1st Meeting of

International Oral Health Engineering Consortium

Perspective and Future of Oral Engineering

- *Korea University*
- *Taipei Medical University*
- *Central Taiwan University of Science and Technology*
- *Hiroshima University*
- *Osaka Dental University*
- *Tokyo Medical and Dental University*

September 24 (Mon.), 2018 **Tokyo, JAPAN**

VENUE Tokyo Medical and Dental University

URL: http://www.tmd.ac.jp/bmoe/1stconsortium/consortium.html

The 1st Meeting of International Oral Health Engineering Consortium Organizing Committee

Organizer:

Course for Oral Health Engineering, Faculty of Dentistry, School of Oral Health Care Sciences, Tokyo Medical and Dental University

President: Tetsuya SUZUKI (Oral Prosthetic Engineering)

Chair: Hidekazu TAKAHASHI (Oral Biomaterials Development Engineering)

Members: Kazuhiro AOKI (Basic Oral Health Engineering)

Meiko OKI (Basic Oral Health Engineering)

Shingo KAMIJO (Basic Oral Health Engineering)

Tohru YASUE (Oral Biomaterials Development Engineering)

Naohiko IWASAKI (Oral Biomaterials Development Engineering)

Masaomi IKEDA (Oral Prosthetic Engineering)

Maho SHIOZAWA (Oral Prosthetic Engineering)

Advisors: Hiroki NIKAWA (Hiroshima University)

Chung-Kwei LIN (Taipei Medical University)

Welcome to the 1st International Oral Health Engineering Consortium

We are delighted to have you here to participate and share in the 1st International Oral Health Engineering Consortium hosted by Tokyo Medical and Dental University. Thank you for coming. That many of you travel long distances serves to remind us all just how important our work is.

Japan is now a unique super aging society in the world, and the dental laboratory technology taking a part in dentistry is facing the big change. The rapid progress of digital dentistry changes technique and materials for dental prostheses fabrication; on the other hand, lack of dental technician becomes an urgent issue because young dental technicians quit their job. Therefore, there is the opinion that the conventional education for dental technician cannot catch up the speed of the times. Based on these backgrounds, “the oral health engineering” of four-year system, which focused on the education for not only the dental laboratory techniques but also oral health sciences, was established at Hiroshima University, Tokyo Medical and Dental University, and Osaka Dental University in Japan. A national qualification examination of dental technician is carried out in Korea and Taiwan as well as Japan; there are also the four-year educational institutions established. Accordingly, the International Oral Health Engineering Consortium is proposed for people engaging in four-year university education to convene in one place for discussing dental technicians as next-generation leaders, and education and research for bringing up oral health engineering persons.

It is our great honor to hold the first memorable meeting of International Oral Health Engineering Education, Research Consortium in Tokyo Medical and Dental University. The themes of this year are “Undergraduate and master course education” and “Introduction of cutting-edge research from each institute”. Taipei Medical University and Central Taiwan University of Science and Technology from Taiwan, Korea University from Korea, and Japanese 3 universities, the total of 6 universities will join this consortium. The meeting place is School of Dentistry Special Auditorium of Tokyo Medical and Dental University. In the morning session, professors of each university will perform panel discussions about the present conditions of the undergraduate education and the future prospects. In the afternoon session, undergraduate and graduate students will introduce their cutting-edge research from each university. An excellent presentation will be awarded the prize.

We hope that all participants will enjoy the program, exchange their idea each other, and make this consortium fruitful one.

Tetsuya SUZUKI, D.D.S., PhD

Director of Course for Oral Health Engineering, Tokyo Medical and Dental University

Time table of the consortium

Monday, September 24

9:00- **Registration open**

10:00- **Opening remark** Prof. Junji TAGAMI

(Executive Director of Tokyo Medical and Dental University)

10:10- **Panel Discussion for Oral Engineering Education**

- Focus and prospects of undergraduate study -

Chair: Prof. Hidekazu TAKAHASHI (Tokyo Medical and Dental University)

Hiroki NIKAWA (Hiroshima University)

Yung-Kang SHEN (Taipei Medical University)

Kazutoshi KAKIMOTO (Osaka Dental University)

Hsueh-Chuan HSU (Central Taiwan University of Science and Technology)

Tetsuya SUZUKI (Tokyo Medical and Dental University)

Woong-Chul KIM (Korea University)

12:00-13:30 **Business Working Lunch** *(All faculty members are invited)*

(Medical Hospital 16F, Restaurant Medico)

Lunch for students and other participants *(Fee included)*

(Restaurant Building 1F, Arumeida)

14:00- **Oral Presentation Competition 1**

Chair: Prof. Hiroki NIKAWA (Hiroshima University)

OP1: Color change of color modified CAD/CAM composite resin blocks after toothbrush wear

Yusuke YAMAMOTO *et al*. (Tokyo Medical and Dental University),

OP2: Emerging application of characteristics and mechanism of stimuli-responsive shape memory composite on 4D printing

Jing-Shiuan LAI *et al*. (Taipei Medical University)

OP3: Fatigue resistance of yttria-stabilized tetragonal zirconia polycrystal clasps for removable partial dentures

Tzu-Yu PENG (Hiroshima University)

15:00- **Oral Presentation Competition 2**

Chair: Prof. Yung-Kang SHEN (Taipei Medical University)

OP4: Injectable and partially biodegradable polymethylmetacrylate-based bone filler for craniomaxillofacial bone defect

Ling YEH *et al.* (Taipei Medical University)

OP5: Investigation of scaffold materials suitable for new bone anabolic agents

Ayaka URAKAWA *et al*. (Tokyo Medical and Dental University)

OP6: *In vitro* effects of epigallocatechin-3-gallate with mesoporous bioactive glasses in the treatment of periodontal pocket

Yi-Ting WANG *et al*. (Taipei Medical University)

16:00- **<u>Oral Presentation Competition 3</u>**

Chair: Kazuhiro AOKI (Tokyo Medical and Dental University)

OP7: Learning at ODU so far and in future

Anna SHIMA (Osaka Dental University)

OP8: Application of dispatching rules for dental technical work and its evaluation by discrete-event simulation

Hiroki YANASE *et al.* (Hiroshima University)

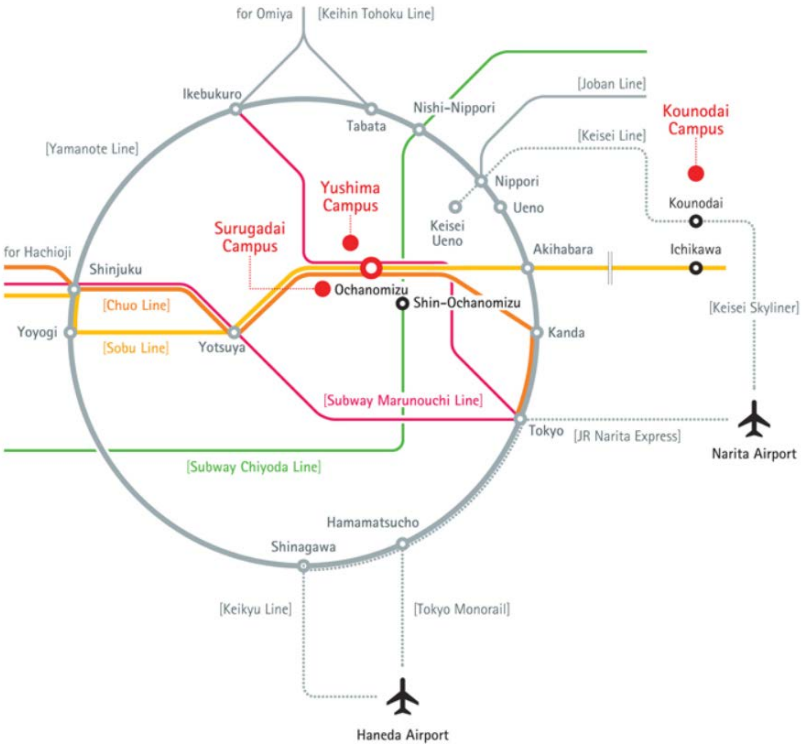
OP9: Analysis of three-dimensional shape of mandibular complete dentures

Van Anh NGUYEN VU *et al*. (Tokyo Medical and Dental University)

17:00-17:30 **Award committee meeting**

18:00- **Banquet** - *Presentation Awards and Acknowledgements* -

(M&D Tower 26F, Faculty Lounge)



Information for participants

Registration Time

Monday, September 24, 9:00-15:00

Request of the Name Card Wearing

A name card will be handed at a registration desk. Please wear your name card during the meeting.

Attention at the Time of the Consortium Participation

Please change your cell-phone to silent mode during presentation.

Photography, picture and sound recording during presentation are not accepted.

Panel Discussion

This panel discussion should be with one PC projector. Each panelist should present for 15 minutes. At the end of the panel, we will discuss.

Oral Presentation Competition

This oral presentation should be with one PC projector.

Please bring your own PC for your presentation.

The presentation and discussion time for each presentation are 12 and 3 minutes, respectively.

Registration Fee (Included banquet for student and faculty)

Student 2,000 yen, Faculty 10,000 yen

Accompanying person (only for banquet: 4,000 yen)

Introduction of Course for Oral Engineering, Hiroshima University

Hiroki NIKAWA, DDS, PhD
Department of Oral Biology & Engineering
Graduate School of Biomedical and Health Sciences, Hiroshima University

Faculty of Dentistry, Hiroshima University has two schools, one is School of Dentistry, and the other one is School of Oral Health Sciences. The latter has been established in 2005, and comprises Course for Oral Health Science, and Course for Oral Engineering, based upon either the dental hygienist school or dental technician school. The course for Oral Engineering is the first school in Japan, which provide 4-years educational curriculum for dental technicians. The quota of our course is 20 students per year.

For the 1st year students, we provide the general subjects, such as mathematics, physics, organic or inorganic chemistry, statistics and so on. From 3rd to 5th semester, we provide the special subject comprised of biology-, technology- and advanced skill-based subjects in addition to the conventional dental technology.

One of the most characteristic practices of biology is Practice of Tissue Culture, which is supported by the Japan Tissue Culture Association, to learn the biological ethics together with standard techniques for tissue culture. In future, when the regenerative dentistry will be realized, who will culture and regenerate the oral tissues including teeth! Is it the job of dentists? No! I hope our graduates will take the job in the regenerative dentistry. As to the technology-based practice, students learn the principle of CAD/CAM system, including C-language and 3-D printers. Students also learn the advanced skill-based subjects, including Anaplastology, fabrication of epitheses, rehabilitation make-up, and dental implant.

From 6th semester, students start the clinical on-site practices in the University Hospital. We hope that

the students learn the importance of Patient-oriented dentistry, and communication skills among patients and hospital staffs through on-site clinical practice. Concurrently, they do the graduation research, and some of them do the job hunting. In contrast, more than half of students wish to go to post-graduate courses comprising master course and PhD course. We would like to have master and/or PhD students from Asian countries!

Hiroki NIKAWA, DDS, PhD

2005- Professor, Department of Oral Biology & Engineering, Hiroshima University.

2005-2007 Director of Oral Engineering Course

2008-2012 Director of School of Oral Health Sciences

2012-2016 Vice Dean of Faculty of Dentistry

2016-2018 Vice Dean of Graduate School of Biomedical and Health Sciences

Oral engineering education for School of Dental Technology at Taipei Medical University

Yung-Kang SHEN, PhD

School of Dental Technology, College of Oral Medicine,

Taipei Medical University

The College of Oral Medicine (COM) was established when Taipei Medical College (TMC) became the Taipei Medical University (TMU) in 2000. The College provides a framework for a complete oral medical education system, which includes three schools (School of Dentistry, School of Dental Technology, School of Oral Hygiene) and Master's and PhD programs. The dental clinic, which began its operation in 1976 when the TMU Hospital was established, provides students with internship opportunities. In recent years, dentistry has grown and flourished rapidly. With its collaboration with the TMU Hospital, Wan Fang Hospital and Shuang Ho Hospital, TMU has become the largest clinical teaching center in the greater Taipei area.

The College of Oral Medicine aims to cultivate dental professionals that are competent in all medical, artistic, and academic aspects. School of Dental Technology is to advance laboratory work of the dental industry by transforming the role of dental technicians into dental designers/engineers.

Three major initiatives are taken to fulfill this vision:

1. Renovation of the traditional dental laboratory technology.

2. Recognition of the contemporary dental materials and instrumentation.

3. Innovation of the digital dentistry.

In the times of industrial 4.0 and health 4.0, the people want to enhance the ability of science and technology, for the current focus of the parties expect. The education of School of Dental Technology also emphasizes the scan technology, computer-aided design (CAD), computer-aided manufacture (CAM), three-dimensional (3D) printing and four-dimensional (4D) printing in the digital dentistry.

The School’s educational goal is to train dental technicians and oral medicine engineers by utilizing the cutting edge technologies and abundant resources of the College of Oral Medicine. The School aims to develop students’ practical skills and research capabilities. We expect the students to apply their academic knowledge to the usage of new materials and the latest technology. More importantly, we expect them to contribute to the developments of such innovations as dental engineers in the future. In this way, Nation's dental technology is sustainable and maintains a global leadership.

History:

1. School of Dental Technology was established in August, 2007.

2. The Master of Science (MS) program was established in August, 2017.

Yung-Kang SHEN, PhD

2014- Professor, School of Dental Technology,
Taipei Medical University

2018- Chairman, School of Dental Technology,
Taipei Medical University

Educational policies on oral health engineering in ODU

Kazutoshi KAKIMOTO, D.D.S., PhD

Department of Oral Health Engineering, Faculty of Health Sciences,

Osaka Dental University

Osaka Dental University (ODU) is the third dentist training school in Japan established more than 100 years ago in 1911. ODU has been training dental technicians since 1964 and dental hygienist since 1968. And, in April 2017, ODU established Faculty of Oral Health Sciences which consists of Department of Oral Health Sciences to train dental hygienists and Department of Oral Health Engineering to train dental technicians. In addition, in April 2018, ODU opened Master's Course of Oral Sciences, Graduate School of Health Sciences for dental hygienists and dental technicians.

At specialized training colleges, ODU has trained professionals who are proficient in knowledge and skills necessary for dental hygienists and dental technicians. However, in dental care in super-aged society, ability to solve oral health problems in cooperation with medical and welfare multi-occupation considering not only the state of the mouth but also the whole body condition and individual social environment, and professional skills for prevention and oral rehabilitation were required. In other words, they are abilities such as understanding, problem solving skills, communication skills, teamwork, ethics. Furthermore, we believe that our ability to adapt to change in the future society and develop dental care is necessary. In order to obtain these capabilities, we think that simply adding digital technology to traditional dental technicians and experiencing visiting dental practice is not enough to extend the term of schooling. We believe that these abilities require the ability as a bachelor's degree after completing a

four-year university. In other words, it is ability of comprehension, problem solving ability, communication skill, team work, ethics, and so on. For that purpose, we incorporate problem-solving learning, learning about communication with patients and medical and welfare-related occupations in the curriculum. In addition, we have established a career center and student support room to enhance student support.

ODU's spirit of architecture is "philanthropy" and "public interest". In Faculty of Health Sciences, we will train medical personnel who can contribute to society by solving the problem of patients with the spirit of "philosophy", proposing the knowledge gained by themselves and the skills developed by the spirit of "public interest" to the world.

Although it is a department that has just opened it, we would like to train dental technicians who can contribute to dental care in the future. And in cooperation with the related persons, we would like to expand the future of dental technicians and contribute to the well-being of people from oral health.

Kazutoshi KAKIMOTO, DDS, PhD

2017- Chairperson of department, Professor, Department of Oral Health Engineering, Faculty of Health Sciences,

Osaka Dental University

2018- Professor, Graduate School of Health Sciences,

Osaka Dental University

Dental technology education in CTUST: present status and future directions

Hsueh-Chuan HSU, PhD

Professor, Department of Dental Technology and Materials Science,

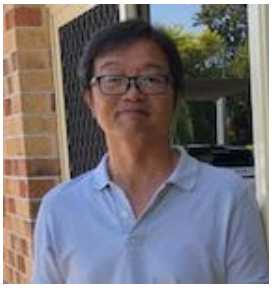
Central Taiwan University of Science and Technology

Early dental education policy in Taiwan only focused in training dentists, but not to train their assistants, resulting in many sequelae. In contrast, in view of the increasingly specialized dental science that the traditional way of dental care must be changed, some advanced countries, such as the United States, Japan and other European countries separated the profession of dental restoration from the dental science to make it independent to meet the social needs. However, because of the lack of formal trained dental technicians to assist the dentists, dental restorations were mostly conducted by apprentices based on their personal experiences. At that time, most of the apprentices didn't received appropriate professional trainings to manufacture oral prostheses, resulting in many medical disputes. In view of this, the university set up the Department of Dental Technology in 1981 to raise the level of oral prosthetic skill of dental technicians to promote dental health of the citizens. The students had received education of dental technology for 5 years. The university was promoted and renamed to Chungtai Institute of Health and Technology in 1998.The following year, the department was approved to recruit students for 2-year and 4-year BS programs.

With the rapid advance of materials science and technology, the dental technology has been greatly promoted. Since the progress of dental technology and the development of material science are closely related, in 2009 the Department was again renamed to Department of Dental Technology and Materials Science. Among the technical universities in Taiwan, our Department is currently the only one focusing

on expertise in dental technology and R&D in material science. In addition to holding well-recognized reputation, our university has also received acclaim in the Asia-Pacific region (especially in Southeast Asia) for its contribution in healthcare professional nurturing and achievement in company-university cooperation. In addition, in order to be in line with the government's policy towards the south and to benefit the overseas Chinese, the Overseas Chinese Youth Dental Technology Training Program was established in 2013, to recruit Malaysian overseas Chinese students to provide them the opportunity to receive the education of dental technology. The department was also approved to establish the MS program at the same year and started recruiting graduate students.

- The Department of Dental Technology was established in August, 1981 and started recruiting I class of students. It is the first class in Taiwan.
- In December, 1998, the Department was reorganized and started recruiting students of 2-year and 4-year BS programs.
- In 2008, the Department was renamed to Department of Dental Technology and Materials Science.
- The Master of Science (MS) program was established in 2013 and started recruiting students in 2014.
- In 2013, the Department was approved by Overseas Community Affairs Council, Taiwan, to establish the “Training Class of Dental Technology for Youth Overseas Chinese” to recruit Malaysian overseas Chinese.



Hsueh-Chuan HSU, PhD

Professor, Department of Dental Technology and Materials Science,
Central Taiwan University of Science and Technology

Present status and future perspective of education in TMDU

Tetsuya SUZUKI, D.D.S., PhD

Course for Oral Health Engineering, Tokyo Medical and Dental University

TMDU Oral Health Engineering Course was established in 2011, as the second Japanese university to offer a four-year program for future dental technicians. The mission of this course is to cultivate dental professionals capable of combining advanced engineering, science and technology to improve oral health and aesthetics. After the graduation, various career paths are open to our students. Up to now, 54 students have already graduated. Forty percent of them are working as dental technicians. Meanwhile, 40 percent of them found jobs in companies related to medical and dental care. Some of them are working in the companies as researchers. Twenty percent of them have entered our graduate school or transferred to other dental schools.

From these facts, we improve a new curriculum from 2019 based on the following three keywords for undergraduate education; 1) Latest digital dental technology, 2) Multidisciplinary collaboration, 3) Globalization. We set several lectures and practices about digital dentistry for each grade student. We installed the latest CAD/CAM systems, such as 3D scanners, 3D printers and milling machines. Each student has access to each CAD computer to learn. They have the opportunity to learn presentation skills in English and to participate in an overseas exchange program held in Taiwan. This exchange program between Taipei Medical University and us has been implemented every year since 2012. We are also doing many lectures about multidisciplinary collaboration. However, I think that a great barrier exists for dental technicians to multidisciplinary collaboration after graduation. Dental technicians are not allowed face to face practice with patients in Japan. The rapidly growing aged society is problem in

Japan, which means a shortage of human resources to support medical and dental care for the elderly. Therefore, we consider the opportunity to establish a new qualification system for dental care for the elderly, especially to manage denture care and digital dental data. For example, archives of dental treatment history and record of digital image information of patients are useful for planning the patient future dental treatment. I want to name this qualification system as a clinical denture management engineer. For establishment of this qualification system, lectures and practice of new subjects might be required. We appreciate very much if you provide us your opinion for this idea.

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Tetsuya SUZUKI, DDS, PhD

2011- Director and Professor, Course for Oral Health Engineering,
Tokyo Medical and Dental University

2015- Professor, Department of Oral Prosthetic Engineering,
Graduate School of Medical and Dental Sciences,
Tokyo Medical and Dental University

Present status of dental technology education in Korea and desirable education

Woong-Chul KIM D.P.H., PhD

Major in Dental Lab Science & Engineering, Graduate School, Korea University

Dental technology education in Korea began in 1971. There are 19 educational institutions, all private. Fifteen of them are 3-year-course and 4 are 4-year-based. Dental technology department of Korea University was established in 1971 as the first two-year-course college in Korea and turned into a four-year program in 2006. However, the school is currently being closed. Instead, Korea University Graduate School currently has a master's and doctoral course in Dental Lab Science & Engineering major. Thus, Korea's dental technology school education is mainly three-year-based, with some recently promoted four-year-course colleges and graduate courses. Therefore, it has the most diverse education system in the world

The vision and goals of the dental technology department are changing at four-year universities in Korea. In addition to traditional analog dental technology, it is set to adapt to changes in the fourth industrial revolution and digital age. Therefore, we are seeking to cultivate global talents with diversity, integrated thinking, and creativity by combining cutting-edge knowledge with traditional hand techniques. As a result, new subjects are added in addition to the traditional technique related subjects.

The new subjects are as follows. First, digital technology related subjects such as CAD/CAM, Auto CAD, 3D modeling. Second, the integration of other fields with biomedical engineering, medical instrumentation, metal, polymer and ceramic materials, materials engineering, laboratory instrumental analysis. Third, subjects related to dental industry management include global practice, internship,

foreign language, management, dental technology capstone design.

In order to keep pace with change of time, the dental technology education should expand its branch to the entire dental industry through education that is integrated with other fields and advanced digital technology. In order to do so, the three-year program should focus on developing and enhancing existing dental technology. The four-year program should strive to develop talented people with potential for R & D along with the expansion of the area. Furthermore, the graduate school should nurture advanced brain capable of deep research and development related to the dental industry as a whole. This will greatly help the dental field, and ultimately provide dental patients with a high level of dental care.

Thus, dental technology education is at a new turning point. Nowadays, not only apprentice education but also advanced digital and integrated education are required. Since it is a rapidly changing technology, it will have many difficulties and limitations. Nevertheless, four-year-course dental technology school educators should be at the center of discussion and overcome these problems. It is time for us to have a serious discussion in order to prepare appropriate measures.

Woong-Chul Kim, DPH, PhD

Professor, Korea University

Chairman of Dental CAD/CAM Evaluation Study Group

Former Dean, College of Health Sciences, Korea University

Oral presentation 1

Color change of color modified CAD/CAM composite resin blocks after toothbrush wear

Yusuke YAMAMOTO, Naohiko IWASAKI, Toru YASUE, Hidekazu TAKAHASHI

Department of Oral Biomaterials Development Engineering,

Graduate School of Medical and Dental Sciences,

Tokyo Medical and Dental University

When a CAD/CAM composite resin crown is applied for anterior tooth, color modification using paint-on resins is essential to improve its esthetic appearance; however, the toothbrush wear resistance of paint-on resins has not been clearly elucidated.

Six products of CAD/CAM composite resin blocks (AVE, AVP, C27, C30, KZ2, KZ3) and their corresponding paint-on resins were selected in this study. Rectangular shaped specimens with a width of 10 mm, a thickness of 2 mm and a length of 14mm were prepared and paint-on resins were applied on the surface of specimens. A toothbrush wear test was performed with tooth paste until 50,000 brush strokes. The paint-on resins were not clearly peeled off from specimens until 50,000 brush strokes. CIEL*a*b was measured before and after every 1,000 brush strokes using a colorimeter and color differences (ΔE) were calculated. Two-way ANOVA of ΔE revealed that product and number of brush strokes and their interaction were significant. Number of brush strokes did not influence ΔE of all product except for KZ2 and KZ3 which significantly decreased at the initial 10,000 cycles. ΔE of all products after 50,000 brush strokes were suggested that examined paint-on resins were sufficient tooth brush wear resistance.

Oral presentation 2

Emerging application of characteristics and mechanism of stimuli-responsive shape memory composite on 4D printing

Jing-Shiuan LAI, Yung-Kang SHEN

School of Dental Technology, College of Oral Medicine,

Taipei Medical University

In the times of industrial 4.0 and health 4.0, the people want to enhance the ability of science and technology, for the current focus of the parties expect. 3D printing technology has been introduced for more than 40 years, initially known as rapid prototyping or additive manufacturing, which can quickly and accurately produce the finished product. However, in the intelligent, green energy, biomedicine today, the traditional 3D printing technology has been unable to meet our demands, so the 4D printing has appeared. In 2013, Tibbits first proposed a new combination of material with a 3D printer, creating a linear object, the object into the water, can change the shape, and finally he defined the 3D print with time, that is 4D printing. The 4D printing is defined to print out the changes over time with the object. Shape memory materials, such as shape memory polymers, shape memory metals, shape memory ceramics and shape memory composites; have been developed for 30 years under different stimuli effect (water, light, heat, electricity, magnetism, pH, etc.) that the shape memory materials can change their shape. So to shape memory materials with 4D print, people can create a 4D print on the next spring. In this paper, shape memory materials with 3D printing technology create 4D composite material. The research is expected to use polylactic acid (PLA) as the matrix, the mixture of paper, then uses of 3D printing in fused deposition modeling (FDM) to create a composite material, and the heat source to change the shape of 3D composite material, so we can develop the 4D printing technology. This research we explores that the 4D composite materials are deformed at different heat source strengths (temperatures).

Oral presentation 3

Polycrystal clasps for removable partial dentures

Tzu-Yu PENG

Department of Anatomy and Functional Restoration,

Oral Health Sciences Major,

Graduate School of Biomedical & Health Sciences,

Hiroshima University

PURPOSE

With the rapid development of CAD/CAM systems, the application of zirconia in removable partial dentures (RPDs) is expected to expand. The aim of this study was to examine the fatigue resistance of yttria-stabilized tetragonal zirconia polycrystal (Y-TZP) clasps for RPDs.

MATERIALS & METHODS

Y-TZP specimens were prepared by CAD/CAM systems. Specimens were either of semicircular-type or flat-type, with cross-sectional areas with taper ratios of 0.50, 0.75, and 1.00. For comparison, cobalt-chromium (Co-Cr) specimens of the same shape as Y-TZP were also prepared. All specimens were subjected to cantilever test and constant displacement fatigue test.

RESULTS

During the cantilever test, the maximum displacement prior to fracture was greater than the required undercut, and the semicircular-type exhibited a higher fracture load. Both Y-TZP and Co-Cr specimens did not undergo permanent deformation and showed almost the same degree of deformation after fatigue testing. In addition, a lower taper ratio was associated with lower average load values and greater displacement.

CONCLUSION

Within the limitations of this study, it was possible to conclude that Y-TZP provides the required undercut and adequate retentive force for RPD clasps. Additionally, Y-TZP and Co-Cr had almost the same degree of deformation even after the simulated lifespan for RPDs.

Oral presentation 4

Injectable and partially biodegradable polymethylmetacrylate-based bone filler for craniomaxillofacial bone defect

Ling YEH[1)], Yun-Jia HUANG[1)], Chang-Chin WU[2)], Kai-Chiang YANG[1)]

1) School of Dental Technology, College of Oral Medicine, Taipei Medical University

2) Department of Orthopedics, En Chu Kong Hospital, New Taipei City

Vertebroplasty is a widely used approach to treat osteoporotic vertebral compression fractures through the minimally invasive surgical procedure of percutaneous intrasomatic injection of acrylic cement. Among the injectable bone cement materials, polymethylmethacrylate (PMMA) has been used as a bone defect filler to stabilize fractured vertebra. PMMA has characterized by its low viscosity for injection, sufficient ability to strengthen and stiffen vertebral body quickly, and good mechanical properties with both hardness and toughness. However, the exothermic reaction during polymerization and the excessive hardness are the major concerns. These shortages not only cause tissue necrosis but also result in adjacent bone fracture again. Therefore, several research groups tried to develop modified PMMA-based bone cements. Accordingly, we improved the properties of PMMA through the additions of beta-tricalcium phosphate (β-TCP) ceramic in this study. The present results revealed that the addition of β-TCP to PMMA prolonged the setting time but decreased the setting temperature. Adding β-TCP to PMMA increased the weight, compressive strength, and radiocapacity of the PMMA samples, and the increase was directly proportional to the amount of β-TCP added. In spite of the hydroxyapatite was not formed in these β-TCP/PMMA composites after simulated body fluid immersion, the β-TCP-incorporated PMMA bone cement showed better biocompatibility than that of PMMA both *in vitro* and *in vivo*. In conclusion, the addition of β-TCP can improve the physical and biocompatible properties of PMMA-based bone cement.

Oral presentation 5

An investigation of scaffold materials suitable for new bone anabolic agents

Ayaka URAKAWA[1)], Masud KHAN[2)], Yosuke SASAKI[2)], Michiko OZAWA[3)], Kazunari AKIYOSHI[4)], Kazuhiro AOKI[2)]

1) Course for Oral Health Engineering, Faculty of Dentistry, Tokyo Medical and Dental University

2) Department of Basic Oral Health Engineering, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University

3) Department of Dentistry, Oral and Maxillofacial Surgery, Jichi Medical University

4) Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University

Cells, growth factors, and scaffolds are three important factors for tissue regeneration. We investigated suitable scaffolds for bone regeneration. We recently developed a combination therapy with osteogenic peptide OP3-4 and bone morphogenetic protein 2 (BMP-2) for clinical application. Using gelatin hydrogel (GH) as a carrier for both growth factors resulted in thicker bone regeneration in a calvarial-defect murine model than in a collagen carrier, which is the standard carrier for bone regeneration. As collagen carriers degrade more quickly than GH carriers, slower degradation of the carrier might be beneficial for our strategy. The disadvantage of using GH carrier with our bone regeneration strategy is that the bone thickness cannot be predicted at the operation. We therefore examined two types of cholesterol bearing pullulan (CHP) nanogel as new carriers: a slower- and a faster-control-release type. A new dotted type of bone formation was observed in the defect of the calvaria when using the fast-release carrier, but almost no bone formation was observed when using the slow-release carrier. Although our data are preliminary results, there may be an appropriate rate of sustained release to induce sufficient bone regeneration with our strategy.

Oral presentation 6

In vitro effects of epigallocatechin-3-gallate with mesoporous bioactive glasses in the treatment of periodontal pocket

Yi-Ting WANG, Fang-Yu FAN

School of Dental Technology, College of Oral Medicine,

Taipei Medical University

Periodontal disease is a common chronic oral disease, which is caused by the destruction of alveolar bone and periodontal ligament due to bacterial infection. The loose of teeth and systematic diseases might be occurred when it is getting worse. *Fusobacterium nucleatum* in the bacterial biofilm of the main pathogenic bacteria is one of the leading causes, which is made the depth of periodontal pocket increasing. Therefore, the complete periodontal treatment is to eliminate the source of infection and to construct a proper tissue environment. To fill with composite biomaterials in the wound will be facilitated tissue regeneration. One of the composite biomaterials, bioactive glass, is characterized by high bioactivity and specific surface area. It could be generated the hydroxyapatite on the material surface and offer excellent potential as drug release carriers.

Biological scaffolds will help the implant to reconstruct the defect area of the bone, but the strength of the scaffold is also the key point to be considered. This study aims to investigate the *in vitro* effects of epigallocatechin-3-gallate to the porous bioactive glass. Through the X-Ray diffraction (XRD), scanning electron microscopy (SEM), Brunauer-Emmet-Teller (BET) and contact angle measurement to evaluate the material characterization. On the other hand, the UV spectrophotometer and cell culture will record the drug release and biocompatibility. It is hoped that the results of this project will be important references for oral and maxillofacial restructure application.

Oral presentation 7

Learning at ODU so far and in future

Anna SHIMA

Department of Oral Health Engineering, Faculty of Health Sciences,

Osaka Dental University

I am a second grader in ODU. I chose ODU not only the necessary knowledge as a dental technician but also want to master broad knowledge in 4 years. In this presentation, I will talk about learning at ODU and future.

The teacher and students are friendly and easy to talk at ODU.

In the first grade, we had learned basic and professional subjects. At first every tooth looked the same to me. I found that each tooth has its own characteristics by practice. From the second grade, production practice of prosthesis began. I have been making personal trays and occlusal rim. And from the third year, it is scheduled to clinical practice at the ODU hospital begins. Then, taking advantage of what you learned in two years, we will communicate with patients. Not only practical training at ODU hospital but also rehabilitation hospital and visiting medical examination are planned.

Through learning at ODU, I want to be a dental technician who has the ability to quickly find and improve problems of laboratory equipment.

I think that what I should do now is to increase knowledge and establish it. So I want to do my best to study.

Oral presentation 8

Application of dispatching rules for dental technical work and its evaluation by discrete-event simulation

Hiroki YANASE[1)], Yuichi MINE[1)], Toru EGUCHI[2)], Takeshi MURAYAMA[1)]

1) Graduate School of Biomedical & Health Sciences, Hiroshima University

2) Graduate School of Engineering, Hiroshima University

Dental laboratories deal with various types of jobs (e.g., fabrication of crowns and bridges), and they often process several jobs concurrently. When a dental technologist has several jobs to be processed, he/she needs to select one among them. The selection is usually performed, according to his/her heuristics. This study proposes a method of the selection based on dispatching rules that are used for scheduling in industry fields. To show the effectiveness of the method, we perform discrete-event simulation, in which jobs are generated randomly and are selected one after another by a dispatching rule. We built six simulation models corresponding to the six dispatching rules. The models assume that the dental laboratory deals with five types of dental prostheses including CAD/CAM crowns and that several wax patterns can be put together to cast. We consider the cases of one, three, and five dental technologists working in the dental laboratory and we consider the cases of accepting orders at fixed time and at any time. We carried out the simulation using each of the models. The result of the simulation showed that we can find the dispatching rule suitable for the specific dental laboratory.

Oral presentation 9

Analysis of three-dimensional shape of mandibular complete dentures

Van Anh NGUYEN VU[1)], Maho SHIOZAWA[1)], Meiko OKI[2)], Tetsuya SUZUKI[1)]

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2) Department of Basic Oral Health Engineering, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University

In recent years, CAD/CAM technology has been applied to removable prostheses in dentistry. To simplify the fabrication of complete dentures using CAD/CAM system, a standard form of the complete denture will be beneficial.

The aim of this study was to obtain the average form of well-functioning dentures and to clarify main factors that reflect the differences of the shape of mandibular complete dentures. Twenty mandibular complete dentures were duplicated and digitized using a handheld optical scanner (Artec Spider). The digital data for each denture were transformed to a homologous model by homologous body modeling software (mHBM, Body-Rugle). By transforming to all homologous models, the data of denture consist of the same number of data points of the same topology, and have the same anatomical meaning. Moreover, the data could be processed statistically. These models were then analyzed with principal component analysis (DHRC-HBS-PCA). After analyzing, the average form of 20 mandibular complete dentures and 15 principal components were obtained. Five principal components explained >70% of the total variance of the denture shapes. These factors could be effective for promotion of the complete denture fabrication using CAD/CAM system.

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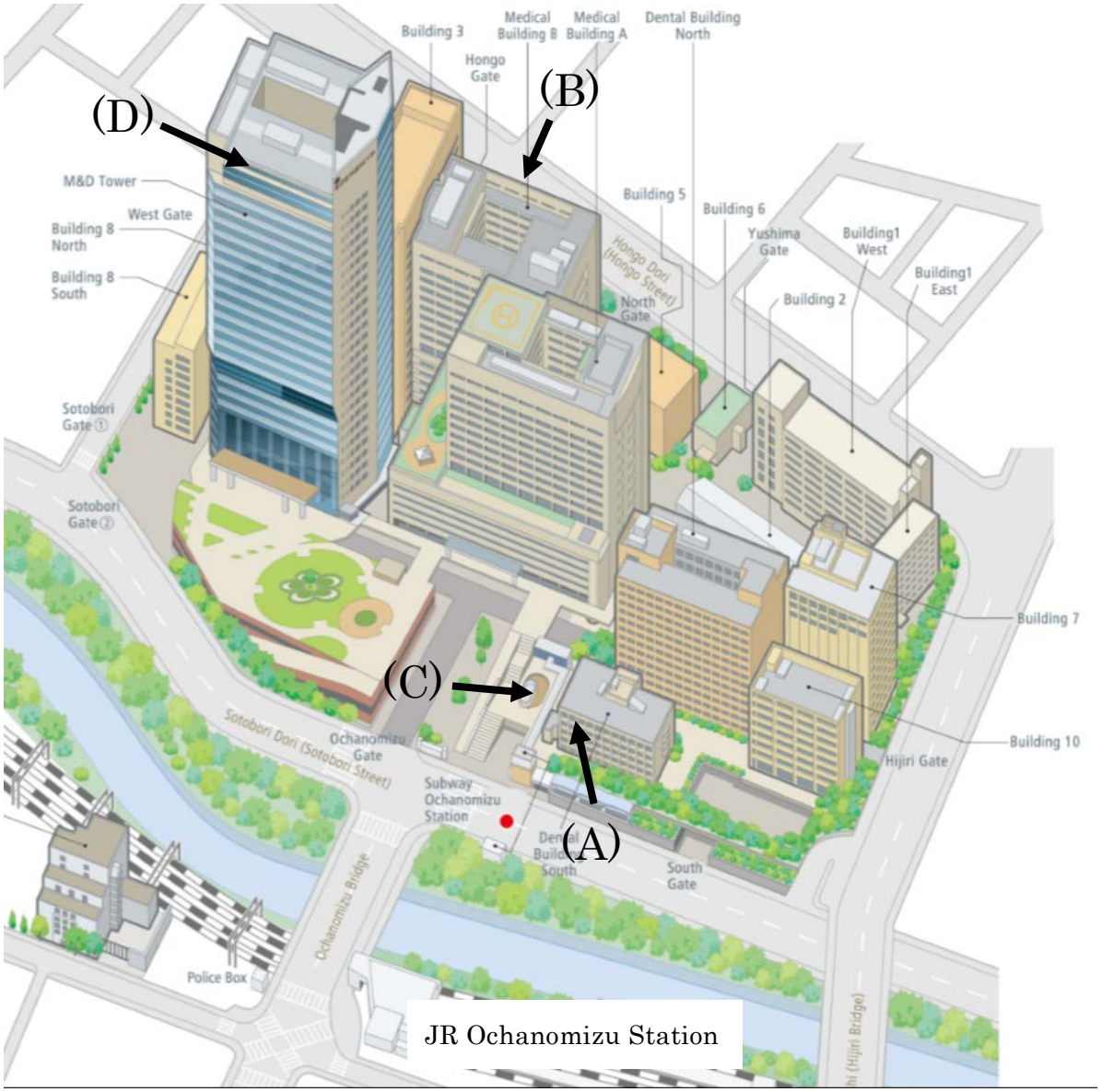

✧ **Panel Discussion and Oral Presentation**

Special Auditorium Dental Building South 4F **(A)**

✧ **Lunch** Restaurant Medico Medical Hospital North 16F **(B)**

Restaurant Arumeida Restaurant Building 1F **(C)**

✧ **Banquet** Faculty Lounge M&D Tower 26F **(D)**

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