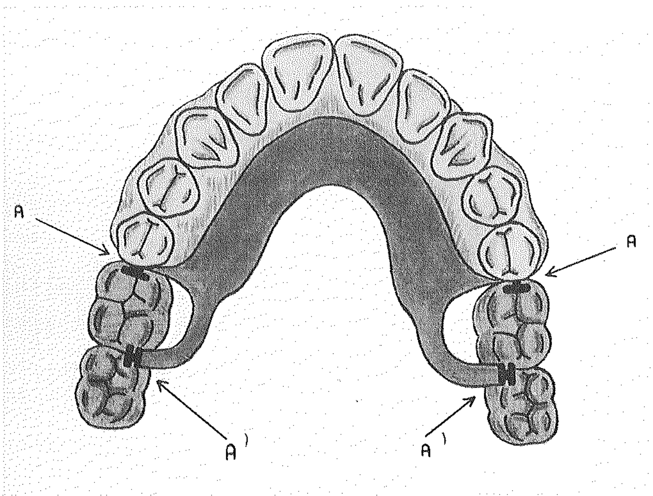


Fig. 31. Typical horse-shoe form of a palatal connector in a Class IV situation. The mesial attachments (A) support the denture. The palatal attachments (A 1) splint the abutment teeth.

Missing anterior teeth should be replaced by a firm bridge. The anterior teeth are mesial to the denture attachments. When loaded, they can cause dangerous leverages which may endanger the whole appliance (Fig. 26).

If incisors are planned as abutments for a bounded saddle, their shape precludes the use of intracoronal retainers. For this reason, bridge connecting links are used for insertion of the attachments (Figs. 27 and 28), provided that these are bounded saddles with strong abutments.

If possible, the removable part should be bilateral with an absolutely rigid major connector (Figs. 29, 30 and 31).

An exception to this rule would be a Class II situation with only molars missing. A unilateral denture may suffice in these circumstances. The methods shown in Figs. 233—237 (atlas) have proved valuable.

The shape of the free-end saddles must be carefully chosen. FISCHER (Stuttgart) has calculated that the incisive tip of a canine can be displaced 0.3 mm. when loaded by a free-end saddle. This lies within physiological limits. If the free-end saddle is shortened from 50 mm. to 25 mm., the movement at the tip of the canine is doubled from 0.3 to 0.6 mm. This means that the longer the saddle, the lower the movement of the abutment tooth. Conversely, the shorter the saddle, the greater the movement of the tooth. This will increase the danger of overstepping the physiological limit. Saddles should therefore be extended as far distally as possible. The width of the saddle is determined by the soft tissues. Further extention would lead to instability and soreness. The area between the external oblique ridge and edentulous ridge (the buccal shelf) is a useful loadbearing area.

3. The Pre-Prosthetic Preparation

Pre-prosthetic preparations can be divided into surgical, conservative, orthodontic and periodontal measures.

a) Surgical Preparation

Pathological processes should be surgically removed, and grossly tilted or over-erupted teeth should be extracted. If in doubt, extract the tooth. This policy has been supported by clinical experience. We have often regretted keeping a doubtful abutment.

b) Conservative Preparation

All restorations should be removed from abutment teeth. Root fillings should be tested if the tooth is devitalized. HÄUPL has shown that 50% of root fillings which were clinically and radiographically satisfactory were infected. One must be cautious about using devitalized teeth as abutments, especially as the medical history may preclude retention of non-vital teeth. The radiographic controls shown in Fig. 32 a—e are intended to explain the importance of the time factor. This decides whether teeth

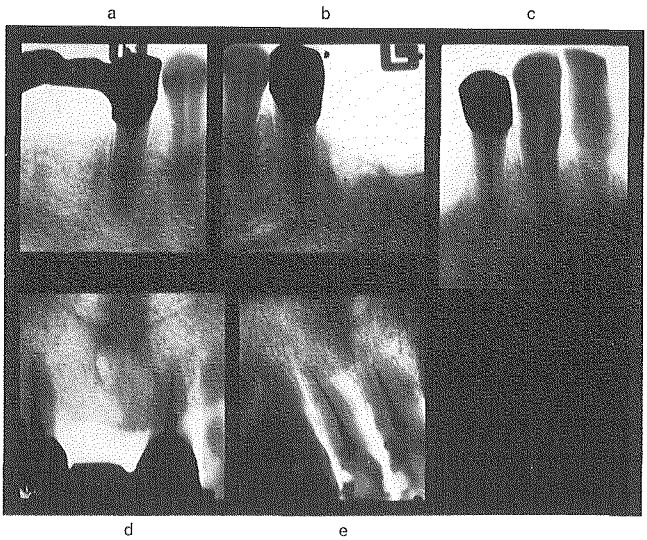


Fig. 32 a—e. Different control cases.
Fig. 32 a. Control after 10 years. r.t. & r.f. 44.
Fig. 32 b. Control after 11 years. r.t. & r.f. 34.
Fig. 32 c. Control after 25 years. r.t. & r.f. 44.
Fig. 32 d. Control after 25 years. r.t. & r.f. 12, 21.
Fig. 32 e. Control after 28 years. 11—12.
r.t. = root treatment.
r.f. = root filling.

with treated roots are to be included in the prosthetic construction or not. All root treatments were carried out on one side at a time, under anaesthesia. The following materials were used for filling the root: Chlora-percha and Gutta-percha points, i. e. AH 26 and Gutta-percha points.

c) Orthodontic Preparation

Pre-prosthetic orthodontics attempts to restore occlusal harmony and remove deflective contacts which may affect centric occlusion.

For intra-maxillary corrections a Japanese hemp fibre, known as "grassline", is useful. "Grassline" shrinks by one tenth of its length within 24 hours following absorption of oral fluid. Through the gradual tension it effects the closing of gaps and diastemas. The ligature should be left for three days, for stabilization of the results. It is then replaced by a wire ligature, otherwise fresh "grassline" has to be applied. The following case illustrates the effectiveness of "grasline".

A 38 year-old female patient had lost the lower right central incisor through periodontal disease. Since the missing tooth had not been replaced, the left incisor had moved into the gap (Fig. 33). When eventually she decided to have the tooth replaced the gap had become too small to fit a lower incisor of normal width into it. A "grassline" ligature was applied (Fig. 34). Within one day the left central incisor was brought into contact with the left lateral incisor. The teeth 31, 32, 33 were now fixed with a

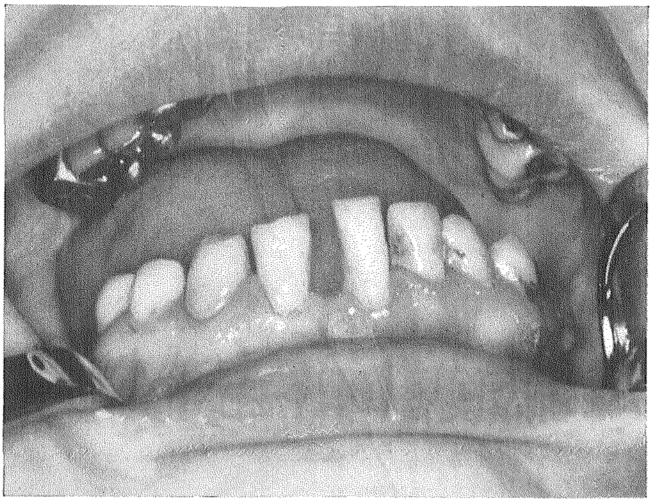


Fig. 33. Loss of the right central incisor.

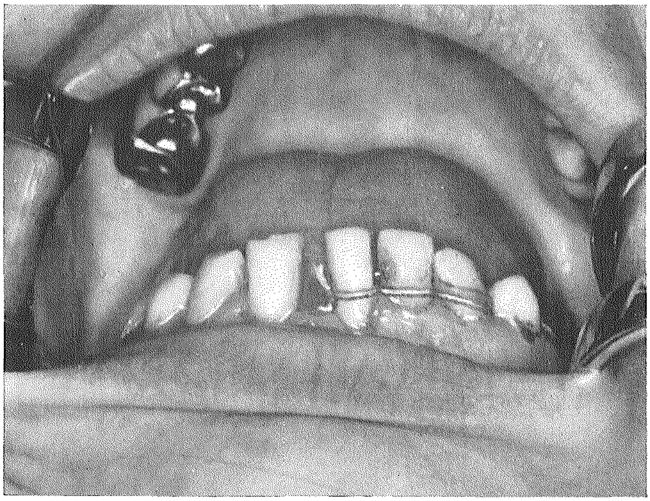


Fig. 34. "Grassline" ligature.

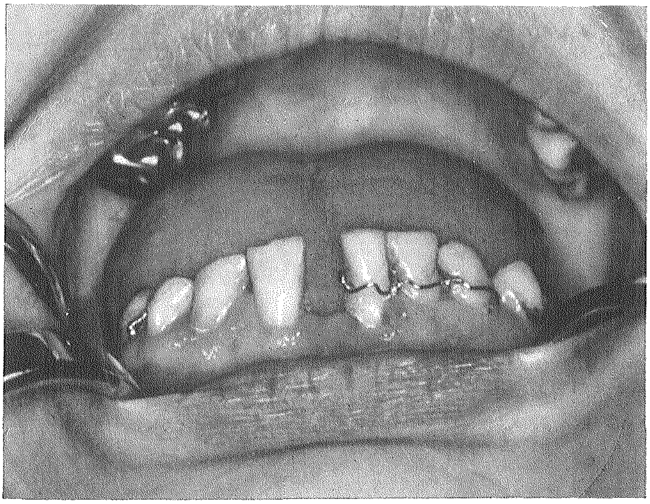


Fig. 35. Wire ligature.

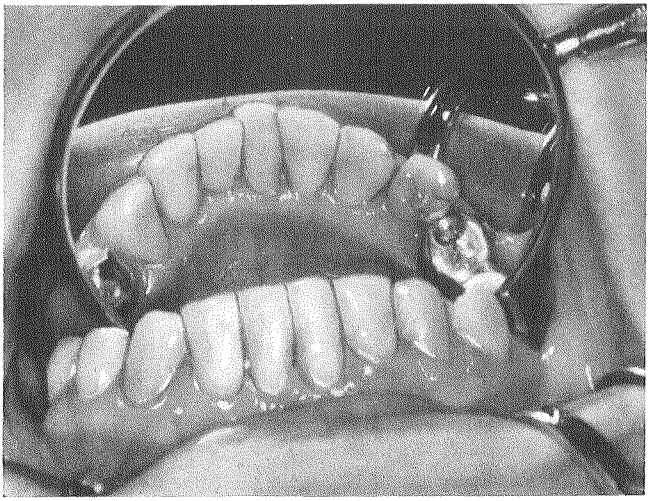


Fig. 36. Prosthetic closure of the gap after preliminary orthodontic treatment.

wire ligature (Fig. 35). The missing right first incisor was later replaced by a plastic tooth held in a temporary splint (Fig. 36).

The gentle effects of "grassline" remain within physiological limits. Because of its ease of use, it is the treatment of choice for the correction of diastemas.

d) Periodontal Treatment

Dental restorations and periodontal health are inseparably interrelated; periodontal health is necessary for the proper function of all restorations, and the functional stimulation provided by dental restorations is essential for the preservation of the periodontium.

Gingival and periodontal disease must be eliminated before restorative procedures are begun, for the following reasons:

Tooth mobility and pain from food impaction in periodontal pockets interfere with mastication and function of the prosthesis.

Inflammation and degeneration of the periodontium impair the capacity of abutment teeth to meet the functional demands of the prosthesis. Restorations constructed so as to provide beneficial functional stimulation to a healthy periodontium become a destructive influence when superimposed upon existing periodontal disease, and shorten the life span of the teeth and the prosthesis.

Partial prosthesis constructed on casts made from impressions of diseased gingiva and edentulous mucosa will not fit properly when periodontal health is restored.

To properly locate the gingival margin of restorations, the position of the healthy gingival sulcus must be established before the tooth is prepared. Margins of restorations hidden behind diseased gingiva will be exposed when the inflamed gingiva shrinks following periodontal treatment.

To overcome periodontal problems the following treatment plan ist suggested:

Treatment Plan

I. Initial preparation of mouth

1. Removal of all calculus deposits and thorough root planing;
2. instructions in oral physiotherapy;
3. removal of caries;
4. tooth movement;
5. temporary stabilization;
6. occlusal adjustment.

Reevaluation: reasons for initial preparation of the mouth

a) Reduction of inflammation;

b) pockets may be eliminated by initial preparation alone;

c) through the instructions in oral physiotherapy patients collaborate efficiently;

d) bone defects may be eliminated by tooth movement in the defect.

II. Pocket elimination

1. Suprabony

a) gingival	(soft red edematous less than 5 mm)	gingival → curettage	gingival → shrinkage
b) periodontal	(soft red edematous less than 5 mm)	gingival → curettage	gingival → shrinkage
c) gingival	(dense, firm, fibrosis more than 5 mm with adequate zone of attached gingiva)	gingivectomy → or flap	→ resection of soft tissue wall of pocket
d) periodontal	(dense, firm, fibrosis more than 5 mm with adequate zone of attached gingiva)	gingivectomy → or flap	→ resection of soft tissue wall of pocket

2. Infrabony

e) three osseous walls	gingivectomy + curettage / or flap + curettage		→ new attachment
f) two osseous walls	shallow craters:	ostectomy removing one or both walls	
	deep craters or other two wall defects:	free osseous tissue autografts	→ new attachment
g) one osseous wall	1) ostectomy (removing one bony wall)		
	2) contiguous osseous tissue autografts 3) tooth movement into the bony defect		} new attachment
h) combinations			

III. Restoration of the destroyed gingival unit

1. Free soft tissue autografts;

2. contiguous soft tissue autografts;
   a) laterally positioned flap;
   b) double papillae positioned flap;
   c) oblique rotated flap;
   d) apically positioned flap.

IV. Restoration of lesions of the attachment apparatus

1. Permanent stabilization;

2. Periodontal prosthesis.

4. Registration of the Vertical Relations

It is necessary to distinguish between the vertical relation of rest and the vertical relation of occlusion. The vertical relation of rest is the position held by the mandible when its supporting musculature is in a state of tonic equilibrium. The vertical relation of occlusion represents the vertical separation of the jaws when the teeth are in occlusion.

The latter relation is a physical phenomenon, while the vertical relation of rest is a physiological state. It is most important to record the correct vertical relation, since the vertical relations determine the relationships of the units of the maxillofacial system, and are a useful guide to appearance.

Increasing the vertical separation of the jaws can lead to functional disturbances as well as a change of appearance. These disturbances may manifest themselves as:

a) Hastened resorption of the alveolar ridge under mucosal-borne denture saddles.

b) Excessive burdening of the periodontal membrane of the natural teeth. This may lead to secondary phenomena.

c) Disturbances within the temporomandibular joints.

Decreasing the vertical separation of the jaws will give the patient an aged, prognathic appearance. Temporomandibular joint disturbances have also been ascribed to this cause.

We record the vertical relation by using a method described by KAZIS, SHOHET, SHPUNTOFF and others. It is based on measuring the distance between the vertical relation of occlusion and the vertical relation of rest. This distance represents the inter-occlusal distance or free-way space. The measurements are simple and can easily be carried out in practice.

Two points are marked on the face. One is marked on the tip of the nose, the other on the point of the chin.

K O R K H A U S' orthodontic calipers have been proved a practical measuring instrument as each millimetre's difference can be immediately read. The vertical relations of occlusion and of rest are measured. The vertical relation of rest is a physiologically determined position, which can be considered the starting and finishing point of all mandibular movements.

Cephalometric and electromyographic studies have revealed that under certain conditions the position of rest can change. In practice, however, these minor changes are of no importance for the determination of the vertical relation of occlusion. Moreover, later tomographic examinations of the temporomandibular joint have proved this method to be scientifically correct, and useful in practice (SCHÖN).

The inter-occlusal distance of the incisor region is usually 2—3 mm., although in some instances it can be as much as 6—12 mm. We do not recommend the use of a standard 3 mm. inter-occlusal distance, because patients' requirements vary so much.

Before contemplating increasing the vertical relation of occlusion, the following factors should be considered:

a) The present inter-occlusal distance.

b) The age of the patient.

c) The adaptability of the patient.

If one finds an occlusion which gives limited inter-alveolar space (close bite) it is important to decide whether there is a primary or secondary cause. Secondary causes include tooth abrasion, loss of posterior supporting areas, tooth displacement and fitting of incorrect restorations.

Features suggestive of a primary cause are:

a) The joint capsules are in their normal position. This can be confirmed by radiographs as well as by palpation of the condyles.

b) A significantly steep inclination of the condylar path.

c) The typical "step-like" effect in the occlusal curve. Other features are overerupted canines and incisors, low premolars and molars, and the typical "step" distal to the canines (Fig. 41).

d) The inter-occlusal distance is within physiological limits.

For secondary causes the following signs are to be found:

a) The condyles are dislocated upwards and backwards.

b) The vertical relation of occlusion is much reduced, and the inter-occlusal distance can sometimes be as much as 12—15 mm.

Fig. 37. Original occlusion.

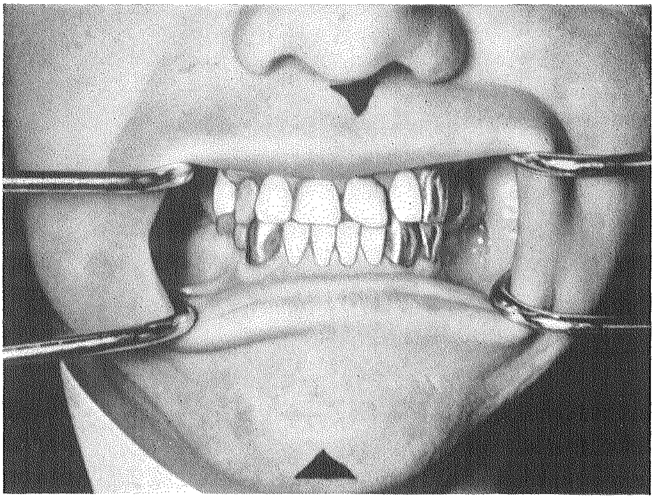


Fig. 38. Measuring the inter-occlusal distance

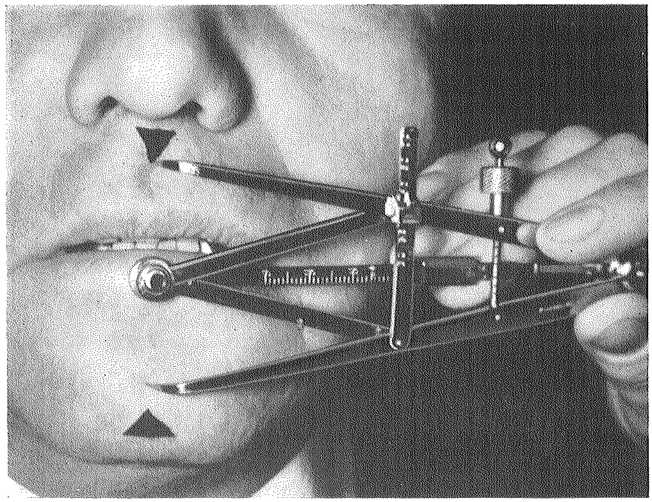
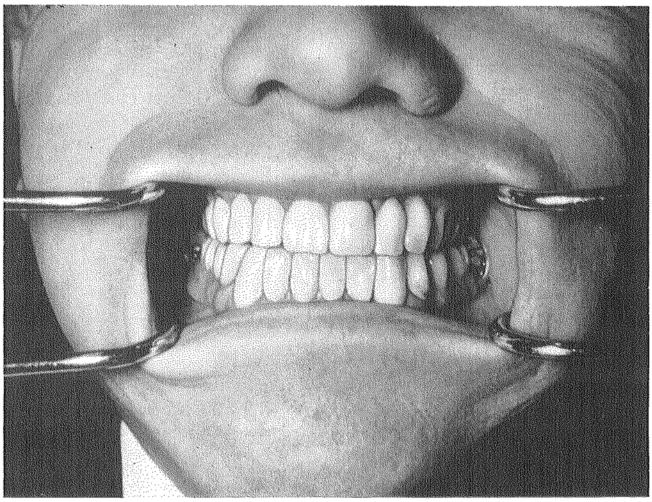


Fig. 39. Occlusion after completed elevation of the vertical relation.



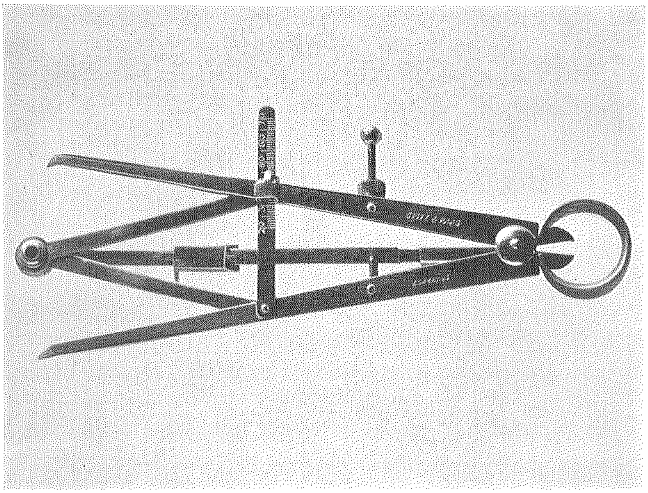


Fig. 40. Korkhaus' calipers.

With regard to treatment, it is necessary to distinguish between an occlusal restoration in the case of a secondary malocclusion and an occlusal correction in the case of a primary malocclusion.

Occlusal elevation should always be carried out at first with acrylic bridges (Fig. 42) or an overlay plate (Fig. 43), since the reaction of the temporomandibular joints to the occlusal elevation can never be foreseen. Occlusal elevation should always be carried out within the inter-occlusal distance.

For some occlusal corrections orthodontic measures are indicated. However, a prosthetic occlusal elevation is recommended for the following cases:

a) When an aged appearance has resulted from overclosure.

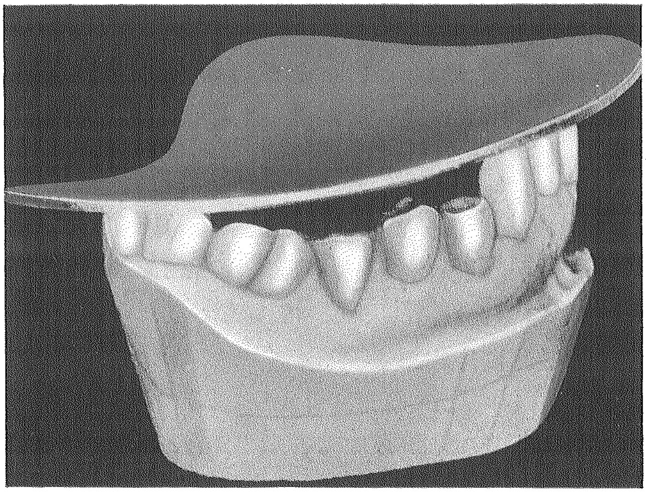


Fig. 41. Occlusal step in the mandible.

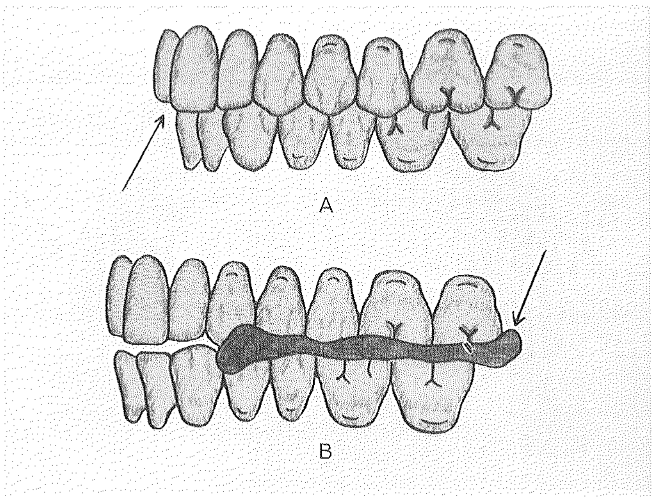


Fig. 42. A: Upper and lower acrylic bridge.
B: Occlusal elevation in wax.

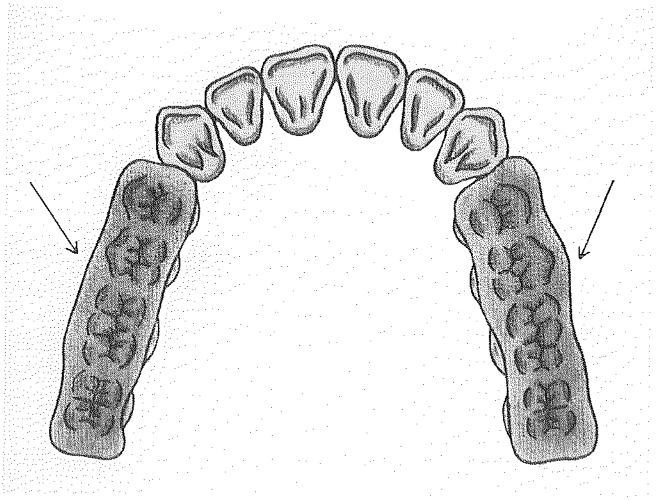


Fig. 43. The same case in occlusal view.

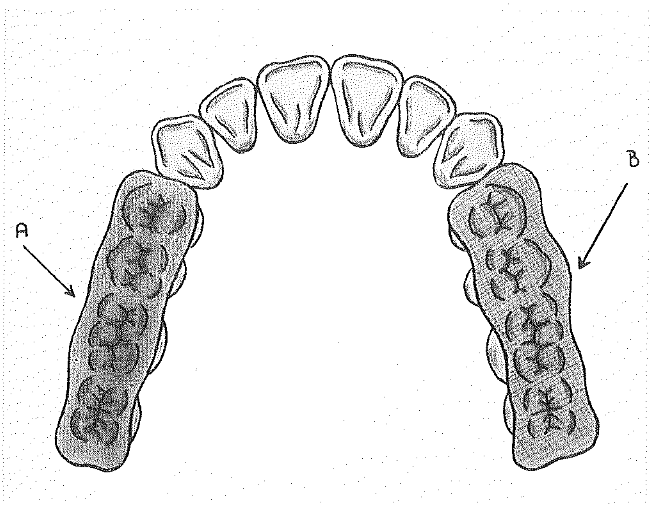


Fig. 44. At A still wax; at B this has been replaced by self-hardening acrylic resin.

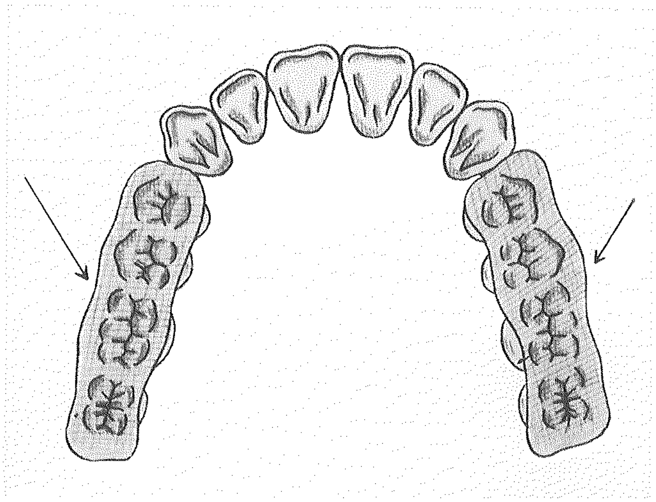
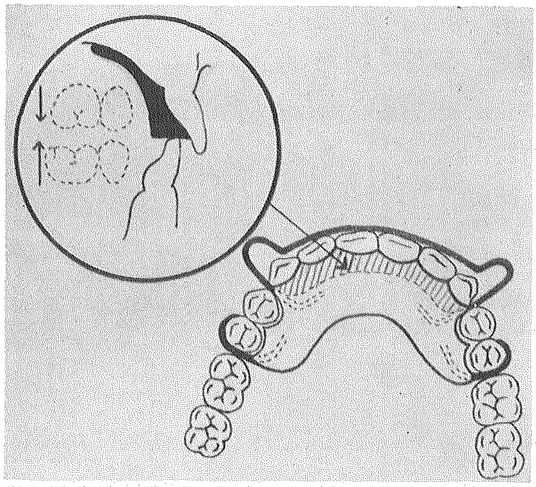


Fig. 45. Now the wax at A has also been replaced by acrylic resin.

Fig. 46. Anterior occlusal plane to encourage eruption of posterior teeth.



b) When masticatory functions appear restricted.

c) When the malocclusion has caused pathological changes. Lower incisors may be biting into the palatal mucosa; there may be disturbances of the temporomandibular joint, abrasion of teeth, or periodontal damage.

d) When a secondary malocclusion is superimposed on a primary one.

Contra-indications to prosthetic occlusal elevation are:

a) Middle-aged patients with physiological abrasion.

Fig. 47. The loss of teeth in the posterior area has led to a secondary occlusal depression with prognathism. The two lower lateral bridges are incorrectly designed.

Fig. 48. Two temporary plastic bridges in the mandible hold the correct occlusion for two months, so that possible reactions of the mandibular joints can be checked.

Fig. 49. Improved appearance; relaxed, normal lip musculature, correct vertical relations.

Fig. 50. Three veneer crowns in the maxilla at 14, 13, 12 and full crown at 17 to balance the occlusal surface.

Fig. 51. The final posterior teeth bridges (veneer crowns) inserted in the mandible.

Fig. 52. Correct occlusion after completion of the prosthetic work.

b) In middle-aged patients the muscles of mastication and the temporomandibular joints have already adapted themselves, and a change of the occlusal position would not be acceptable.

c) The patient's state of health does not permit a radical change in the dentition.

d) The inter-occlusal distance is within the physiological limits (2—3 mm.). This would be eliminated by an occlusal elevation.

5. Recording Centric Occlusion

Recording occlusal relationships for partial denture construction presents difficulties which are reflected in the occlusal adjustments required when fitting the dentures. The customary wax record is prone to errors.

SHANAHAN and LEFF have carried out an interesting experiment. Casts of a complete dentition were mounted in centric occlusion on an articulator. A 3½ mm. strong aluwax plate was warmed and placed on the occlusal surfaces of the lower teeth. The articulator was then closed with a pressure of 5 kilograms. After the wax had hardened it was glued to the upper cast and the lower cast removed from the articulator. The impression that the lower teeth had made in the wax was filled with plaster. This new cast was then articulated with the upper cast. It was found that considerable differences existed between the occlusions of the first set of casts and those of the other set. When self-polymerizing acrylic resins were substituted for wax, the occlusions did not differ. The authors concluded that wax is therefore unsuitable for recording inter-occlusal relationships. Self-hardening materials are preferred.

We have made use of this knowledge in devising a new technique for occlusal registration. It does not register a point, but a contact area of approximately ¼ mm. mesially and distally. This is the area of contact described by STANSBERRY.

Previous techniques required the occlusal records to be transferred to a cast of the edentulous area. Our method reverses this procedure. At the beginning, the intercusping of maxillary and mandibular teeth are precisely recorded in self-polymerizing acrylic resins. This is followed by a functional impression of the edentulous area. This is known as the SINGER-SOSNOWSKI "biodynamic" compression imprint. It combines two impressions on the same model, thereby eliminating sources of error involved in transferring records from a soft (mouth) to a hard basis (plaster).

The practical procedures can be demonstrated in a typical patient:

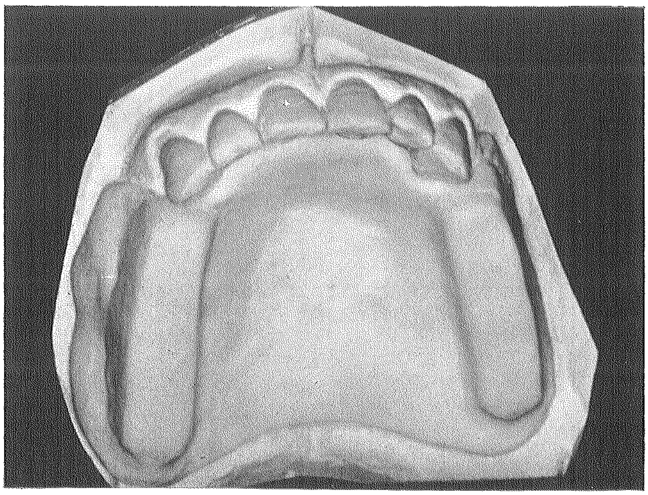
A denture is to be made for a maxilla in which only the six anterior teeth are standing. An acrylic resin occlusal rim is prepared on the diagnostic cast (Fig. 53), the abutments prepared for veneer crowns (Fig. 54), and a copper ring Kerr impression is taken from each single abutment. Acrylic resin transfer copings (Fig. 55) are prepared on the copper-plated cast. An acrylic facing has been positioned on the left incisor to help judge appearance. The occlusal rim can now be prepared. The edges of the rim are formed by the application of zinc oxide-eugenol paste, which is moulded to the denture outline. A self-polymerizing acrylic resin is applied to the occlusal surface and the patient closes his mouth. This establishes accurate intercusping. (Fig. 56).

The fitting surfaces of the saddle areas are now coated with adhesive powder.

A plaster overall impression is then taken to include both occlusal rims and transfer-copings. The copper-plated stumps are then fitted in the copings and the veneer crowns can be made on this cast. The crowns are tried in separately, an over-impression is taken for localization, and then they are soldered together.

The casting of the anterior teeth is now fitted and the functional impression repeated (Fig. 57). The layer of impression paste is removed from the saddle base and the impression retaken (Fig. 58). After the impression paste has hardened in occlusion, a plaster impression is again taken over the occlusal rim and the casting. The position of the occlusal rim has not been changed during the plaster impression since the excess impression paste retained it under the metal frame of the splint. The whole prosthesis is now completed and assembled on this final cast (Figs. 59, 60 and 61). This tech-

Fig. 53. Plastic occlusal mould.



nique therefore combines what were previously three separate techniques. It provides a possible solution to the important problem of accurate occlusal records for partial denture construction.

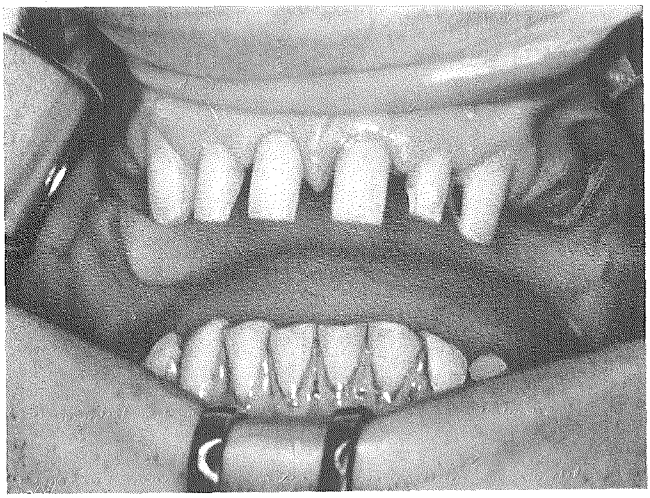


Fig. 54. The remaining natural teeth prepared for the veneer crowns.

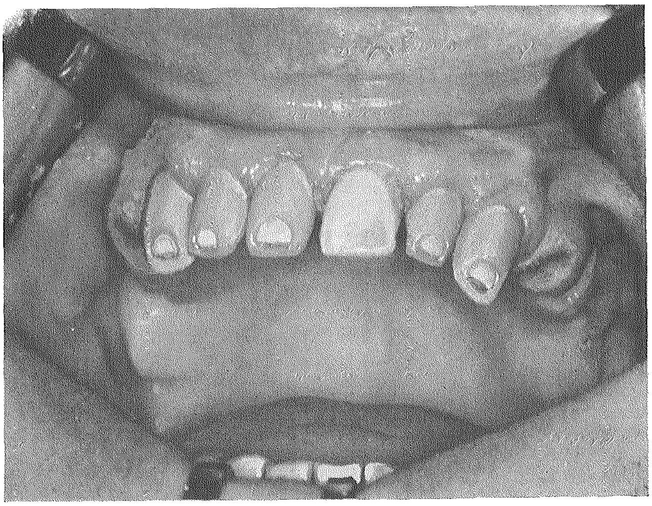


Fig. 55. Acrylic transfer copings, fitted on to the abutments. A facet is made in the coping of the upper left central incisor for checking the correct length of the veneer crown.

Fig. 56. Establishing the intercusping position with a self-polymerizing acrylic resin.

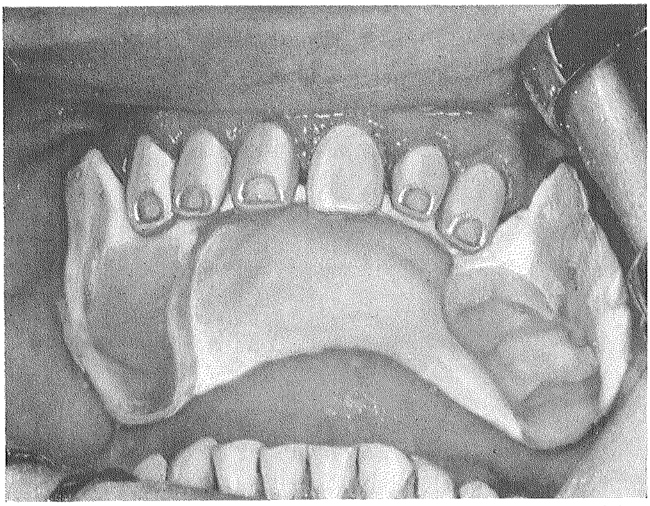


Fig. 57. Splint in rough cast state.

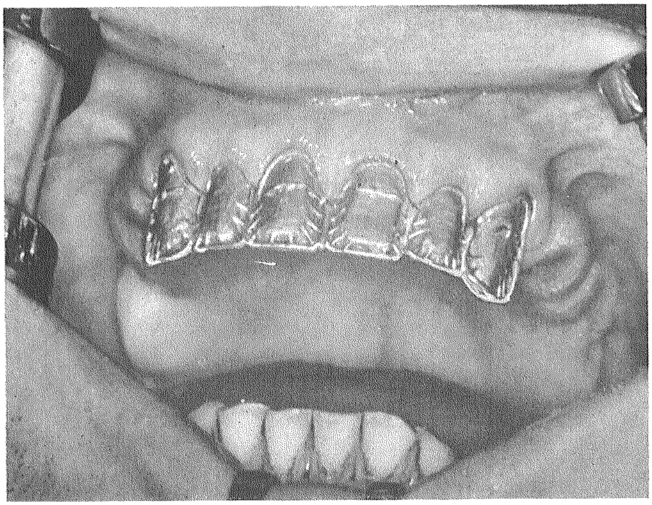
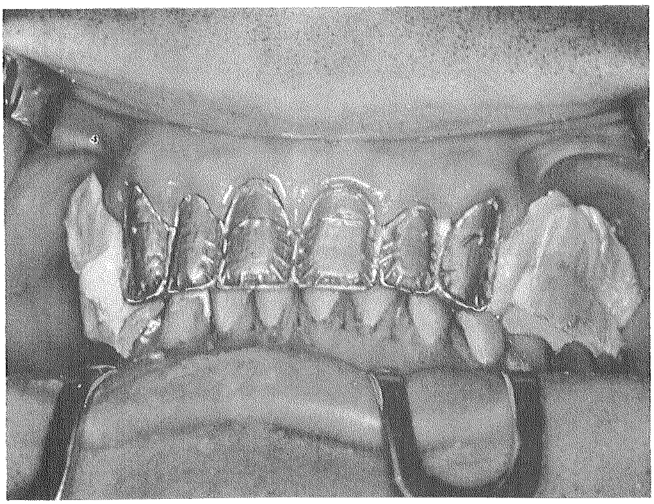


Fig. 58. Second functional impression with the splint.



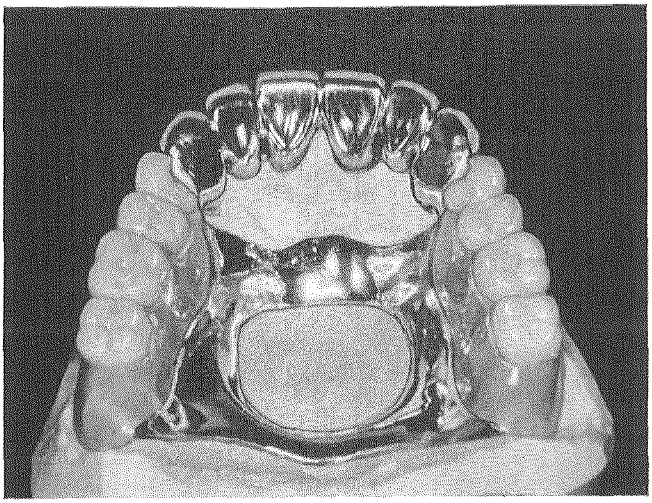


Fig. 59. Completed construction on the model; the veneer crown splint of the anterior teeth consisting of 6 units. The bilateral free-end prosthesis is rigidly anchored by precision attachments.

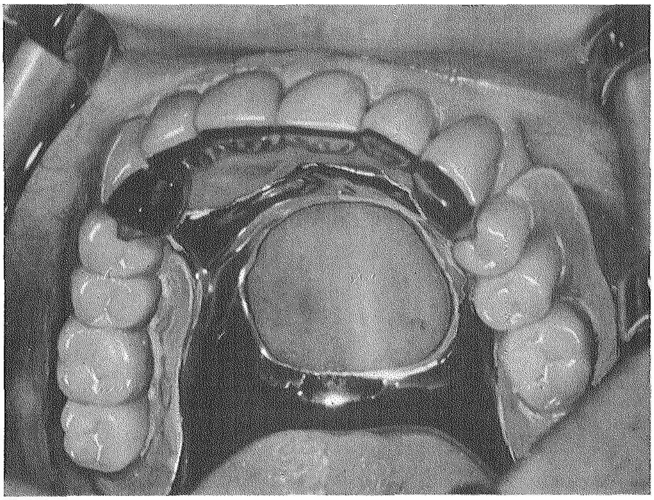


Fig. 60. The completed work in the mouth (palatal view).

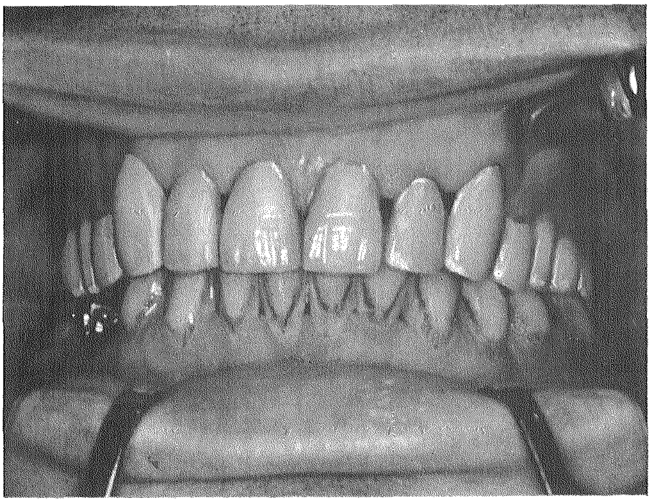


Fig. 61. Completed work in occlusion.

6. The Problem of Articulation

In the previous chapter we emphasized the importance of accurate occlusal registration. Occlusal corrections not only waste time but can spoil good work.

With partial dentures the relation of the two jaws may be established by the standing teeth. Where there are no standing teeth the problem is more difficult. On the subject of articulation, REICHENBACH has recently disproved much of GYSI'S work. Few former theories stand up to modern practical knowledge.

Nearly every school of prosthetic thought has devised methods of relating jaw movements and transferring them to an apparatus on which dentures are constructed — the articulator. Many prosthetists have felt duty-bound to construct their own articulators. The literature abounds with descriptions of articulators, yet none of them accurately imitate physiological masticatory function. The following points should be remembered:

a) A mechanical construction will never be able to reproduce perfectly the complex functional jaw movements of each individual.

b) The articulation is not entirely dependent on the temporomandibular joints (KÖRBER, STEINHARDT, BRECKER). All measures aiming to transfer the joint tracks onto an articulator are irrelevant.

c) In most articulators the maxilla is moveable and the mandible is fixed; it is the other way round in the mouth. During functional movements the mandible does not always close in a completely vertical direction, but from slightly right to left; however, many articulators can only close in one vertical direction.

d) The sliding movements of the mandible can be duplicated by the articulator, but lateral functional movement are small, especially in the molar region. Protrusive movements do not generally appear within the masticatory cycle.

e) The sliding movements of the articulator are mainly horizontal, whereas the functional movements of the mandible are mainly vertical with only a slight lateral component.

Some prosthetists suggest the use of fixed path articulation of average values. These are said to reproduce approximately the change in position which appears in the contact channel of the teeth of a denture wearer. Supporters of this type of articulation claim that:

a) The relationship of the casts to the rotational axis of the articulator conform with the relationship of the jaws to the rotational axis of the mandible.

b) The alignment of the models to CAMPER'S plane is facilitated by the facial curve.

It should be pointed out that the alignment of the occlusal plane can be more accurately determined by referency to the plane joining the points distal to the maxillary tuberosities. We have already mentioned that neither the temporomandibular joints of the patient nor the articulator joints form a crucial factor in determining the articulation. Although occlusal anomalies can lead to disturbances of function of the temporomandibular joints, the temporomandibular joints have no determining effects on the occlusion of the teeth. Artificial reproduction of the complexities of jaw movements is therefore virtually impossible.

In the field of masticatory function, the research carried out by BOSWELL, JANKELSON and SHANAHAN is notable.

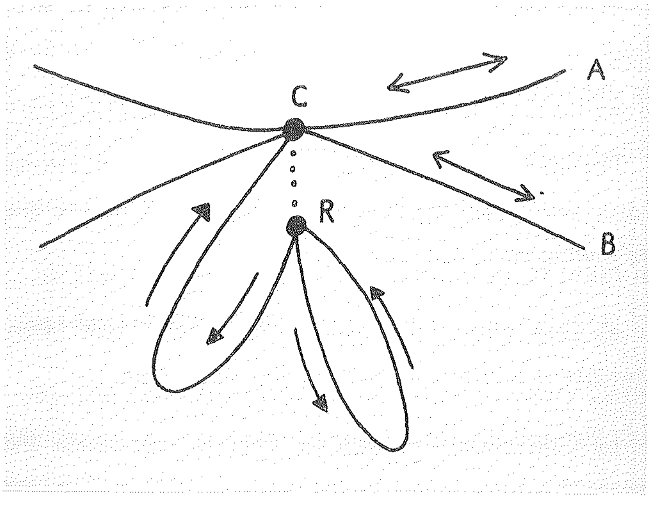


Fig. 62. Shanahan's graph of the Boswell's masticatory cycle. C = centric occlusion; R = physiologic position of rest. The line from A—C shows the horizontal direction of the upper part of an articulator during lateral movement. The line B—R represents the occlusal surface of the upper teeth. The two elliptical curves graphically illustrate the vertically aligned masticatory cycles in the frontal plane (Boswell and Jankelson).

BOSWELL, with the aid of the mandibulograph and the mandibuloscope, proved that the masticatory cycle starts in the physiologic position of rest. When food is taken in the mandible opens and moves laterally at the same time, then it closes with a simultaneous mesial movement; here the cycle ends in centric relation and then starts again (Fig. 62).

In addition to this, JANKELSON discovered that the intercusping reaches its highest level at the end of the masticatory cycle only when swallowing is carried out; however, if no swallowing takes place the masticatory movements stop slightly before a complete closure of the teeth, and a new cycle is started immediately. If the bolus is between the teeth, the working side of the mandibular teeth will be parallel to the maxillary teeth, while the non-working (balancing) side will close a little more tightly, nearly in occlusion.

Thus we know that the functional masticatory cycle starts and ends in the position of maximum intercusping of the teeth, therefore it is quite sufficient to copy this static phase when setting up artificial teeth, since its functional value for the denture is assured.

For this purpose a rationally constructed articulator would be sufficient, as long as it meets the following requirements:

a) One should be able to dismantle and reassemble it without disturbing the occlusion.

b) One should always be able to reproduce the correct intercusping in the same position. For this

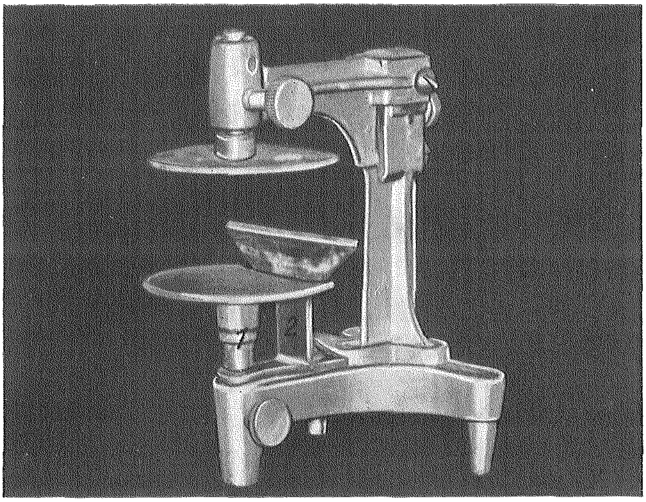


Fig. 63. Fournet Dual Check Articulator. In the upper part which opens is the socket for the model of the maxilla. On the lower part: 1. the concave, plate-like spherical segment which corresponds to the Spee curve; 2. behind it is the retromaxillary plane; both are vertically displaceable.

reason, no resilient part should be included in the construction and the articulator should be a completely rigid unit.

The construction should be as simple as possible and consist only of absolutely essential parts.

In this respect the FOURNET DUAL CHECK ARTICULATOR (Fig. 63) has proved its clinical efficiency. This articulator has two considerable advantages over its European counterparts:

a) The SPEE curve for the setting up of teeth is already predetermined.

b) The vertically displaceable retromaxillary plane facilitates a perfectly accurate orientation of the occlusal surface.

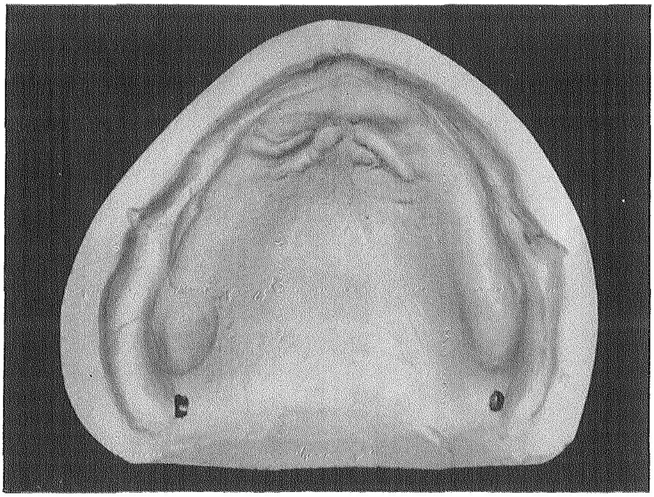


Fig. 64. The two retromaxillary points of the maxilla model.

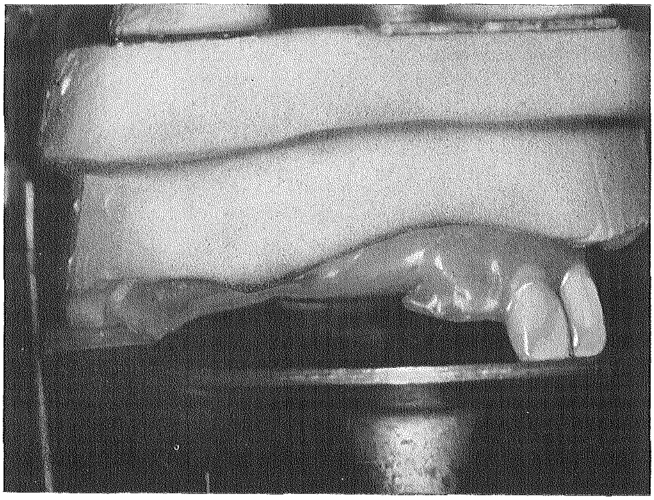


Fig. 65. The upper cast in the articulator fitted according to the three fixed points. Anteriorly the two central incisors are already adjusted to the Spee curve, which is established by the spherical template. Posteriorly the two retromaxillary points rest on the upper edge of the retromaxillary plane.

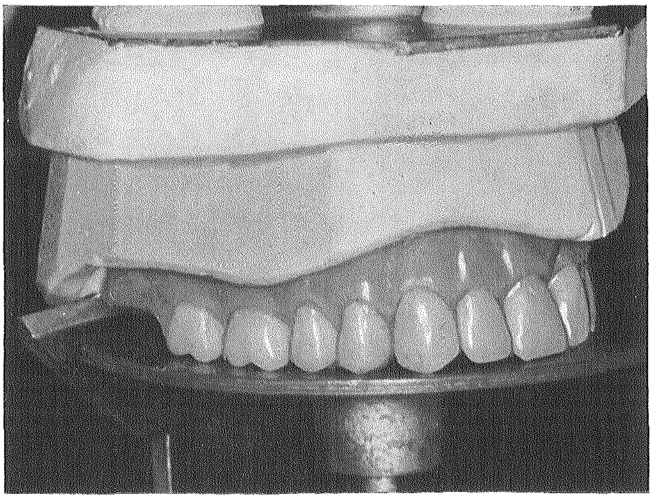


Fig. 66. The upper teeth set up.

The fixed model of the maxilla can be removed and replaced by a simple hinged flap, which can be locked by a screw.

The orientation of the maxillary cast in the articulator is based on three fixed points: the two retromaxillary points (Fig. 64) posteriorly, and the two central incisors anteriorly (Fig. 65). These teeth have already been set up previously in their correct position with regard to length and median plane. The connection of the two retromaxillary points is practically horizontal and may be called the retromaxillary line. It can be used as an adjunct for determining the occlusal plane.

The upper teeth are set up first (Fig. 66). Their occlusal surfaces are positioned on a concave spherical template with an angulation of 16° which corresponds with the curve of SPEE.

The template is then removed, the lower cast mounted in the articulator and the lower teeth set up.

The same method is also applicable to complete oral rehabilitation by means of fixed pontic constructions (one bridge of 14 units in the maxilla and mandible). In this case the plastic occlusal surface of the temporary upper bridge serves to increase the vertical relation of occlusion. It is adjusted to the SPEE curve of the template and the occlusal level of the lower teeth set to it.

We believe the mandible to be the best articulator. Lateral movements can only be checked in the mouth, after the appliance has been completed.

Occlusion is important to most branches of dentistry, not just complete dentures. It is important to each inlay and crown and is particularly important to partial dentures. We use the Biokop-Occludator for small bridges.

Correct inter-occlusal records are of prime importance. We believe in simple clinical methods which follow nature by establishing each individual masticatory cycle. We attempt to blend our constructions to it. It is unnecessary to register temporomandibular joint axes and transfer them to complex articulators.

7. Retentive and Supportive Elements
a) Clasps

A large variety of wrought and cast clasps are available. ESCHLER has shown that if a wrought clasp exerts a permanent force of 5 g. detectable changes of the periodontal ligament take place. 10 g. produces oedema and bone resorption, while 50 g. will cause considerable damage.

If LOEBICH is correct, a 1 mm. strong wire deformed 0.5 mm. has a dynamic effect of 500 g. It will be seen that wrought clasps can cause sonsiderable damage to the abutment teeth. We therefore feel that only the well designed cast clasp is acceptable.

The three elements of each clasp (Figs. 67 and 68) are:

a) The occlusal rest, which loads the tooth vertically in the direction of its long axis.

b) The bracing section, which lies rigidly above the survey line.

c) The resilient part, which provides retention by engaging the undercut below the survey line.

This type of clasp has been known for more than thirty years. It has proved valuable for bounded saddle dentures (KENNEDY Class III and IV) but we have found it unsuitable for free-end saddle dentures (KENNEDY Class I and II). In the latter case the abutment teeth are prone to distal tilting by the saddle.

The NEY system has resolved the vast array of clasps into five specific types. Each type can be used in a particular place. A surveyor or Parallelometer not only determines the path of insertion of the denture but also marks the survey line and the undercuts necessary for clasp design (Fig. 69).

Of the five basic types of the NEY system only some are known in Europe (Fig. 70):

1. Clasp I by AKER
2. Clasp II by ROACH
3. The combination clasp I—II
4. The back-action clasp by NEY
5. The ring clasp by NEY

The five basic forms can be divided into two main groups with similar properties:

Group 1 (Fig. 71). Clasp I, Clasp II, combination Clasp I—II.

All clasps of this group possess double bracing and double retention.

Group 2 (Fig. 72). The back-action clasp and ring clasp.

In this group the bracing is only on one side of the abutment tooth. The retention of the back-action clasp is distal; it can only be used bilaterally, symmetrically in mirror-image (Fig. 73).

Clasp I (Fig. 74 a, b, c, d) grasps the abutment tooth rigidly. It is only indicated for bounded saddles and not for tilted teeth. The rigid part of the clasp arm (above the survey line) forms two-thirds, the resilient part (reaching into the undercut for retention) only one-third of the total length of the arm.

Clasp II (Fig. 75 a, b, c) is indicated for free-end saddles where the undercuts of the abutment teeth are situated deeply near the neck of the tooth; the bracing action is small. The retentive areas are adjacent to the denture saddle.

The combination clasp I—II (Fig. 76) is applied to:

1. Teeth which are bounded by other teeth.

2. Situations where the buccal (upper) or palatine (lower) conditions call for the use of clasp I, and lingual (lower) or buccal (upper) conditions call

for the use of clasp II (usually in the case of tilted teeth).

The occlusal surface support is always supplied by the strongest part of the clasp, i. e. the rigid arm of clasp I.

The first clasp type of the second group, the back-action clasp by NEY (Fig. 77 a, b, c) is well suited for free-end saddles. It can be attached to premolars, canines and incisors. It is connected to the stabilizing bar of the denture by a mesiolingual strong arm. The two retentive points are situated mesio-buccally and distally. The latter prevents the saddle being displaced by the mucosa.

There are two types of back-action clasp:

1. The reverse back-action clasp (Figs. 77 c, 78). When the abutment tooth is tilted lingually, the survey line lies near the occlusal surface on this side. This clasp has its bracing part buccally and its retentive part lingually.

2. The "Sedelac clasp" (Fig 79a, b) is an ingenious variation of the back-action clasp. The occlusal rest is directly connected to the denture saddle and is separated from the other parts of the clasp.

Apart from the back-action clasps, the ring clasps are also in the second group (Fig. 80). Ring clasps are useful for buccally tilted upper molars (Fig. 81 a) or lingually tilted lower molars (Fig. 81 b). As the ring clasp is so long, we normally stabilize it by two occlusal rests and a double support for its bracing arm. which runs 2—3 mm. from the gingival margin.

When designing a rigid clasps system, one must not overlook a rigid major connector. We feel that the continuous clasps, frequently used as a connector and indirect retainer (tilt-stopper), may act as an orthodontic appliance. We do not recommend its use.

Abutment teeth should be crowned, since the unavoidable rubbing effect of the cast surface of the clasp may lead to a carious lesion. A rest seat may be incorporated into the crown. We have found a tendency for caries to occur if a rest seat is ground in a natural tooth. The only circumstances in which the abutment teeth need not be crowned are those in which there is a high natural resistance to caries and good oral hygiene. Rest seats should not be ground in natural teeth. If necessary, the cusp of the opposing tooth should be adjusted. The rest seat should be 1.0—1.3 mm. deep, saucer-shaped, with its greatest depth mesially. The occlusal rest itself must be rigid.

While the Ney system provides many advantages, we feel that an unsplinted abutment tooth may be subjected to pathological stresses. In most cases, the buccal and lingual survey lines are not on the same horizontal plane.

This could lead to a tilting of the crown in one direction and a movement of the root in the opposite direction (Fig. 82 a, b). This danger is accentuated if the clasp is empirically adjusted at a later date.

The occlusal rest is situated at a high point on one side of the tooth. Occlusal loads can lead to tilting of the tooth (Fig. 83). For these reasons we strongly advocate splinting the remaining teeth.

b) Internal Attachments

The internal attachment (NEY-CHAYES, STERN-BAKER, and others) provides a series of important advantages over clasps.

1. No metal is shown.

2. During the dynamic phase of mastication only vertical forces affect the abutment, while during the static phase the patrix rests passively within the matrix.

3. The path of insertion of the denture is precisely determined.

4. Loose attachments can be tightened without harmful effects.

c) Telescopic Constructions

Telescopic crowns provide a solution to the situation where only a few natural teeth remain (HÄUPL). The denture wearer is given confidence because of the transfer of some of the occlusal load to the periodontal ligament.

Retention of telescopic crowns is not always ensured by the large frictional surface of the telescopic crown (removable unit) on the telescopic cap (fixed unit).

When the clinical crown of the tooth is too short, the retention of the telescopic construction will be inadequate. The retention with normal-shaped teeth diminishes with wear of the material. Consequently the firm fit of the telescopic crown eventually slackens.

The introduction of an adjustable retentive device for telescopic constructions has solved this problem. The retentive part is placed in the removable unit and is known as the "Pressomatic mechanism". A bolt is adjusted to a determined tension and engages a slot cut in the lingual or palatal surface of the fixed telescope cap.

Copper ring impressions of each abutment preparation are taken, followed by a localising impression in alginate. The caps (fixed part) are constructed on this cast. A working impression of the edentulous area is taken in a special tray with zinc oxide-eugenol paste. The occlusal rim is constructed to the cast of this impression. The "Pressomatic" device is positioned with sticky wax halfway up the cap and the crown waxed up around it. When the crown has been cast, the correct position for the slot is determined and cut in the cap. This attachment provides useful retention and has proved to be of considerable value.

Electrolytic Silver or Copper-Plating of Impressions

A hard die is required for constructing precision cast objects. Plaster or cement casts are easily abraded while amalgam dies can lead to mercurial damage of the precious metal. We recommend silver or copper-plated casts made on a rubber base impression.

For copper-plating the following solution is used:
To 1 litre distilled water is added —
200 g copper sulphate
50 g concentrated sulphuric acid
10 g potassium sulphate.

(We recommend adding a generous dash of detergent to the prepared solution).

The silver solution should be prepared as follows:
55 g/l potassium silver cyanide (54%)
50 g/l potassium cyanide
30 g/l potassium carbonate.

Alternatively 30% DEGUSSA silver double salt (100 g silver double salt to 1 litre) can be used.

Distilled water should always be used for the silver solution.

Silver-plating takes much less time than copper-plating. In this case, the copper anode is replaced by a fine silver anode and the solution by an appropriate silver solution. The latter is a potassium cyanide solution and therefore very poisonous. All

Illustrations to the section on Clasps

Fig. 67. Diagram of the three most important elements of a clasp. (Illustrations of the Ney-clasp system have been taken from the Ney book).

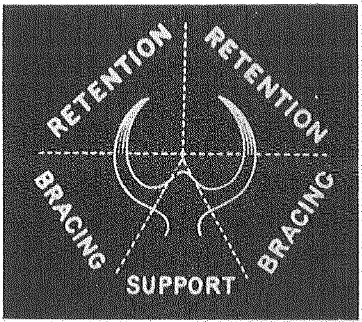


Fig. 68. The most important parts of a clasp. Support — left; bracing — centre; retention — right.

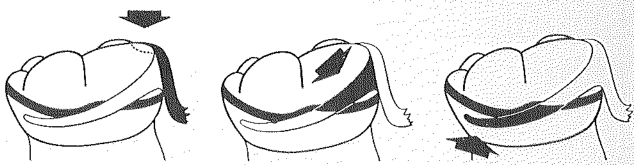


Fig. 69. Surveyor (Parallelometer) with tilting base.

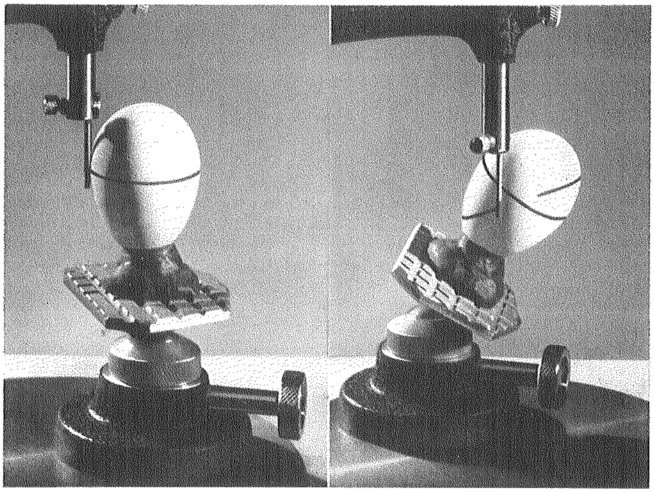


Fig. 70. From left to right: clasp No. 1, clasp No. 2, combination clasp No. 1—2, back-action clasp, ring clasp.

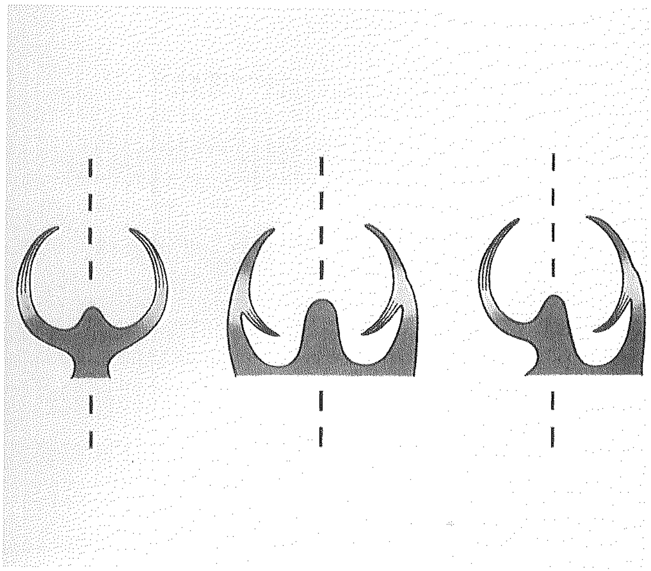


Fig. 71. Clasp No. 1, clasp No. 2, and combination clasp 1—2 provide double support and double retention.

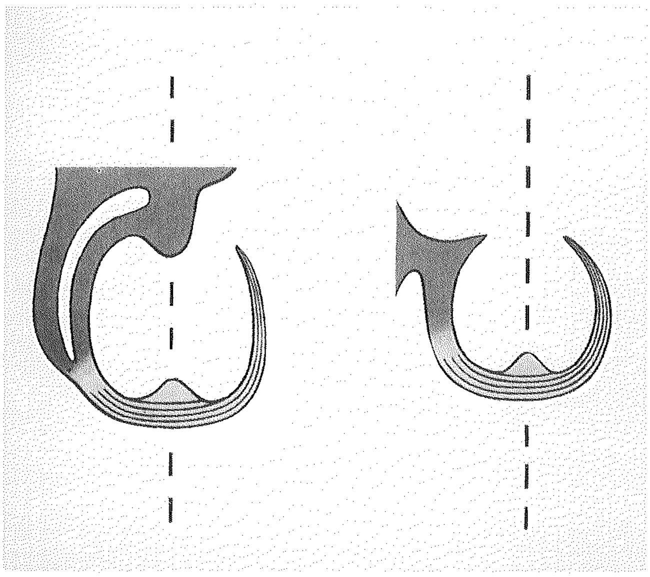


Fig. 72. Ring clasp and one-armed clasp support only in one direction.

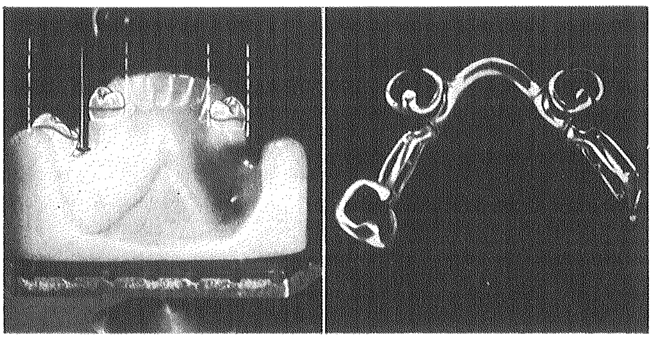


Fig. 73. Design with symmetrical use of the back-action clasp.

Fig. 74 a. Diagram of clasp 1 by Aker.

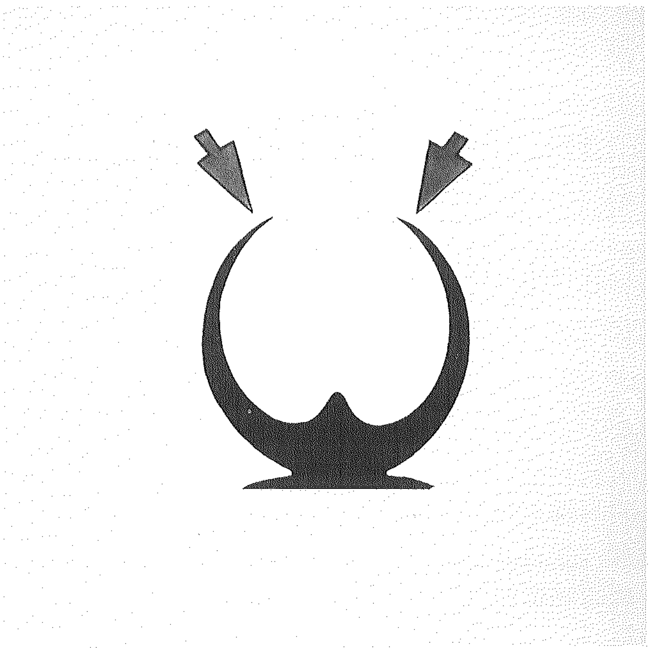


Fig. 74 b. The rigid clasp parts are always situated above. The resilient parts below the surveyor line.

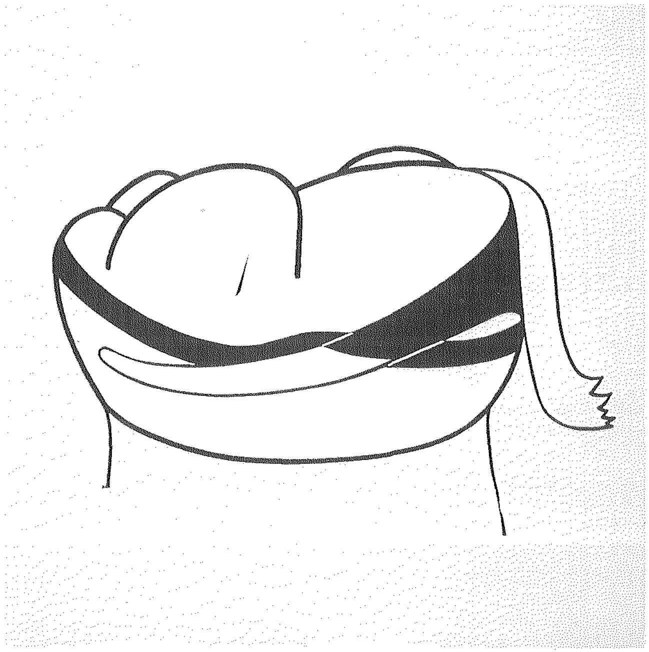
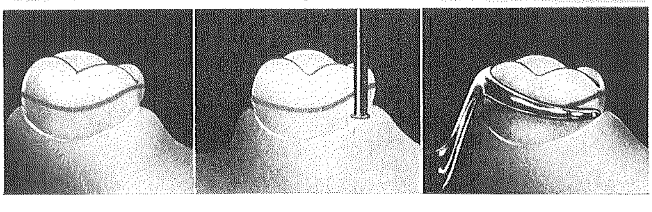


Fig. 74 c. Left: the survey line. Centre: measuring the lower undercut with measuring rod No. 20. Right: clasp No. 1 in correct position.



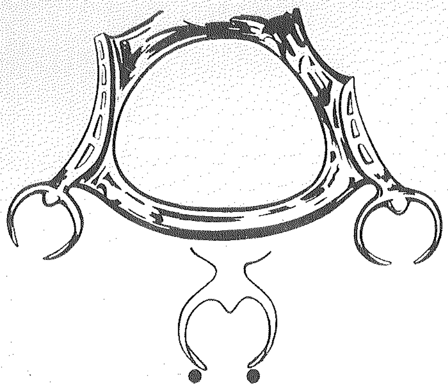


Fig. 74 d. Diagram of a design.

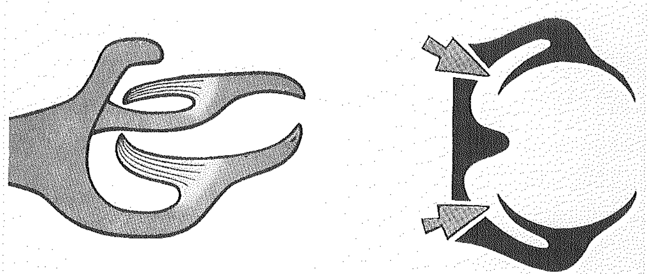


Fig. 75 a. Diagram of clasp No. 2.

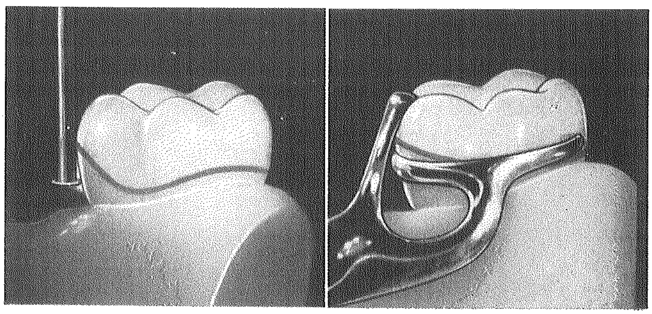


Fig. 75 b. The bracing parts are always situated above the survey line, the retentive parts always below it, towards the side of the free-end saddle.

Fig. 75 c. Diagram of a design.

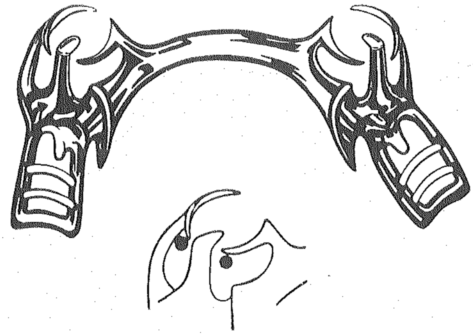


Fig. 76. The combination clasp No. 1—2 is half formed by a clasp No. 1 and half by a clasp No. 2.

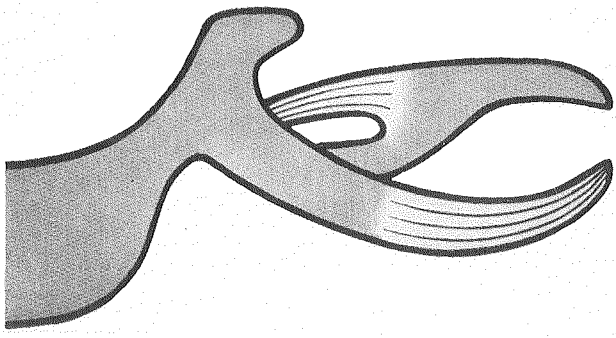


Fig. 77 a. Diagram of a back-action clasp.

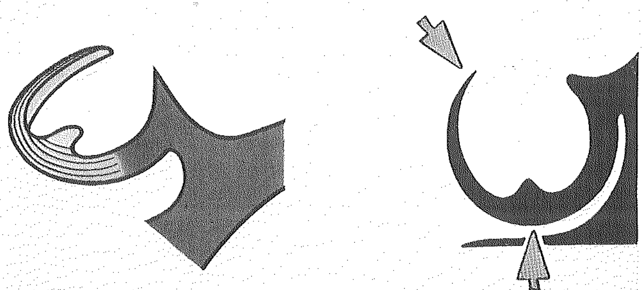
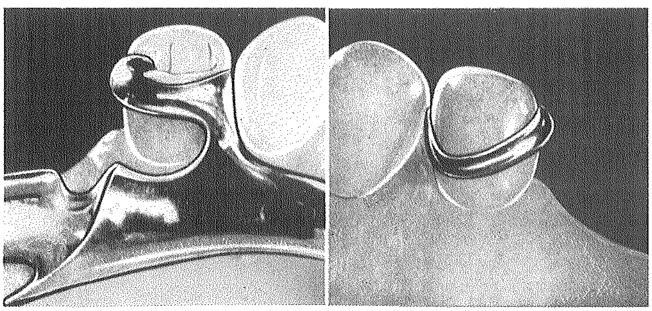


Fig. 77 b. Lingual and buccal view of a back-action clasp.



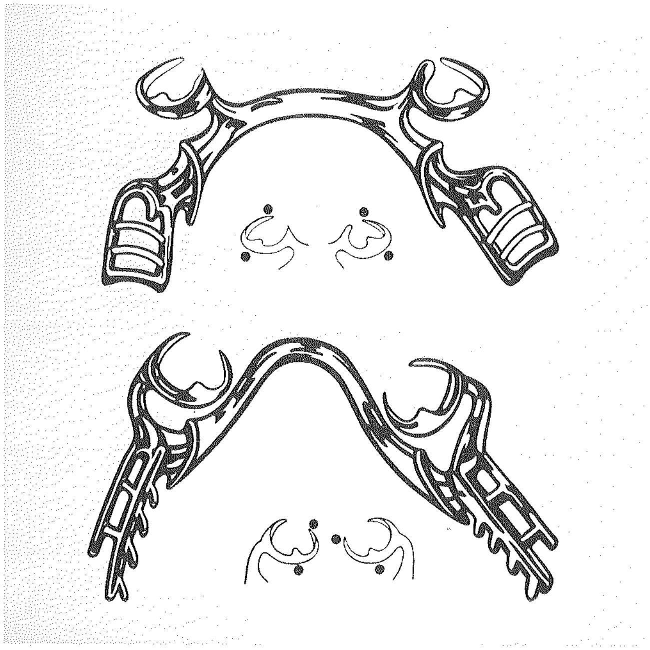


Fig. 77 c. Diagram of two designs.

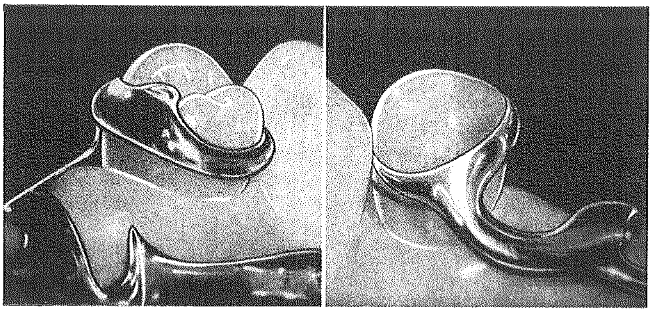


Fig. 78. Lingual and buccal view of a reverse back-action clasp.

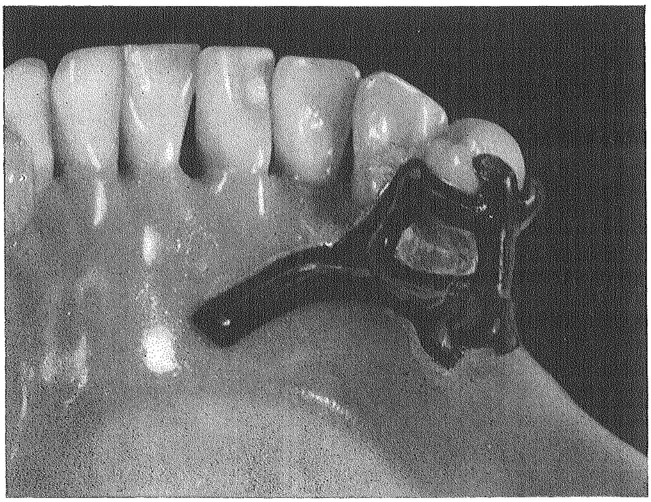


Fig. 79 a. "Sedalac" clasp in construction.

Fig. 79 b. Diagram of a "Sedalac" clasp.

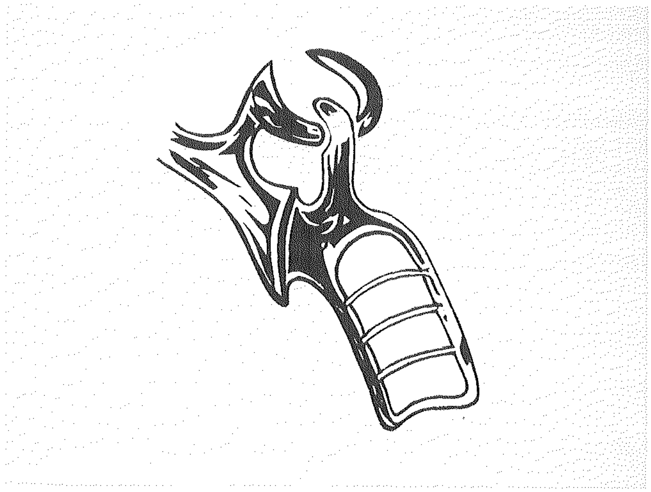


Fig. 80. Diagram of a ring clasp.

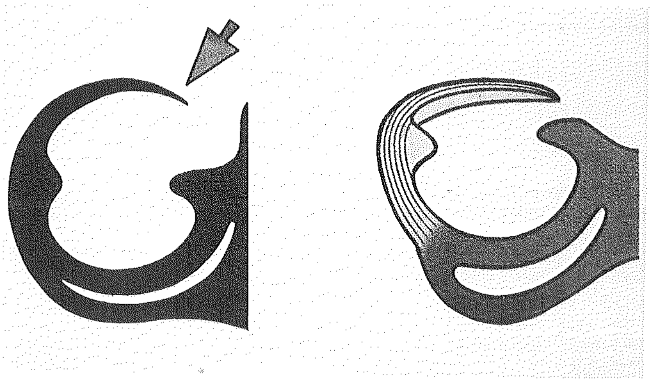


Fig. 81 a. Guiding lines and construction of an upper denture with ring clasps.

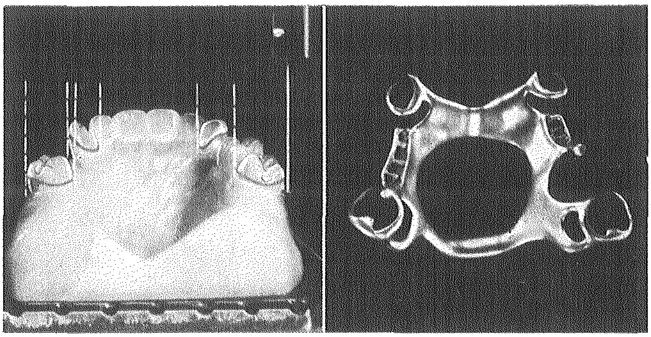
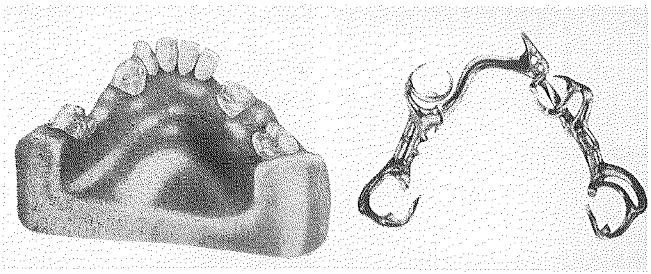


Fig. 81 b. A lower denture with ring clasps.



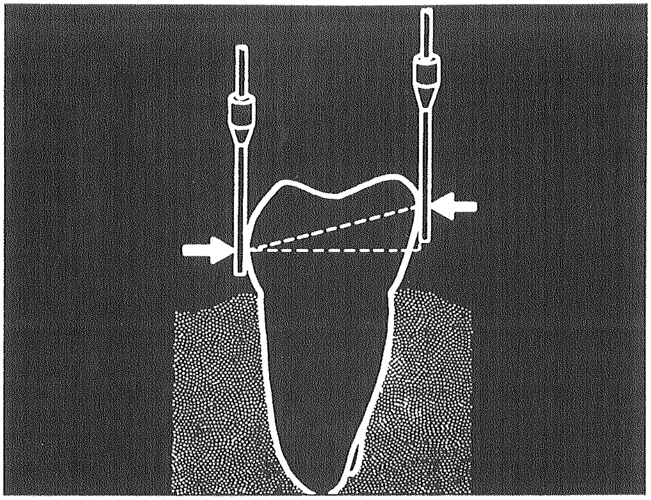


Fig. 82 a. Diagram: buccal and lingual survey lines are not on the same level.

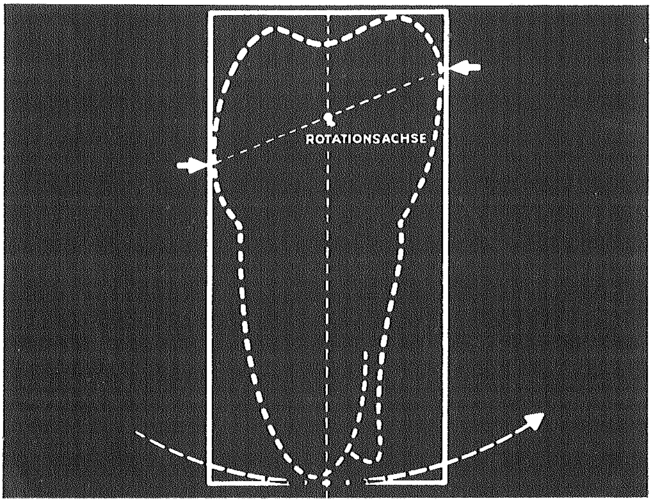


Fig. 82 b. Diagram: the result is a rotational force.

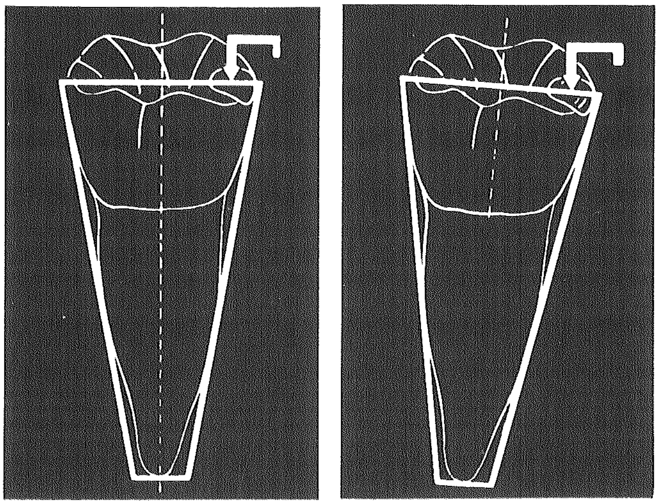


Fig. 83. Placing the occlusal rest on the edge of the abutment tooth may cause it to tilt.

Internal Attachments
Illustrations to the section on

Fig. 84. Preparation of maxillary abutments for veneer crowns.

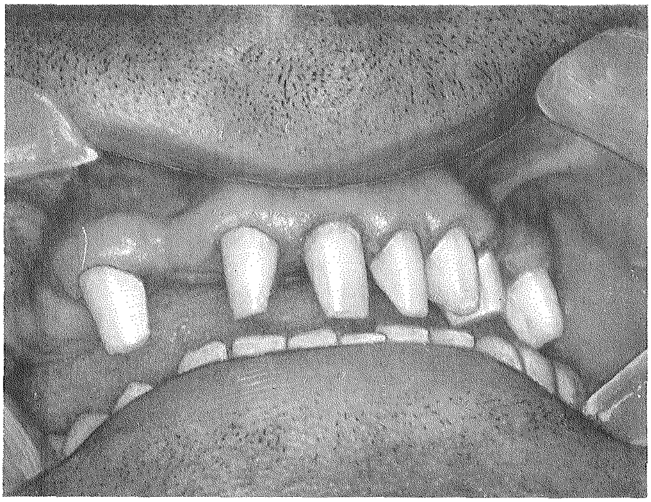


Fig. 85. Hard plaster cast poured to an alginate impression. The plaster cast serves for the construction of the temporary bridge and base plate.

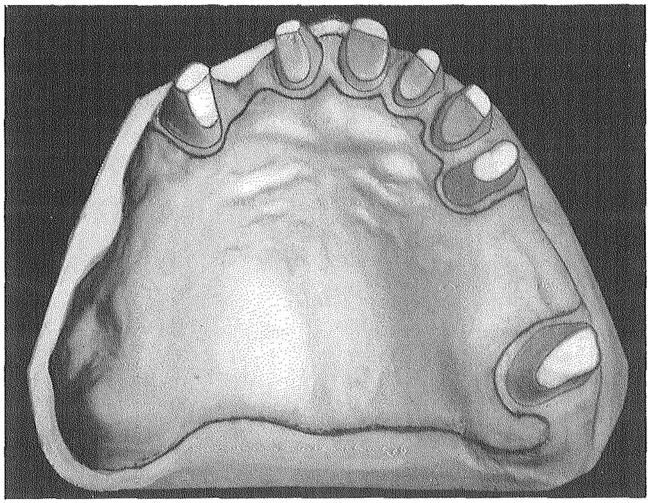


Fig. 86. Base plate, made from self-hardening plastics, on the cast.

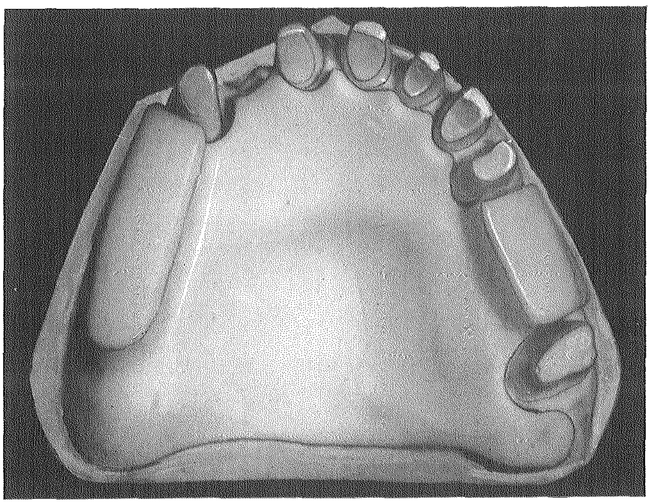


Fig. 87. The temporary plastic bridge (Acryl-splint).

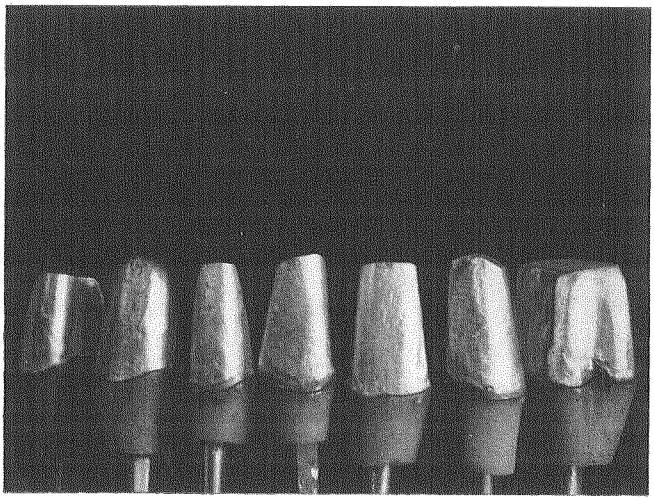


Fig. 88. Model stumps electrolytically copper-plated.

parts which have been in contact with the silver solution should be very carefully rinsed before they are used again.

Since dental impression substances do not conduct electricity, the impression surfaces must be prepared for treatment by applying a conducting layer.

The copper ring impression is evenly brushed with silver powder (DEGUSSA, KERR) or graphite powder (SCHÖTTL & KRAMER). To provide a contact, a thin brass or copper wire is wound round the copper ring in such a way that the end of the wire touches the conducting layer. This wire also serves to suspend the impression. Wax is applied to the parts of the impression and wire which are not to be plated. The wire can also be covered by a rubber or polythene hose.

The object is now attached to the cathode stirrup and suspended in the solution (Fig. 89). Care must be taken to ensure that no air bubbles remain inside the cast since this prevents an even silver-plating. We recommend pipetting a little of the solution into the cast.

After approximately 10 minutes the impression is tested for the formation of an even metallic deposit. If this has not occurred, the cast is rinsed under distilled water, well dried with air pressure and again brushed with graphitic or silver powder.

The time taken for copper-plating is between 8—15 hours; for silver-plating only 2½—3 hours.

The cast is then taken out of the bath, thoroughly rinsed under running water and filled with hard plaster (Velmix-Stone, KERR-COMPANY). For the root stumps it is best to use the ready made plastic stumps by GÄSSLER/Ulm; for the construction of inlays by the Kerr method, the dowel pins supplied by the NEY COMPANY are recommended. For vibrating the hard plaster, the vibrating apparatus by the HERAEUS COMPANY has proved very efficient.

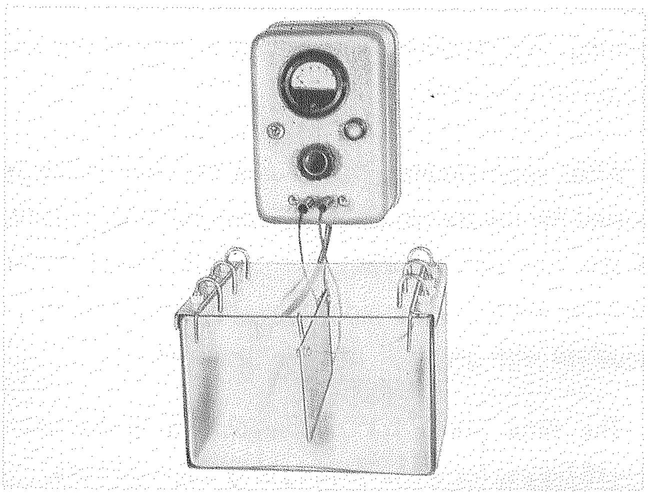


Fig. 89. Galvanizing apparatus by Mihm-Vogt (Karlsruhe).

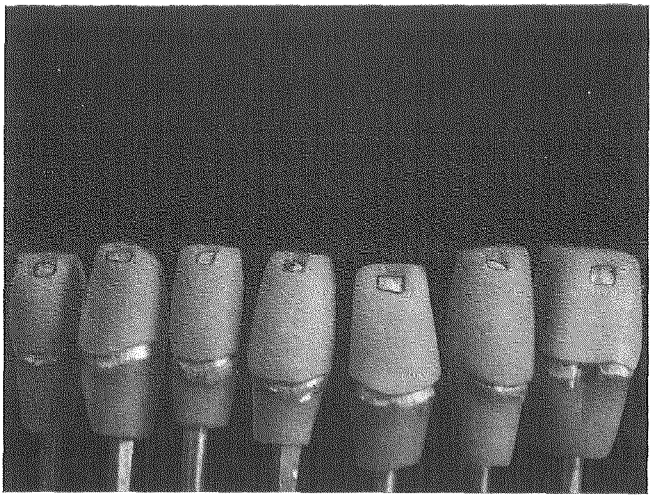


Fig. 90. Transfer copings made from self-polymerising acrylic resins, with incisal openings for the control of a correct fit of the copings on the stump.

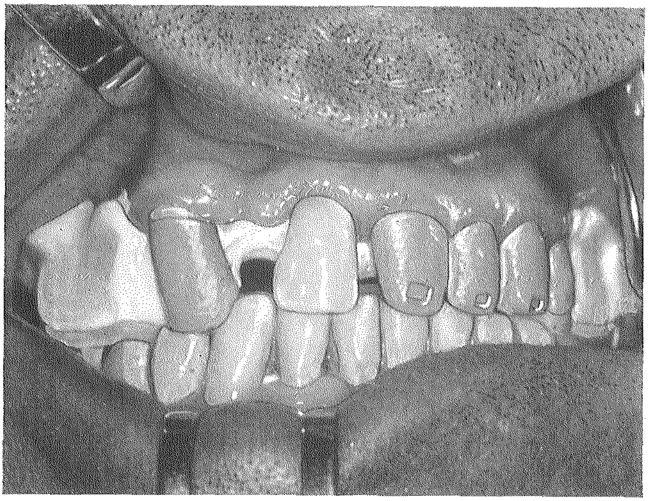


Fig. 91. First functional impression and occlusal impression in the mouth. A plastic facing has been ground hollow and stuck on 11; occlusal impression is taken to establish the occlusal plane.

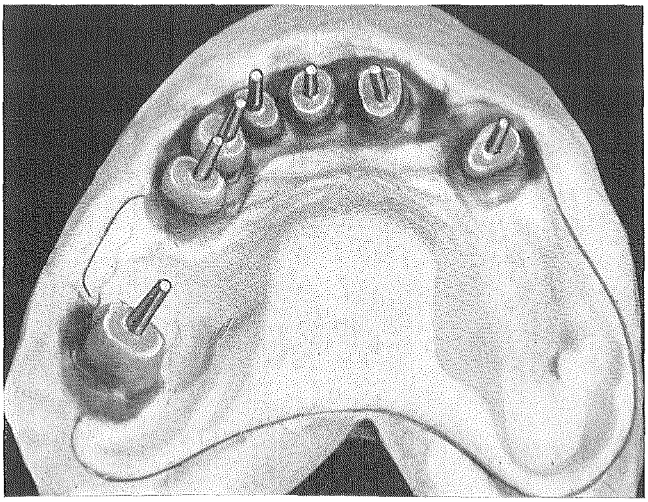


Fig. 92. Stumps are fitted and waxed into the functional impression.

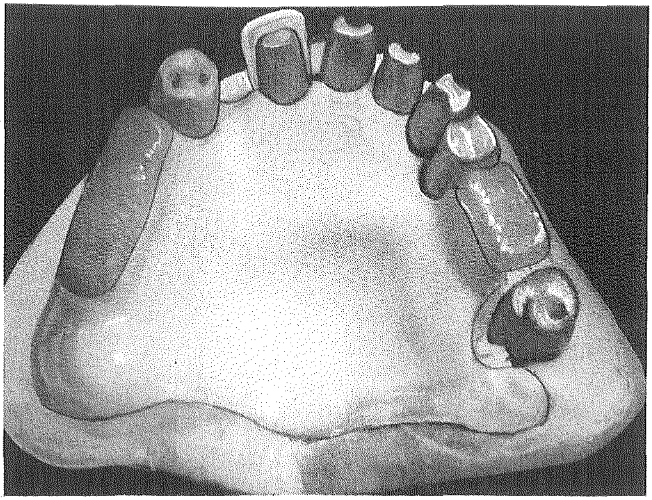


Fig. 93. Hard plaster cast of this impression.

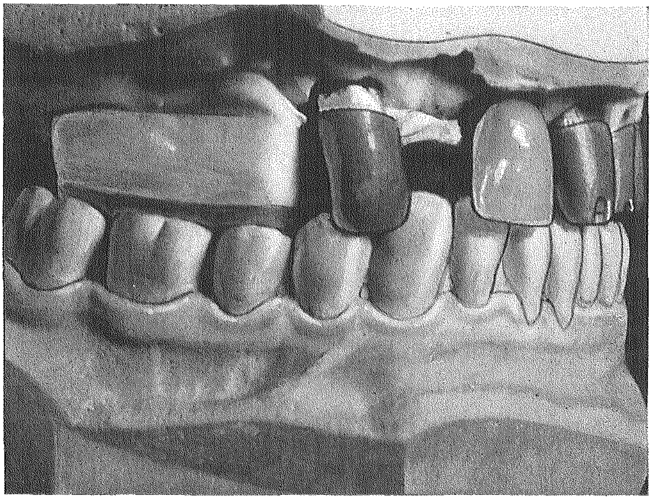


Fig. 94. Casts on the articulator.

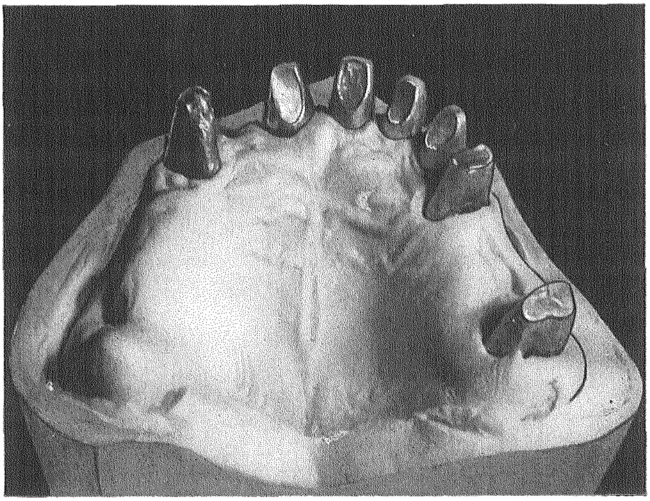


Fig. 95. Cast without occlusal plate and transfer copings.

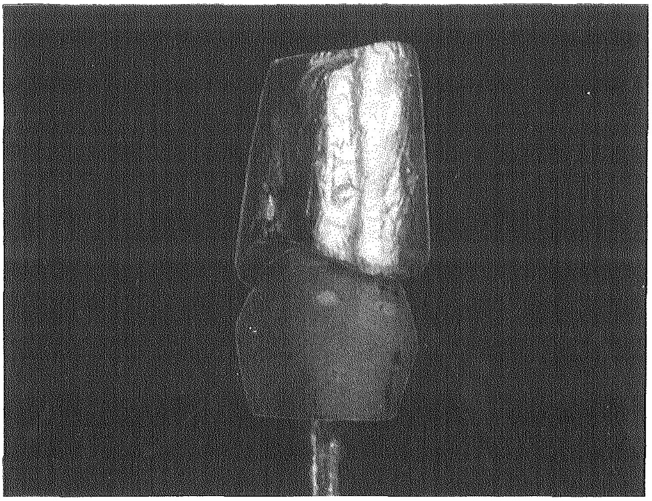


Fig. 96. Cervical forming of stump edges prior to modelling veneer crowns.

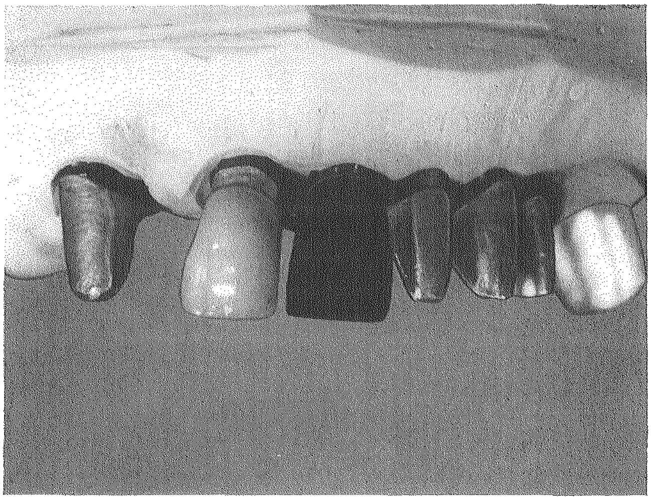


Fig. 97. On 21 modelled wax crown made to fit the facet stuck in mouth.

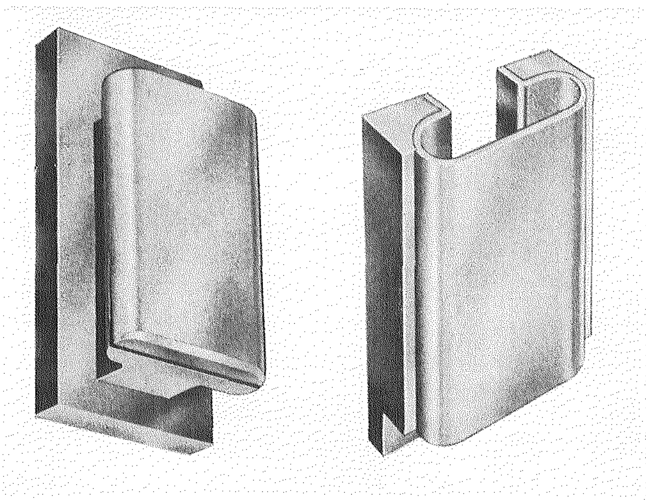


Fig. 98. Illustration of an internal attachment.

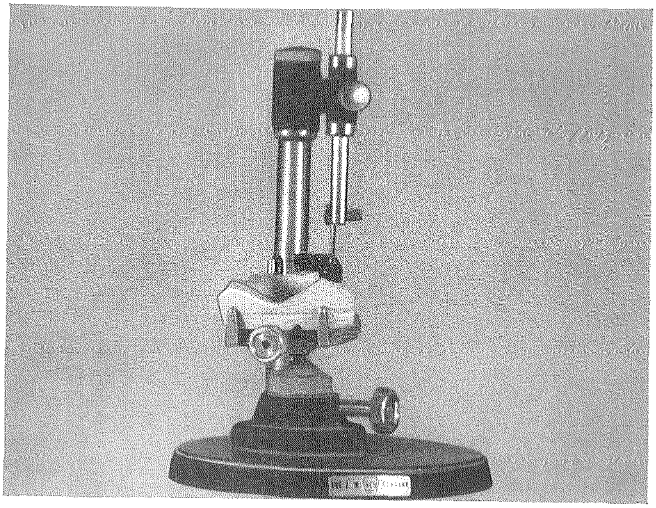


Fig. 99. Parallelometer for use with internal attachments.

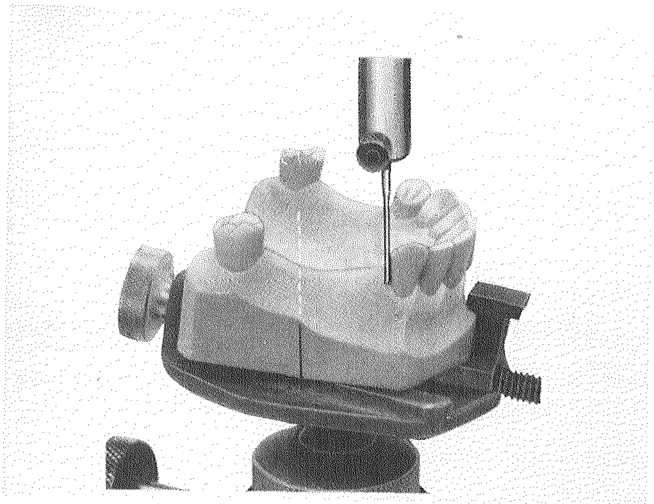


Fig. 100 a. Establishing the path of insertion before aligning the attachment.

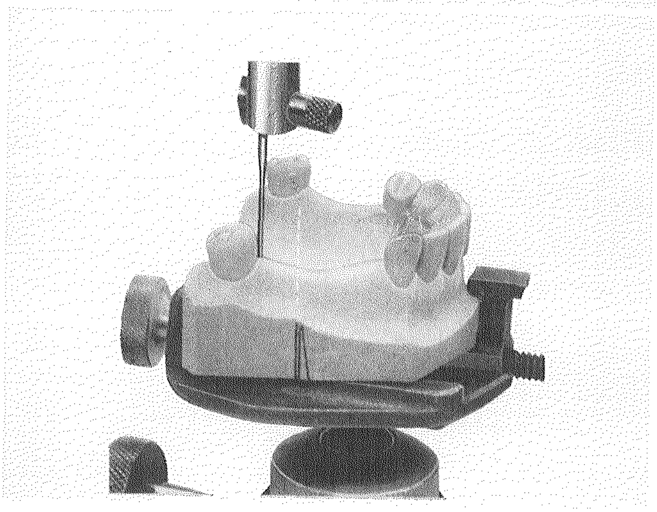


Fig. 100 b.

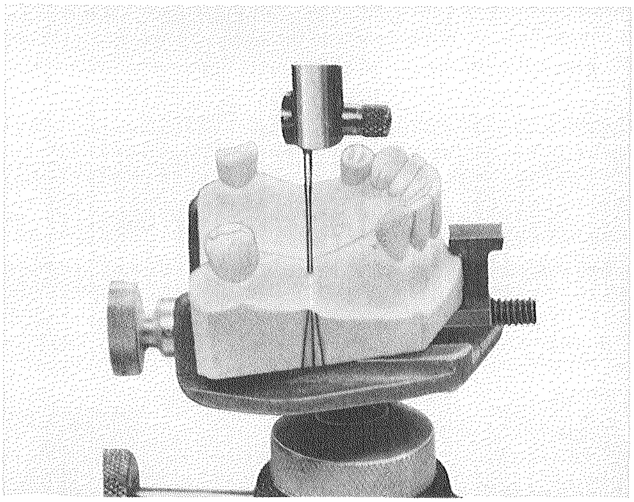


Fig. 100 c.

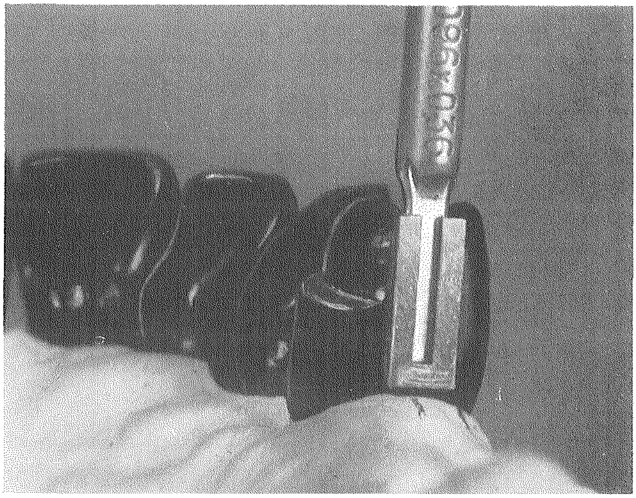


Fig. 101 a. Attachment matrix is countersunk intracoronally, guide and palatal step are modelled for the denture arm.

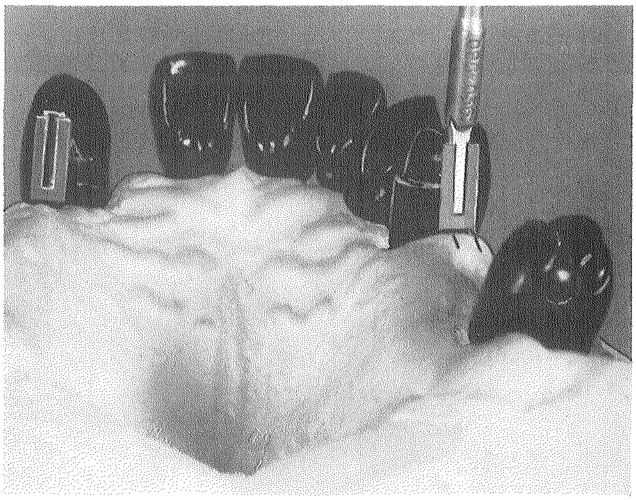


Fig. 101 b.

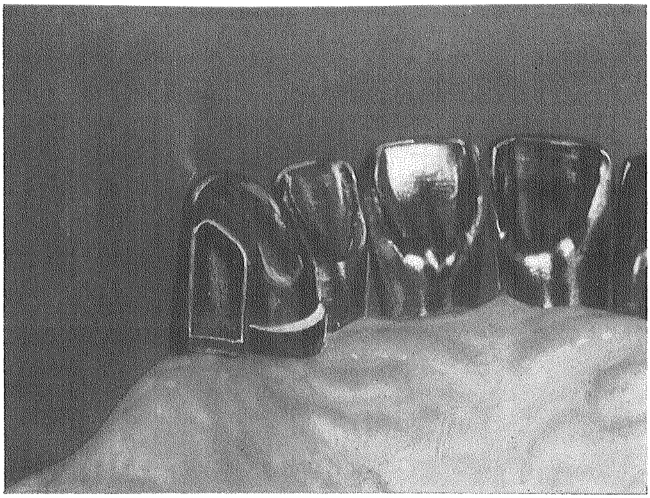


Fig. 102. The cast veneer crowns on the model.

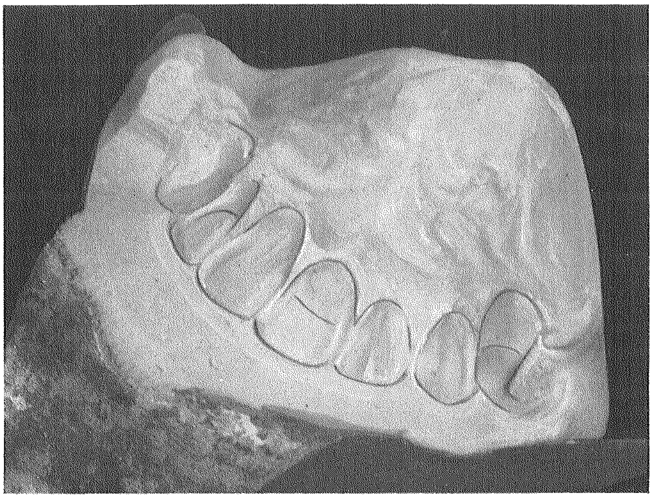


Fig. 103. Soldering impression in plaster.

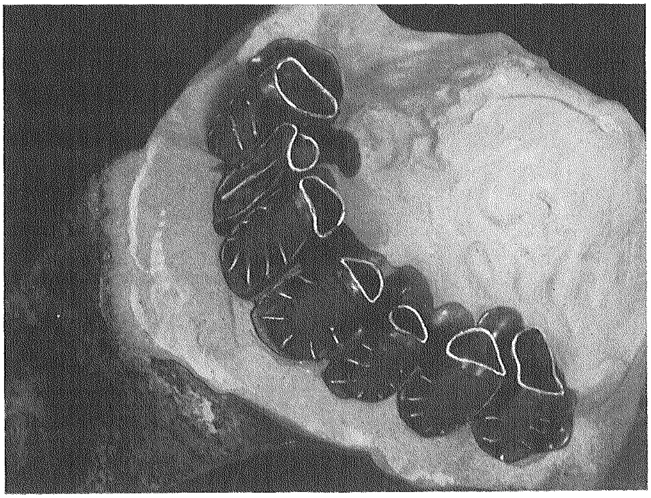


Fig. 104. Impression prepared for soldering.

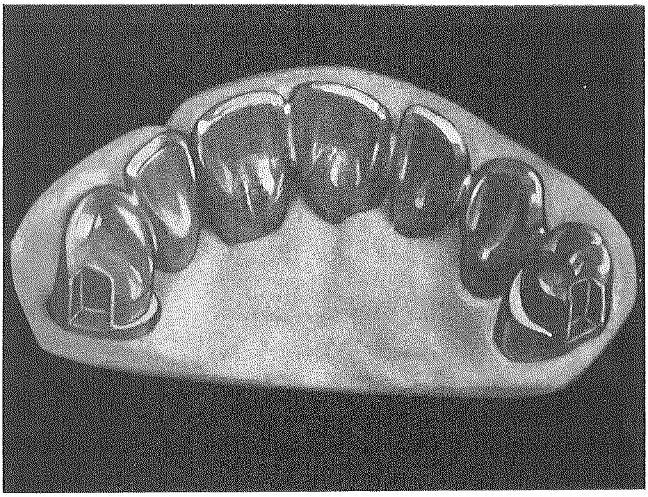


Fig. 105. The soldered unit.

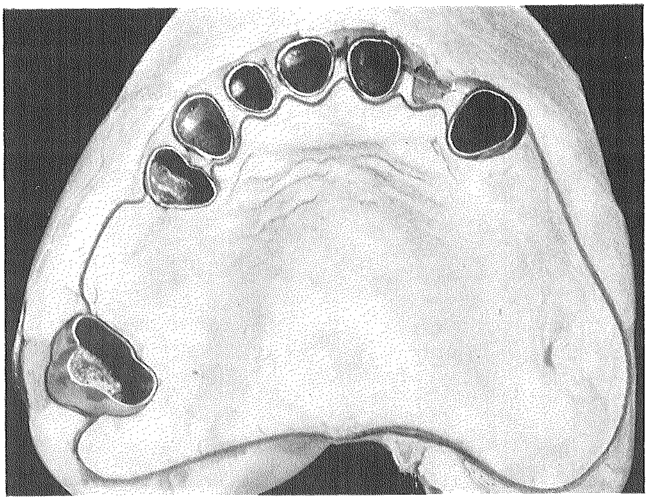


Fig. 106. Second and final functional impression.

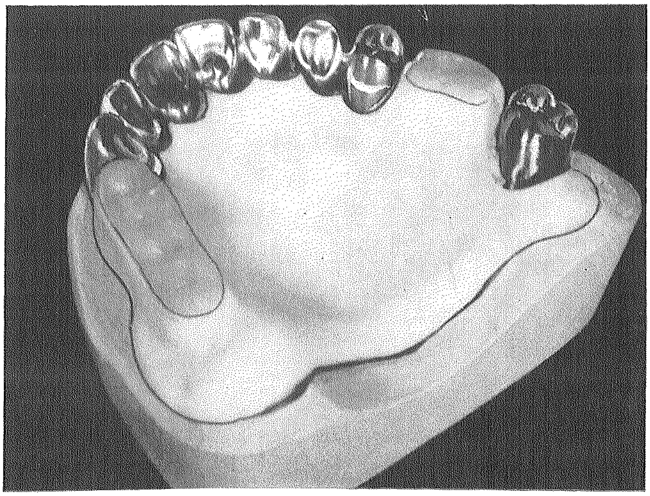


Fig. 107. Cast and occlusal rim on which the accurate intercusping in self-polymerising acrylic resin can be seen.

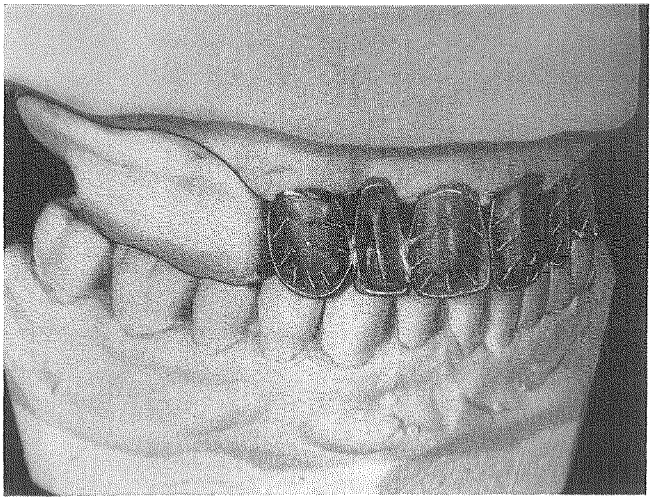


Fig. 108. Cast on the articulator.

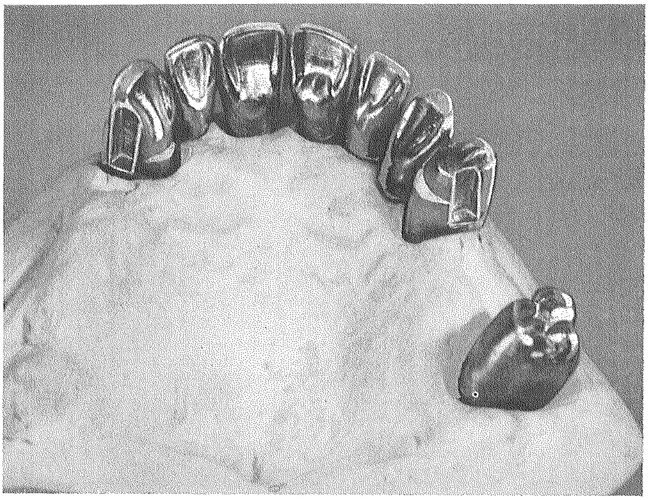


Fig. 109. Cast after removal of the occlusal rim and before insertion of the internal attachment.

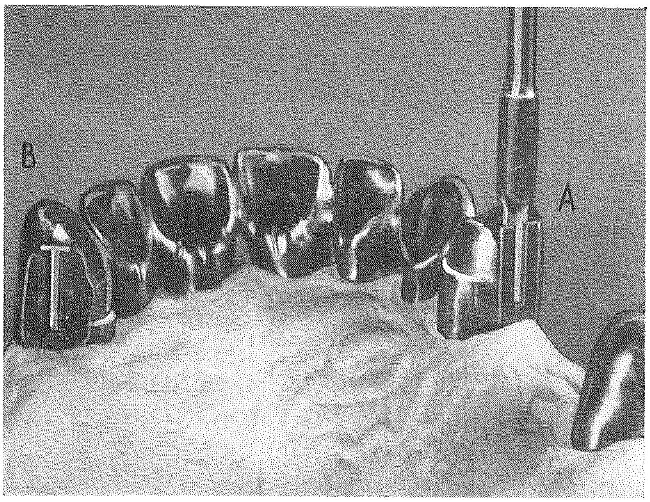


Fig. 110. A — attachment inserted intracoronally by means of a parallelometer; B — inserted attachment fixed with wax.

Fig. 111. Graphite rods inserted together with a special expanding insertion substance (Kerr-Christobalite).

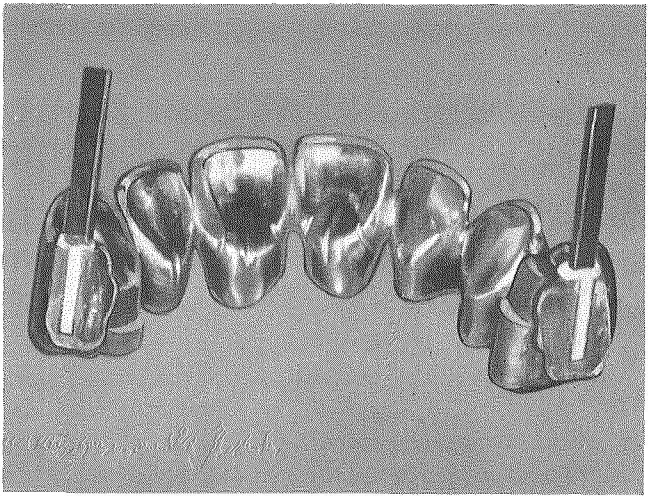


Fig. 112. Internal attachment (matrix) ready for soldering. (A — contact plate of matrix is brushed over with an antiflux).

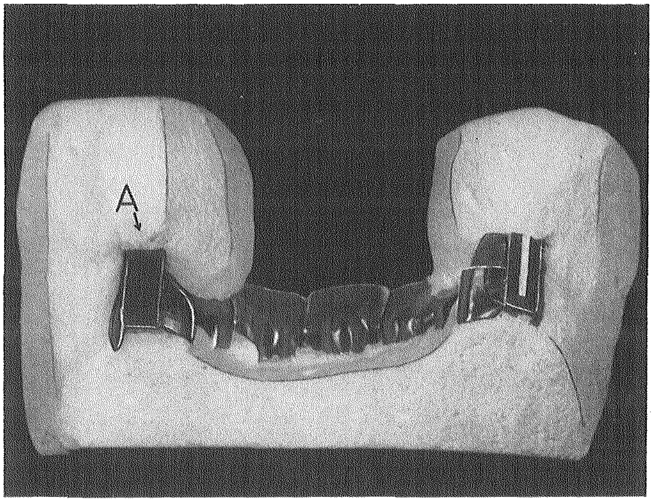
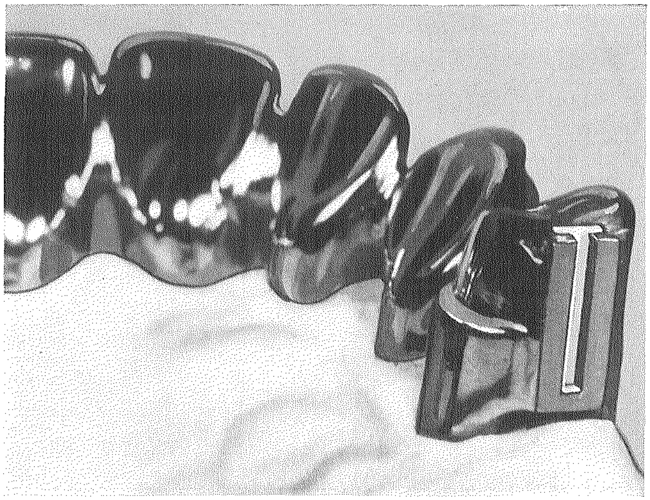


Fig. 113. Soldered matrix and polished bridge.



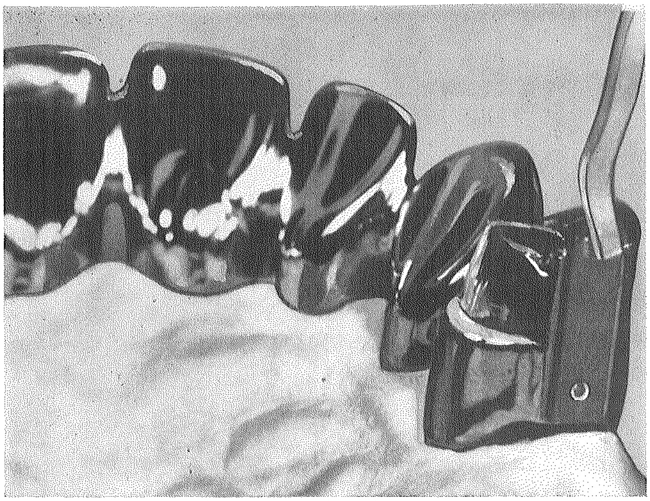


Fig. 114. Patrix put on.

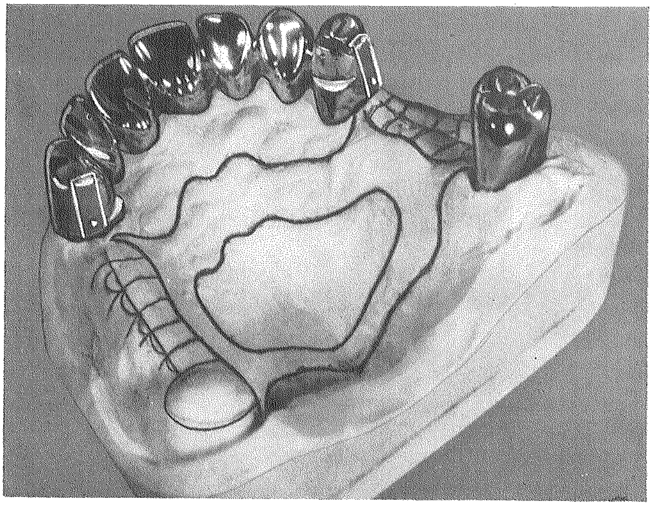


Fig. 115. Outline of the metal framework of the removable denture.

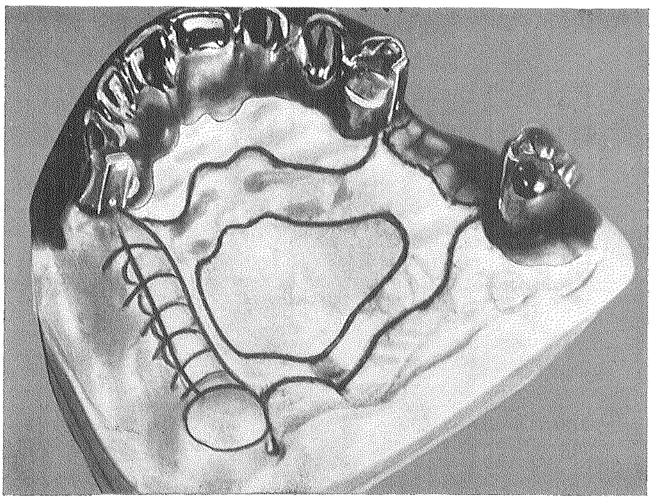


Fig. 116. Cast prepared for duplication.

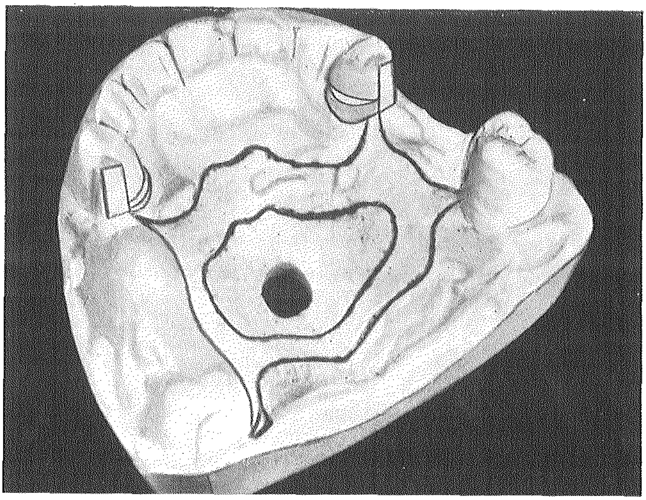


Fig. 117. Duplicate cast.

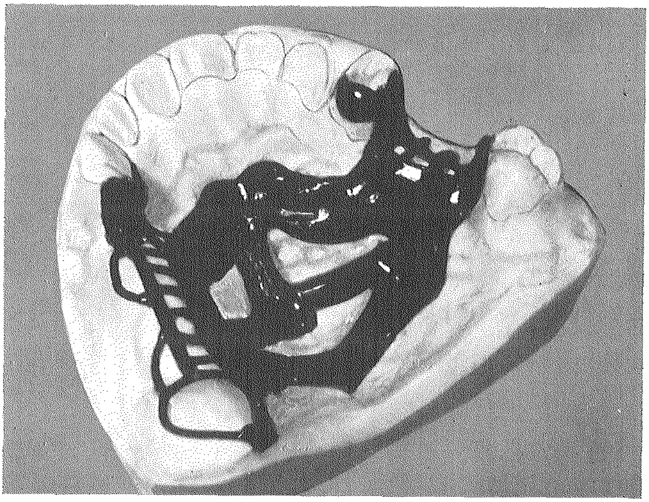


Fig. 118. Waxed up framework ready for investment.

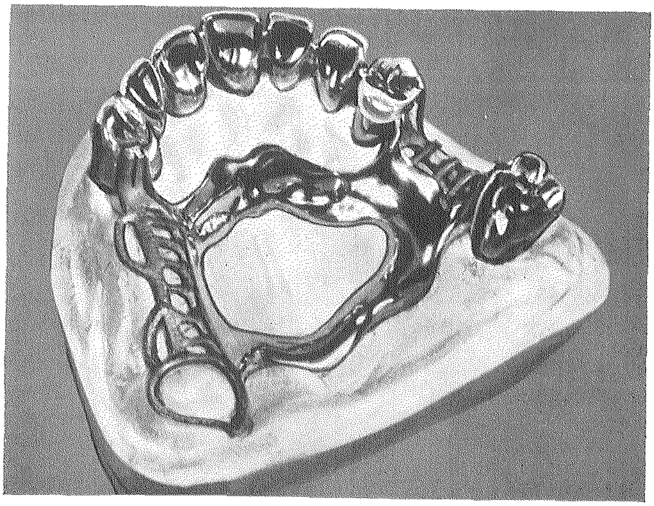


Fig. 119. Cast and polished framework ready to be soldered to the attachment patrix.

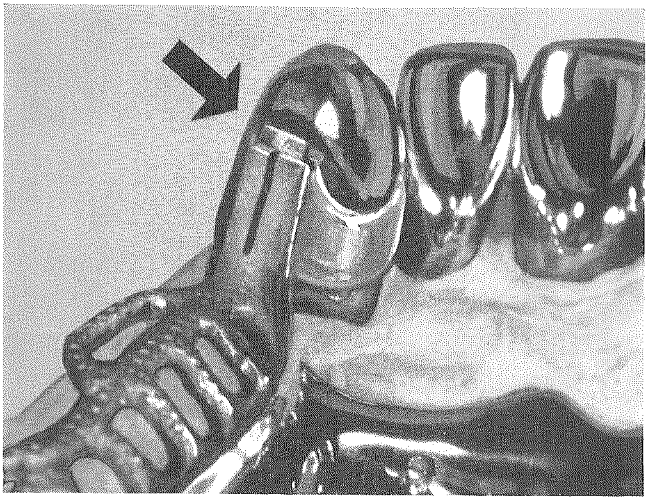


Fig. 120. Step for fixing the patrix by electro-soldering.

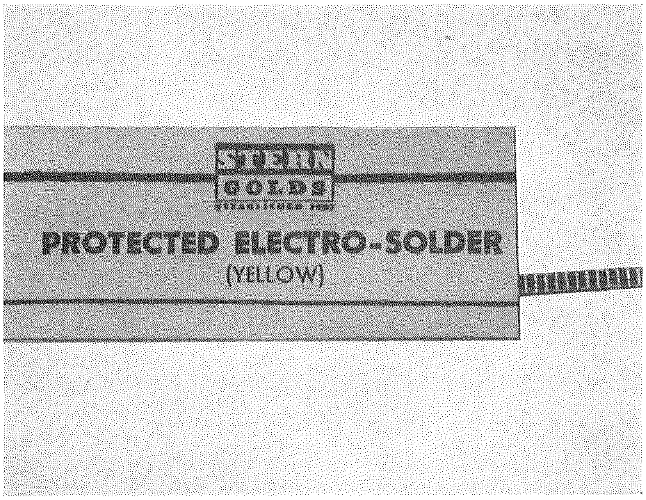


Fig. 121. Special solder for electro-soldering.

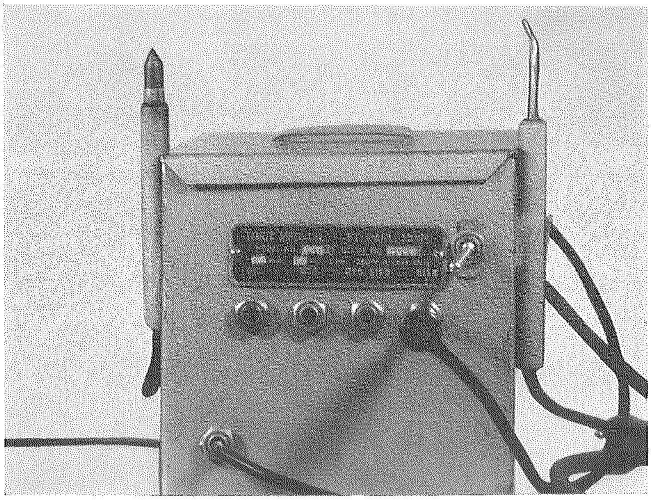


Fig. 122. Electro-soldering apparatus.

Fig. 123. Diagram of the electro-soldering apparatus.

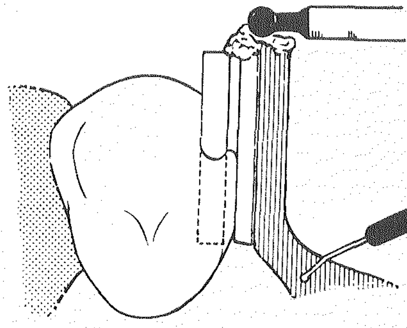


Fig. 124. Electrically soldered patrices.

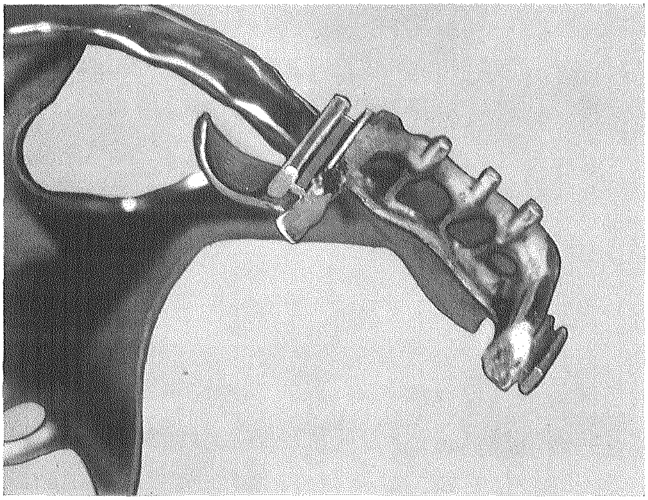
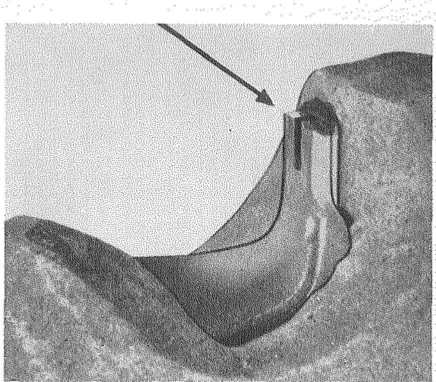


Fig. 125. Patrix and metal base inserted.



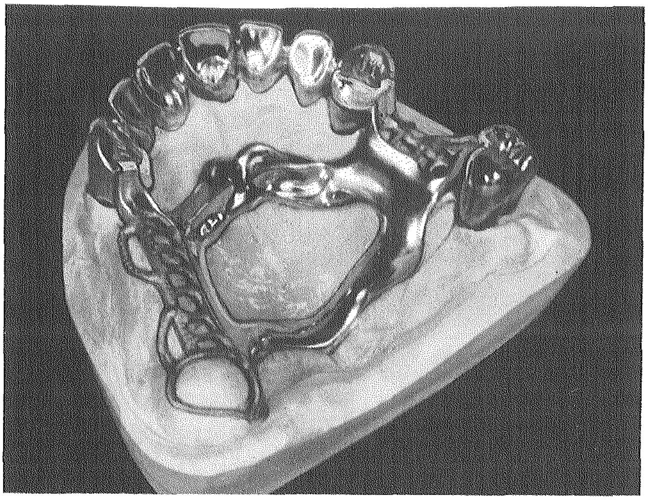


Fig. 126. Completed metal base prepared to take the acrylic resin.

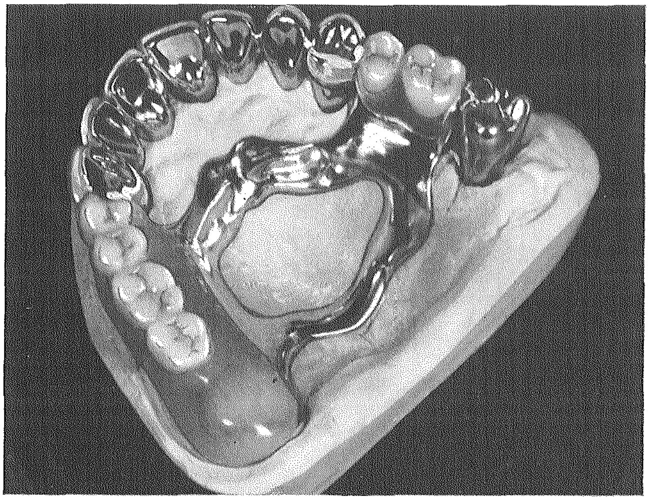


Fig. 127. Completed work on the cast.

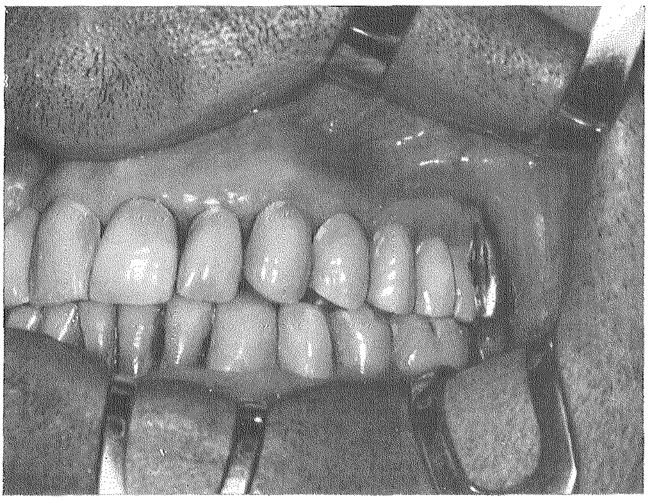


Fig. 128 a. Completed work in the mouth.

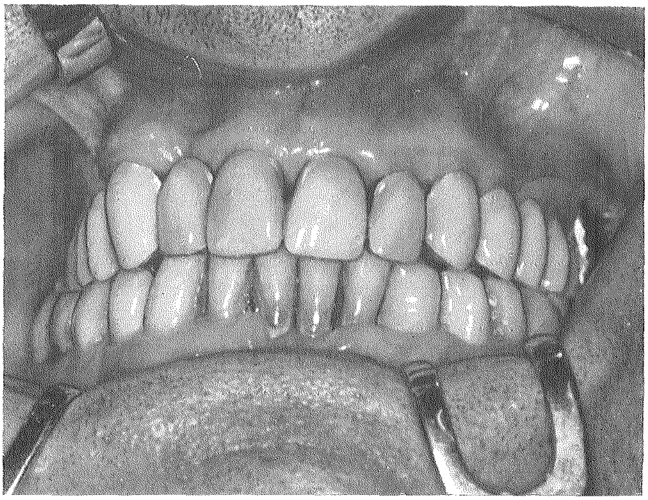


Fig. 128 b.

Illustrations to the section on Telescopic Constructions

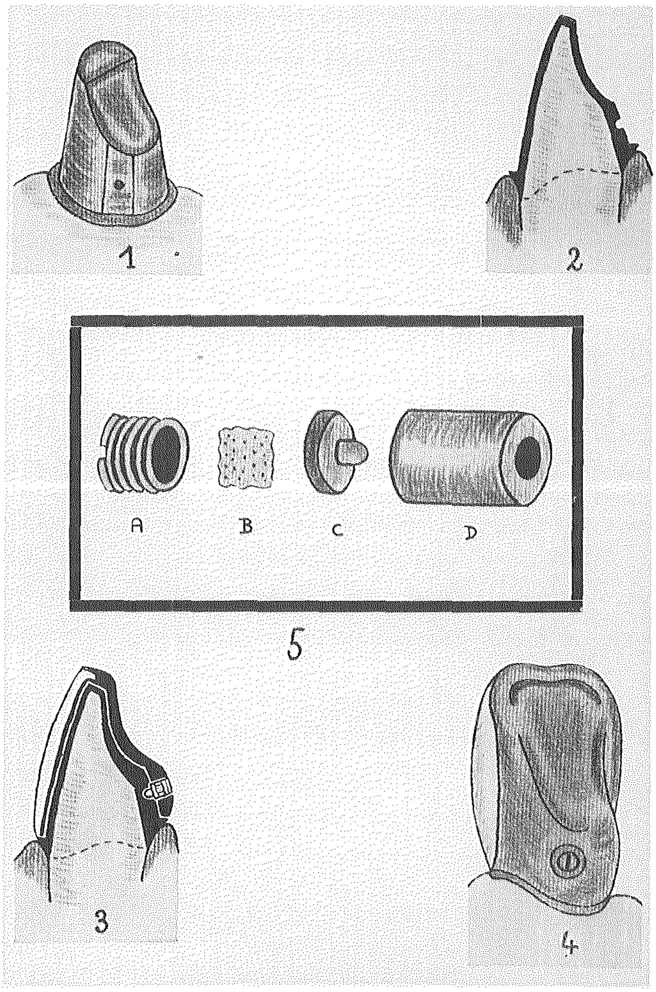


Fig. 129. Diagrams of the "Pressomatic" telescopic crowns.

1. Cap of the internal telescope with notch for pressomatic plunger.
2. Cross-section of the cap of the internal telescope.
3. Cross-section of internal and external telescopic crowns with pressomatic attachment.
4. Palatal view showing adjustable screw.
5. Exploded view of the plunger mechanism.

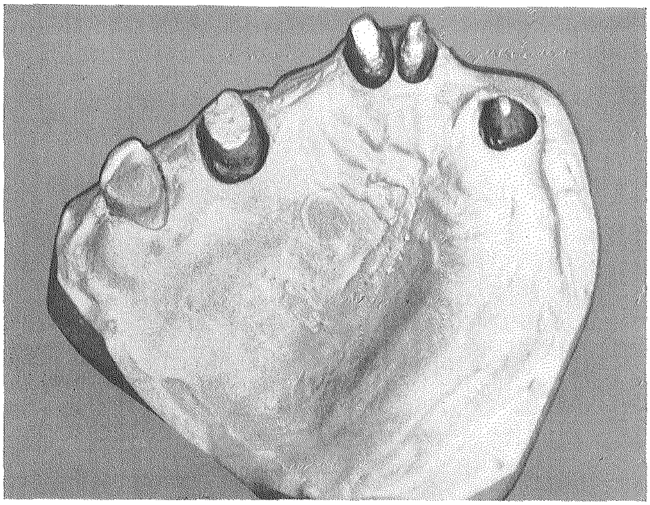


Fig. 130. Cast with prepared stumps.

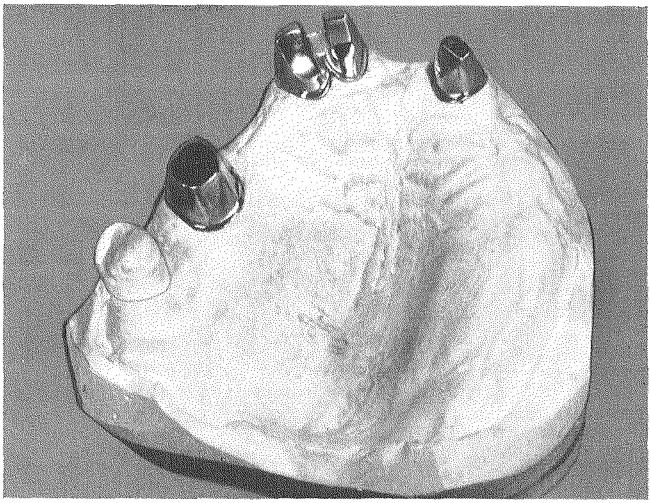


Fig. 131. Cast with internal telescopes fitted.

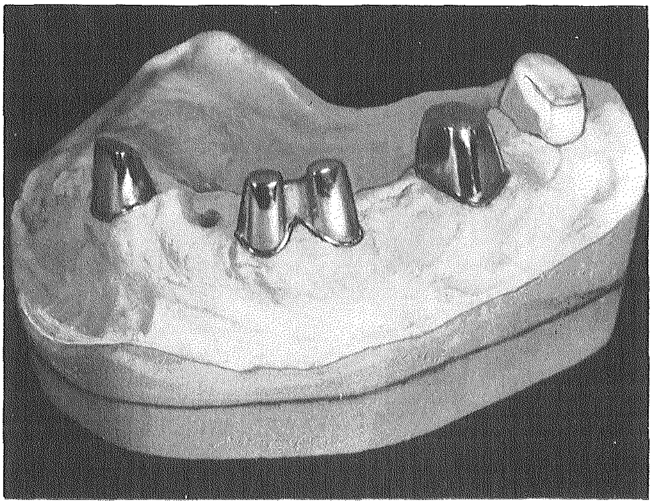


Fig. 132.

Fig. 133. Details of the construction of an external telescope.

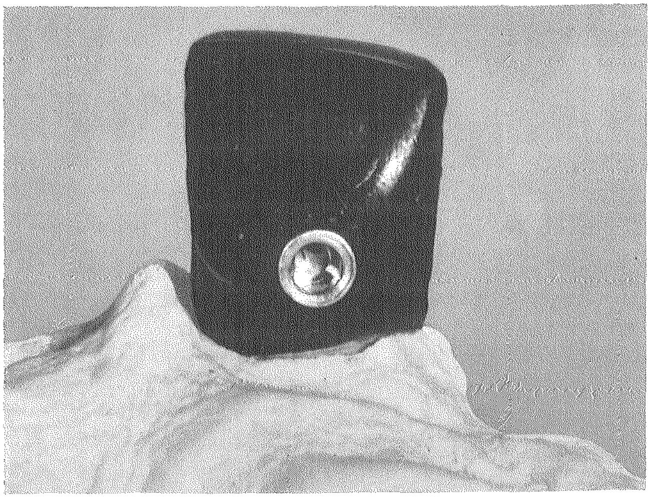


Fig. 134 a. External telescope completed in wax.

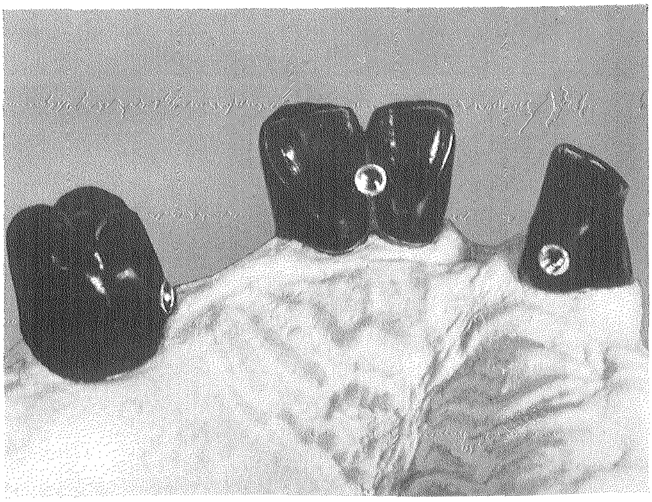


Fig. 134 b.

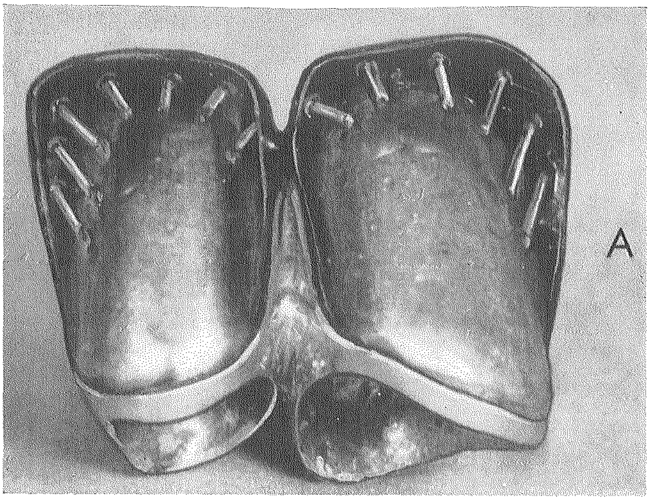


Fig. 135a. Labial view of the external telescopic crown. A — in wax. B — in gold.

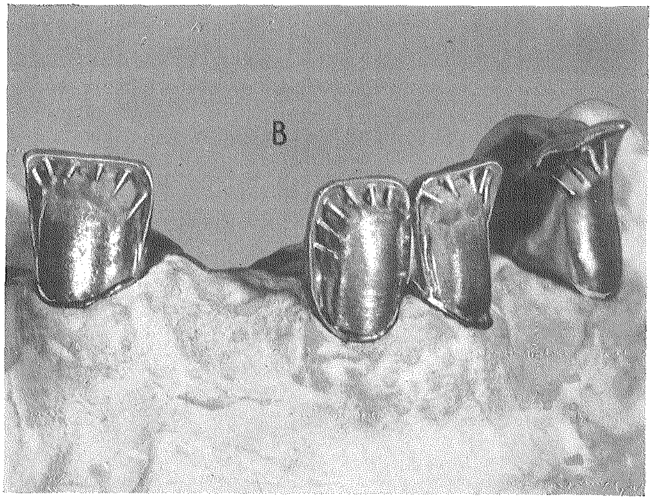


Fig. 135b.

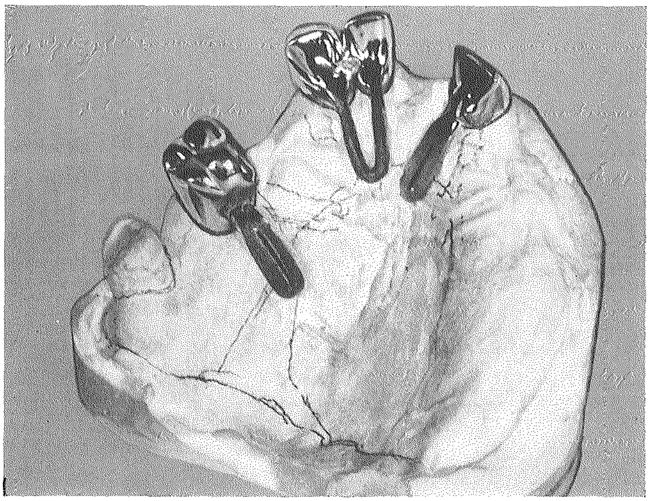


Fig. 136. Crowns with soldered retention tags.

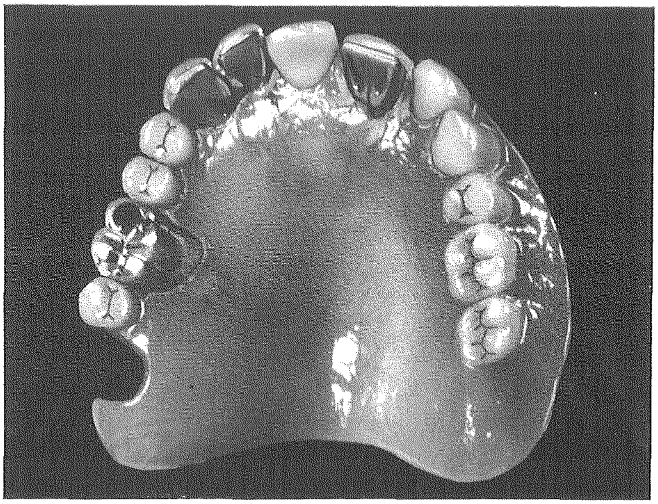


Fig. 137. Completed work.

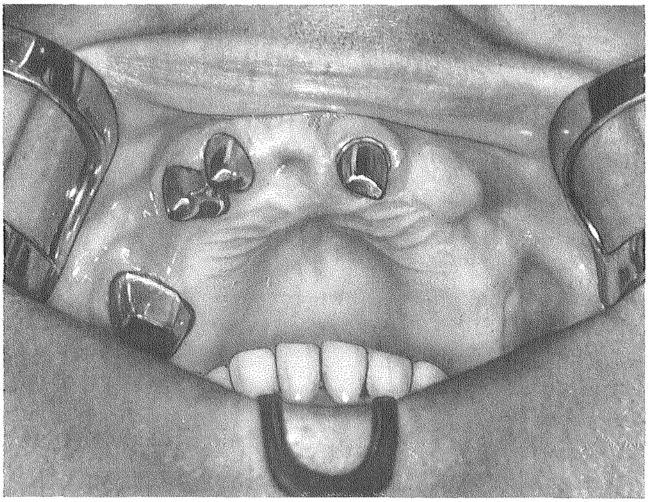


Fig. 138. Internal telescopes cemented in the mouth.

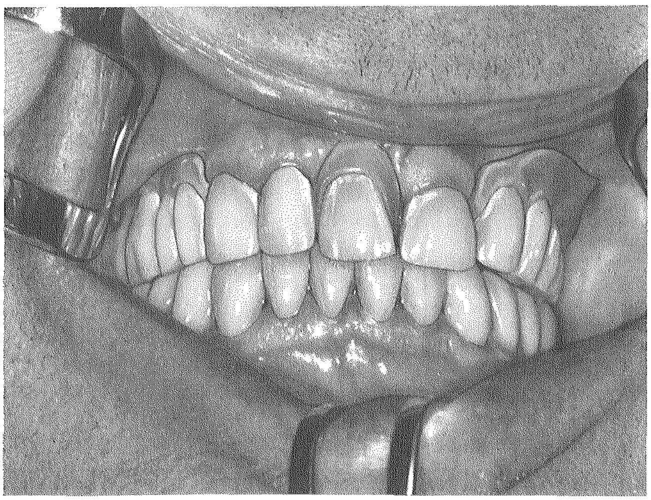


Fig. 139. Completed work in the mouth.

8. Veneer Crowns

We recommend full coverage restorations for splinting natural teeth. Partial coverage is contra-indicated in the following situations:

1. Caries predisposition.
2. Discolored teeth.
3. Teeth with large fillings.
4. A short clinical tooth crown.
5. Tilted or rotated teeth.
6. Teeth with dead pulp.
7. Bridge constructions serving for an occlusal elevation.
8. When it is planned to join an attachment to the retainer.

The most popular modern restoration is the veneer crown, which can be veneered with both porcelain and acrylic resins.

a) The Acrylic Veneer Crown

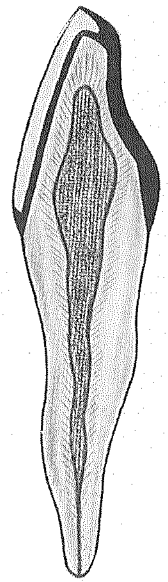
The bonded porcelain techniques originated in the United States, yet the acrylic veneer crown is still more popular there. This crown has all the advantages of a solid cast crown, yet the appearance is first class. The preparation can be conical, which facilitates the insertion of several splinted crowns. It also makes room for the labial veneer.

A labial shoulder is not usually required. Should more space be required for the facing, the step should never be sharp like a jacket crown shoulder

(Fig. 140). It is necessary to completely cover the prepared abutment with gold, so that no connection between tooth and acrylic resin exists.

Since acrylic resins do not adhere to gold, the labial facing must be securely anchored. This can be achieved by:

Fig. 140.



1. Making an undercut frame all the way around it.

2. Connecting the edge of the V-shaped frame to the labial gold surfaces by fine cast wires (Figs. 141 and 142).

Fig. 141.

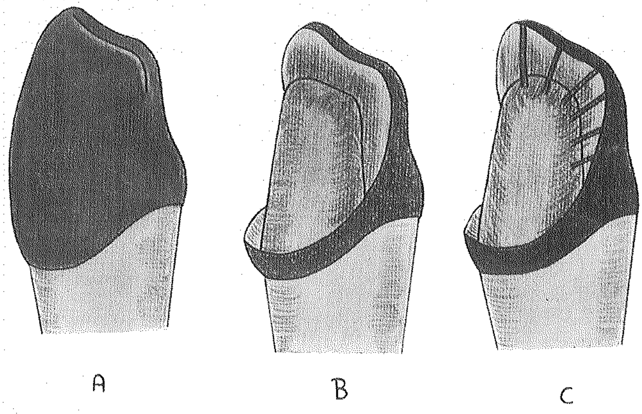
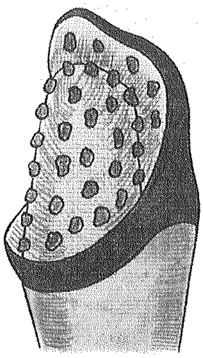


Fig. 142.



The shape of the V-shaped frame is of particular importance at the gingival margins, since it effectively stops the infiltration of oral fluids and subsequent discoloration. The best proof of the success of this method lies in the clinical results. At the Meran dental clinic more than two thousand acrylic veneer crowns made in this way are fitted each year, and have been so for nearly ten years. Patients are requested to come in for a check-up after one year, and approximately 80 per cent of them do so. It is surprising that not once has discoloring of the acrylic facing been observed. On the other hand, in the smaller Halle dental clinic the acrylic veneer crowns are constructed by another method. The acrylic resin was found to be discolored in 38 per cent of all cases, after a relatively short period of time.

This shows that the discoloration of acrylic resins is not a defect of the material itself, but is caused by incorrect handling. An acrylic facing should have a minimum thickness of 1 mm. and should be applied to an absolutely clean layer of fine gold.

The appearance is particularly pleasing with upper teeth. With lower teeth, a small protective ledge of gold is visible. This latter area is ideal for the use of porcelain veneer crowns.

b) The Veneer Jacket Crown

The problem of porcelain-fused-to-metal veneer crowns lies in the porcelain fracture.

An aesthetic problem, which is common to both types of veneer crown (resin and porcelain), is represented by the gingival retraction of the epithelial attachment. Some clinicians avoid the metallic extension on the bonded porcelain crown for this reason.

Before a discussion of these problems, a few basic principles will be outlined.

Regardless of which material for veneering is used, there is little difference in tooth preparation.

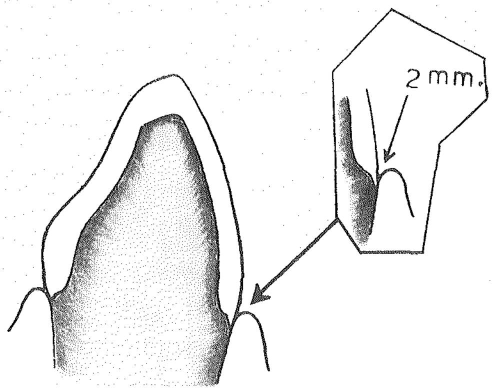


Fig. 143. Tooth preparation for veneer crowns with chamfered shoulders.

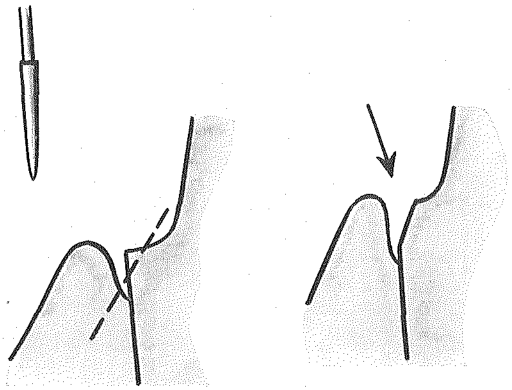
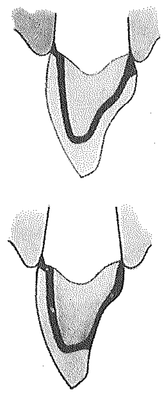


Fig. 144. Tooth preparation for veneer crowns with chamfered shoulders.

Naturally — perhaps unfortunately — we must sacrifice more tooth substance in the bonded porcelain preparation. Some clinicians recommend an angular shoulder as for jacket crowns, but generally, today, there is a preference for a chamfered shoulder which is prepared at the level of the free margin of the gingival tissues; then follows the preparation for the metallic feather edge, which reaches the base of the physiologic gingival pocket, whose extension is 1.5—2 mm. (Fig. 143 and 144).

Fig. 145. Porcelain-fused-to-metal veneer crown: a) normal occlusion; b) deep bite.



This last phase of preparation must not be accomplished with the high-speed turbine, but slowly rotating diamonds.

The particular fields for application of porcelain-fused-to-metal veneer crowns (Fig. 145) are:

1. in the mandibular anteriors from cuspid to cuspid;

2. in the mandibular bicuspid and first molar region, where owing to the visibility of the gold-protected occlusal surfaces of resin veneered crowns, that kind of restoration is unacceptable from the aesthetic point of view (Fig. 146 and 147);

3. in all kinds of fixed restoration for younger patients, in which the utmost stability of shape and colour is the most important requirement.

Fixed partial dentures in porcelain-fused-to-metal restorations should not be too extensive lest there be flexing of the rigid substructure and subsequent porcelain fracture. In these cases it is advisable to connect the single parts by means of precision rests (Fig. 148—153).

Restoration of second molars should never be accomplished by a porcelain-fused-to-metal crown, because practice has shown that the porcelain

Fig. 146. Sometimes there may be objections to the visibility of the gold occlusal surfaces as illustrated.

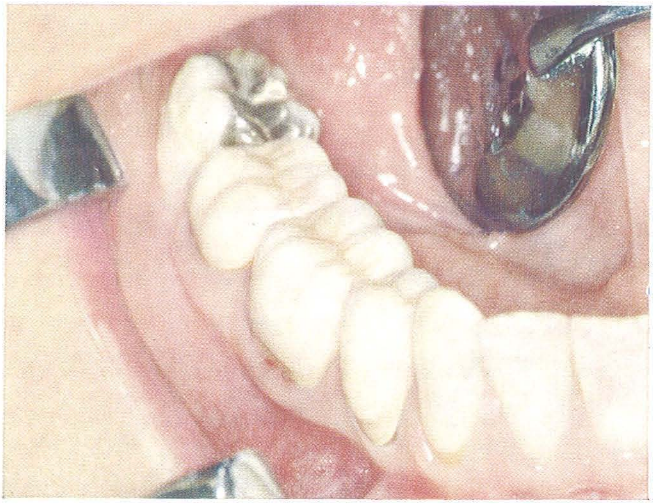


Fig. 147. Aesthetic appearance of porcelain-fused-to-metal jacket crowns.

Fig. 148.

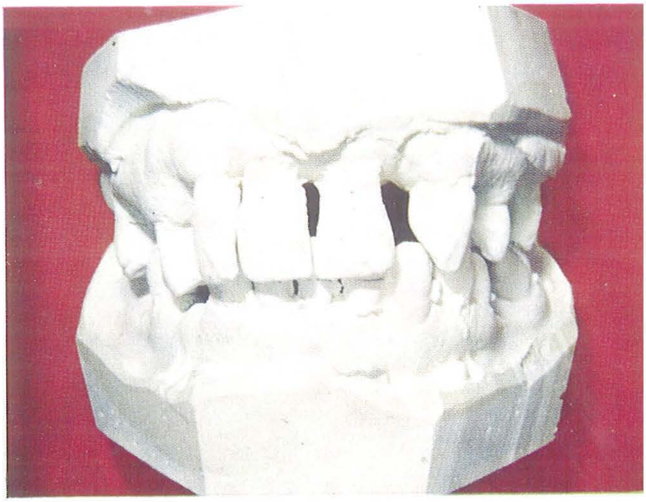


Fig. 149.

Fig. 150.

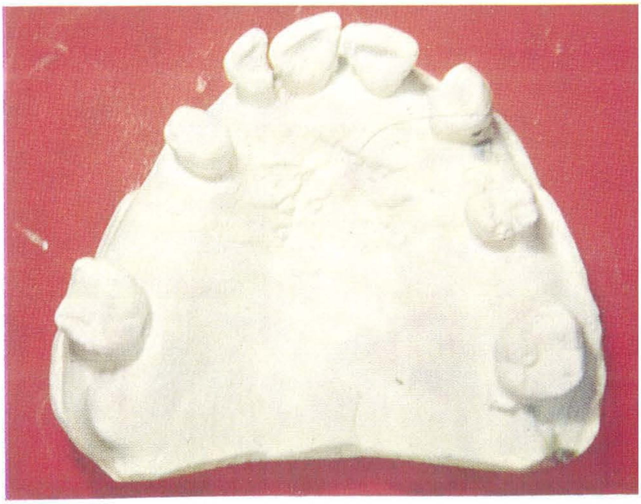


Fig. 151.

Fig. 152.

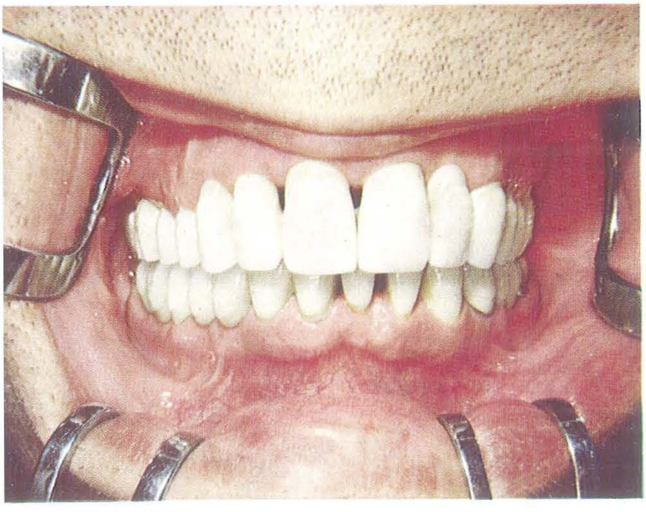


Fig. 153. Full mouth restoration by means of porcelain-fused-to-metal-bridges: study casts (148—150); the maxillary reconstruction in two-parts, connected in the mid-line by a precision attachment (Fig. 151); the two mandibular bridges (Fig. 152); the complete reconstruction in the mouth (Fig. 153).

veneering in this region is unable to resist the heavy functional stress.

The buccal cusp of bicuspids and molars of a porcelain-fused-to-metal restoration should never be protected by an entirely metal occlusal surface, which is not rigid enough and therefore causes fracture of the porcelain (Fig. 154); the connection between metal and porcelain must be rectangular in order to give sufficient strength to both materials (Fig. 155 and 156).

Finally, the prevention of the gingival retraction in aesthetic fixed reconstructions of the frontal region will be discussed. The basic condition for avoiding gingival irritation and with it gingival retraction and loss of aesthetic appearance is the accuracy of the marginal fit of the gingival termination of the veneer crown; the marginal periodontium is the barometer of the accuracy of our fixed restorations. But the prime essential for a successful prosthetic reconstruction is represented by the inital periodontal therapy (scaling and curettage or gingivectomy) and the subsequent daily periodontal home care prophylaxis, because periodontal treatment and prosthetic dentistry form an indivisable therapeutic unity.

It might be said that the less the gingival termination of our restorations interferes with the periodontal tissues, the more favourable it is for periodontal health. Therefore periodontists prefer partial-coverage restorations; but this kind of

Fig. 154. Buccal fracture of the porcelain veneering in a second maxillary left bicuspid; the occlusal gold protection is not only superfluous, but even disadvantageous, because the metal is too flexible.

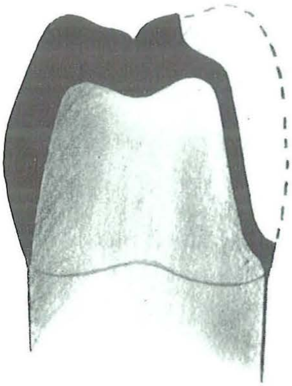


Fig. 155. Correct forms of cuspal reconstruction in porcelain. Schematic design.

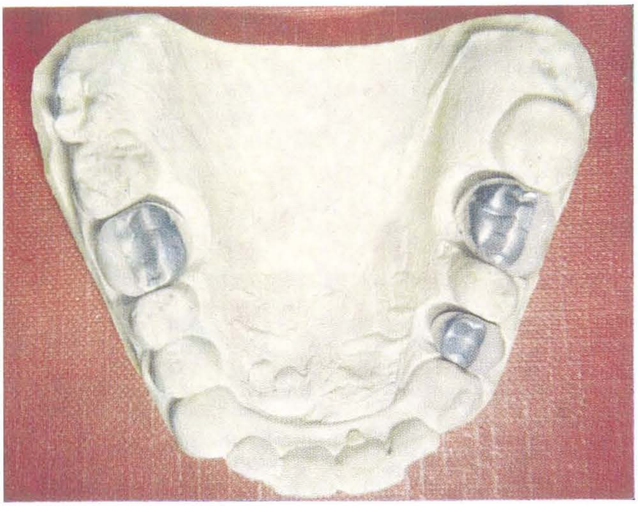


Fig. 156. 3 porcelain-fused-to-metal crowns, right first mandibular molar, left first bicuspid and first molar, on the cast.

restoration — particularly in the anteriors — is not advisable in the following cases:

- when teeth are subject to carious attack;
- when the labial part of the tooth is discolored or in any way defective;
- when there are large fillings;
- when the anatomic crown of the tooth is too short or too thin and therefore transparent;
- when teeth are tilted, protruded or rotated;
- when the jaw relationship is raised by the restoration;
- when the insertion of an precision attachment in the restoration is planned.

In these cases full coverage offers the best protection against any further tooth structure deterioration and pulpal involvement and superior mechanical retention as well as the greatest aesthetic superiority.

When periodontal therapy has created healthy periodontal conditions, these will be maintained, after the insertion of a full-coverage restoration, by exact daily periodontal prophylaxis, which is accomplished:

- by brushing following the modified Bass-method, using the right brushes, also the Interspace-tooth-brush (Fig. 157);
- by cleaning the interdental space and stimulating the interdental papillae with the rubber-tip, or with pick-a-dent or with orange-wood tooth-pick (Fig. 158);

Fig. 157. Interspace-tooth-brush.

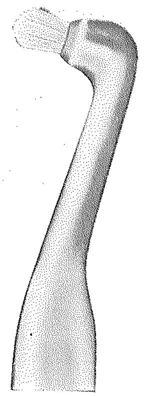


Fig. 158. Orangewood tooth-pick on a handle.

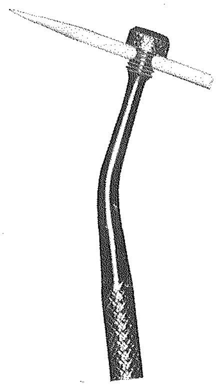


Fig. 159. Rubber cup on a handle.

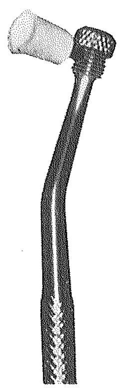


Fig. 160 and 161. Vibra-Mat a gum-stimulating electric vibrator (Fig. 160) with interchangeable accessories (Fig. 161).

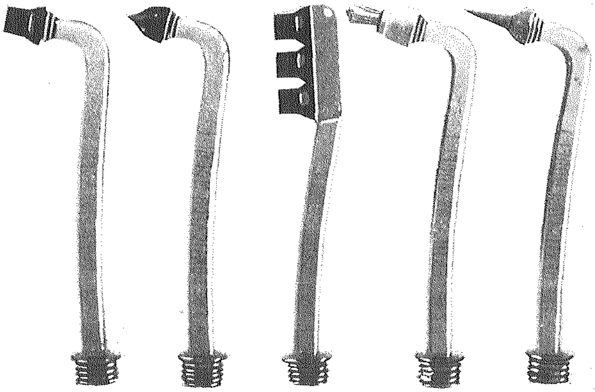


Fig. 161.

— by stimulating the buccal gingival tissue with rubber cup (Fig. 159, 160 and 161).

By all these prophylactic procedures periodontal health is maintained, and the margin of the gingival tissue possibly will remain static in the younger patient for a lengthy period; in the older patient with senile periodontal involution the physiologic gingival retraction will not be increased by such crowns.

We hesitate to recommend the use of the electric tooth-brush, but do recommend the use of Acqua-pik.

Prevention of occlusal Traumatism and Porcelain-Fracture in Gold-Bond Porcelain Restorations

The use of gold-bond porcelain restorations occurs more and more frequently, because shape and color remain constant owing to the hardness of the material, which, in contact with the marginal parodontium, does not irritate the tissue.

On the other hand, the disadvantages must be admitted. Apart from the fact that porcelain restorations are very expensive and that we must sacrifice more tooth substance in the preparation of the abutments than for resin veneered crowns, there are two hazards: 1. fracture; 2. traumatic occlusion owing to the excessive hardness of the porcelain, even when the inter-oclusal contacts are perfectly adjusted.

The occlusal trauma is not caused by masticatory function, because, during chewing, food is between the teeth at all times, tooth contact being negligible and nonfunctional, except as a tactile warning to terminate the masticatory stroke.

On the contrary, occlusal trauma might be provoked by deglutition and the pathogenetic phenomenon of bruxism (the latter while sleeping), because only then decisive and strong tooth contact occurs.

Clinical experience has proven that the most effective remedy against both problems, i.e. fracture and traumatic occlusion, is represented by a night-guard, made of a thin (half millimeter thickness), transparent sheet of acrylic resin and applied on the mandibular teeth during the night (figs. 162 and 163).

This night-guard does not only avoid hard inter-occlusal contacts because of the softness of the acrylic resin, but much more it acts in the most favourable way upon the neuro-muscular reflexes of the stomatognathic system: by a slight increase of the vertical dimension, there is no more inter-cuspation and the mandible gains complete freedom of movement. In this way the musculature is enabled to move the mandible according to its normal neuro-muscular reflexes. So muscle-spasms are spontaneously relieved and parafunctions like bruxing and clenching are stopped because of the absence of premature contacts.

All patients, to whom this night-guard was applied, unanimously agree to the comfort and relaxing effect of the device. The positive clinical experience with this appliance up to now suggests that a new approach in prosthodontics has been reached and that further research in this field must be achieved.

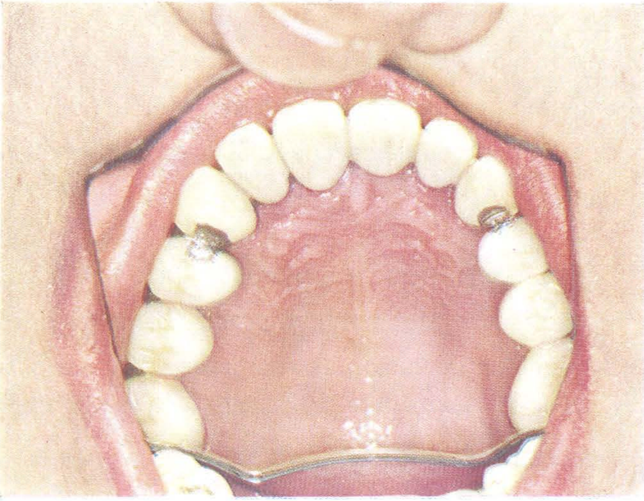


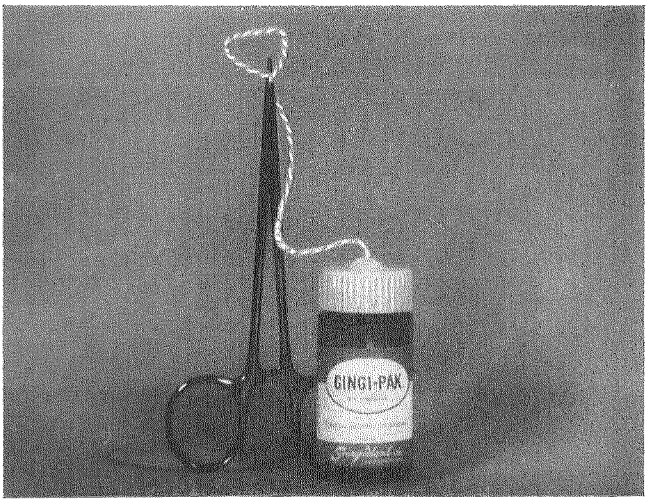
Fig. 162. Porcelain-fused-to-metal upper bridge of 12 units; in order to avoid fracture, owing to the elasticity of the metallic substructure, the bridge is divided into three parts (one frontal and two lateral), connected by precision rests; in addition, this division provides a separate function of every part.

Fig. 163. Cast of the mandible with the night-guard.

Impression Taking

The methods of taking impressions of the prepared abutment teeth need only brief mention, since every practitioner will have chosen a method, modified it to individual preference and be experienced in its use. It is immaterial wheter the "Hydrocoloid" technique, the copper ring Kerr method, the "Permlastic" method or any other method is used. All methods use one of the numerous impression substances supplied by the industry. Only one factor is basically important: to prepare the gingival margin for taking an impression of the prepared abutment. This is facilitated by inserting a fibre containing adrenaline (Gingipak, Retraction Kit and others) into the gingival crevice by means of a pair of forceps (Figs. 164 and 165). Within a few minutes the marginal gingivae will have drawn back by $1\frac{1}{2}$ to 2 mm., the crevice is completely free and the impression taken now will definitely include the whole stump.

Fig. 164.



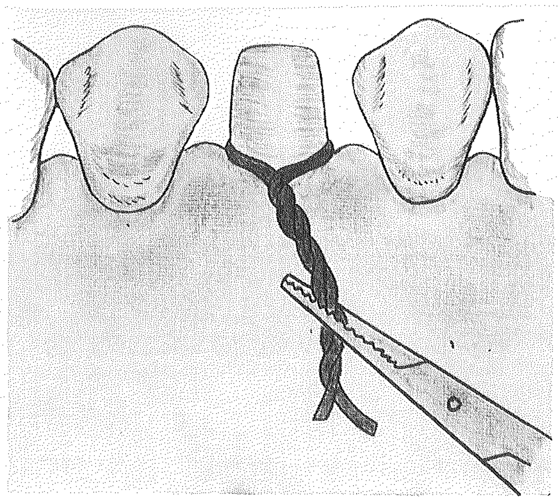


Fig. 165.

9. Care of Prepared Vital Abutment Teeth

While we aim to use only vital abutment teeth, it must be admitted that difficulties are frequently experienced due to pulp reaction to cavity preparation. Clinical experience has shown that all kinds of pulp reaction, from hyperaemia to gangrene with periapical complications, can appear as a result of insufficient care while preparing abutments.

The cause of these complications can easily be recognized when it is realized that with each square millimetre of prepared dentine 40,000 to 70,000 dentinal tubules are laid bare. The Thomes' processes within them are the direct continuations of the odontoblasts, i. e. the pulp itself.

Histological studies have revealed that high-speed preparation does not only cut into these processes, but that they are even partially torn out.

American statistics have revealed that the pulps of lower incisors are especially endangered by preparations, so that pulp necroses can be observed quite frequently in this area. The American authors recommend devitalizing the lower incisors right at the beginning. It is therefore important to take great care of the pulp.

We recommend the following procedures for pulp care:

1. Electro-impregnation
2. Chemical impregnation
3. Temporary crowns
4. Protection against the acid of the cement immediately before insertion.

1. Electro-impregnation

Immediately after the preparation has been finished, while the anaesthesia is still effective, the vital abutment is dried by the air-blower an brushed over with a 2% solution of sodium fluoride. A low galvanic current (6—9 volt, 2—5 milliampere) is used to diffuse the sodium fluoride into the dentinal tubules by ionophoresis. The patient holds the positive cylinder electrode in his hand, while the surgeon brushes the dental surface with a brush soaked in sodium fluoride for 40 to 60 seconds. Attention must be paid to keeping the gums dry, since the current would be conducted away too fast over the damp, better-conductive gingivae.

Two instruments can be used for electro-impregnation:

a) the Siemon-Chayes Desensitizer of American origin (Fig. 166);

b) the Pyo-cure apparatus of Japanese origin (Fig. 167). Apart from the impregnation of the dentine this also serves for the treatment of the gingivae.

In spite of the satisfactory results achieved with teeth impregnated in this manner, further histolo-

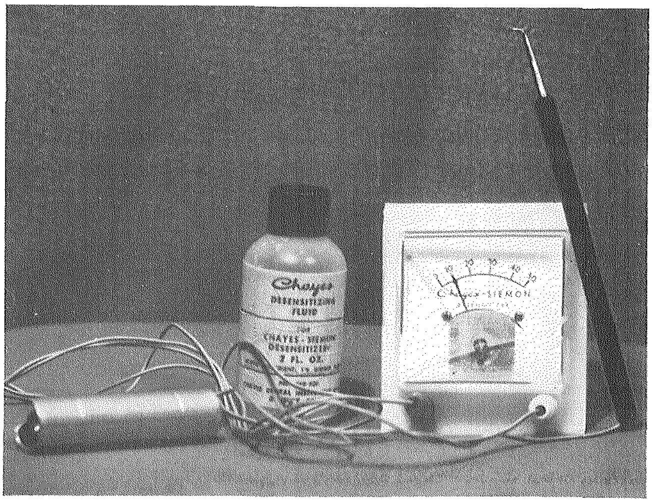


Fig. 166. The Siemon-Chayes Desensitizer.

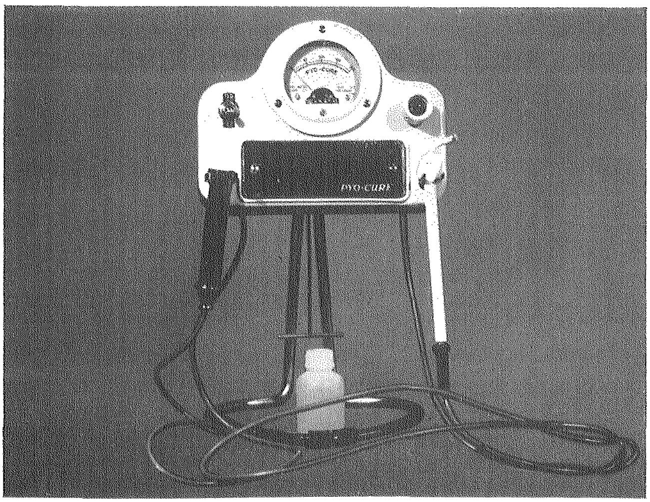
gical studies are being carried out in the University Dental Clinic of Bologna, in order to determine the effect of the galvanic current on the pulp. The results of these will be published at a later date.

2. Chemical impregnation

Through research work carried out in America (FRY) and Switzerland (SCHROEDER-TRIADAN), the anti-inflammatory effect of corticosteroids on the pulp tissue has been discovered.

The prophylactic application of cortisone preparations, especially prednisolone, has also proved effective for the protection of the bare dentine against thermal irritations. 1 % of prednisolone in powder form is added to a solution of 25 % chlorine phenol, 25 % cresylic acetate (cresatine) and 50 % camphor. The prepared vital stump is dried, brushed over with this mixture for one minute, and then a temporary crown is put on. The effect of the cortisone reduces the pulp reaction to preparation trauma. Whether or

Fig. 167. The Pyo-cure apparatus.



not the cortisone preparations can have a damaging effect on the pulp tissues, as has lately been claimed, has yet to be proved by histological examinations.

The combination of electro-impregnation and cortisone treatment has led to the best clinical results so far. An additional refinement is the application of Perudent (a Peruvian balsam preparation by PLISCHKA) to the abutment with a cotton wool swab. This substance dries very quickly and forms a sticky layer of lacquer, on which zinc oxide powder is applied. This application of Perudent has proved effective because of the known anti-inflammatory effect of Peruvian balsam.

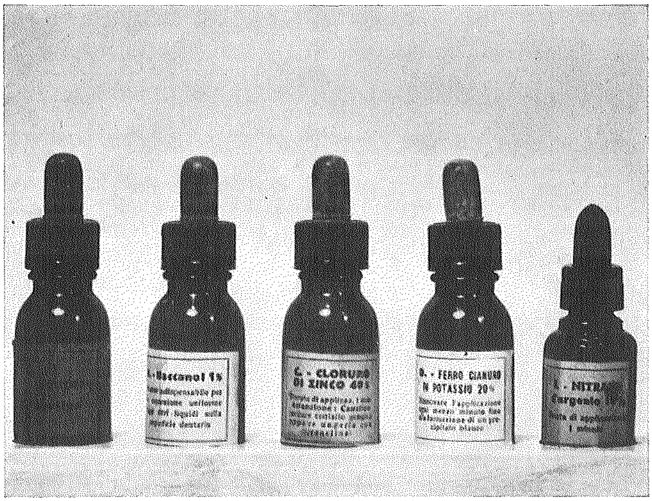


Fig. 168. The five chemicals used in Gottlieb's impregnation method.

GOTTLIEB's chemical impregnation method is also frequently used. It is carried out as follows:

a) the stump is cleaned with benzole;

b) surface tension is reduced with a solution of 1 % maccanole;

c) a solution of 40 % zinc chloride is applied for 30 seconds;

d) a solution of 20 % potassium ferrocyanide is applied every 30 seconds until a white deposit has formed;

e) a solution of 10 % nitrate of silver is applied for 1 minute (Fig. 168).

In this way a cover of three salts which are insoluble in water is formed on the dentinal surface. However, it must be mentioned that GOTTLIEB himself deviated from his method during the last years of his work because the results had not been consistent. Some other disadvantages were: cauterization of the gingivae caused by the zinc chloride and intensive blackening of the abutment after impregnation.

3. Temporary Crowns

Temporary crowns are cemented with a zinc oxide-eugenol paste on to the treated stumps. The purposes of this measure are:

a) to protect the prepared abutment from thermal, mechanical, chemical and bacterial attacks.

b) to maintain function and appearance.

c) to fix the position of the prepared abutment teeth. During the preparation, the mesial and distal contact points are ground away and the masticatory surface is put out of occlusion. The temporary crown prevents the tooth moving distally or the prepared stump from growing into occlusion again.

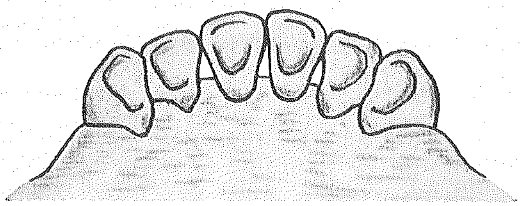


Fig. 169 a. Remaining natural teeth before preparation.

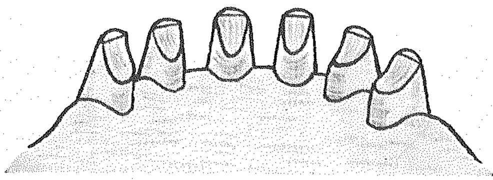


Fig. 169 b. An alginate impression is taken of the prepared teeth and cast.

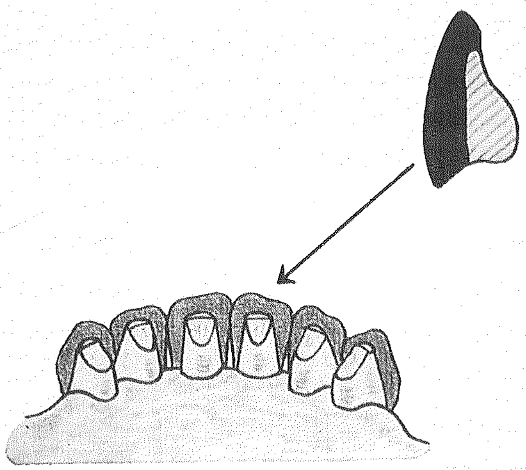


Fig. 169 c. Shells are ground from suitable plastic teeth and fixed on the stumps with adhesive wax.

Fig. 169 d. A preliminary overcast is prepared, which will fit the facings even after the wax has been removed. Then the spaces between acrylic shell, stump, and the lingual side are filled with quick self-polymerizing acrylic resin, which is moulded while it hardens.

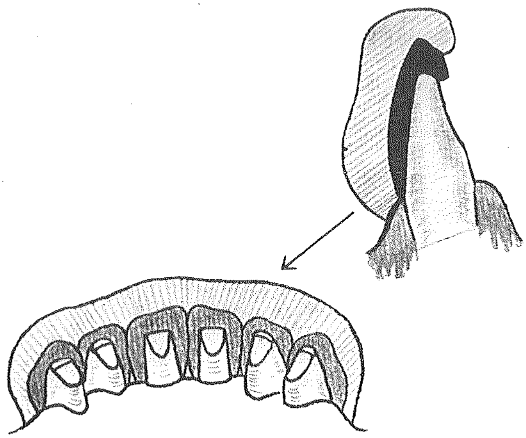
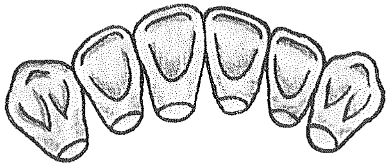


Fig. 169 e. After the acrylic hardens, the cap splint is removed from the cast, finished and polished. The cap splint is always fitted temporarily by means of a lining paste. It can therefore be easily removed and replaced for trial fittings of the final construction.



In the case of pontic constructions a temporary acrylic bridge (Fig. 169 a—e) is fitted after preparation of the bridge abutments. It has to keep the prepared teeth in their original position until the final construction is fitted. With precision casts made from a platinum gold alloy, even the slightest change in position of the abutment will make the fitting of the bridge impossible.

Should the stumps prove sensitive when the crowns are tried on, we recommend mixing "Ledermix", with the zinc oxide-eugenol paste. This is a well known preparation by SCHROEDER-TRIADAN, consisting of a mixture of hydrocortisone, an antibiotic and an anaesthetic agent. It has shown good results in the treatment of pulpitis.

4. Protection Against Cement Acid

Just before the restoration is finally cemented, the stumps are covered with "Copalite". This is a lacquer on a plastic base which dries immediately to form a fine cover. The main component is zinc copal which protects the dentine from the acid on the cement. "Pulpdent" can be used instead. It is applied and dried with the warm air blower until a white protective layer has formed.

Control of Salivation

Drying the vital stumps with an air blower causes an increased salivation in most patients. This is due to thc sensitivity of the dentine and makes the important final phase more difficult. An anaesthetic alone is not sufficient, although it interrupts the conducting system. Salivation can only be controlled effectively through treating the innervation of the salivary glands.

The parasympathetic fibres to the submaxillary and sublingual glands are distributed via the chorda tympani of the facial nerve and via the lingual nerve. The parotid gland is supplied with parasympathetic fibres via the glossopharyngeal nerve, the lesser superficial petrosal nerve, the otic ganglion, and the auriculotemporal nerve.

It has been known for a long time that atropine reduces salivary secretion, but it has depressant effects on the central nervous system. The elimination of these undesirable side effects has been successfully achieved in a derivative of atropine called eumydrin (methyl atropine with nitric acid ester). It controls the secretion of saliva through blocking the parasympathetic nerve endings. Eumydrin is three times as effective as atropine and considerably less toxic.

KANTOROWICZ recommends the use of 1 cc. vials containing a 0.02% solution of eumydrin which are added to the local anaesthetic. No uncomfortable side effects have been shown. Since eumydrin is not available in ready-to-use form, we recommend Skopyl which is already on the market.

If, in spite of all care, symptoms of a hyperaemic pulp appear, there are still several remedies. ROST advocates the use of a local anaesthetic such as 2% hydroxy procaine or 3% hostacaine. These contain no vasoconstrictor and "nip the starting pulp in the bud".

Prosthetic Picture Atlas

Several ways will be shown of treating each of the Kennedy class situations. The following illustrations will be shown of each case:

Illustration of standing teeth.
Sketch of a typical design for the situation.
Sketch of the ideal design.

Illustrations will also show:

a) The patient's mouth before treatment.
b) The appliance on the master cast.
c) The patient's mouth after treatment.

The simpler designs involve the construction of a partial denture with clasps. We will show typical examples of this type of denture. We feel that it proves satisfactory only when the teeth are caries resistant and when the periodontal condition is sound. However, these ideal conditions are seldom found.

Clasped teeth should be crowned to prevent the occurrence of caries. The unavoidable leverages associated with clasp construction make it necessary to use at least two splinted teeth as abutments. With long free-end saddles, all the remaining teeth should be splinted together. Firm splinting is more important when there are a small number of natural teeth.

1. Kennedy Class I (Bilateral Free-end Saddles)

Case 1

Fig. 170. Position of teeth.

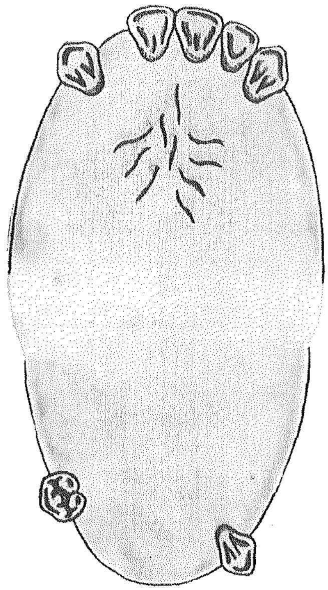
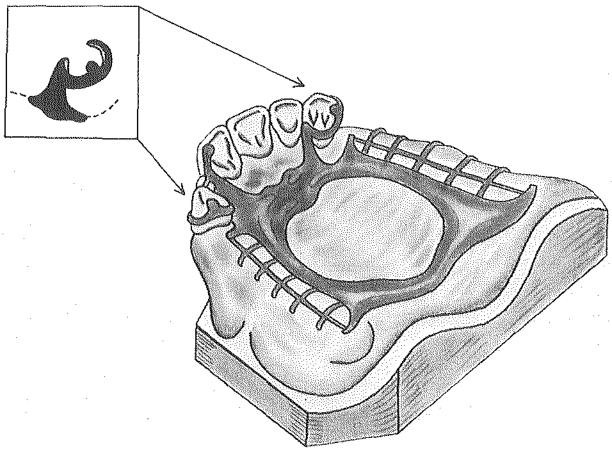


Fig. 171. Typical design for the maxilla with clasps on 13, 23. This type of Ney design will only survive if the anterior gap is closed by means of a fixed bridge.



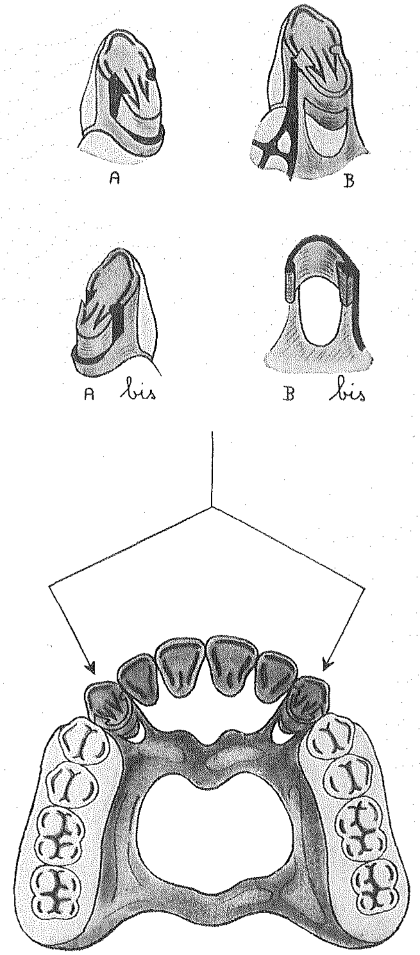


Fig. 172. Another design: fixed bridge splinting anteriorly, interlock clasps on both abutment teeth. The appearance is satisfactory. A = veneer crown for interlock clasp is modelled, distal view (wedgelike conical recess, palatal step). A bis = the same veneer crown, mesial view (semi-circular recess). B = fitted interlock clasp. B bis = the interlock clasp alone.

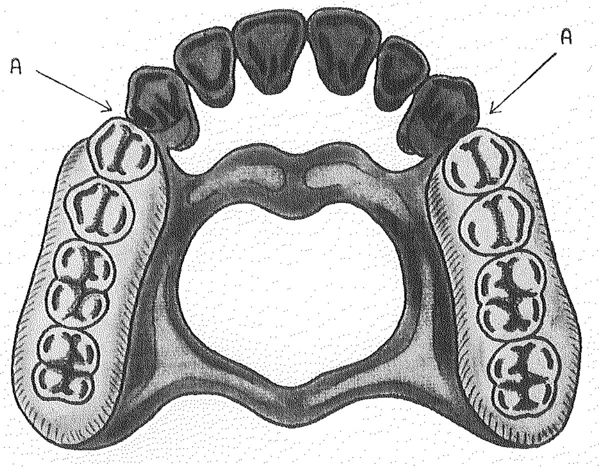


Fig. 173. Ideal design for the maxilla (splinting of anterior teeth and attachments).

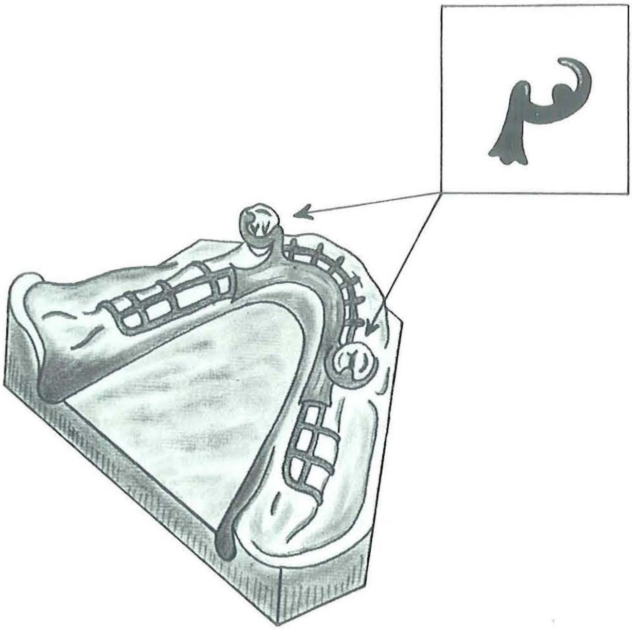


Fig. 174. A typical design for a lower denture with clasps.

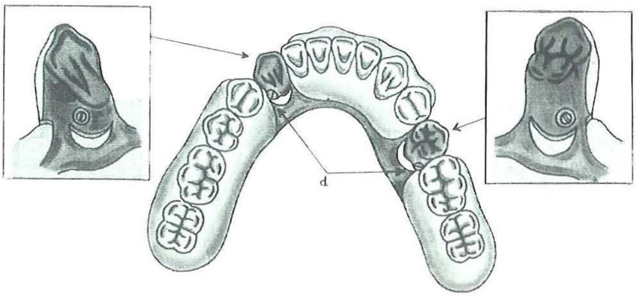


Fig. 175. Ideal design for a lower denture (telescopic crowns with pressomatic retention).

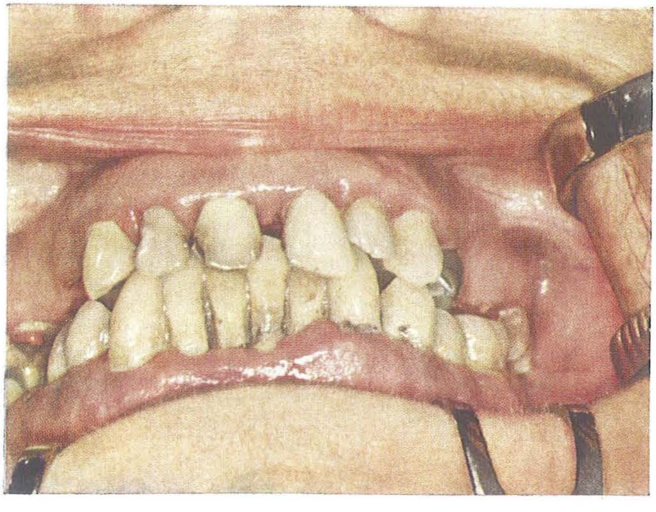


Fig. 176. Original condition of a patient.

Fig. 177. The same patient after extractions, gingivectomy and abutment preparation.

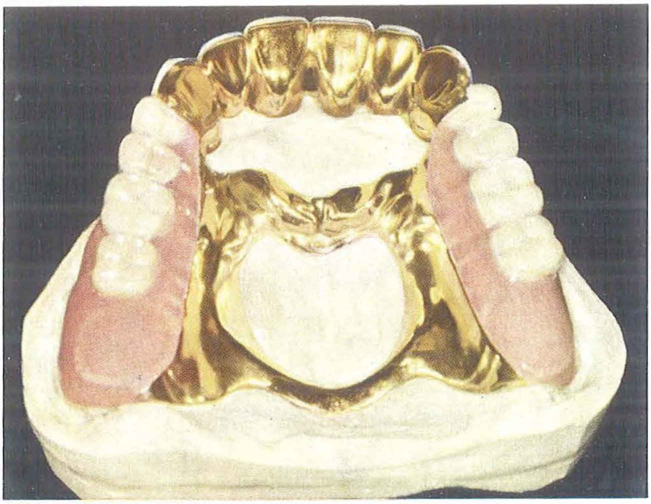


Fig. 178. Completed work on the upper cast.

Fig. 179. Telescopic crowns for a lower denture.

Fig. 180. Completed work in the mouth.

Case 2

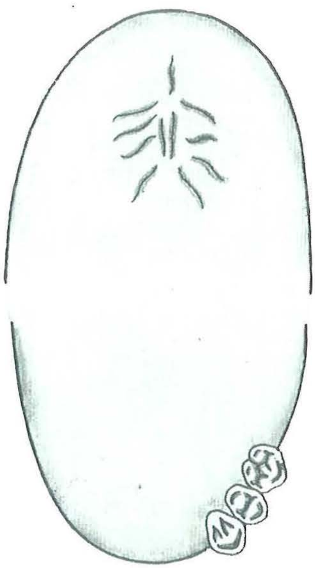


Fig. 181. Position of teeth.

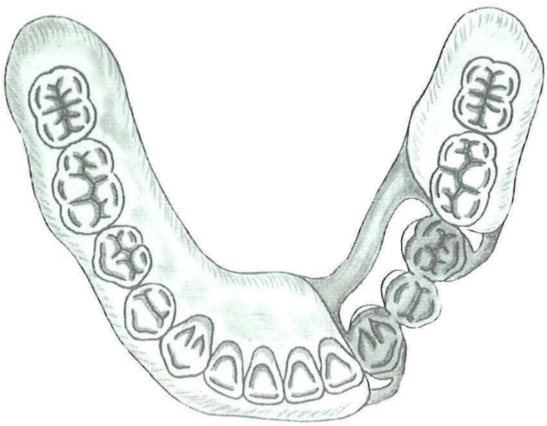


Fig. 182. The prosthetic construction involves splinting of the remaining teeth with veneer crowns, Spreng cap splint and clasps.

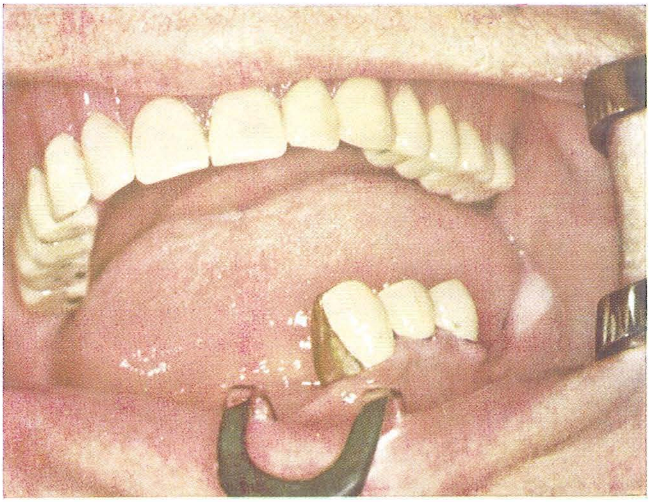


Fig. 183. The three soldered veneer crowns in the mouth.

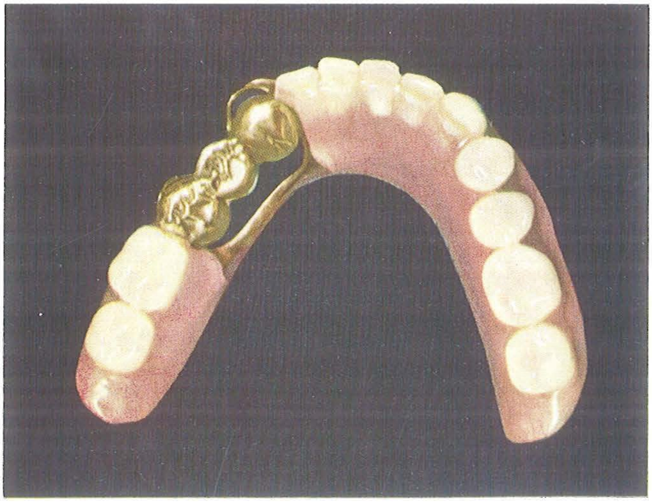


Fig. 184. The partial denture with cap splint (occlusal view).

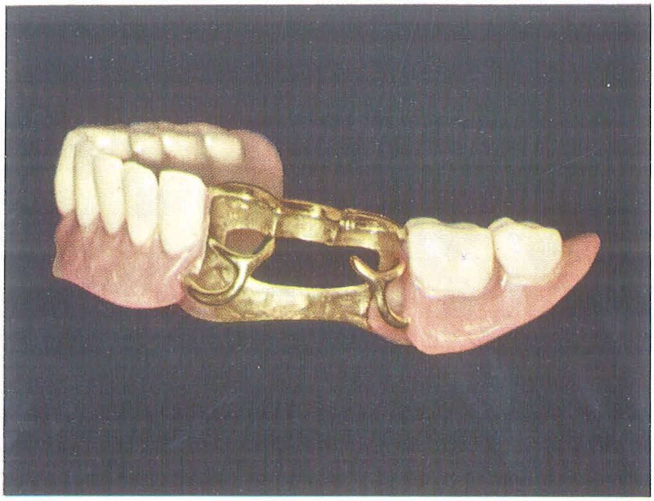


Fig. 185. The same viewed from the side.

Fig. 186. Completed work in the mouth.

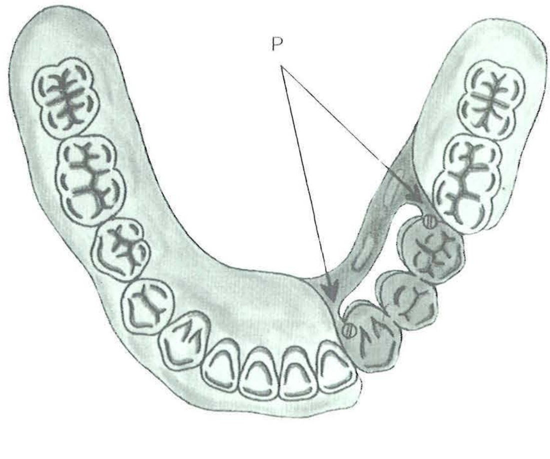


Fig. 187. The satisfactory appearance achieved with a telescopic construction. Telescopic construction with telescopic crowns on 45, 44, 43. P = pressomatic attachment.

Case 3

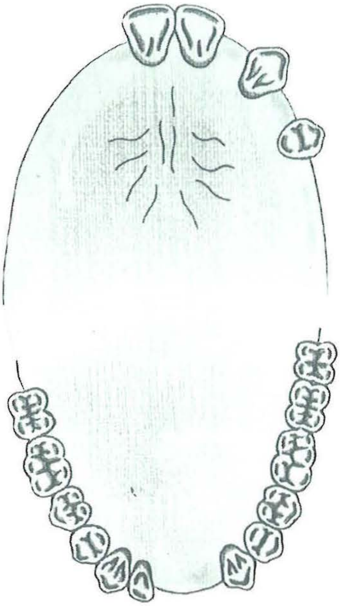


Fig. 188. Position of teeth.

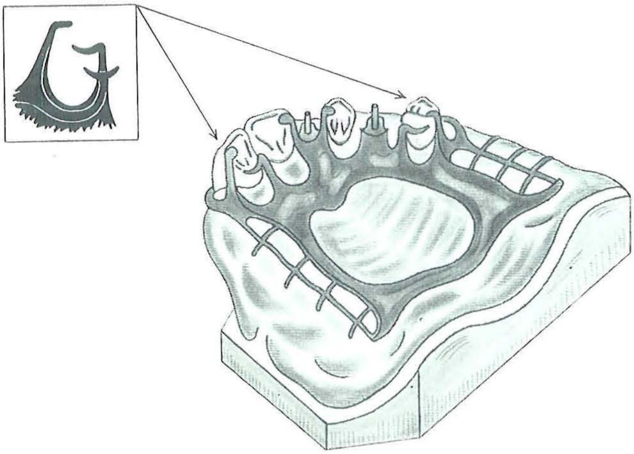


Fig. 189. Typical design with clasps on 11, 21, 23, 25. This diagrammatic Ney construction can only be satisfactory if the anterior gap is filled by a fixed bridge.

Fig. 190. Another solution: fixed splinting from 11 to 25; interlock clasps (see Fig. 173) on the abutment teeth.

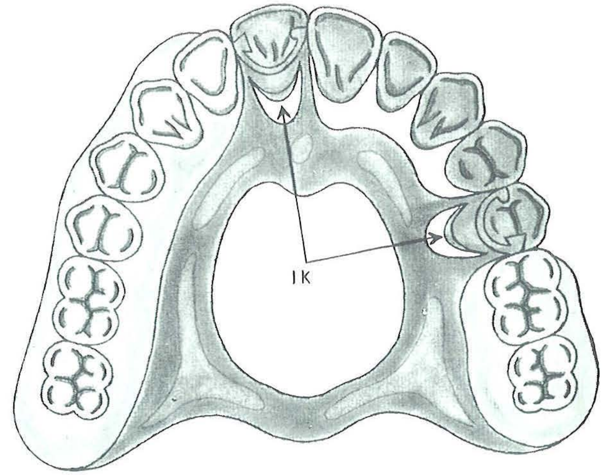


Fig. 191. Ideal design with attachments.

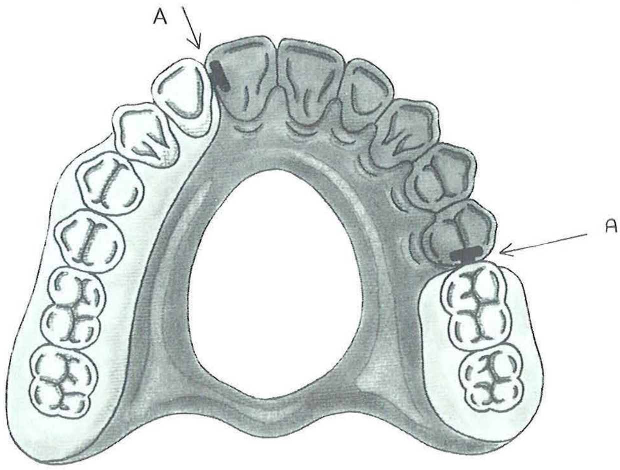
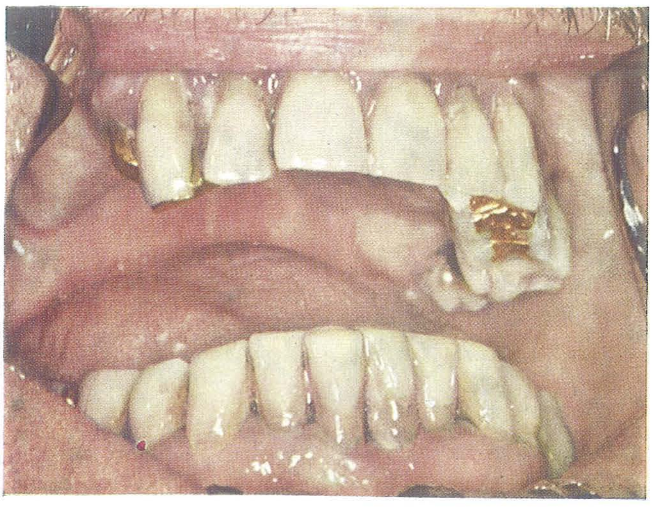


Fig. 192. Original condition.



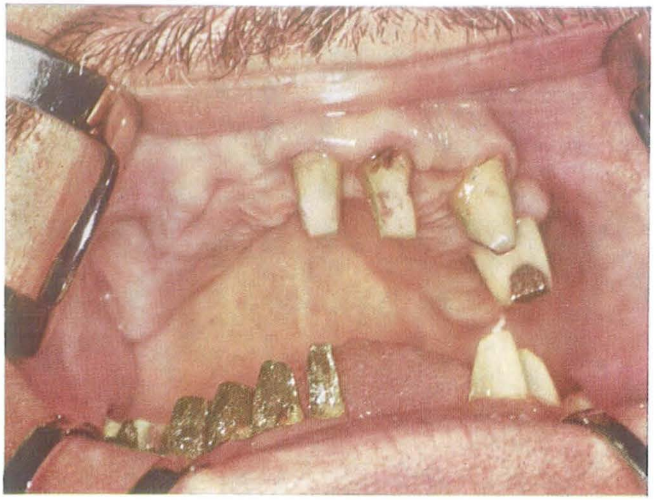
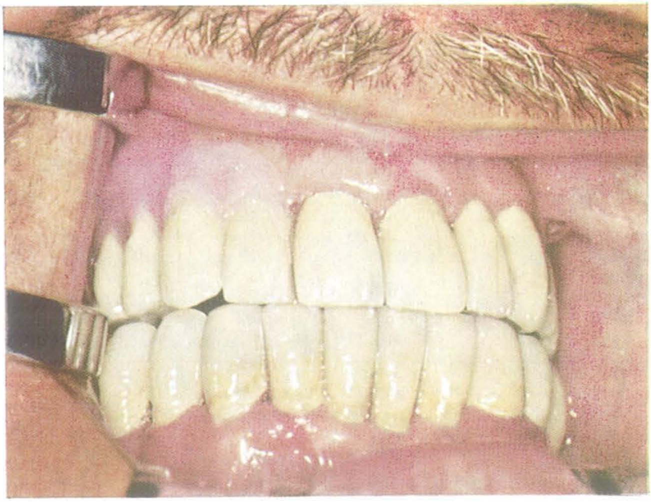


Fig. 193. The same case after extractions, gingivectomy and abutment preparation.

Fig. 194. Completed maxillary design on the cast: note the palatal surface of the veneer crown splint lying on the palatal plate. Because of deep palatal gingival crevices, not only these but the adjoining palatal mucosa had to be removed as far back as the rugae during the gingivectomy. After fitting the first upper denture, which left a 5 mm, free space for the gingival margins, the patient had a speech defect. This was a result of too much palatal mucosa having been removed. The original dimensions had to be restored by means of the palatal plate illustrated here, after which the speech immediately returned to normal.

Fig. 195. Lower fixed bridge: in the area of posterior teeth (premolars and molars) are veneer crowns; anteriorly thimble jacket crowns are fitted on the canines. Three incisors had been extracted.

Fig. 196. Completed work in the mouth.



Case 4

Fig. 197. Position of teeth.

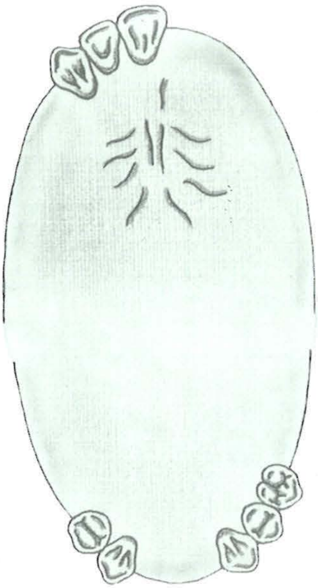
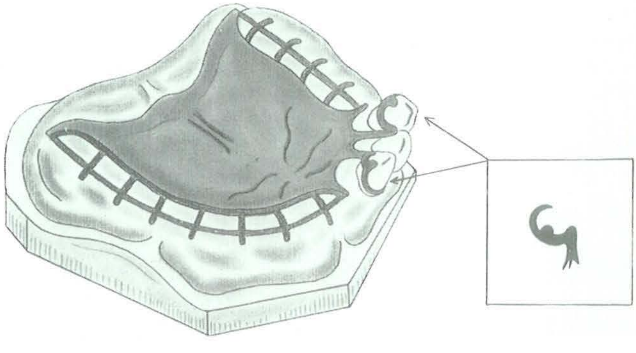


Fig. 198. Typical design of an upper denture with clasps on 13, 12, 11.



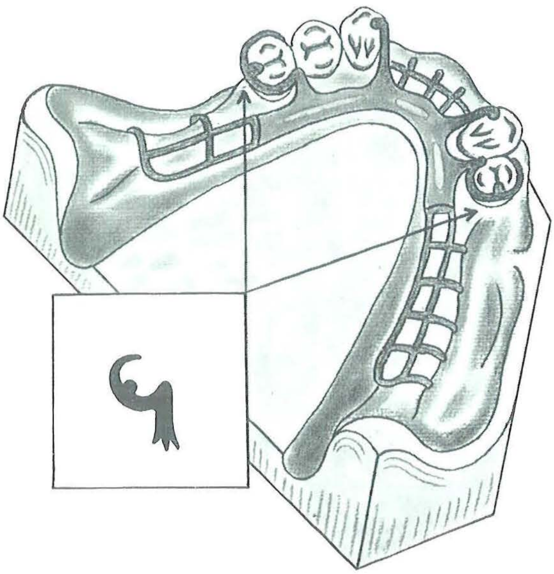


Fig. 199. Typical design for a lower denture. This diagrammatic Ney construction will only work satisfactorily if the anterior gap is closed by a fixed bridge.

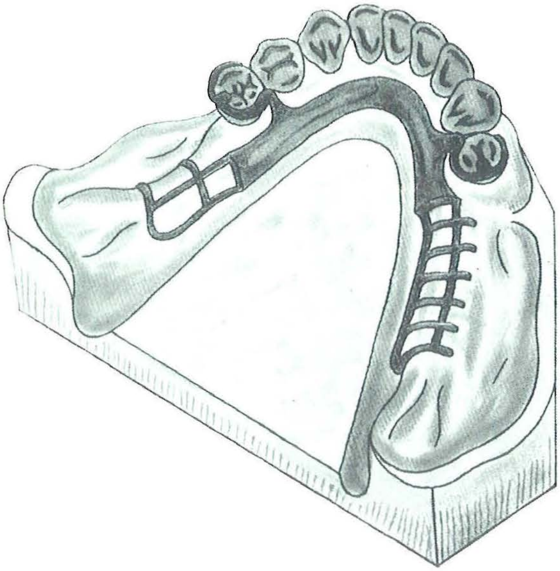


Fig. 200. An improved design: fixed bridge from 44 to 34; back-action clasps on the abutment teeth.

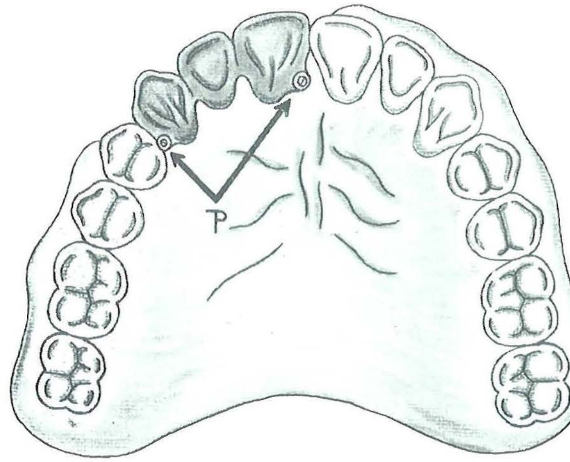


Fig. 201. Ideal design for the maxilla (splinting of remaining natural teeth with internal telescopes; external telescopic crowns with pressomatic retention).

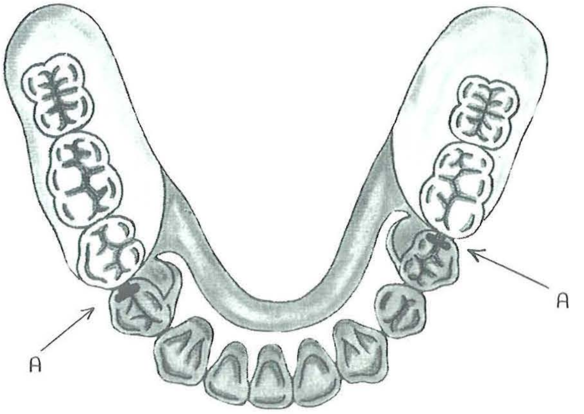


Fig. 202. Ideal design for the mandible (splinting of remaining natural teeth with veneer crowns and attachments).

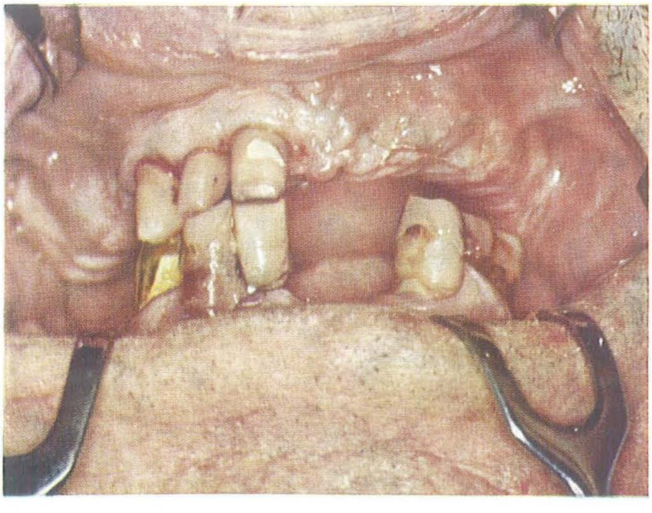


Fig. 203. Original condition of a patient.

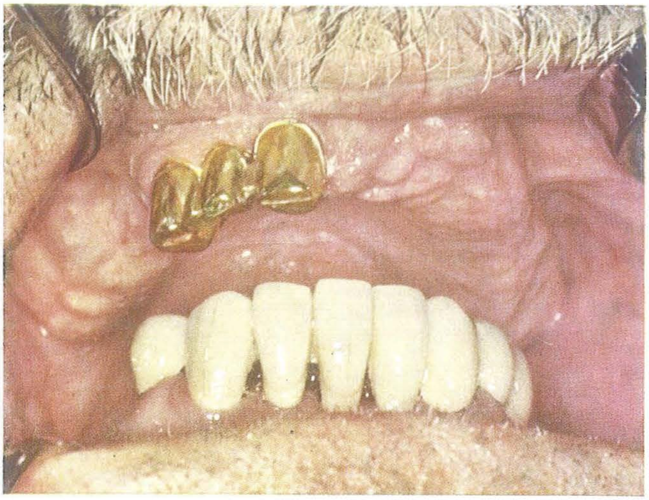


Fig. 204. Fixed construction in the mouth. Maxilla = the three soldered internal telescopic crowns. Mandible = the fixed splint.

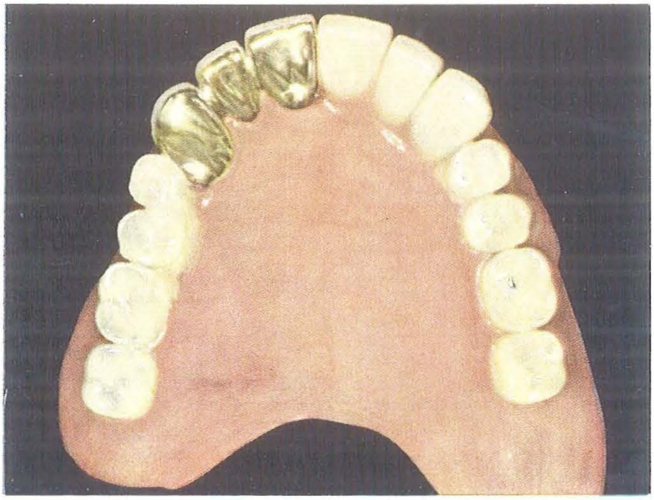
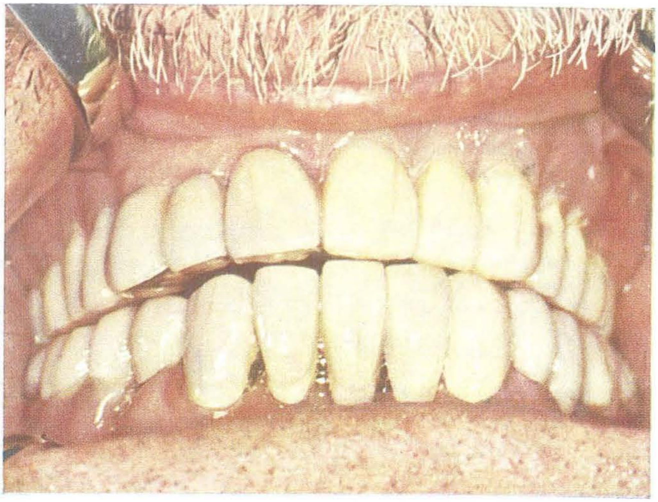


Fig. 205. The upper telescopic construction: external telescopes with veneer work.

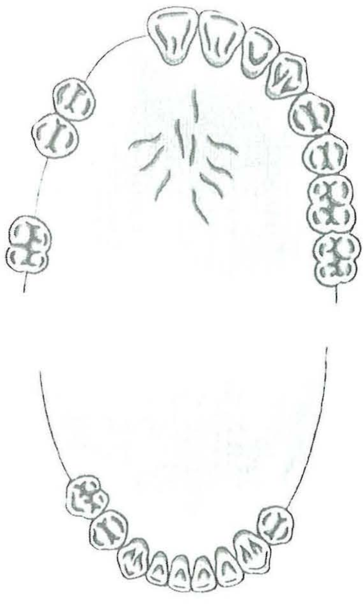
Fig. 206. Complete lower construction (bridge splint and internal attachment denture).

Fig. 207. Completed work in the mouth.



Case 5

Fig. 208. Position of teeth.



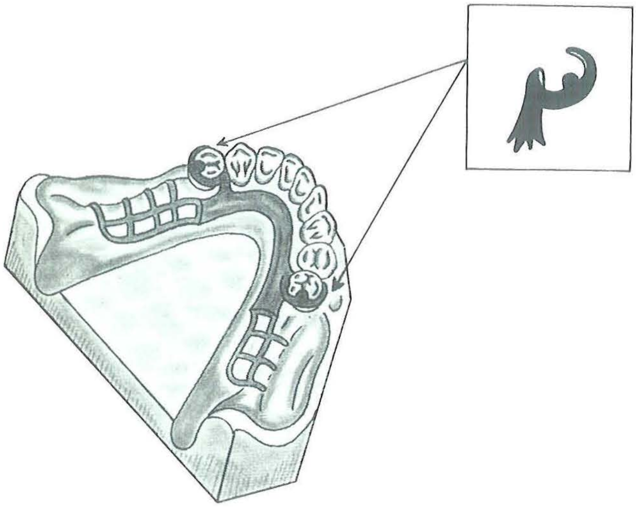


Fig. 209. Typical design with clasps on 44, 35.

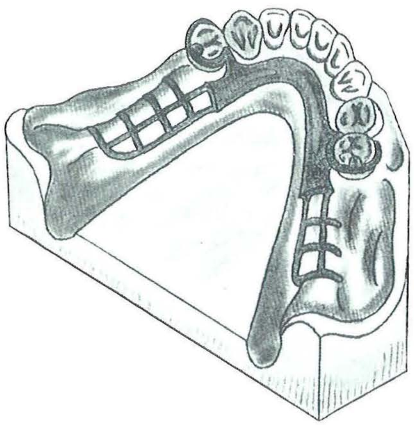


Fig. 210. Another design: one soldered pair of veneer crowns each on 44, 43 and 34, 35; back-action clasps on abutment teeth.

2. Kennedy Class II (Unilateral Free-end Saddles)

Case 1

Fig. 211. Position of teeth.

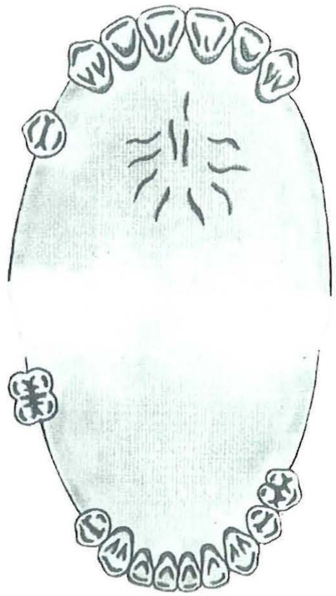
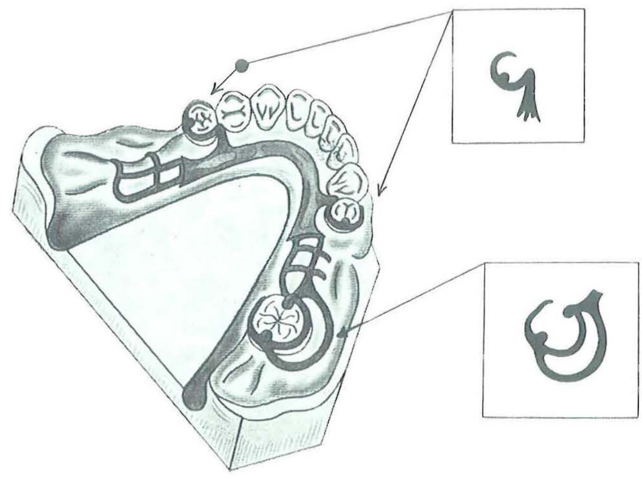


Fig. 212. Typical lower denture, 17, 14, 13, 12, 11, 21, 22, 23, 24, 25 standing.



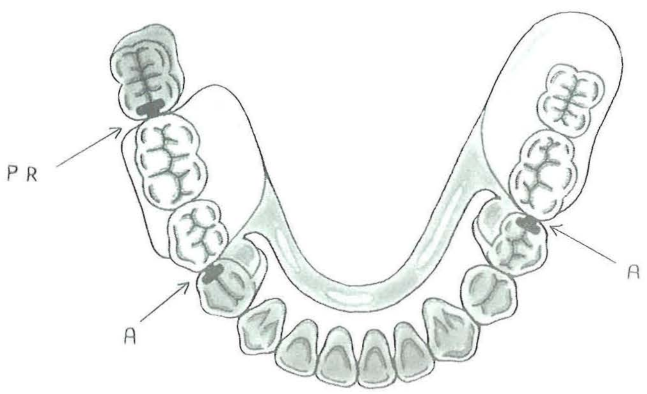


Fig. 213. Ideal design: fixed splinting from 44 to 35, denture with distal attachments (A — A), precision rest, mesial on 47.
With unilateral free-end saddles, stability is achieved from a bounded saddle on the opposite side.

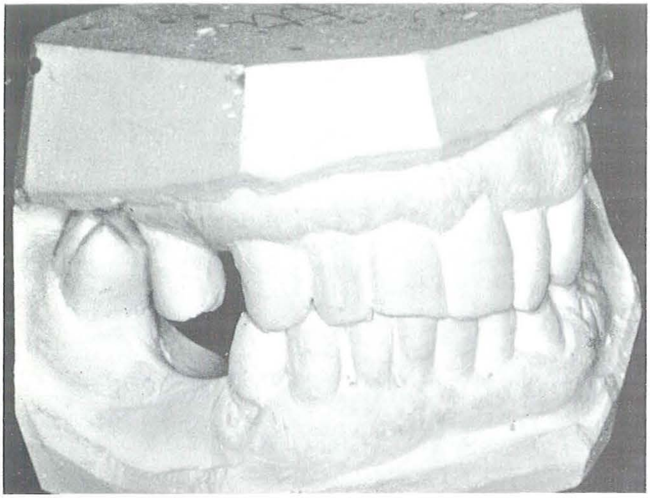


Fig. 214. Diagnostic casts of the original condition.

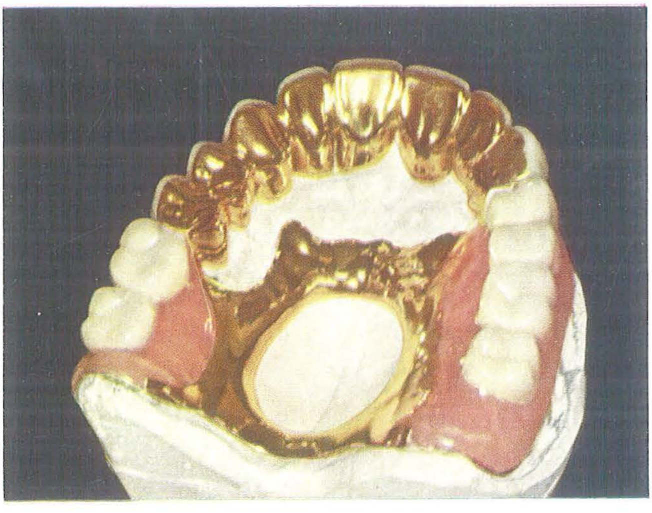


Fig. 215. Bilateral free-end saddle with attachments and splinting of remaining teeth.

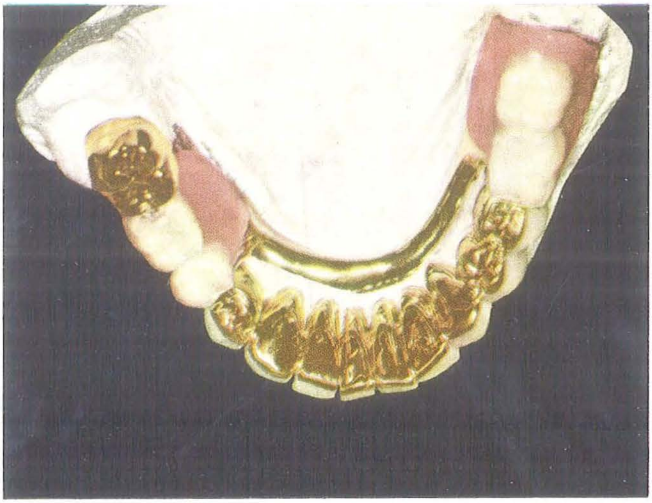


Fig. 216. Lower construction on the cast: splinting of remaining natural teeth, and denture with attachments; free-end saddle on the left, bounded saddle on the right.

Fig. 217. The precision rest on 47 is clearly visible on the removed denture.

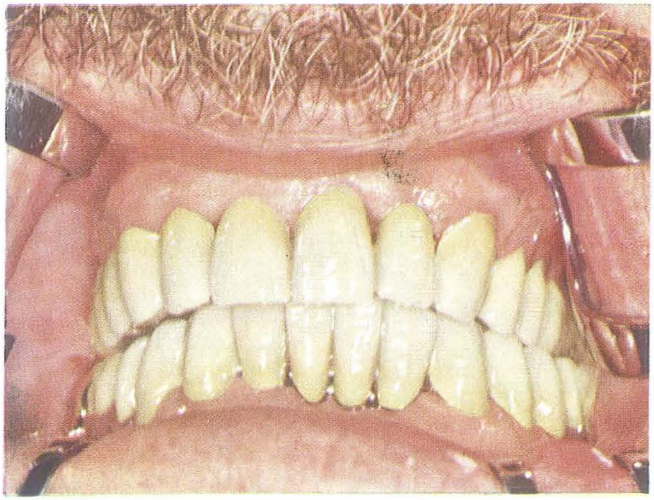


Fig. 218. Completed work in the mouth.

Case 2

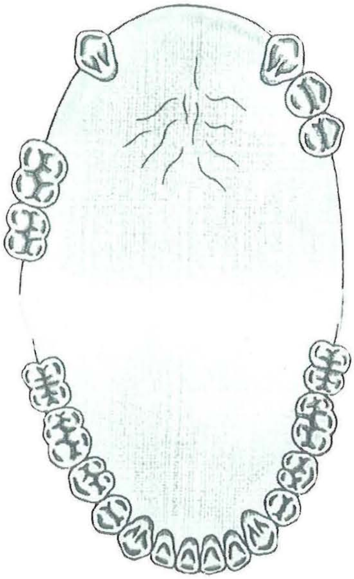


Fig. 219. Position of teeth.

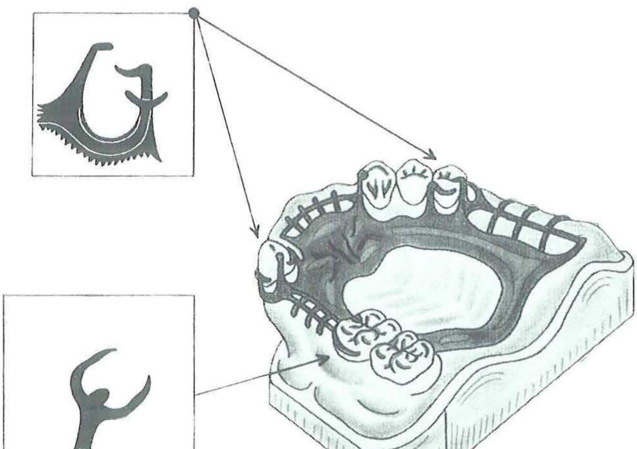


Fig. 220. Typical design with clasps on 17, 16, 13, 23, 24, 25. This diagrammatic Ney construction will only work if the anterior gap is closed by a fixed bridge.

Fig. 221. Another design: fixed bridge from 13 to 25; two crowns, soldered together, on 17, 16; interlock clasps (see Fig. 172) on 13 and 25.

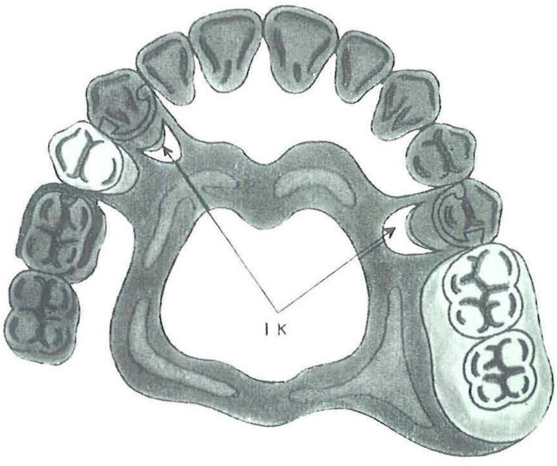


Fig. 222. Ideal design: fixed bridge splinting from 17 to 25; unilaterial free-end saddle with attachment (A — A) on the bridge.

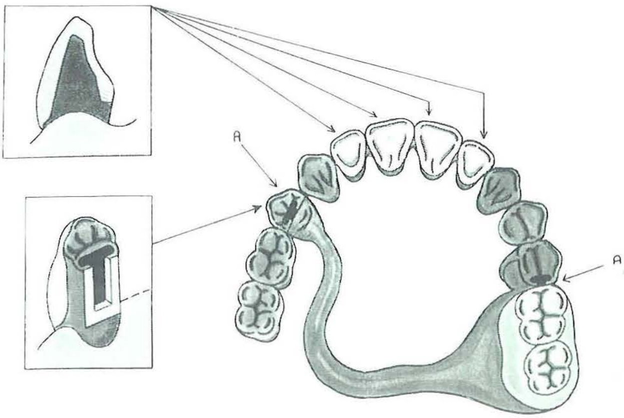


Fig. 223. Original condition (advanced periodontal disease).

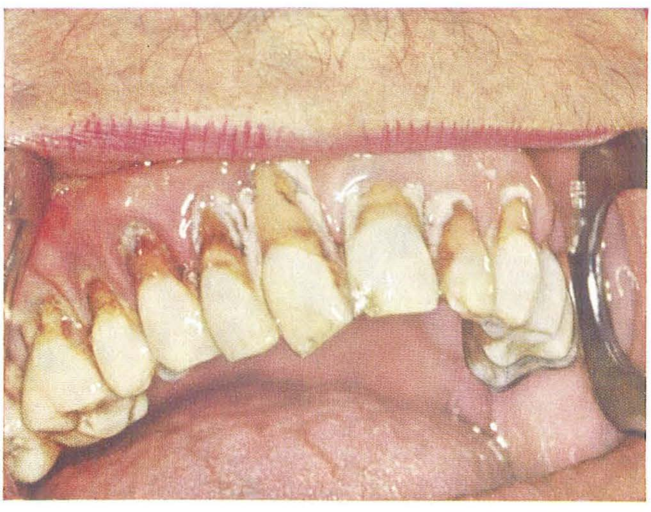


Fig. 224. Upper design on the cast.

Fig. 225. Completed work in the mouth.

Case 3

Fig. 226. Unilateral lower free-end saddle with no lingual bar. Two attachments are anchored to the two abutment teeth (soldered veneer crowns on the premolars); one attachment is fastened distally on the posterior abutment, the other one lingually on the anterior abutment or . . .

Fig. 227. . . . in the space between the two retainers. This design — known as the Nesbet construction — is indicated in the mandible, when the molars are missing and the two premolars are used as abutments.

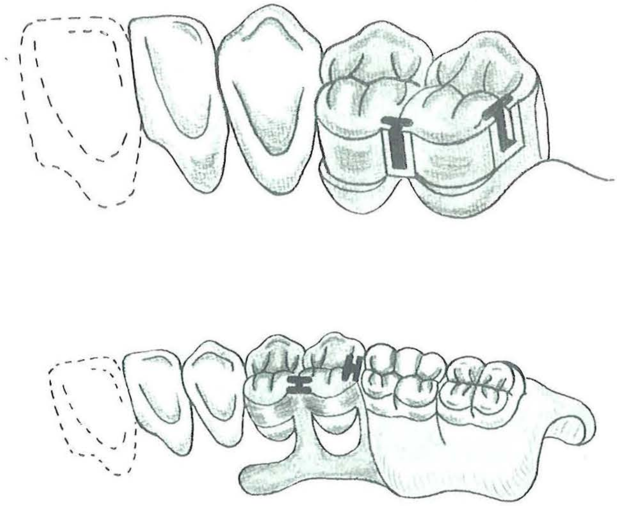
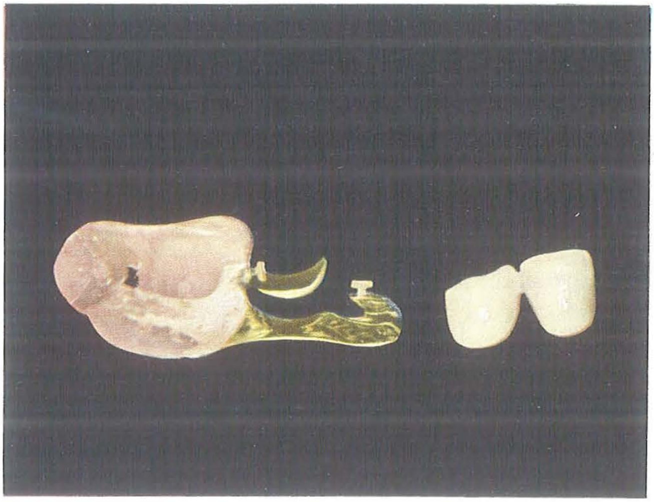


Fig. 228. Removed free-end saddle seen from below.



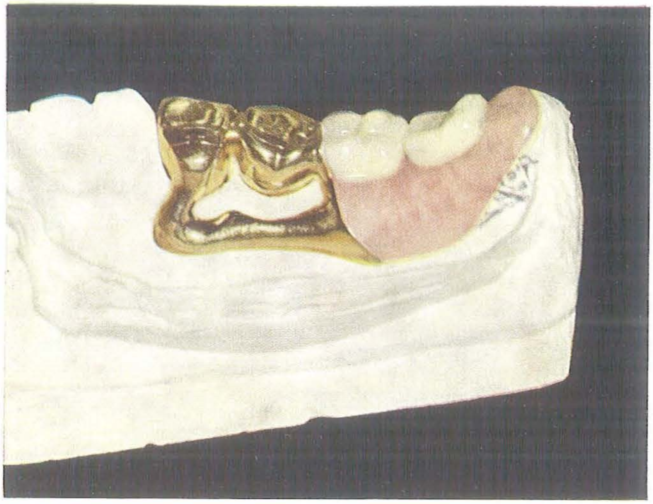


Fig. 229. Finished appliance on the cast.

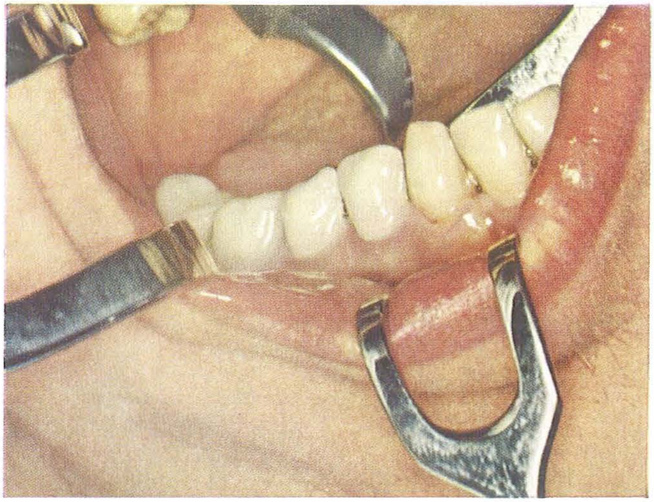


Fig. 230. Completed work in the mouth.

Case 4

Fig. 231. Position of teeth.

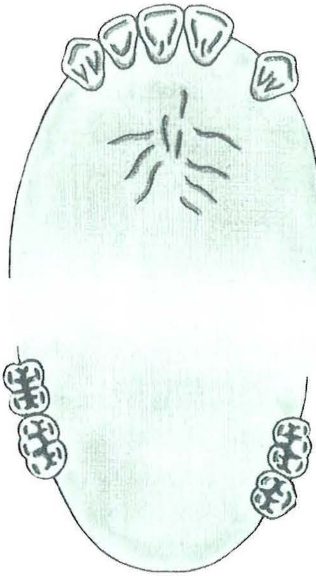
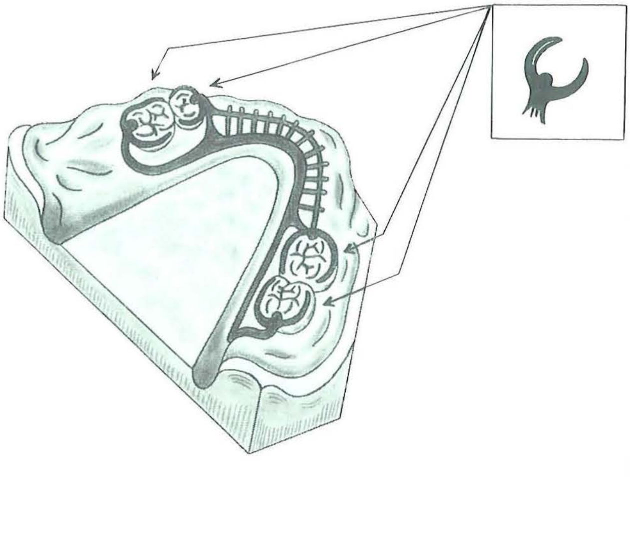


Fig. 232. Typical design with clasps: one pair of crowns, soldered together, on 17, 16 and 25, 26.



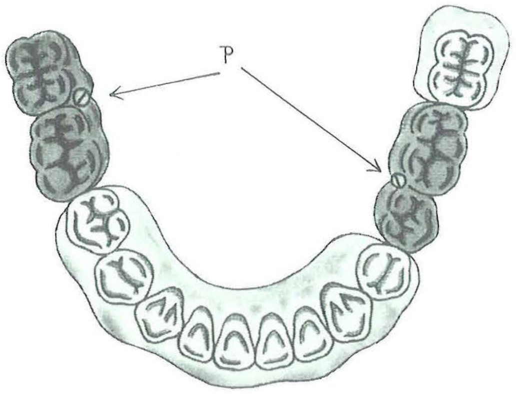


Fig. 233. Ideal design: telescopic attachment with pressomatic retention (P).

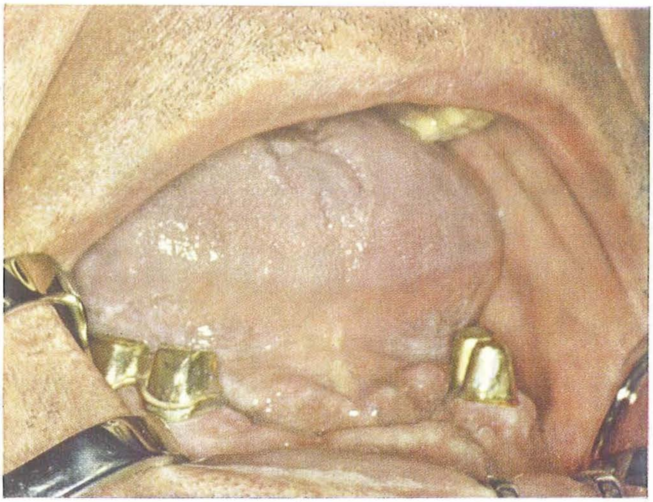


Fig. 234. The four internal telescopes in the mouth.

Fig. 235. Telescopic attachments seen from below.

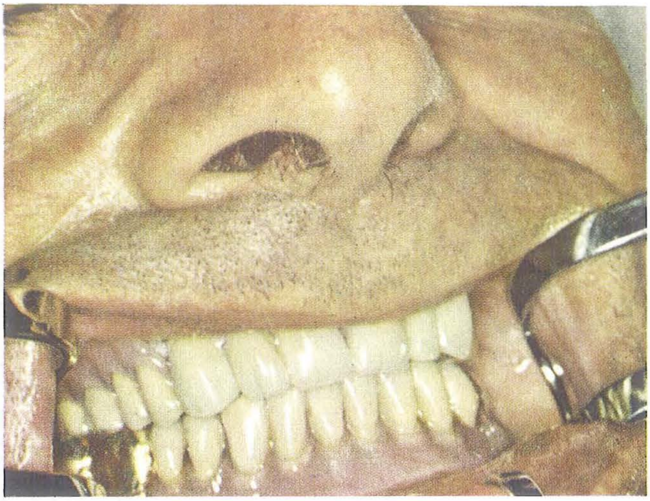


Fig. 236. Completed work in the mouth.

3. Kennedy Class III (Bounded Saddle Dentures)

Case 1

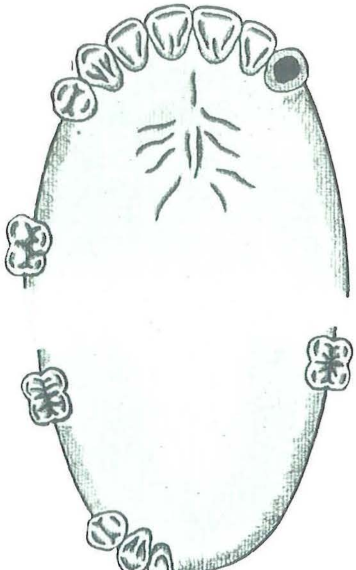


Fig. 237. Position of teeth.

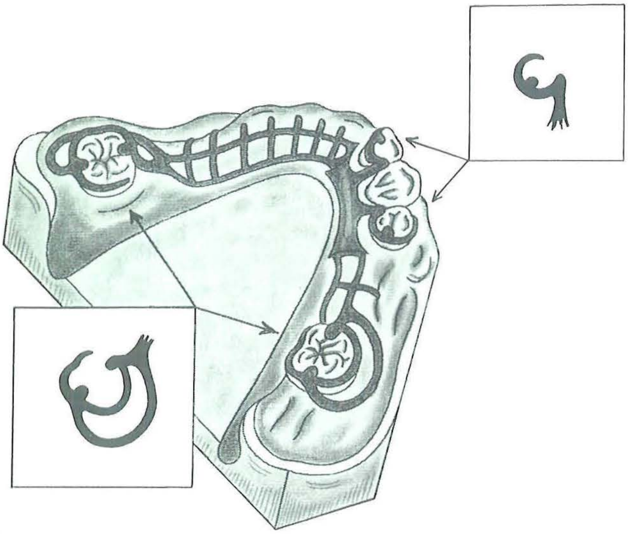


Fig. 238. Typical denture with clasps on 47, 44, 43, 42, 38.

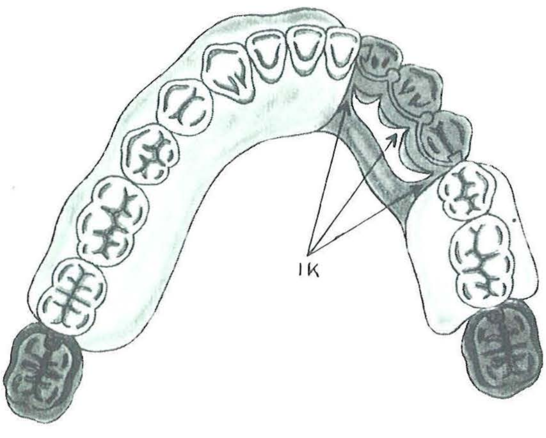


Fig. 239. Improved design: crowns on 47 and 38, fixed splinting with veneer crowns on 44, 43, 42, on which interlock clasps (see Fig. 172) are fitted.

Fig. 240. Ideal design with attachments (A) and precision rests (PR), firm splinting from 42 to 34.

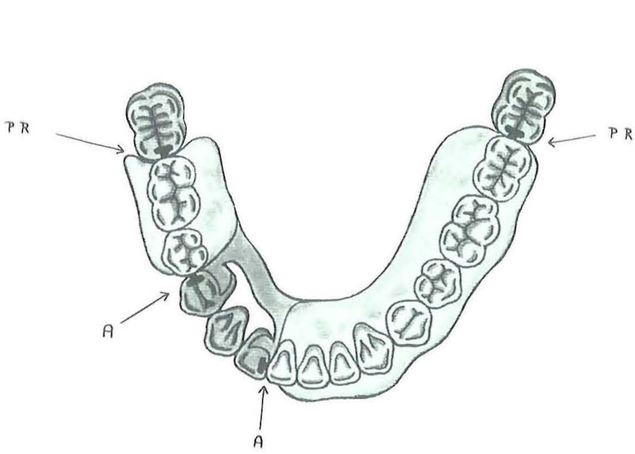


Fig. 241. Upper teeth (original condition).

Fig. 242. Lower teeth (original condition).

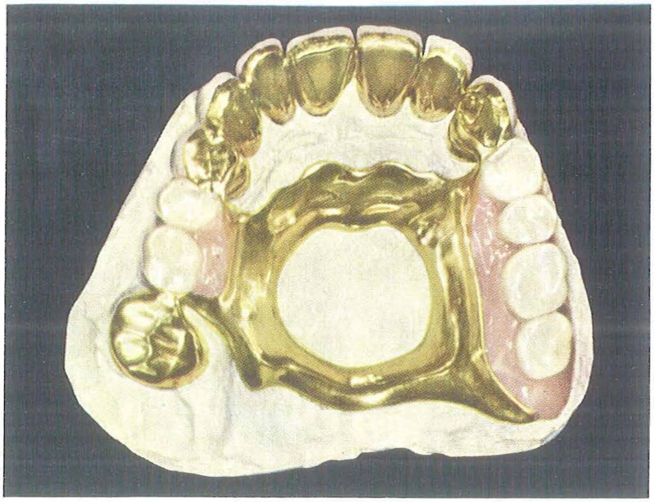


Fig. 243. Upper appliance on the cast: fixed bridge splinting from 14 to 23, denture with attachments at 14 and 23 distally, at 17 a precision rest mesially.

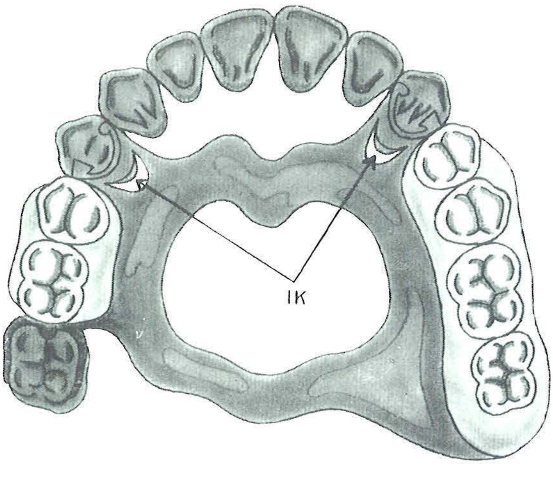


Fig. 244. Satisfactory design: crown on 17; fixed veneer crown bridge from 14 to 13; interlock clasps (see Fig. 172) on 14 and 13; clasp on 17.

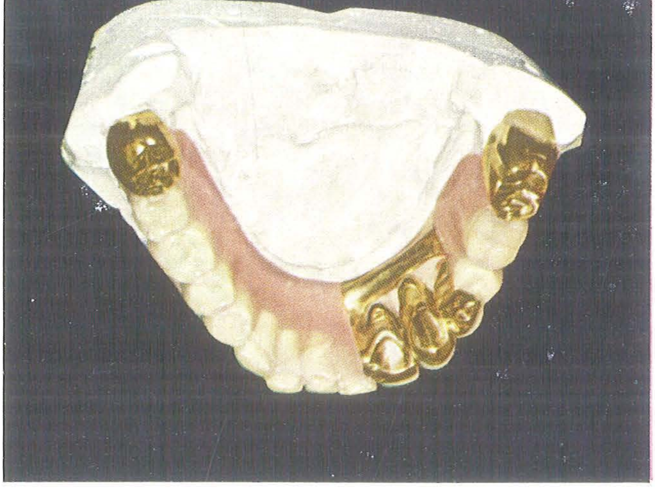


Fig. 245. Lower appliance on the cast.

Fig. 246. Completed work in the mouth.

Case 2

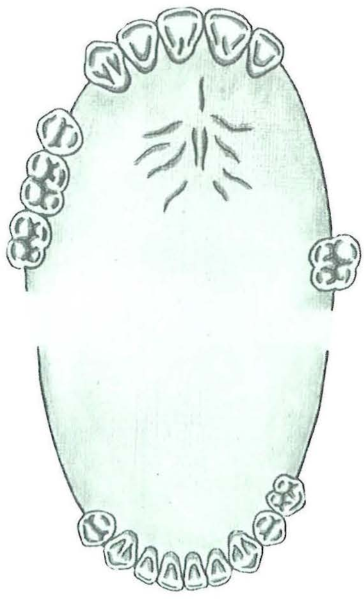


Fig. 247. Position of teeth.

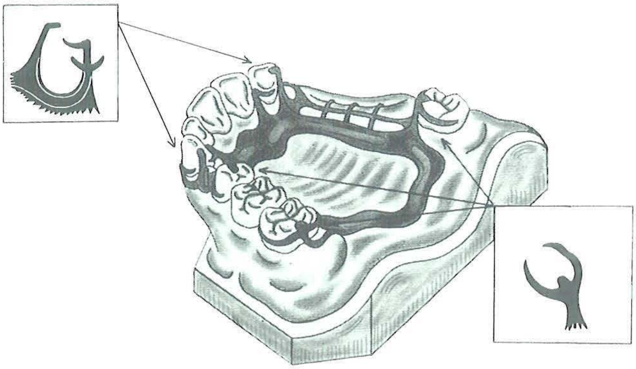


Fig. 248. Typical design with clasps.

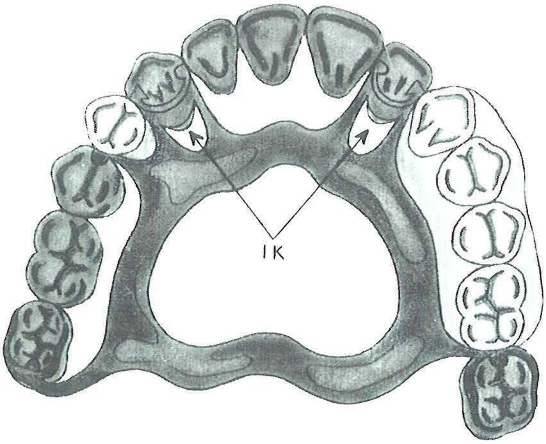


Fig. 249. Improved design: crowning and splinting of 17, 16, 15; fixed bridge splint with veneer crowns from 13 to 22, crown on 27. Denture with interlock clasps on 13 and 22; Ney class I clasp on 17 and 27.

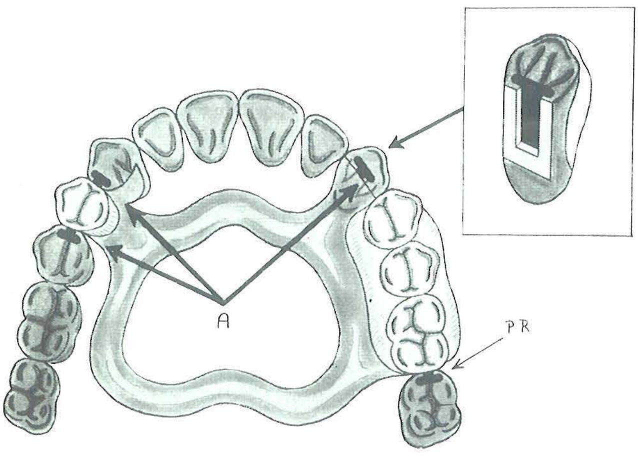


Fig. 250. Ideal design: two firm splinted-units from 13 to 22 and from 15 to 17; denture with attachments (A) and precision rests (PR). The 23 is an appendage, in which a sliding joint is inserted, since the 22 is too fragile to carry an intracoronal attachment. This design, however, is only indicated for bounded saddles.

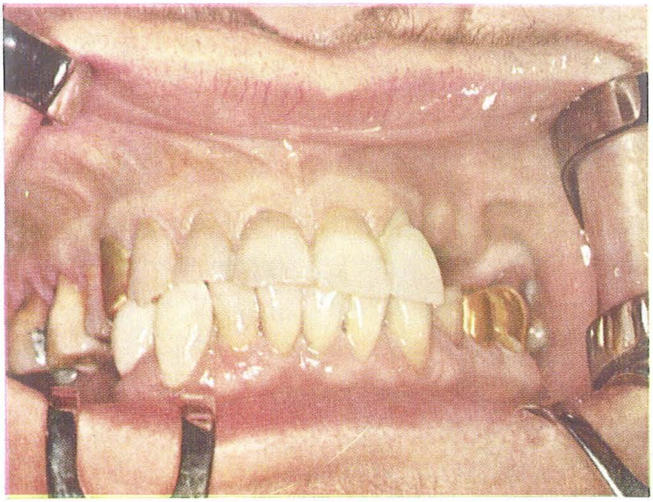


Fig. 251. Original condition of a patient.


Fig. 252. The upper appliance on the cast.


Fig. 253. Upper denture.

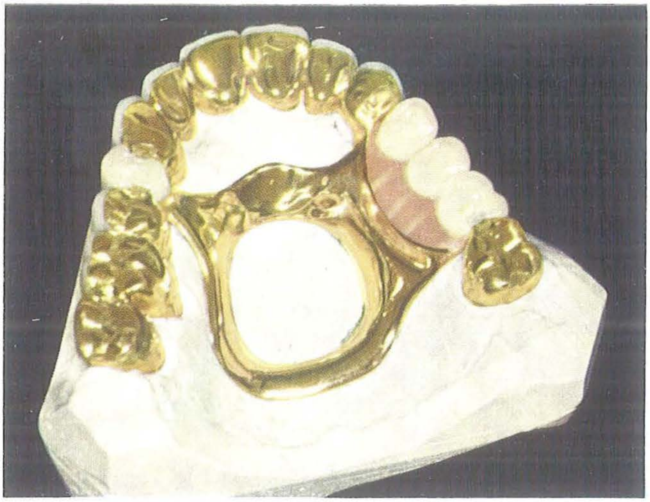


Fig. 254. The complete upper appliance on the cast.

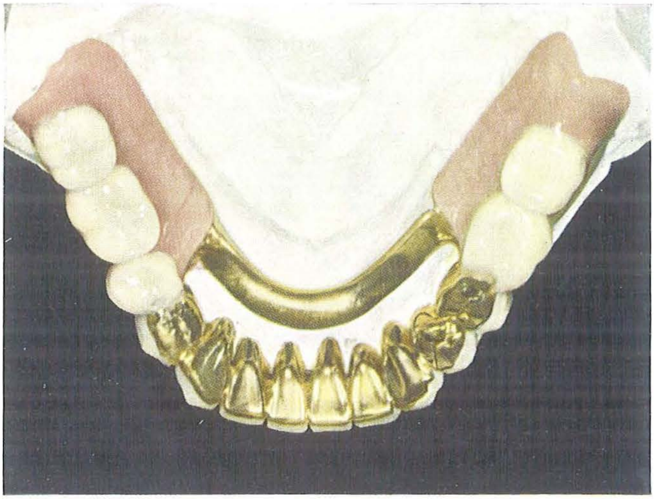


Fig. 255. The complete lower appliance on the cast: firm splinting from 44 to 35; bilateral free-end saddle with attachments.

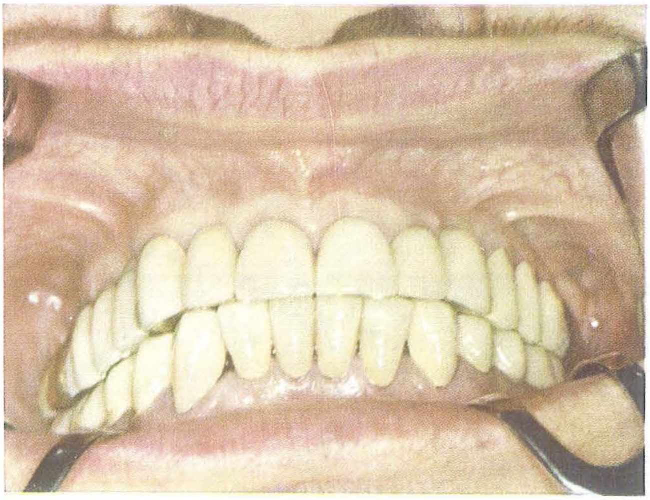


Fig. 256. Completed work in the mouth.

Case 3

Fig. 257. Position of teeth.

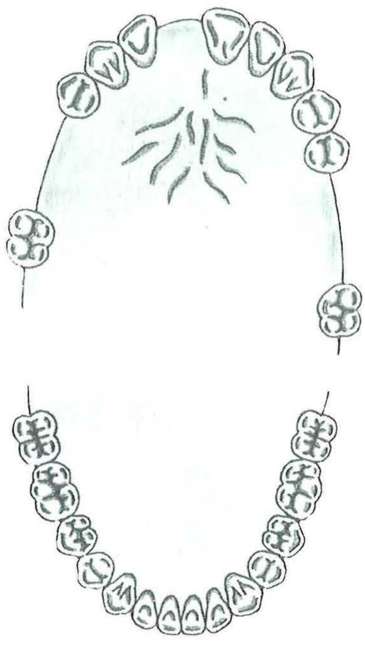
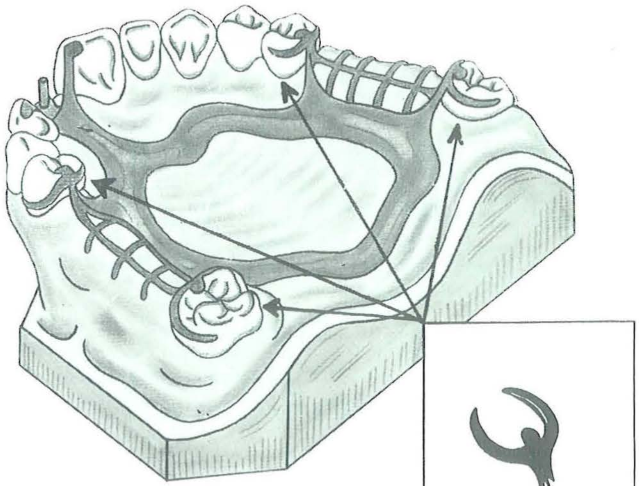


Fig. 258. Typical design with clasps. This diagrammatic Ney construction requires the anterior gap to be closed by a fixed bridge.



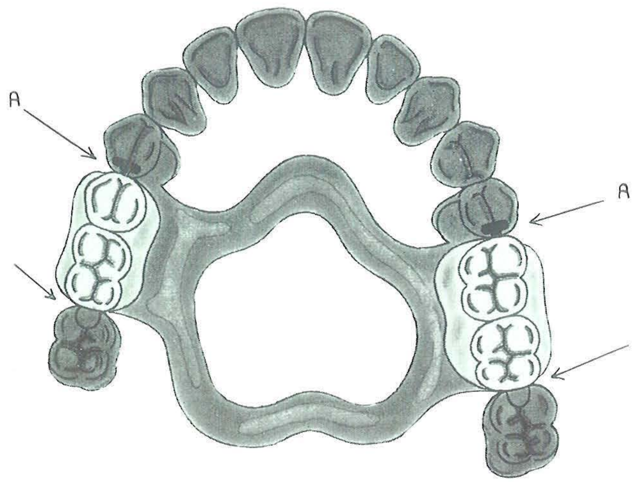


Fig. 259. Ideal design: firm splinting from 14 to 25; the last molars on the left and right were not included in the splinting because they were slightly loose. Should they be lost the bounded saddle denture becomes a free-end saddle by an extension and inclusion of the tuberosities.

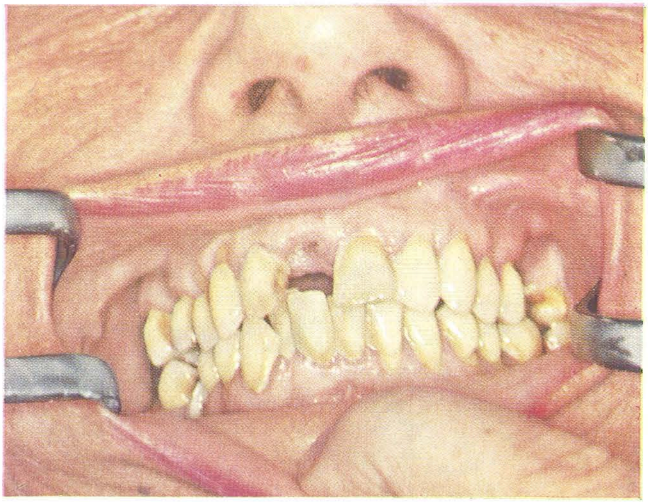


Fig. 260. Original condition.

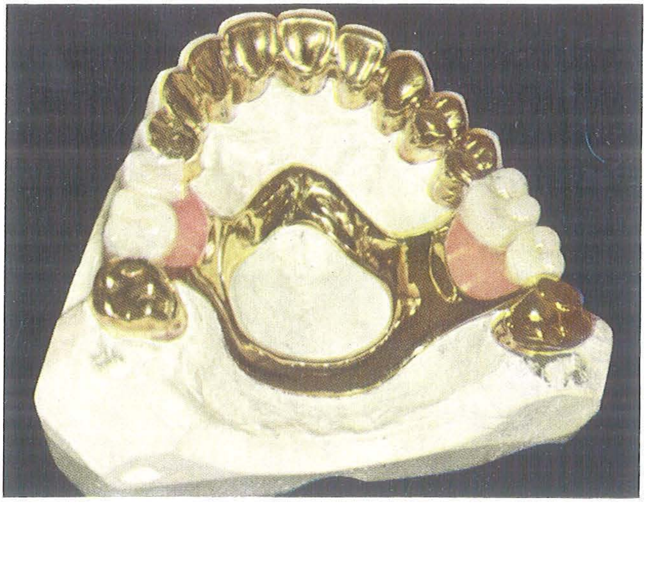


Fig. 261. Upper appliance on the cast.

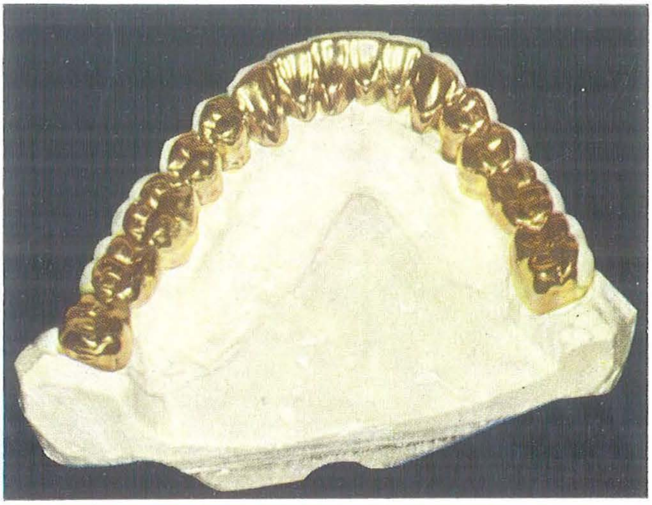


Fig. 262. Lower fixed bridge on the cast.

Fig. 263 Completed work in the mouth.

4. Kennedy Class IV (Teeth gaps mesially from remaining teeth)

Case 1

Fig. 264. Position of teeth.

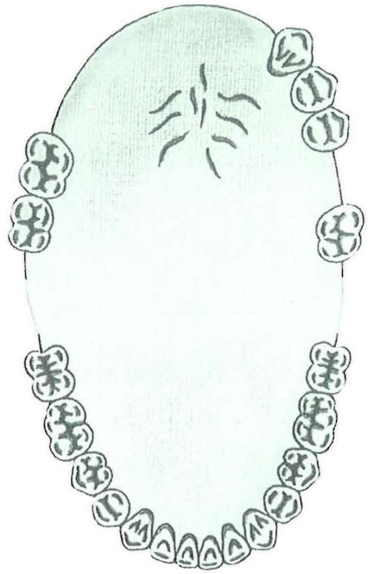


Fig. 265. Typical design with clasps.

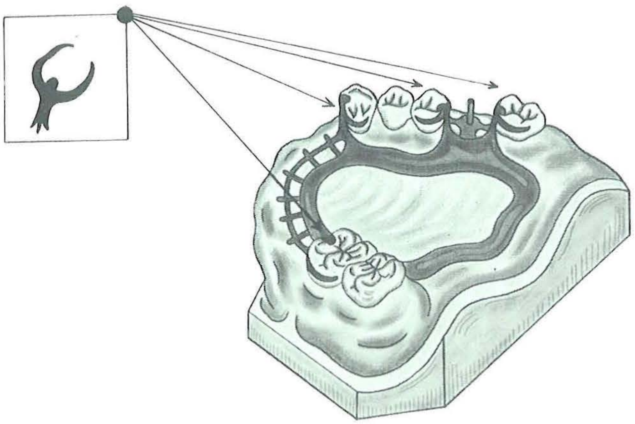


Fig. 266. An improved design: fixed bridge splinting from 23 to 27; crowning and splinting of 16 and 17. Clasped denture with interlock clasps (see Fig. 172) on 23 and 16; typical horseshoe form of palatal plate.

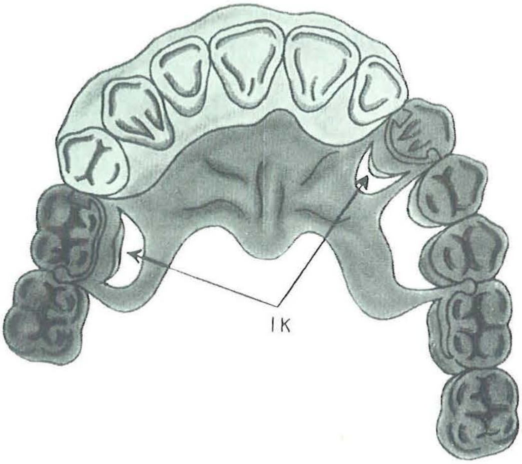


Fig. 267. Ideal design: fixed splinting of remaining natural teeth on the right and left; denture with attachments (A — A) and precision rests (PR).

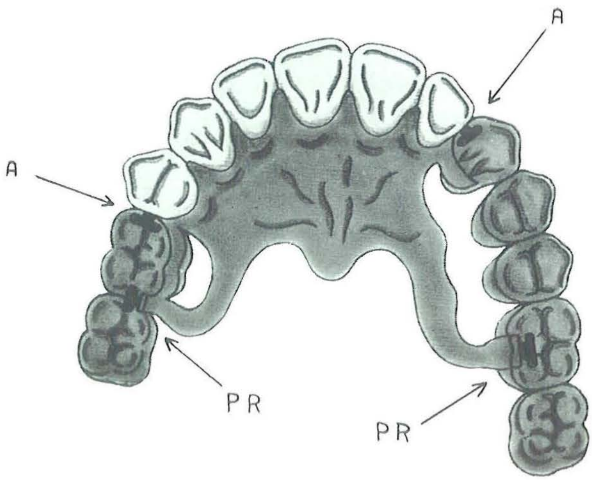
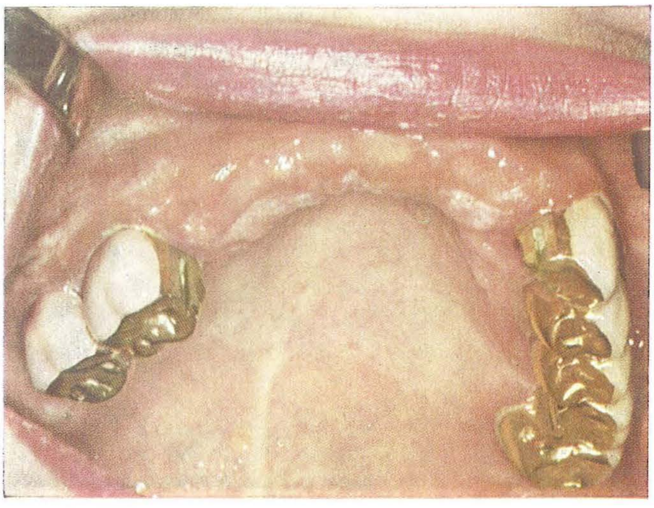


Fig. 268. The fixed splinting in the mouth.



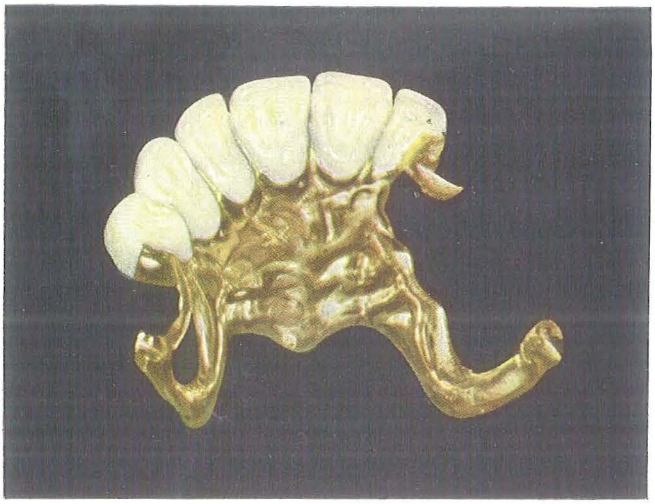


Fig. 269. The denture.

Fig. 270. Completed work in the mouth (palatal view).

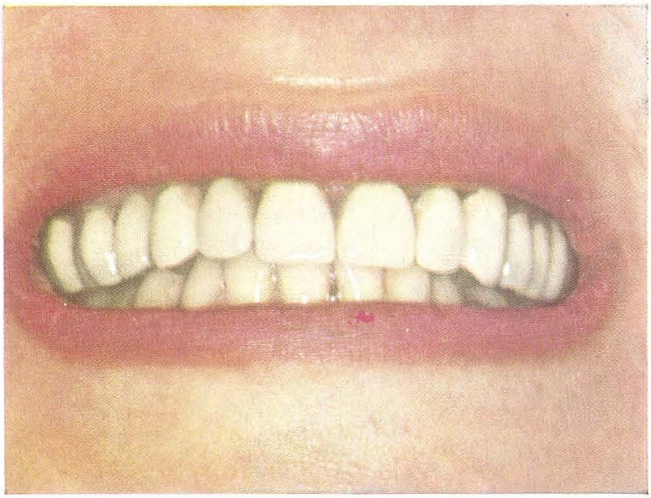


Fig. 271. Completed work in the mouth (labial view).

Case 2

Fig. 272. Position of teeth.

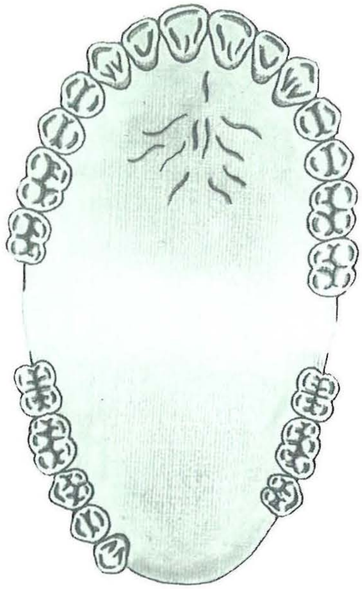
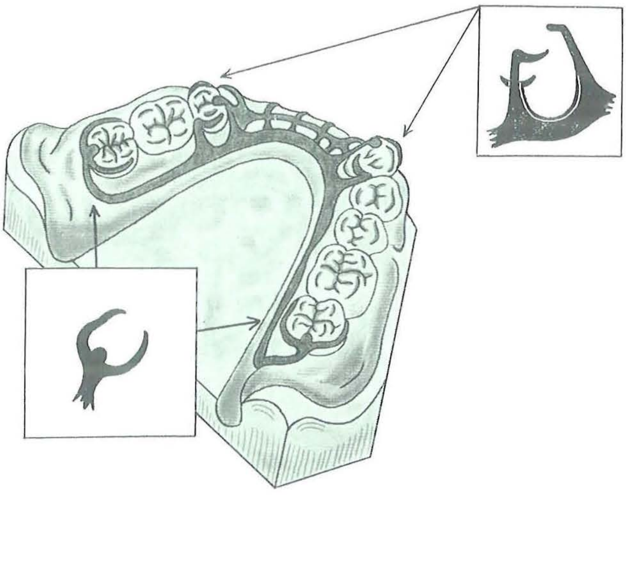


Fig. 273. Typical design with clasps.



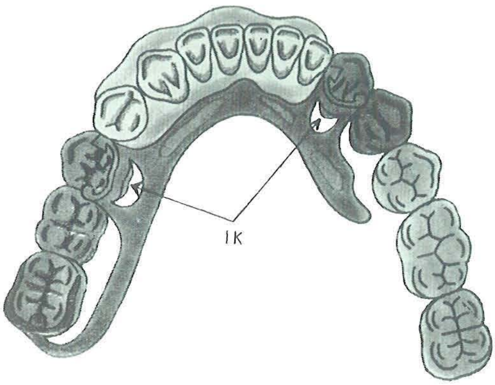


Fig. 274. An improved design: crowning and splinting of 35, 36, 37 and 44, 43; clasped denture with interlock clasps on 44 and 35; Ney class I clasp on 37.

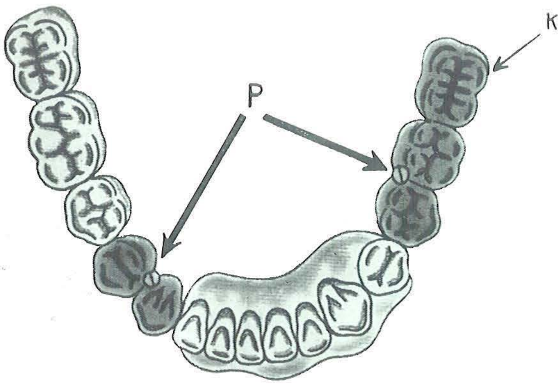


Fig. 275. A good design with four telescopes: 44, 43, 35, 36. P = pressomatic retention. K = unconnected crown.

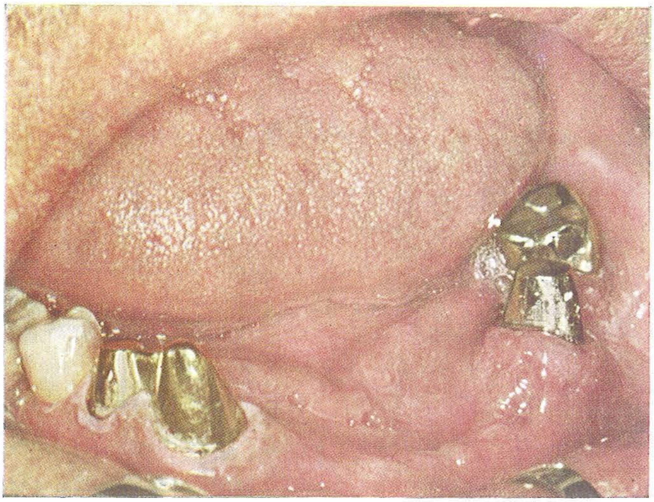


Fig. 276. The internal telescopic crowns in the mouth.

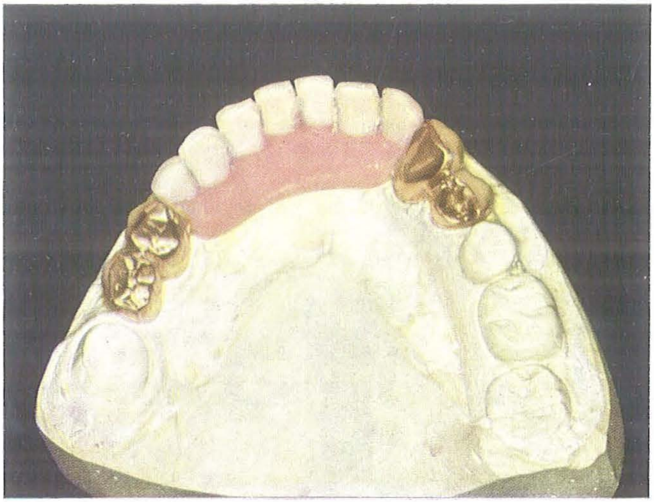


Fig. 277. The completed appliance on the cast.

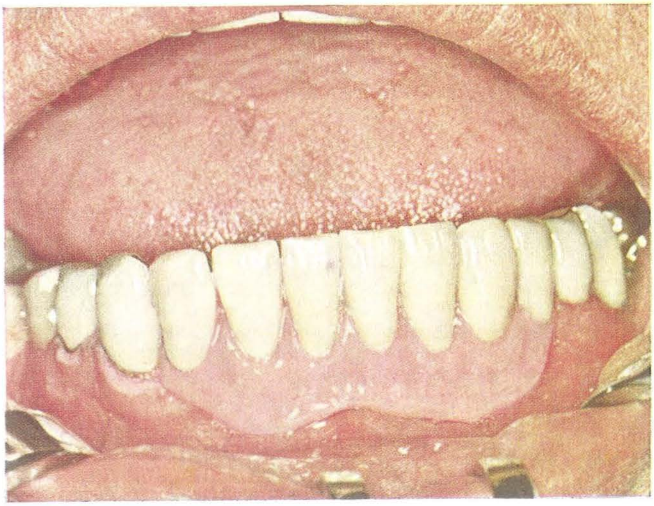


Fig. 278. Completed work in the mouth.

Case 3

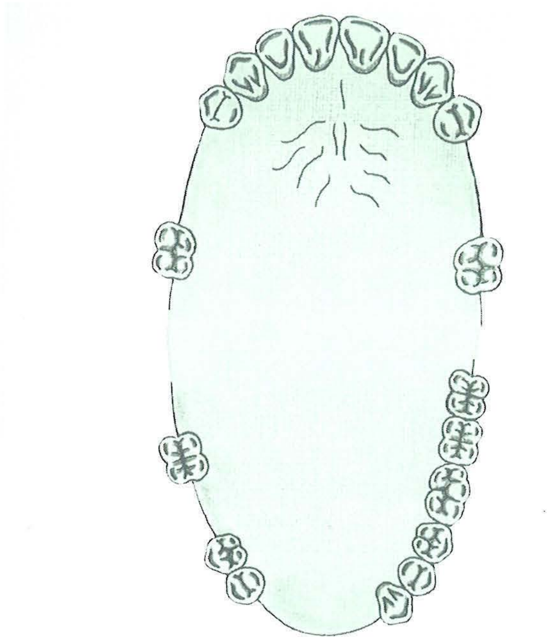


Fig. 279. Position of teeth.

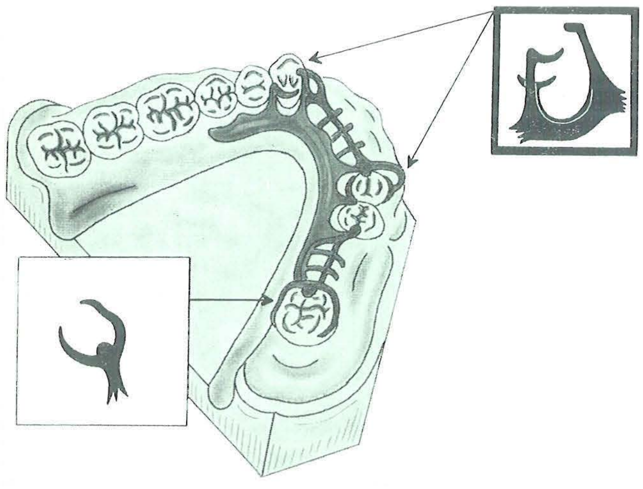


Fig. 280. Typical design with clasps.

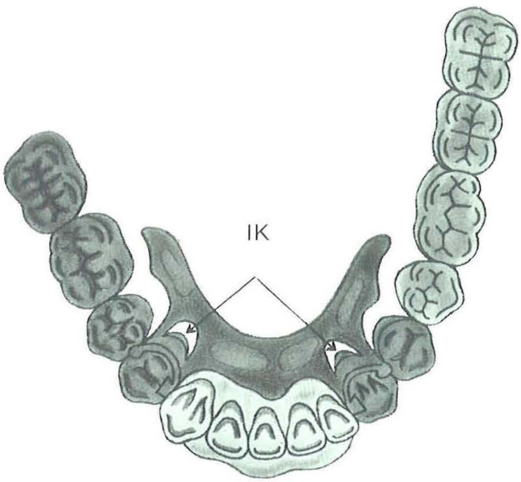


Fig. 281. An improved design: firm bridge from 44 to 47; two soldered veneer crowns on 33, 34· clasped denture with interlocking clasps on 44 and 33.

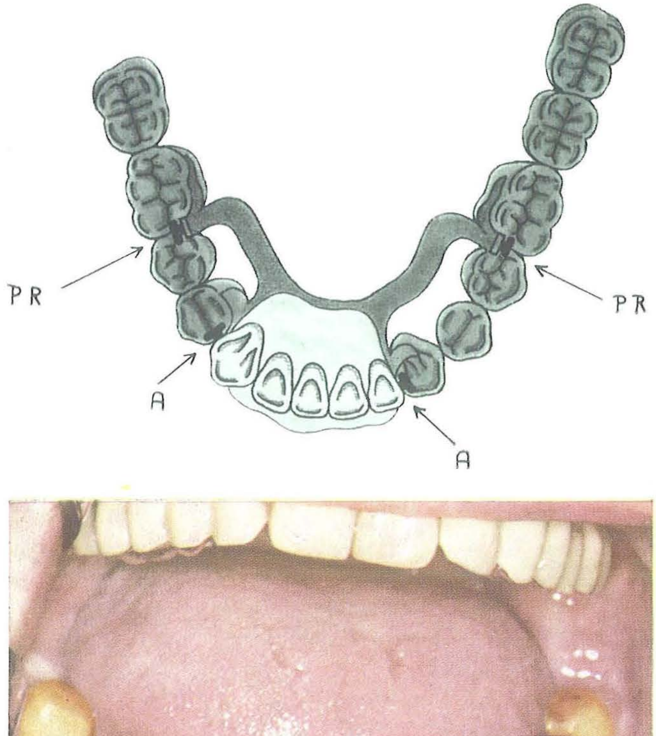


Fig. 282. Ideal design: two fixed splinted units of natural teeth on the right and left; denture with attachments (A — A) and precision rests (PR — PR).

Fig. 283. The prepared abutments.

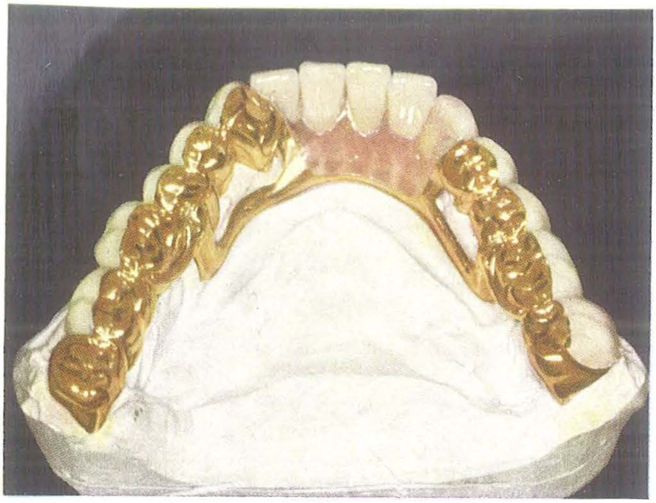


Fig. 284. Completed appliance on the cast.

Fig. 285. The denture.

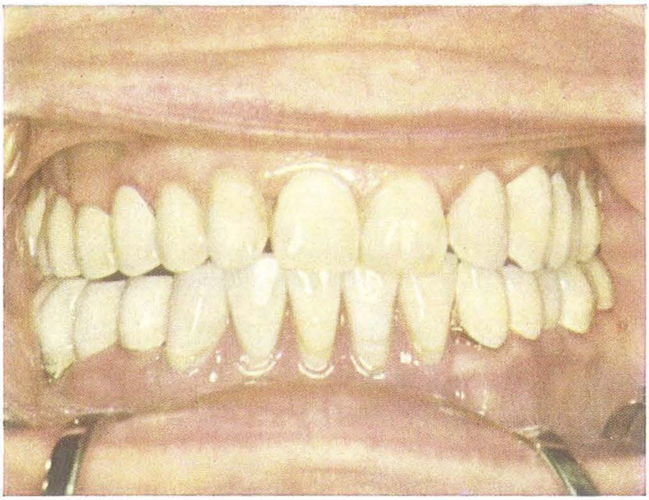


Fig. 286. Completed work in the mouth.

Improved attachment designs

Loosening of the attachment in the matrix, which may be anticipated after a certain time interval, can be corrected by adjustment of the elastic portion of the attachment. Because such adjustments diminish the elastic properties, readjustments at shorter time intervals become necessary. Furthermore, such adjustments do not touch the true cause of the loosening — loss of material.

Each type of treatment should be directed at a cause; treatment of symptoms (i. e., loosening) here does not touch the cause (i. e., material loss through abrasion). To attack the cause in this instance, the functional stress on the attachment must be reduced significantly. The attachment must be extensively relieved of strain, to the end that no activation adjustments are required over a long-term period. This problem has been solved in a manner which has brought other significant advantages as well.

Seating of the denture saddle is not left solely to the attachment on the distal side of the last abutment tooth. Rather, a precision rest (Fig. 287) is placed in the space between the most distal abutment and its neighbor, to assure retention. The precision rest is connected to the skeleton of the denture and to the attachment with an arm and a bar; the arm rests on the oral surface of the tooth. This improved design provides a series of important advantages:

1. The distal abutment is supported mesially as well as distally, allowing only vertically acting

strains (i. e., those along the vertical axis of the tooth) to have any effect. All other forces — the distal ones — are relieved. In other words, lateral forces in both directions nullify each other. This relieves the distal abutment greatly, and that is the tooth which otherwise absorbs all the forces, in spite of splinting.

2. Loss of material is reduced to a minimum, a condition which brings with it the result that no further activation of the attachment is required.

3. The attachment and the precision matrix are each now supported on two teeth, leading to better distribution of forces.

4. Insertion and removal of the prosthesis is made much easier and the patient gains the feeling of absolute security.

5. In the presence of short clinical abutments requiring correspondingly short retentive devices, the attachments in the past had to be short. This circumstance led to reduced guidance and retention of the attachment and finally to a question of its satisfactory function. Additional support provided by the precision rest makes reduced size attachments as functionally normal as though the short retainers and attachments were not required.

Finally, and in conclusion, it should be stressed that the technical development just described, i. e., the combination of precision attachment and precision rest, one attains a significant diminution of strain on the attachment. The attachment is no longer the sole bearer of strains from the natural dentition-partial denture system. This reduces the loss of substance of the attachment. In addition, the principle of rigid support of the removable partial denture on the remaining natural teeth is translated into reality in a heretofore unavailable manner. The double security afforded by this system eliminates any degrees of freedom of motion for the denture saddle.

That is the reason that this further technical improvement has particular significance. We must be modest and satisfied as we succeed in research and in clinical experience if we make small but certain progress toward the citadel toward which we all strive but which none of us will ever reach, that is, perfection.

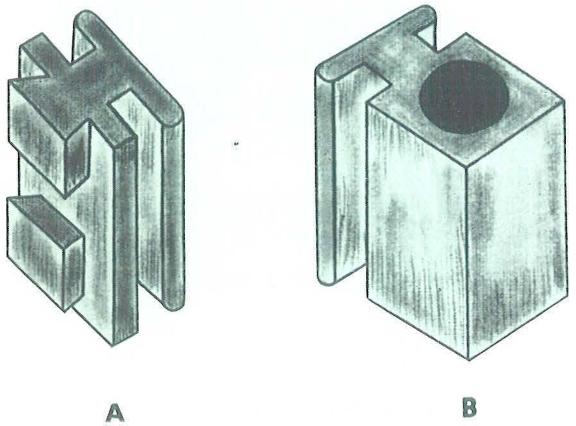


Fig. 287. A = precision rest, B = a chromium-nickel alloy matrix for the precision rest which is soldered into the partial denture splint after appropriate space was provided in the wax model. The matrix is then destroyed with a 50 % solution of nitric acid.

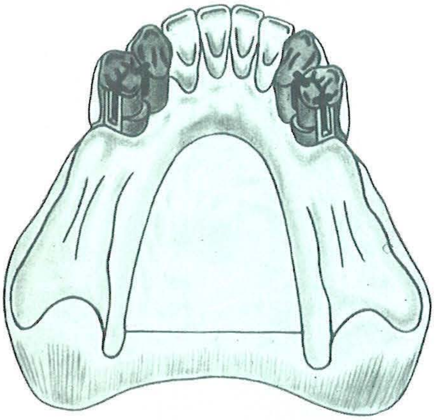


Fig. 288. Schematic drawing. Two teeth are fitted with veneer crowns bilaterally and these are soldered. The distal abutment bears an attachment distally. The precision rest is to be placed in the space between the final and the penultimate abutment.

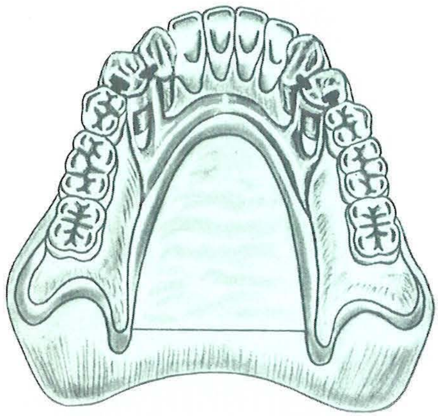


Fig. 289. Complete design: Two veneer crowns with a bilateral free-end partial denture.

Fig. 290. The same case mounted on the model.

Fig. 291. The same case seen in place.

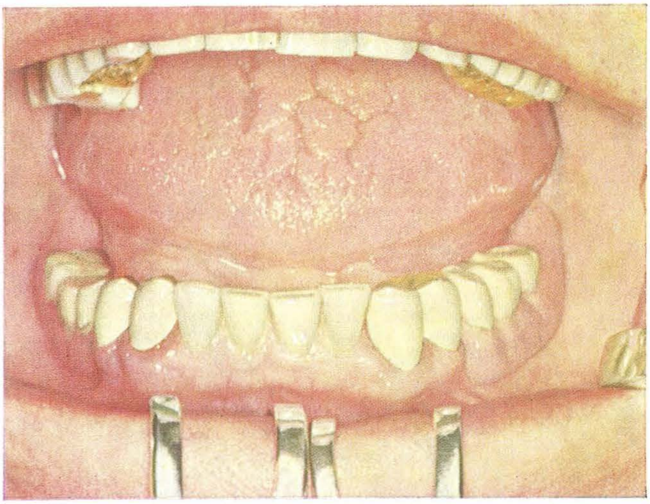
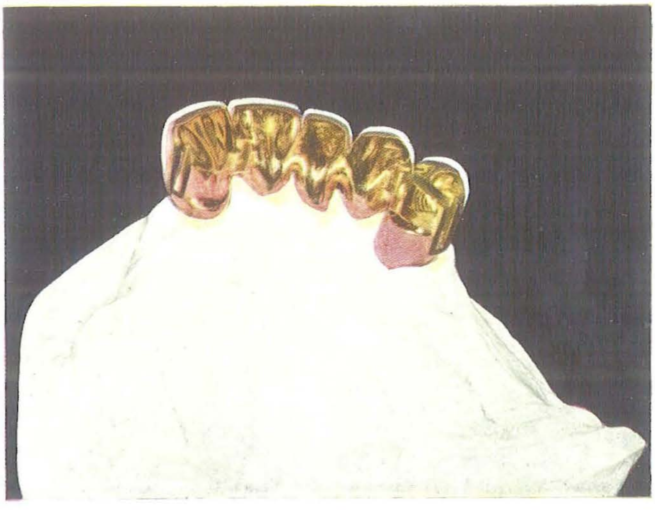


Fig. 292. Rigid splinting (veneer crowns) of 11, 21, 22, 23.



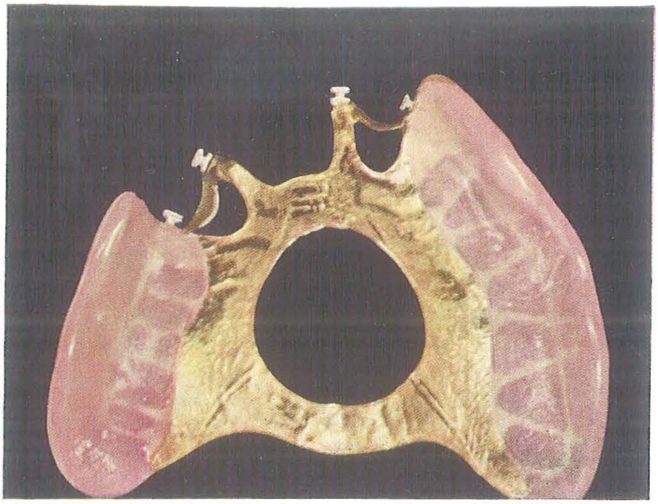


Fig. 293. A partial maxillary denture with distal attachments and precision rests.

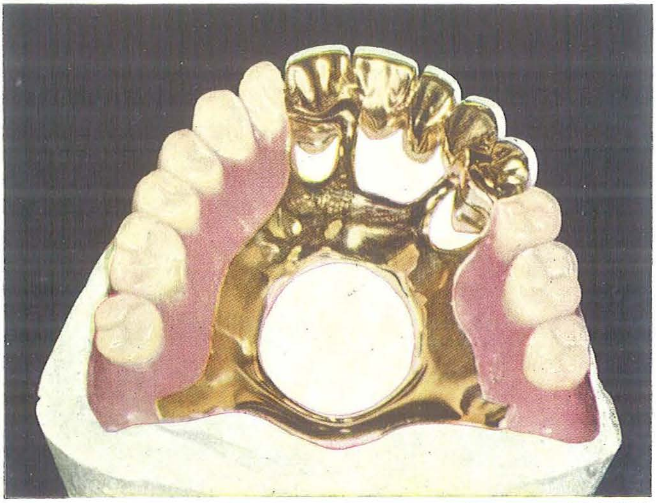


Fig. 294. The completed partial denture on the model.

Fig. 295. The same design in place.

ACADEMY of denture prosthesis — Principles, concepts and practices in prosthodontics, III report Journal of Prosthetic Dentistry 1963/2.

ANDERSON, J. A. — The dimensional stability of silicone base impression materials. The dental practitioner, 8, 368–374, 1957.

APPLEGATE, O. C. — Essentials of removable partial denture Prosthesis. Saunders Company, S. Louis 1958.

BAGNOLI, S. — Un mito: la relazione centrica mandibolare condizionata dai condili. Annali di Stomatologia, 1961/10.

BANDETTINI, R. — Impronta mucostatica e preparazione di placche fuse. Clinica Odontoiatrica, 1949, S. 341–342. – I ganci fusi – Sintesi analitica. Clinica Odontoprotesica, 1959. – Protesi scheletrata. Considerazioni dottrinali e applicazioni cliniche. Rivista Odontoprotesica, I, 1; 1953. – I movimenti dei congiuntori articolati nelle protesi scheletriche ad estremità libera. Rivista Odontoprotesica, I, 3, 1954.

BANDETTINI, R. and CASAGRANDE, G. — Gli attacchi di precisione nelle protesi ad estremità libera. Annali di Stomatologia, Vol. X, 1961/7.

BANDETTINI, R. and DETTORI, L. — Introduzione allo studio della situazione del muscoli masticatori come condizione preminente per la registrazione della dimensione verticale e considerazioni di ordine biomeccanico. Clinica Odontoprotesica. 1960/3. – La posizione di riposo e lo spazio libero come condizioni essenziali nel determinismo della dimensione verticale. Annali di Stomatologia, vol. X, 1961/6.

BAUME, L. J. and FIORE-DONNO — Kortikosteroidbehandlung der Pulpa pathohistologisch in Frage gestellt. Z.W./R. 1963/14.

BENAGIANO, A. — La fisiologia della masticazione. Minerva Stomatologica. 1961/5.

BENNETT, N. — A contribution to the study of the movement of the mandible. J.A.D.A. 1958/41.

BERLINER, A. — Clinical Periodontology. The Park Press, New York 1953.

BERTOLINI, A. — Lanciamo una pietra contro i congiuntori a molte libertà di movimento. Clinica Odontoprotesica, I, 86, 1954.

BIAGGI-ELBRECHT — Gelenkige Prothesen und ihre Indikation. Verlag Zahnärztliche Welt 1951.

BIAGGI-STEIMER — Das Technische in der zahnärztlichen Prothetik. Z.W. 1955/16.

BONORA, L. and MEGIGHIAN, A. — La costruzione razionale di ganci fusi su Veneer Crowns per protesi rimovibili. Odontes, 1957/3.

BOSWELL, J. V. — Practical occlusion in relation to complete dentures. Journal of Prosthetic Dentistry 1307, 1951.

BÖTTGER, H. — Das Teleskop-System in der zahnärztlichen Prothetik. Zahnärztl. Fortbildung. J. A. Barth, 1961/4.

BOUCHER, L. and JACOBY, J. — Posterior border movements of the human mandible. Journal of Prosthetic Dentistry 1961/5.

BRANZI, A. — La protesi nei soggetti affetti da paradenziopatie. Rivista Italiana di Stomatologia, 1947/9. – I moderni orientamenti della protesi dentaria. Progressi di Terapia, April 1953. – Sull'applicazione pratica della protesi a ponte rimovibile con attacchi. Odontoiatria e Stomatologia, Master Ed., Rome, 1952. – Le basi teoriche e le indicazioni cliniche della protesi a ponte rimovibile con attacchi. Nova Acta Stomat., 1949/1. – Teleologiia protesica. Arti Sanitarie Ausiliarie, 1960/11. – Protesi superiore di fissazione e di sostituzione in soggetto parodontopatico. Mondo Odontostomatologico, 1961. – Restaurazione protesica per la perdita dei molari monolateralmente. Odontoiatria e Stomatologia, 1952. – Basi dottrinali e pratiche della protesi ammortizzata. Odontoiatria e Stomatologia, 1952. – La terapia protesica nella masticazione raccorciata. Clinica Odontoprotesica, 1954/4. – Protesi e potenziale economico. Mondo Odontostomatologico, 1960/4.

BRANZI, A. and KELESCIAN, A.	La presa dell'impronta per la costruzione di corone in porcellana e in resina sintetica. Rivista Italiana di Stomatologia, 1946/5-6.
BRANZI, A. and KOVACS, G.	Il corpo protesico negli apparecchi parziali mobili forniti di ammortizzatori. Clinica Odont. 1949/7.
BRANZI, A. and MORANDI, F.	Un nuovo dispositivo funzionante da riduttore di pressione e da attacco. Rivista di Odontoiatra a Ortognatia, vol. 1947/11. – Brevi considerazioni teorico-pratiche nella protesi ammortizzata. Rassegna Trimestrale di Odontoiatria. 1949/1.
BRANZI, A. and ZUCCOLI, G.	The problem of Unilateral Removable Appliances. J. of the Philippine Dental Ass., 1953/3.
BRECKER, C. S.	Clinical Procedures in Occlusal Rehabilitation. Saunders Co. 1958. Philadelphia-London. The Porcelain Jacket Crown. The C. V. Mosby Company, St. Louis, 1951.
BUY	Il rialzo dell'articolato nella protesi dentale. Rivista It. di Stomat., 1950/4.
CALANDRIELLO, M.	Attualità di tecniche operatorie in protesi fissa. Nova Acta Stomatologica, vol. XIII, 1961. – Sull'impiego delle resine autopolimerizzanti nella protesi fisiologica (varietà protesi fissa). Mondo Odontostomat., vol. IV, July-Aug. 1961.
CERIA, G.	L'equilibramento dell'occlusione. Nota sulla correzione delle malposizioni dentarie. Acts of the ARPA Congress, Pavia-Salice Terme, April, 1956.
CHALIFOUR, R. L.	Gingivektomien und Gingivo-Osteoplastiken mittels Luftturbinen. D.Z.Z. 1963/16.
CHECCHI, G.	Considerazioni comparative nelle varietà rimovibili e inamovibili delle protesi di fissazione definitiva. Mondo Odontostomat., 1961/4.
CHECCHI, G. and CUPPINI, G.	Su un nuovo attacco di precisione. Mondo Odontostomat., 1962/3.
CHECCHI, G. and PRETOLANI, E.	Corone in resina con rivestimento interno in foglia aurea. Clinica Odontoprot., 1955/1.
COHN, L. A.	The physiologic basis for tooth fixation in precision-attached partial dentures. Journal of Prosthetic Dentistry, 1956/2. Staining acrylic resin restorations. Journal of Prosthetic Dentistry, 1957/3.
COSTEN, J. B.	A syndrome of ear and sinus symptoms dependent upon disturbed function of the temporomandibular joint. Ann. Otol. & Laryngol., **43**, 1, 1934.
CRADDOCK, F. W.	Recording procedures in Partial Denture Construction. Intern. D. J. 8:367–369. 1958.
DETTORI, L.	Rilievi liminari alla dimensione verticale. Clinica Odontoprot., 1956/2.
DIAMOND, N.	Rubber elastic impression materials. Tufts Dental Outlook, **29**, 16–17, 1956.
DRIAK, F.	Die Bedeutung der Acrylate in der modernen Zahnheilkunde. Ztschr. f. Stomat., 1962/2.
DRUM	Über Parafunktionen, insbesondere über die unbewußte (Karolyi-)Parafunktion des Gebisses. Z.R. 1950/59.
ESCHLER, L.	Elektrophysiologische und -pathologische Untersuchungen des Kausystems. DZZ 1952/7.
EWING, J. E.	Fixed partial prosthesis. Lea & Febiger, Philadelphia, 1959.

FILICORI, R. — Contributo allo studio della protesi a ponte rimovibile con attacchi. Riv. di Odontoiatria e Ortognatia, 1948/11. - Il rialzo permanente del combaciamento in protesi fissa. Acta Stomat. Patav., vol. VI, 1959.

FLASCHENTREHER, M. H. — Ästhetisch einwandfreier Zahnersatz. ZWR 1959/18. -Wiederherstellung ästhetisch entarteter Gebisse. ZWR 1959/24.

FRECHETTE, A. R. — Partial denture planning with special reference to stress distribution. Journal of Prosthetic Dentistry, 1, 710, 1951.

FREITAG, H. — Vergütung dentaler Kunststoffe. DZZ 1957/12. - Modifikationen bei der Verblendkrone und Brückentechnik, Z. P. 1959/24.

FREIVOGEL, H. — Zahnersatz aus Porzellan und Platinmetall. DZZ 1957/11. - Bericht über Permadent. DZZ 1957/5.

FRÖHLICH, E. — Oral-Rehabilitation, Befunderhebung. DZZ 1961/13.
Die Wiederherstellung des Kauorgans (Oral Rehabilitation). DZZ 1961/3.

FRY, A. E. — Topical use of Corticosteroids for the relief of pain sensivity of dentine and pulp. Oral Surg., Oral Med. & Oral Path., 13:594, 1960.

GADE, E. — Hygienic problems of fixed restorations. I.D.J. 1963/2.

GALASINSKA-LANDSBERGEROWA, F. J. — Prosthetic treatment of the incomplete dentition: The removable bridges as a prosthesis. I.D.J. 1963/2.

GARNICK, J. and RAMFJORD, S. P. — Rest position. Journal of Prosthetic Dentistry, 1962/5.

GERBER, A. and ARMBRECHT, E. — Unsere Methode der Facettenkrone mit mineralischer Verblendung. Zahnmedizin im Bild. 1962/2.

GERRY, R. G. — Clinical problems of the temporomandibular articulation. J.A.D.A., **34**, 261. 1947.

GILLIS, R. K. — Balanced occlusion and lost vertical dimension. J.A.D.A., **25**, 228, 1938.

GINS, H. — Erfahrungen eines jungen deutschen Zahnarztes in Amerika. Z. R. 1955/24.

GLICKMAN, I. — Clinical Periodontology. Saunders Company, Philadelphia 1958.
Clinical Periodontology; W. B. Saunders, Philadelphia-London-Toronto, 1972.

GOODMAN, J. J. and GOODMAN, H. W. — Balance of force in precision free-end restorations. Journal of Prosthetic Dentistry, 1963/2.

GOLDMAN, H. M., COHEN, D. W. — Periodontal Therapy, C. V. Mosby Comp., Saint Louis, 1969.

GÖRANSSON, P. — Hydrocollodial avtrycksteknik. Odontologiske Tidskrift 1957/2.

HARTLMAIER, K. M. — Biologische Zahnheilkunde. Z.M. 1958/11.

HATTEMER, A. J. — Die antiphlogistische Allgemeinbehandlung bei Parodontopathien. DZZ 1958/2.

HEINRICH, A. — Lebendige Prothetik. Berlinische Verlagsanstalt.

HEINTZ — Kann die traditionelle Auffassung von Artikulation und Funktion weiterhin aufrechterhalten werden? Z.W. 1953/19.

HEISS, J. — Chirurgische Methoden zur Herstellung eines tragfähigen Alveolarkammes. Dtsch. Stomat. 1953/6.

HÖRAUF, K. — Frontzahnstellungen und Körperbautypen. Selbstverlag 1956. – Über das Wesen des Konstitutionstypus und seinen Korrelationswert . . . DZZ 1957/4. – Die konstitutionelle Unterscheidung der Form und Stellung der Vorderzähne . . . Dent. Labor 1958/10. – Über die konstitutionelle Abhängigkeit . . . ZWR 1959/11. – Über die konstitutionelle Unterscheidung der Vorderzahnformen. DZZ 1958/20. – Form und Stellung der Frontzähne in ihrer Beziehung zu Körperbautypen. Carl Hanser Ed. Munich, 1958.

HOTZ — Die Bedeutung, Beurteilung und Behandlung beim Trauma im Frontzahngebiet vom Standpunkt des Kieferorthopäden. DZZ 1958/1.

HROMATKA, A. — Zur Oberflächengestaltung der totalen unteren Prothese. Z.W. 1958/14. – Der Schluckabdruck. Z.W. 1935/13. – Die partielle Oberkieferprothese aus Kunststoff. Carl Hanser Ed. Munich, 1953. – Prothetische Bißverschiebungen. DZZ 1953/13.

HRUSKA, A. — La protesi multipla collegata e incorporata. Sperling & Kupfer, 1954.

HUPFAUF, L. — Über die Bißhebung im Lückengebiß. DZZ 1961/3. – Bißkonstruktion und Bißkorrektur bei Veränderungen der vertikalen Dimension. ZP 1959/7. – Über die physiologische Ruhelage des Unterkiefers. DZZ 1959/15. Rekonstruktion der Bißhöhe im Lückengebiß. ZP 1959/7.

JANKELSON, B. — Physiology of human dental occlusion. J.A.D.A., 50, 6, 664, 1955. – Consideration of occlusion in fixed partial dentures. Dental Clinics of North America, 187, Philadelphia-London 1959. – Consideration of occlusion in fixed partial dentures. Dent. Clin. North. America, 1962, 50, 52. – The Physiology of the Stomatognathic System. J.A.D.A., 46, pp. 375–386, April 1953.

JOHNSTON, J. F. — Construction and assembly of Porcelain Veneer Gold Crowns and Pontics. Journal of Prosthetic Dentistry 1962/6.

JOHNSTON, J. F., DYKEMA, R. W. and CUNNINGHAM, D. M. — Porcelain Veneer bonded to gold castings. A progress report. Journal of Prosthetic Dentistry, Jan. 1958, p. 120.

JUNG — Vorschläge zur Verbesserung der oberen gingivalgetragenen Teilprothese. DZZ 1953/13.

KAHN, E. K. — Considerations in the use of partial and full coverage in periodontal prosthesis. The Journal of Prosthetic Dentistry, 1965/1.

KASLOFF, Z. — Recent advances in casting techniques and their evaluation. I.D.J. 1963/2.

KAZIS, H. — Complete Mouth Rehabilitation through the restoration of lost vertical dimension. J.A.D.A. 1948/7.

KAZIS & KAZIS — Complete Mouth Rehabilitation . . . Lea & Febiger, Philadelphia 1956.

KILPATRICK, H. C. — Work simplification in dental practice. Journal of Prosthetic Dentistry 1962/3.

KIRCHNER — Die Schönheit der harmonischen oro-facialen Beziehungen. DZZ 1958/15.

KLUCZKA, J. — Überblick über die Parodontose-Schienen. ZWR 1958/23.

KÖHLER — Zahnärztliche Chirurgie. Dr. A. Hüthig Verlag Heidelberg 1956, vol. I & II.

KOIVUMAA, K. K. — Prosthetic treatment of incomplete dentition and removable dentures. I.D.J. 1963/2.

KOLLER — Freiendprothesen, die der Tragfähigkeit der Pfeiler und der Nachgiebigkeit des Weichgewebes durch Ringfedern angepaßt sind. ZWR 1959/5.

KÖRBER — DZZ 1957/16.

KORKHAUS, G. — Handbuch der Zahnheilkunde. Bergmann Ed. Munich 1939.

KRÜGER — Erfahrungen mit der Oral-Rehabilitation auf Grund eigener Studien in den USA. DZZ 1961/3.

KURTH, L. E. — Physiology of mandibular movement related to prosthodontia. New York Dent. J., **15,** 323, 1949.

LINDBLOM, G. — Oral Rehabilitation, Praktische Durchführung. DZZ 1961/3.
Technique for roentgenphotographic registration of the different condyle positions in the temporomandibular joint. Dental Cosmos, **78,** 1927, 1936.

LINKOW, L. J. — Copper plating of multiple modeling compound band impression. Journal of Prosthetic Dentistry 1962/4.

LÜBECK — Erfahrungen mit Gelenkprothesen. DZZ 1954/21.

MARTONE — Anatomy of Facial Expression and its Prosthodontic Significance. Journal of Prosthetic Dentistry 1962/6.

MATHE, G. — Inlay- und Kronenarbeiten. Urban & Schwarzenberg, Vienna 1948.

Mc CRACKEN, W. L. — Survey of Partial Denture Designs by Commercial Dental Laboratories. Journal of Prosthetic Dentistry 1962/6.

MEGIGHIAN, A. — L'importanza dei "rests" nell'ancoraggio delle protesi rimovibili. From "Atti 1. Congresso Società Ital. di Odontostomatologia e Chirurgia Maxillo-Facciale", Pavia, Sept. 1958.

MILLER, C. J. — Evaluation of modern impression materials for restorative dentistry. Alpha Omegon, **51,** 216, 1951.
Inlays, Crowns and Bridges. W. B. Saunders Comp., Philadelphia 1962.

MILLER, I. F. and FEINBERG, E. — Full coverage restorations. Journal of Prosthetic Dentistry 1962/2.

MOSTELLER, J. H. — Use of Prednisolone in the elimination of postoperative thermal sensitivity. Journal of Prosthetic Dentistry 1962/6.

MOYERS, R. E. — Some physiologic considerations of centric and other jaw relations. Journal of Prosthetic Dentistry 1956/6.

NALLY, J.-N. — La couronne à incrustation vestibulaire de porcelaine ou couronne Hollenback. Schweizerische Monatsschrift f. Zahnheilkd. 1962/16.

NEGRISOLI, A. — Considerazioni pratiche sui rapporti tra prestazioni protesiche e profilassi, e cura delle parodontopatie. Rassegna trimestrale di Odontoiatria, 1956.

NEY-COMPANY — Planned Partials. Hartford, Connecticut.

NISWONGER, M. E. — The Rest Position of the Mandible and Centric Relation. J.A.D.A. 1934/21.

ORBAN, B. — Periodontics. Mosby Company- St. Louis 1958.

ORLEAN, S. L. and MALLON, CH. F. — Vestibuloplasty and prostodontic transfers in the rehabilitation of edentulous patients. Journal of Prosthetic Dentistry 1963/2.

PAGE, H. — Critical appraisal of centric relation. Dental Digest. Aug. 1953.

PALAZZI, S., ZEROSI, C., BERTOLINI, A., BARATIERI, A. and DE RYSKY, S. — Indicazioni cliniche e realizzazioni pratiche degli ancoraggi nelle protesi parziali rimovibili. Ricerche biologiche sperimentali. Minerva Stomat., 1958.

PALET, G. — Rassegna critica sugli attacchi più in uso per protesi rimovibile con particolare riguardo alla costruzione e alle indicazioni del pressomatic. Riv. it. Stom., 1958/2.

PEYTON, F. A. and CRAIG, R. G. — Current evaluation of plastics in crown and bridge prosthesis. Journal of Prosthetic Dentistry 1964/4.

PHILLIPS, R. W. and CHAIRMAN, M. S. — Report of the committee on scientific investigation of the American Academy of Restorative Dentistry, Journal of Prosthetic Dentistry 1963/3.

PINCUS, CH. L. — The role of Jacket Crown and fixed Bridge Restorations in the prevention and treatment of Periodontal Disease. Southern California State Dental Association Journal. Febr. 1960.

PINI, C. E. — La sbarra palatina. Riv. It. Stomat., 1956/1.

PIZZITUTTI, R. M. — Alcune considerazioni sul gancio Equi-poise. Riv. Ital. Stomat. 1955/4. – Le zone d'ombra nelle protesi estetiche. Ann. di Stomat., **6**, 518, 1956. – La molatura selettiva in protesi e in paradontologia. Riv. It. di Stomat. ,1960/12.

POSSELT, U. — Studien der Beweglichkeit des menschlichen Unterkiefers. Acta odont. Scand. 1952/10. – Physiology of Occlusion and Rehabilitation. Blackwell Scientific Publications, Oxford 1962. – Occlusal relationship in deglutition and mastication Trans. of the European Orthodontic Society, 1958. – Hinge opening axis of the mandible. Acta Odont. Scand., **14**, 1, 49, 1956.

PRETOLANI, E. — Corona aurea fusa a peso ridotto. Mondo Odontostomat. Sept./Oct. 1962.

REICHBORN-KJENNERUD, J. — Die orale Rehabilitation. DZZ 1961/3. – Parodontalprophylaxe und Therapie durch Gebißeinschleifen. Zahnmedizin im Bild, **5**, 105, 1960.

REICHENBACH, E. — Bilanz der sogenannten klassischen Artikulationslehre. DZZ 1961/17.

REUMUTH, E. — Die Ästhetik des festsitzenden Zahnersatzes. Zahnmedizin im Bild, 1961/5. – Kritik und Bewährung von Brückenankern auf vitalen Pfeilern. Z. R. 1955/10.

RHEINWALD, U. — Zahnärztliche Chirurgie. J. A. Barth, Leipzig 1958.

RIESNER, S. E. — Temporomandibular reaction to occlusal anomalies. J.A.D.A. and D. Cosmos, **25**, 1938, 1938.

RINN, L. A. — Verblendkronen als Brückenanker fester und abnehmbarer Restaurationen. ZP 1962/8.

RITTER — Die Abkehr der Praxis von der klassischen Artikulationslehre. Zahn-, Mund- u. Kiefernheilkunde in Vorträgen, 14. Carl Hanser Ed. Munich 1953.

RITZE, H. — Frontzahnersatz, Kunststoff oder Porzellan, Deutsche Zahnärztliche Zeitschrift, 1969/8.

ROST, A. — Die infiltrative Behandlung der Pulpitis, ZWR 2:31 (1958). – Die Infiltrationsanästhesie bei der Behandlung der Pulpitis. Dtsch. Stoma **5**, 361–367 (1955). Die Lokalanästhesie als Adjuvans bei der Behandlung der Pulpitis. Zahnärztl. Rdsch. **64**, 445–449 (1955). – Vitalerhaltung entzündeter Pulpen durch Infiltrationsanästhesie. Zahnärztl. Praxis **7**, 1–2 (1956). – Pulpitisbehandlung durch Infiltrationsanästhesie. Dtsch. zahnärztl. Zschr. **12**, 1178–1183 (1957). – Histologische Untersuchungen nach Infiltrationsanästhesie bei entzündlich veränderten Pulpen. Dtsch. zahnärztl. Zschr. **13**, 137–145 (1958).

RUTISHAUSER — Ernährungsstörungen des Knochens. Schweizer Ärztl. Mtschr., **3**, 285, 1947. – Les lésions osseuses par surcharge. Bull. Acad. Suisse Sciences Méd., **6**, 333, 1950.

SAEGESSER — L'ostéonecrose traumatique. Thèse de Genève, 1945.

SAUSER, C. W. — Pretreatment evaluation of partially edentulous patients, Journal of Prosthetic Dentistry 1961/5.

SCHMIDT, A. H. — Prescription survey design. Journal of Prosthetic Dentistry 1962/2.

SCHÖN — Immediatprothese und Alveolarkammplastik. Z. W. 1948/13. – Über die kosmetische und hygienische Gestaltung der Brückenzwischenglieder. DZZ 1949/13. – Die Immediatprothese. DZZ 1955/21. – Neuere balneologische Behandlungsmöglichkeiten bei Parodontopathien, Zschr. f. prophylakt. Medizin 1956/2. – Kosmetik und moderne Zahnheilkunde. J. f. Med. Kosmetik 1956/8. – Ästhetik des modernen Zahnersatzes. Kosmet. Fachz. 1956/49. – Die Immediatprothese. Umschau 1957/3. – Der Immediatersatz. DDZ 1958/17. – Röntgenübersichtsaufnahmen der Kiefer. DDZ 1958/17. – Die klammerlose Verankerung skelettierter Oberkieferprothesen bei geringem Restgebiß. Zahnmed. i. Bild 1960/4. – Die temporäre und die definitive Bißhebung. DZZ 1961/3. – Rehabilitation nach einer schweren Zertrümmerungsdefektfraktur. Z. W./R. 1961/9. – Die temporäre und die definitive Schienung von Zähnen (Fixation, Blockierung, Splintage). DDZ 1961/9. – Die Ästhetik des abnehmbaren Zahnersatzes. Zahnmed. i. Bild 1961/4. – Die Korrektur des alternden Gesichts. Fortschr. d. Kiefer- u. Ges.-Chir. 1961. – Moderne Prinzipien des Freiendersatzes. DZZ 1962/6. – Grundsätzliches über die Bißhebung. Österr. Tonbandztg. 1962. – Über die Bißhebung. Z. P. 1962/23. – Die Auswahl künstlicher Zähne. Z. W./R. 1962/13. – Ästhetische Zahnheilkunde, Quintessenz 1962/1963. Die ästhetische Verbesserung des alternden Gesichts durch zahnärztliche Maßnahmen. Münchn. Med. Wschr. 1963/25. – Was sollte der Arzt vom heutigen Stand der modernen Zahnheilkunde wissen? Med. Klinik 1963/12. Die Interlock-Klammer. Z. P. 1964/4.

SCHROEDER, A. — Kunststoff in der Kronen- und Brückenprothetik . . . DZZ 1958/16. – Moderne Prinzipien der klassischen Wurzelbehandlung. Schweizerische Monatsschrift f. Zahnheilkunde, 1962/11.

SCHUYLER — Faktoren der Okklusion, die in der täglichen Praxis zu beachten sind. Quintessenz 1958/11.

SCHWARTZ, L. — Temporomandibular Joint Disorders. W. B. Saunders Co., Philadelphia, 1960.

SHANAHAN, T. — Individual occlusal curvature and occlusion. Journal of Prosthetic Dentistry, 230–240, 1958.
Mandibular and Articulator movements. Journal of Prosthetic Dentistry, 941, 1959.

SHANAHAN, T. and LEFF, A. — Interocclusal records, Journal of Prosthetic Dentistry, 10:842–848, 1960.

SHORE, N. A. — Occlusal Equilibration and T. M. J. Dysfunction. Lippincott Co., Philadelphia, 1959.

SILIMBANI, C. — Protesi fisiologica. Mondo Odontostomatologico, 1961/6.

SILVESTRINI BIAVATI, M. — Considerazioni critiche sugli ancoraggi delle protesi di fissazione permanenti nei paradenziopatici. Clinica Odontoprotesica, 1955/2.

SINGER, F.

Functional impressions and accurate interocclusal records for removable partial dentures. The Journal of Prosthetic Dentistry, 1962/3. – Solution du problème de la précision de l'occlusion centrique combinée avec une nouvelle méthode d'empreinte fonctionnelle en prothèse partielle amovible. Revue française d'Odontostomatologie, 1961/3. – Die vollkommene Orale Rehabilitation und das Präzisionsgeschiebe. DZZ, 1961/3. – Full Mouth Rehabilitation. Mondo Odontostomatologico, 1960/3. – Der biodynamische Kompressionsabdruck und exakte Bißnahme bei partiellem Zahnersatz. Z. P. 1961/2. – Die ästhetische Frontzahnbrücke. Zahnmedizin im Bild, Heft 1, 1960. – Das Präzisionsgeschiebe im Rahmen der vollkommenen Oral-Rehabilitation. DDZ, 1960/17. – L'esthétique du bridge antérieur fixe. Revue française d'Odontostomatologie. 1960/7. – Klammern, Gelenke, Geschiebe. Handlexikon der zahnärztlichen Praxis. Medica Verlag Stuttgart-Zürich, 1960. – Die Fingerhutmantelkrone. Zahnmedizin im Bild, 1960/1. – Ästhetik beim Frontzahnersatz. Z. R. 1959/21. – Porzellan in der Front, seine Verarbeitung und Vorteile. Österr. Ztschr. f. Stomatologie, 1961/1. – Die medikamentöse Hemmung der Speichelsekretion. ZWR, May 1955. – L'ancoraggio delle protesi mobili eseguite secondo il sistema Ney. Clinica Odontoprotesica, voll. III, Nr. 4, 1956. – Terapia medicamentosa dei processi infiammatori del parodonto marginale e delle mucositi buccali. Mondo Odontostomatologico, 1963/2. – Ist die Verwendung von Artikulatoren heute noch vertretbar? Z. P., 1962/13. – Artikulator oder Okkludator? Zahn-, Mund- u. Kieferheilkunde, 1962/5–10. – Réactions tissulaires sous les selles de prothèses partielles amovibles. Revue française d'Odontostomatologie, 1963/3. – Verbesserte Ästhetik festsitzenden Frontzahnersatzes durch neue Verfahren. Z. R., 1960/9. – Die amerikanische Standardmethode der Verblendkrone und ihre klinisch-ästhetische Bedeutung. Zahnmedizin im Bild, 1961/3. – Der Versorgung von beschliffenen vitalen Pfeilerzähnen. Z. P., April 1963. – Aesthetics in Anterior Bridgework. Newsletter No. 4 of Anglo-Continental Dental Society, December 1962. – Die einfache orthodontische Korrektur bei Erwachsenen. Schweizerische Monatsschrift f. Zahnheilkunde, 1962/12. – Lösung des Problems der Präzision der zentralen Okklusion bei abnehmbarem Teilersatz mittels einer neuen Abdruckmethode. Quintessenz, 1962/1. – Der exakte Interkuspidationsbiß bei partiellen Prothesen. DZZ, 1961/23. – Prinzipielle Gesichtspunkte bei Planung und Konstruktion von abnehmbarem Teilersatz. ZWR 1962/13. – Le rehaussement prothétique de l'occlusion basse. Revue française d'Odontostomatologie, 1962/3. – Le ricostruzione del combaciamento. Atrophie des Kieferknochens unter Prothesensätteln. Österr. Zeitschr. f. Stomatologie, H. 11/12, Nov. 1961. – Die präprothetische Behandlung des parodontosegefährdeten Gebisses. Österr. Ztschr. f. Stomatologie, 1956/4. – Le indicazioni del ponte fisso. Revista Italiana di Stomatologia. 1958/9. – Starr - federnd - gelenkig. Z. P., March 1955. – Das Ney-Klammernsystem. DZZ 1956/4. – Die Retention der Kunststoff-Facette bei Verblendkronen. Quintessenz 1956/1. – Eine neue Art von Verblendkrone. DZZ 1957/3. Indications of fixed bridges. International Dent. Journal 1958/2, p. 352. – Die verbesserte Retention bei Teleskop-Kronen. Österr. Ztschr. f. Stomatologie, 1958/7, p. 377. – Die amerikanische Standardmethode der Verblendkrone und ihre klinisch-ästhetische Bedeutung. Zahnmedizin im Bild, 1961, No. 4. – Aesthetics in anterior bridge work. Newsletter of the Anglo-Continental Dental Society, No. 4, Dec. 1962. – Occlusion, functions and parafunctions. Internat. Dent. Journal, vol. 16, No. 3, Sept. 1966. – The Veneer Jacket Crown. Quintessence International, 1969/1.

Il carico masticatorio e la terapia protesica. Clinica Odontoprotesica, 1958/1. – La corona ad'anello. Odontes, 1959/1. – Eiie neue vorteilhafte Modifikation des Lingualbügels in Verbindung mit dem Pressomatic als Retentionselement bei unteren doppelseitigen Freiendprothesen. ZWR 1959/8. – La sbarra linguale modificata. Minerva Stomat., 1959/2. – Accorgimenti pratici per la costruzione della travata di ponte in resina acrilica e leghe auree. Clinica Odontoprotesica, 1959/3. – Contributo allo studio dell'insorgenza e della prevenzione delle discromie della resina acrilica per ponti e corone, Odontes, 1959/'2.

SPRENG,, M. — Die Prothese und die lebenden Gewebe. Apollonia Verlag, Basel, 1954.

STAFFANOU, R. S. — Reverse Pin-Porcelain Vener and Pontic Technique. Journal of Prosthetic Dentistry, 1962/6.

STANSBERRY, C. J. — Balanced occlusion in relation to lost vertical dimension. J.A.D.A., **25,** 228, 1938.

STEINHARDT, G. — Vermeidung von Kiefergelenkstörungen durch Eingliederung von Sofortprothesen. DZZ 1957/21. – Über den Kaudruck und dessen Bedeutung . . . Z. W. 1951/13.
Kiefergelenkerkrankungen. Zahn-, Mund- u. Kieferheilkunde, 3, 517, Munich-Berlin 1958.

STRINI, F. — La protesi fissa. Rivista Italiana di Stomatologia, 1954/10.

STRACK — Die Problematik der Versorgung des Lückengebisses. DZZ 1953/13.

SWENSON, M. G. and TERKLA, L. G. — Partial dentures. St. Louis. C. V. Mosby Co., 1955, p. 239.

TANZER — Zahnärztliche Klinik und Technik der Vollprothese. Rich. Pflaum Ed. Munich 1951. – Physiognomische Prothetik. ZWR 1957/18.

TEMPEL, F. J. — Treatment of incomplete dentition with removable prosthesis. I.D.J. 1963/2.

THIELEMANN — Funktionelle Zusammenhänge von Zahnreihenformen, Kiefergelenken und Kieferbewegungen. Paradentium 1939/11. – Behebung der Bißsenkung im Lückengebiß. DZZ 1953/13.

THOMPSON, J. R. — The rest position of the mandible and its significance to dental science. J.A.D.A., **33,** 151, 1946.

TYLMAN, S. D. — Crown and Bridge Prosthetics. Mosby Comp., 1956, St. Louis. – Theory and Practice of Crown and Bridge Prosthesis. Mosby Company, St. Louis, 1947.
Relationship of the structural designs of dental bridges to their supporting tissues. I.D.J. 1963/2.

TYLMAN, S. D. and PEYTON, F. A. — Acrylics and other dental resins. Philadelphia, 1946.

TRAPOZZANO, V. R. — Periodontal aspects of partial denture design. Journal of Prosthetic Dentistry, **2,** 101, 1952.

UEHLINGER, E. — Der chronisch-traumatische Skelettschaden. Verlag Dtsch. Ges. Path., 1959/27.

VAN THIEL, H. — Doppelendige Freiendprothese für den Unterkiefer. DZZ 1953/13. – Aufgabe und Leistungsmöglichkeit der partiellen Prothese. DZZ 1958/19.

WALKER, R. C. — A comparison of jaw relation recording methods. Journal of Prosthetic Dentistry 1962/4.

WANNENMACHER, E. P. — Beitrag zur Therapie des Lückengebisses mit starren Prothesen. Schweizerische Mtschr. f. Zahnheilkunde, 1959/11.

WHEELER, R. C. — Textbook of Dental Anatomy and Physiology. Philadelphia, W. B. Saunders Co., 1944, p. 396.

WUPPER, H. — Kasuistischer Beitrag zur statistischen und prothetischen Behandlung des Lückengebisses. ZWR 1959/5. – Eine neue Form der Verblendkrone, insbesondere als Schienungselement für Frontzähne im Unterkiefer. ZWR 1957/11. – Die Schienung als vorbereitende Maßnahme bei der Planung partieller Prothesen. ZWR 1957/2.

ZEROSI, C. — Statica e dinamica delle protesi amovibili monolaterali. Rass. Trim. Odont., 1948/4.

ZICHNER, H. E.

Chirurgische Parodontaltherapie im Rahmen der Gesamtwiederherstellung des Kauorgans. ZP 1963/7.

ZUCCOLI, G.

Ponti amovibili con attacchi. Riv. It. Stomat., 1948/8. – La terapia protesica col sistema del ponte rimovibile con attacchi. Riv. Ital. Stomat. 1949/7. – Facciamo il punto sulla protesi rimovibile. Riv. Ital. Stomat. 1951. – Considerazioni sull'impiego delle masse idrocolloidali pe le importe. Riv. Ital. Stomat., 1951. – L'asse a cerniera di McCollum. Il rilievo gnatoscopico e le pratiche applicazioni in stomatologia . . . Riv. Ital. Stomat., 1952/8. – Restaurazione protesica con attacchi in soggetto paradenziopatico. – Riv. Odontoprot. 1953/1. – Gli attuali orientamenti nella cosidetta „protesi fissa". Riv. Ital. Stomat. 1953/9. – Prothèse partielle amortie ou prothèse partielle rigide? Revue française d'Odontostomat. 1961/3.

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