

# 56TH ANNUAL MEETING OF THE AMERICAN ACADEMY OF IMPLANT DENTISTRY AND THE WORLD CONGRESS OF ORAL IMPLANTOLOGY 7 ABSTRACTS, 2007

## 1. CLINICAL EVALUATION FOR THIN-FILM HA-COATED IMPLANTS

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**Objectives:** Hydroxyapatite (HA) coated implants are united to bone by the crystal level in the early stage. However, titanium implants are only in contact with surrounding bone. That being said, the HA coating on dental implants have been known to peel off or fracture and this appears to be dependent upon the HA coating layer thickness. Recently, to improve these disadvantages of HA, thin-film HA coated implants were developed. We report the results of thin-film HA coatings on dental implants long term.

**Method:** HA thin-film implants (PLATON Implant Bio<sup>®</sup>) that have a HA layer of 3–5 μm were used. 241 implants in 84 patients (male 21 and female 63) were inserted and clinical courses were evaluated for up to 7 years. Long-term observation cases were evaluated with eleven items that include bone absorption, gingivitis index, pain, bleeding index, plaque index, pocket depth, mobility, patient's satisfaction (chewing function, esthetics, pronunciation) and safety.

**Results:** We used thin film HA coated implants for seven years. Two out of 241 implants were removed only. These implants showed high survival rate of 99.2%, the prognosis was very stable after long-term passage. The long-term observation cases were evaluated with eleven items. Thin film HA coated implants achieved high evaluation of 99.6 points after operation at twenty four weeks. In addition, these implants had high evaluation of 99.3 points after five years or longer.

**Discussion and Conclusion:** Thin film HA coated

implants may not be a problem with clinical use. These results suggested that thin film HA coated implants were successful.

## 2. A STUDY OF BIOCOMPATIBILITY ABOUT TITANIUM MEDICAL APATITE (TMA)

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**Introduction:** Bone substitutes have been developed to avoid the problems posed by the surgical morbidity of autologous bone grafts and those associated with the inherent immunogenicity of allografts. Most of the materials used are inorganic compounds such as hydroxyapatite and tricalcium phosphate, and anorganic bone or combination of the various phases of calcium phosphate. These materials have both advantages and disadvantages, indeed. Therefore, we have developed a new apatite of titanium medical apatite (TMA) for bone substitute. The purpose of this study is to evaluate biocompatibility about a novel vacuum sintered body with TMA using *in vivo* and *in vitro* model.

**Material and Methods:** Preparation of vacuum sintered body with TMA: TMA is a new apatite that it is sold by Taihei chemical industry Inc. with a trade name of "TMA". The chemical formulas of TMA is Ca<sub>10</sub>(PO<sub>4</sub>)<sub>6</sub>·TiO<sub>2</sub>(OH)<sub>2</sub>·nH<sub>2</sub>O. TMA powders are kneaded with water, and are formed by the compacting pressure with a vessel. The sintering TMA carried out

using a resistance furnace with the vacuum. *In vivo* study using rabbit mandible: Ten white Japanese rabbits were operated on to create bone defects in the left and right sides of mandible. These defects were filled with TMA or pure Titanium (Ti, control material), respectively. At 1 and 3 months after the operation, the mandibles were removed, and undecalcified sections were stained with hematoxylin-eosin for histological observation. This study was approved by animal experimental committee of Nihon University School of Dentistry. *In vitro* study using rat osteoblast: The rat clonal cell line ROS 17/2.8 was used to evaluate cell proliferation in the presence of TMA or Ti. The cells were cultured with MEM containing 10% FBS on TMA or Ti for up to 10 days. At the timepoints indicated, the medium was changed to fresh medium containing 10% cell-counting-kit reagent. The intensity of the reaction products was measured with a microtiter plate reader, and the relative cell numbers were calculated from the relative absorbance values on the basis of a standard curve.

**Results:** *In vivo* study using rabbit mandible: Light microscopic assessment showed that the both TMA and Ti were well tolerated by the surrounding tissue, no adverse tissue reactions being seen in any of the sections. At 3 months, the outer surface of both materials was covered by new bone formation. *In vitro* study using rat osteoblast: The proliferation of the ROS was determined in the presence of TMA or Ti for up to 10 days of culture. A logarithmic growth phase occurred in all cultures between days 1 and 3 after seeding. The difference between TMA and Ti on the cellular proliferation was not significant.

**Discussion and Conclusions:** On the basis of our findings, a novel TMA vacuum sintered body has the same biocompatibility as Ti, which is generally used as implant materials. Because TMA vacuum sintered body has light weight, low thermal conductivity, high compressive strength and biocompatibility, and easiness of cutting, it may be used as a new bone substitute in implant dentistry.

### 3. THE LONGITUDINAL CLINICAL STUDY OF THE PERI-IMPLANTITIS DURING MAINTENANCE AFTER PLACEMENT

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**Introduction:** Oral implant systems are gaining popularity as an effective clinical replacement for missing teeth. The function and esthetics of oral implants have improved considerably, and perfect methods for insertion of fixture and setting the

superstructure have been established in all systems of implants. But, although implant maintenance is very important from the clinical, histological and bacteriological viewpoints, it seems that the universal maintenance theory does not work perfectly for all implant systems.

**Objectives:** 1) To investigate the condition of peri-implant tissue in long-term maintenance by a retrospective study. 2) To analyze effect of risk factors (such as tobacco) for peri-implantitis. 3) To estimate the usefulness of maintenance for peri-implantitis.

**Study Population and Methods:** Subjects were selected from patients, who had received implant maintenance regularly every three months for over 3 years from 1990 to 2005. The pocket depth (PD) around implants was measured in 4 sites (mesial, distal, buccal, lingual) regularly and the presence of bleeding on probing (BOP) and pus discharge was recorded. The probing pressure was 10g. In the event peri-implantitis was diagnosed, the interval was shortened and the symptoms were treated appropriately. When symptoms of peri-implantitis were detected, they were evaluated at the baseline, middle of the study period and at the final time point. The mean PD was calculated from the values obtained during the regular visits for implant maintenance. Thereafter, the effects of various factors (insertion position, duration maintenance, smoking and so on) on peri-implantitis were analyzed.

**Results:** 359 implants (66.1%) were in healthy condition, and peri-implantitis was already detected in 184 implants (33.9%) at baseline. Only 80 of the 359 healthy implants remained in good condition until the final time point. Thereafter, 205 implants (37.8%) were diagnosed with severe peri-implantitis during maintenance, but, the number of implants which had severe peri-implantitis decreased to 62 at final. In subject-wise analysis, regarding the severity of peri-implantitis, the mean number of implants per subject increased. Analyzing the PD at 4 sites, the mean PD at buccal site was slightly more than the other 3 sites. The mean PD tended to be deeper of subjects who did not attend maintenance visits over 1 year than implants in subjects who received regular maintenance every year. Regarding the effect of tobacco, when the smoking habit had been discontinued more than 10 years previously the mean PD reverted to the same level as in nonsmokers.

**Discussion:** From analysis about subjects, the risk of peri-implantitis was high when the subjects had large number of implants. Because peri-implant tissues are exposed to various risk factors such as oral bacteria, there was possibility that the increasing number of

implants with severe peri-implantitis indicated difficulty of maintenance. Moreover, mesial, distal and lingual sites are more difficult to clean than the buccal site. It seems that the concerning peri-implantitis was self-care related. From analysis concerning the frequency of maintenance, regular professional care was found to be important for prevention of peri-implantitis.

**Conclusions:** 1) Besides professional care, various factors such as self care, tobacco, treatment planning appeared to influence the condition of peri-implantitis. 2) It seems that regular maintenance contributes to prevention and improvement of peri-implantitis after insertion.

#### 4. BACTERIAL CONTAMINATION OF ORAL IMPLANT ASSOCIATED AUTOGENOUS BONE GRAFTS IN JAPANESE PATIENTS

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**Introduction:** The use of autogenous bone is considered to be the best choice for reconstructive surgery of hard tissue. However, bacterial contamination of autogenous bone grafts may lead to postoperative infections<sup>(1)</sup>. It has been reported that these infections can have a detrimental impact upon the success rates of dental implants and of guided bone regeneration. Hence, we investigated the bacteriological contamination of collected autogenous bone debris (CBD) from the site of implant therapy in the oral cavity. Additionally, the method of processing the grafted bone under aseptic condition was examined.

**Materials and Methods:** Collection and grouping of CBD samples:

The bacterial contamination of CBD from the jaw bone of six implant cases was investigated. The treatment and investigation plan were fully informed to all the patients and consents were obtained. The samples were collected for microbial analysis after

group allocation as follows: G1: swab collection from alveolar bone surface at flap opening; G2: CBD by a disposable osseous collector a stringent bone collection protocol in surgical site; G3: CBD by a suction tip with bone trap (Osseous Collection Trap [SALVIN]) a non-stringent aspiration protocol in surgical site; G4: CBD immersed in HOP water with pH 2.7 and below, Oxidation-Reduction Potential (ORP) 1100mv (PANACEE) HOP water, prepared by electrolysis of tap water and sodium chloride (0.05%) with a diaphragm between the cathode and anode; and G5: CBD immersed in H<sub>2</sub>O<sub>2</sub>. Culture condition of bacteria: All samples of five groups were immediately transported for bacterial culture using transporting medium and washed. After the samples were cultured in broth and plated on appropriate separate media, Trypticase soy blood agar, modified Drigalski agar, Chocolate agar were incubated at 35°C for 24 hr and Brucella HK agar at 35°C for 48 hr. Statistical analysis was performed using Steel-Dwass method.

**Results:** Presence of bone contamination was realized on clinical examination immediately after flap opening, especially in G1 and G3 groups. Aerobic cocci dominated the isolates in all groups. The *α-Streptococcus spp.* and *γ-Streptococcus spp.* were found to be predominant, identified almost in every sample and *Neisseria spp.* was second predominant. In all G-3 samples *α-Streptococcus spp.*, *γ-Streptococcus spp.*, *Neisseria spp.*, *Corynebacterium spp.* and anaerobic bacteria were identified almost regularly. However, *α-Streptococcus spp.* and *γ-Streptococcus spp.* were less and irregularly identified. *Pseudomonas spp.* that was non-oral indigenous bacteria was detected in G4 and G5 samples. The HOP water was more effective than H<sub>2</sub>O<sub>2</sub> in the method of processing the grafted bone under aseptic condition.

**Discussion:** The CBD during implant surgery was contaminated at least by a number of aerobic bacteria. The indirect method with a suction filter apparatus (nonstringent aspiration protocol, G3) showed significantly more bacterial contamination than the direct method (stringent bone collection protocol, G2). The method of processing the grafted bone under aseptic condition was investigated. The treatment of CBD with HOP water (G4) was more effective than that with H<sub>2</sub>O<sub>2</sub> (G5). Recently, HOP water has shown strong disinfection potentials and its use is increasingly wide spread. The statistical analysis performed by the Steel-Dwass method showed significant differences between G2 and G3 (P < 0.01), G3 and G4 (P < 0.01), G3 and G5 (P < 0.05). Therefore, it is suggested that more effective additional sanitizing methods other than

conventional stringent bone collection protocol are needed to reduce microbial contamination of CBD.

**Conclusion:** A stringent bone collection protocol showed decreased bacterial contamination than the nonstringent bone collection protocol ( $P < 0.01$ ). Also, autogenous bone processed with HOP water was effective in reducing bacterial contamination level ( $P < 0.01$ ). Therefore, it has been suggested that it is important to explore a convenient method for processing the autogenous bone under most aseptic condition in the future and proper use of HOP water might be a good choice.

#### 5. A STUDY OF TEMPORARY CEMENT FOR DENTAL IMPLANT PROSTHESIS RETENTION

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**Introduction:** Cement-retained prosthesis proposes the advantages of simplicity in adjustment of the superstructure, exclusion of screw loosening and improved esthetics because of the lack of screw access holes. However, the retrievability of superstructure is often crucial for prosthetic complications and maintenance. One of the important factors for temporary cements is adhesive property during the function of an implant; in contrast, an easy removal property from abutment is also required. Therefore, we have to consider selection of temporary cement on both adhesive and retrievable characteristics. In these experiments, we fabricated metal superstructures and compared 1) the Fitness (Marginal Adaptation) of Crowns on Implants and 2) Tensile Strength of Crowns cemented on abutments.

**Materials and Method:** Four temporary cements—2 powder/liquid type and 2 paste/paste type cements—were used in this experiment. Powder/liquid type cements were 1) Hy-bond Temporary Cement Hard (SHOHU):HH, and 2) Hy-bond Temporary Cement Soft (SHOHU):HS. Paste/paste type cements were 1) Temporary Pack (GC):TP, and 2) Temporary Cement (TELEDYNE WATER PIK):OP. Superstructures were cemented to the abutment by loading of 15 kgf for 60 seconds after start of mixing. The positions of a superstructure in the long axis direction were measured by using a laser displacement meter (KEYENCE, LC-2440). The force required in the extracting the superstructure from the support mechanism was measured using INSTRON (Type: 5500N) at crosshead speed of 1000 mm/min. The experiments were repeated 10 times for each material and a one-way ANOVA was performed for each measurement method

in order to evaluate significant differences. In addition, significant differences among materials were evaluated through Scheffe's multiple comparison range test.

**Results:** The fitness were  $38.8 \mu\text{m} \pm 26.0$  for HH,  $57.1 \mu\text{m} \pm 43.7$  for HS,  $0.4 \mu\text{m} \pm 7.9$  for TP and  $3.2 \mu\text{m} \pm 5.0$  for OP, respectively. Some indeterminable factors might have caused of considerable variances when the superstructure pressed the abutment for cementing. The force required for extraction was respectively  $284.8 \text{ k N} \pm 27.4$  for HH,  $197.9 \text{ k N} \pm 10.9$  for HS,  $89.6 \text{ k N} \pm 21.2$  for TP and  $62.1 \text{ k N} \pm 5.9$  for OP, thus showing substantial differences among each material. From the results of multiple comparative evaluations, there were significant or highly significant differences among all of the materials.

**Discussion:** A cement-retained prosthesis has some advantage. However, the retrievability of superstructure is also necessary. When, we use temporary cement, the physical properties of temporary cements for implant prosthesis were still unknown. To measure the marginal discrepancy, some methods were reported. In this measurement, we use a laser displacement meter. It was easy to use and measured the accurate distance rather than that of another device. Concerning the fitness, Paste/paste type temporary cement were clearly observed to be significantly thinner than Powder/liquid type. Cement thickness depended on the particle size containing cement.

**Conclusion:** Paste type temporary cement thickness was clearly observed to be significantly lower than powder/liquid type, while also demonstrating excellent adaptability. It was clearly observed that the strength of the provisional application in restorative materials differed substantially depending on the material.

#### 6. CLINICAL STUDY ON SUPERSTRUCTURE OF DENTAL IMPLANT-POST INSERTION OCCLUSAL CONTACT OF SUPERSTRUCTURE

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**Introduction:** To avoid overload to implants which results in bone resorption, weak occlusal contact, small occlusal table and wide cusp angle were applied on the implant superstructure compared to natural teeth. However, some reports indicated contact between implant superstructure and natural tooth can be the same as natural teeth contact. The purpose of this study was to investigate the clinicians' ideal perception of occlusal form and function of superstructures, and actual application of occlusal force to individual patients.

**Methods:** Questionnaire was performed for 26 prosthodontists and clinicians in an oral implant clinic. 17

male and female patients (average 52.5 y) having 1 to 4 implants in a unilateral posterior region were entered in this study. The patients were satisfied with their impact superstructure. Occlusal force was measured with pressure sensitive film (Dental Prescale, 50H Type R) at maximum clenching. 4 regions, 1) molar region of implant side, 2) molar region of non-implant side, 3) implant superstructure, and 4) natural teeth corresponding to implants on the opposite side were measured by using Occluzer system.

**Results:** In this study, we found the following: 1) how clinicians consider occlusal form and function of superstructures and 2) how occlusal forces were applied in the clinic. 1) About 70% prosthodontist and clinician in the oral implant clinic consider that superstructures should have smaller occlusal table, wider cusp angle and weaker contact than that of natural teeth. 2) Articulating paper and patient sensation are used as the main methods of occlusal adjustment. Materials of superstructures were chosen according to respective cases. 3) Superstructure of implant had almost the same occlusal force when compared to natural teeth at maximum clenching. There is no significant statistical difference between implant side and non-implant sides. But occlusal force on the implant side and implant portion have a tendency to be weaker at even maximum clenching. It shows that occlusal adjustment of superstructures of implants which are not surrounded by periodontal membrane, is really difficult.

#### 7. MEASURING ABILITY OF NO-CONTACT VIBRATION DEVICE FOR IMPLANT STABILITY

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**Aim:** The aim of this study is to evaluate the measuring ability of a no-contact electromagnetic vibration device for implant stability, which was experimentally developed for measuring tooth mobility, and to compare it to the Periotest device.

**Materials and Methods:** This device was consisted with 3 components such as Vibrator, Detector, and Analyzer. It accessed the simulated periodontal tissue conditions associated with three mechanical parameters (the resonant frequency, the elastic modules, and the coefficient of viscosity) obtained from the frequency response characteristics at tooth vibration. This device vibrated the subject with the electrical force produced by the alternating magnetic field between

the vibrator and the disk magnet, and the frequency response characteristics collected with an FFT analyzer were the lead mechanical parameters. In this study, the experimental tooth models consisted of a cylindrical titanium rod, a soft lining material and the foaming urethane simulated the implant, periodontal soft tissues, and alveolar bone. The models were divided to 4 groups with different supporting bone heights. For the measurement, the vibrator was located a no contact position with 1 mm distance between the tip of vibrator and the titanium rod glued to the disk magnet and the acceleration sensor.

**Results:** The resonant frequency and the elastic modules increased with the increase of supporting bone height, and the coefficient of viscosity decreased with the increase of them contrarily. In addition, on different simulated alveolar bones, characteristics of mechanical parameters were similar and the values for the parameters on the foamed urethane were smaller than on the urethane.

On the other hand, Periotest values (PTVs) have decreased with the increase of supporting bone height, and PTVs on the formed urethane was larger than on the urethane contrarily.

**Discussion:** Three mechanical parameters respectively expressed characteristics associated with supporting bone height (volume). The elastic modulus ( $k$ ) and the coefficient of viscosity ( $c$ ) were shown contrary features. This phenomenon was observed with the difference of the elasticity and the viscosity of simulated soft tissue and bone materials, and changes in the conditions. From these results, mechanical parameters have reproduced periodontal tissue conditions and might have a possibility to illustrate their fine details compared to Periotest values.

**Conclusions:** Conclusively, this vibration device may have the ability for analyzing the degrees of tooth and implant stability, and possibly be able to express not only the tooth/implant mobility but various conditions of periodontal tissues.

#### 8. SIMULTANEOUS MAXILLARY ANTERIOR RIDGE AND SINUS FLOOR AUGMENTATION WITH ILIAC BONE

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**Introduction:** The goal of the study was to evaluate the potential for maxillary sinus floor and anterior

ridge augmentation with autogenous iliac bone, using implant SIM/Plant simulation software.

**Materials and Methods:** Five cases of bilateral sinus floor and anterior ridge augmentation lift with a bone graft in the lateral incisor region were performed at Yokohama City University Hospital, and the edentulous maxilla were analyzed by computed tomography and SIM/Plant before surgery. The following items were evaluated with SIM/Plant version 6.7.

**Items Under Consideration:** I: Bone formation at the sinus floor after bone graft. The bone volume required for three regular-sized implants ( $3.75 \times 13$  mm) was calculated. II: Distance from the implant to the anterior wall of the sinus. The vertical distance from the point of implant to the anterior wall of the sinus was measured. III: Anterior ridge bone formation. The bone width required for placement of an optimal regular-sized implant ( $3.75 \times 13$  mm) in the lateral incisor region was calculated. IV: Evaluation of bone formation. If the bone width in the incisor region and bone height in the molar region were insufficient, the errors were evaluated.

**Results:** I: The mean bone volume required for three regular-sized implants ( $3.75 \times 13$  mm) at the sinus was 2.9 mL. II: The mean vertical distances from the apex of the implants to the anterior wall of the sinus were 4.4 mm in the frontal area, 5.9 mm in the middle area, and 6.8 mm in the posterior area. III: The mean bone width required for optimal implant placement in the lateral incisor region was 6.2 mm. IV-i: Postoperative images taken more than six months after surgery were utilized to measure the amount of newly formed bone. Sufficient bone volume and width were obtained in most cases, except in the posterior area in three cases. IV-ii: Insufficient bone for implant placement was found at two anterior implant sites among the 10 implants (5 cases).

**Discussion and Conclusion:** We conclude that sufficient bone formation can be obtained with this augmentation procedure. It is important to pay attention to the posterior part of the sinus floor due to the greater distance between the anterior wall of the sinus and the planned implant position. Due to bone resorption, the maxillary alveolar ridge, which had a concave shape preoperatively, tended to have sufficient bone for implant placement in the middle portion, even after a veneer graft.

#### 9. SERIAL CHANGES IN THE MARGINAL BONE LEVEL OF ANKYLOS IMPLANTS ON JAPANESE PATIENTS AFTER 5 YEAR OF FOLLOW-UP

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**Introduction:** The feasibility of intimate contact between bone and a titanium implant was first demonstrated in 1969, after which osseointegrated implants have been used extensively for treatment of complete or partially edentulous jaws in human patients. The predictability and high success rate of implant treatment have averted attention from factors affecting bone loss around the implants. Radiographic examinations at the time of implantation are important to diagnose changes in the bone tissue following the procedure. While many factors are likely involved, gender, age, occlusal loading, plaque-induced inflammation, biological width, implant design, and the presence of micro-gaps are frequently stated as the most important for negatively affecting bone loss around implants. The Ankylos system was developed in 1985 and has been in clinical use since 1987. Some of its significant design features include a progressive thread structure of the endosseous implant body for targeted load distribution to the apically positioned spongy bone and a gap-free subgingival tapered connection to the abutments. In an attempt to improve survival by directing stress encountered during function away from dense cortical bone and toward resilient trabecular bone, the Ankylos implant has a roughened, progressive thread and a smooth cervical collar. Further, its precise, tapered, and conical abutment connection eliminates the micro-gaps often found in 2-stage implant systems, as their presence may allow the accumulation of food debris and bacteria, as well as micro-movement between the parts during clinical function, both of which can lead to localized inflammation and crestal bone loss. Many longitudinal studies of Brånemark System implants have been published, however, few regarding Ankylos system implants have been reported. Further, most of these reports are of Europeans and Americans, for whom the conditions, such as bone width and bone volume, are well reported, whereas there is no reported investigation of Japanese, whose jaw conditions are different. In the present study, we retrospectively evaluated late fixture loss and marginal bone loss around implants that had been in function for at least 5 years in Japanese patients.

**Materials and Methods:** The present study was conducted with 76 consecutively treated Japanese patients, composed of 19 males (mean age, 58.8 years) and 41 females (mean age, 55.1 years). A total of 149 Ankylos implants were followed for a minimum of 5 years, with changes in marginal bone level clinically evaluated. Serial dental radiographs were taken at the

time periods between fixture insertion and second stage surgery, and second stage surgery and loading, as well as during 2- and 5-year follow-up examinations, to determine changes in marginal bone level. The radiograph method used was the parallel technique, with a CONE INDICATOR III. Bone resorption level was evaluated based on the criteria of Romanos et al. as well as our own.

**Results:** No early failure in obtaining synostosis was noted in any of the patients, with no late failure (loss of synostosis) observed 5 years after loading. Evaluation based on the criteria of Romanos et al.: In the present series, 41.0% of the cases were level 0 and 59.0% were level 1, with none evaluated as level 2, 3, or 4. Evaluation based on our criteria: At the 5-year follow-up examination, no changes in bone level were noted in 61.7% of the cases, while bone resorption was detected in 35.6%. In the time period between the 2- and 5-year follow-up, no changes in bone level were found in 70.5% of the cases, while bone resorption was observed in 28.1%.

**Discussion:** No early failure in obtaining synostosis was noted and no late failure (loss of synostosis) occurred 5 years after loading in any of the patients. And, in the evaluation based on the criteria of Romanos et al.; Level 0 was found in 41.0% and level 1 in 59.0% of the cases, whereas levels 2, 3, and 4 were not observed. These results are the Ankylos implant useful for Japanese jaw conditions, different from Europeans and Americans, such as bone width and bone volume. Marginal bone level changes occurred in the periods between loading and 5-year follow-up, based on our criteria. Therefore, we concluded that the marginal bone level over time should be monitored. At the 5-year follow-up examination, no changes in bone level were noted in 61.7% of the cases, And in the time period between the 2- and 5-year follow-up, no changes in bone level were found in 70.5% of the cases. Few changes of bone level around the implants were indicate that useful for long term on Japanese patients.

**Conclusion:** The Ankylos implant was found to be useful for Japanese patients.

#### 10. OCCLUSAL FORCE TEST ON A PATIENT'S FULL DENTURE RELINED WITH BIO-COMPATIBLE SILICON

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**Introduction:** The stability of occlusal functions on

treatments of full dentures and overdentures has been a growing issue in the recent years. The design we have been studying addresses the resorption of the maxillary ridges with a few residual anterior teeth. To provide maximum stability and increase of occlusal force we planned to place implants in the anterior teeth region and fabricate an overdenture. It is notable that in a case when the lower opposing teeth are natural teeth, upper anterior ridges have a tendency to develop flabby gingival tissue due to high frequencies of occlusion. In this presentation, we report a basic clinical test of the occlusal force in the anterior teeth region with the case of residual teeth at 12, 13 and 22 and embedded implants at 15 and 25 served as abutments. Three types of abutment devices and three types of upper overdentures were prepared to compare the occlusal force.

**Materials and Methods:** Three residual teeth at 12, 13 and 22 and two embedded implants at 15 and 25 served as abutments. Type A: Inner crowns were individually set on the three residual teeth. Type B: The three residual teeth were connected with a gold-bar. Type C: The three residual teeth and two implants were connected with a gold-bar. Three types of overdentures were fabricated to fit the three types A-C respectably. Normal: Made from heat-cured acrylic resin: Acron. T-con: Applied with tissue treatment material: Tissue Conditioner. Silicon: Relined with Bio-compatible silicon on the membrane side: A-558 Realistic with Apposition Type.

**Measurement of Occlusal Force:** Occlusal Force Meter GM-10 was used to measure the occlusal force in the anterior region. The nine combinations of the three types A-C and the three types of overdentures were tested. Each combination was tested six times and the average score was obtained.

**Results:** 1) There was no significant difference in Normal or T-con in any types. 2) The occlusal pressure of Silicon was larger than Normal in all types. 3) When Silicon of C type (194.9 N) was compared with Normal of A type (128.4 N), 99% significant difference had been observed.

**Discussion:** This experiment was initiated in response to patient complaints of wearing a maxillary overdenture and could not bite relatively hard fruits and hot food with their anterior teeth. When both residual teeth and implants served as abutments as in this reported case, the adjustment for occlusal pressure becomes the challenging issue. The occlusal pressure is influenced not only by the number and the position of the natural teeth, the number of implants, the bone quality, bone form-conditions, membrane support, but also by abutment devices and over-

dentures. It has been questioned which abutment, abutment device, and overdenture work best together. Generally abutments are expected to have the following functions: 1) supporting 2) retaining 3) supporting and retaining 4) supporting, retaining and gripping. And attachments are expected to have the following features: 1) clearance capability 2) retaining capability 3) adjustability for various ridge conditions 4) adjustability for stability of dentures 5) frequency and difficulty level of maintenance. In this experiment, the overdenture was relined with silicon that has flexibility in thickness and hardness to provide better stability in the occlusal function. The further progress of the reported experiment will be observed.

**Conclusion:** Using an upper overdenture relined with biocompatible silicon is more effective to increase occlusal pressure in the anterior teeth region. However the stability of an overdenture relies on the stability of the dentures itself. Silicon is basically used to partially reduce the excess load to membrane mucosa and to maintain the health of membrane.

#### 11. RESORPTION OF DIFFERENT PARTICLE SIZED AUTOGENOUS BONE GRAFT IN A RABBIT CRANIAL MODEL

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**Introduction:** Bone augmentation is a common management option for treating inadequate bone volume before implant placement. Typically, autogenous bone, allogeneic bone, xenogeneic bone, and synthetic bone are used as bone grafting materials. Additionally, autologous bone is widely regarded as the gold standard graft material.

It has been reported that grafted autogenous bone became thinner or almost lost in long term follow up in clinical cases. But few reports for precise bone resorption after grafting are available. The purpose of this study was to evaluate and quantitate the precise resorption of two different particle sized autogenous bone graft by histology and radiology.

**Materials and Methods:** Animals: Japanese white rabbit (male) were included in this study. The animals were divided into two groups by experimental periods: 8-week and 4-week. Surgical procedure: General anesthesia (ketamine, thiopental sodium); local anesthesia (2% xylocaine/epinephrine 1:80 000); bone harvest from tibia:K-system 3.2 was used to obtain bone debris (particle size: 150~400  $\mu\text{m}$ ): small particle bone (SPB). Bone forceps was used to obtain bone blocks (particle size: 1.0~2.0 mm): large particle bone (LPB). The same weight of SPB and LPB was prepared.

Fixing bone augmentation chamber: The polytetrafluoroethylene chambers (internal diameter: 5mm, height: 3mm) were fixed with stainless steel screws at each side of temporal bone. Bone Graft: Harvested bone were mixed with blood, and grafted into chambers. Sacrifice: Animals were sacrificed at 4 week, and 8 week for micro CT and histological analysis.

Micro CT analysis: After experiment period, specimens were fixed with 10% neutral buffered formalin for 10 days. Then, grafted regions of specimens were quantified via micro CT analysis. Histological procedures: Undecalcified specimens were dehydrated with graded alcohol and embedded in polyester resin. These sections were sawn in the sagittal direction and ground to a thickness of about 30  $\mu\text{m}$ . The sections were finally stained with 0.1% Toluidine blue.

**Histology:** 4 week: In SPB grafted model, bone area occupied about half height of the chamber, and grafted SPB was united each other with new formed bone in high magnification. In addition, the grafted bone was connected with new formed bone. In LPB grafted model, loose connective tissue was observed around grafted bone. Howship's lacunae were found at surface of grafted bone, and new bone was formed. The center of grafted bone had retained its form. 8-week: In SPB grafted site, relatively lower volume of bone was observed than 4-week SPB grafted model. Grafted bone was bonded by new bone, and grafted bone had lost its original shape. In LPB grafted model, new bone formation was observed around grafted bone and, many osteocyte like cells were observed in it. Several blood vessels and lipocytes were observed in both models.

**Micro CT Analysis:** Total bone volume in each chamber was calculated by micro CT analysis. Both of LPB group has higher volume than SPB grafted group. There were statistical differences between 4-week SPB and LPB grafted group, and 8-weeks SPB and LPB groups.

**Discussion:** It has been well known that autogenous bone graft is the gold standard in implant dentistry. However, this study suggested that its property could be affected by particle size. At 4 weeks the SPB grafted model showed grafted bone was united with new formed bone, otherwise, LPB grafted model showed good preservation of bone volume: bone remodeling was slower than SPB grafted model. At 8 weeks, SPB and LPB model showed lower bone volume than the same model at 4 weeks. Additionally, blood vessels and lipocytes were observed in both models. This finding suggests that tissue surrounding grafted bone was advanced in maturation and differentiation during healing period between 4 and 8 weeks.



**Conclusion:** This present short-term study describes the in vivo resorption of different particle sized autogenous bone graft material in the chamber. LPB graft resorption was slow: therefore it may have better space preservation ability than SPB graft. Meanwhile, SPB graft showed novel new formed bone connection.

## 12. NEW GEOMETRICAL MATRIX FOR BONE REGENERATION: A HONEYCOMB-SHAPED $\beta$ -TCP INDUCED STRAIGHT LONGITUDINAL BONE INSIDE THE TUNNEL

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**Introduction:**  $\beta$ -TCP and hydroxyapatite are used as the bone grafting materials frequently. Tsuruga et al. reported that hydroxyapatite with irregular direction pores showed that the optimal pore size for osteogenesis was 300–400  $\mu$ m. Kuboki et al. reported that the cylindrical hydroxyapatite with straight tunnel (honeycomb) induced bone and cartilage earlier than without straight tunnel. The aim of this study is to develop new  $\beta$ -TCP ceramics with the geometric structure that induces bone formation more rapidly than the conventional  $\beta$ -TCP.

**Materials and Methods:** The honeycomb-shaped  $\beta$ -TCP, cylindrical biodegradable  $\beta$ -TCP with 37 tunnels in diameter 300 $\mu$ m, and conventional  $\beta$ -TCP (porous and non-porous) were combined with BMP-7. Both  $\beta$ -TCP were implanted into the back skin of rat for 1 to 4 weeks. Extracted  $\beta$ -TCPs were observed histologically and analyzed for alkaline phosphatase activity.

**Results:** The honeycomb-shaped  $\beta$ -TCP demonstrated remarkable osteogenesis inside the tunnels. The bone was formed on the surface of tunnels with one or several veins at the center of the tunnel. The alkaline phosphatase activity of honeycomb-shaped  $\beta$ -TCP was higher and imaged earlier than control, conventional  $\beta$ -TCP.

**Discussion:** Our histological and biochemical (ALP activity) results were accorded with Tsugaru's and Kuboki's report. Tsuruga et al. observed that distinctive vascularization at the center of the tunnel. The

honeycomb-shaped  $\beta$ -TCP with the tunnels showed more rapid osteogenesis than without the tunnels. This phenomenon was more clearly observed in the present study.

**Conclusions:** It was suggested that the honeycomb-shaped  $\beta$ -TCP is the biodegradable material always occurred, having a feasible geometry for bone formation which is useful in future clinical application.

## 13. DEVELOPMENT OF MULTI WALLED CARBON NANOTUBES COATED COLLAGEN FOR CELL CULTURING AND APPLICATION TO METALS

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**Introduction:** Carbon nanotubes (CNTs) have been of interest because of its mechanical, chemical and electrical properties. Recently, the biocompatibility of CNTs has been reported. In this study, multi walled carbon nanotubes (MWCNTs) coated cell culture dishes were prepared and their properties on all culturing were evaluated.

**Materials and Methods:** MWCNTs was purified by oxidation and acid treatment. MWCNTs was carboxylated into sodium cholate aqueous solution. The obtained MWCNTs suspension was poured into the collagen-coated dish, rinsed and dried at room temperature. MC3T3-E1 cells were cultured on these dishes and cell activity, proliferation and adhesion were estimated.

**Results:** The collagen coated cell culture dishes were homogeneously coated by MWCNTs as shown in Fig. 1. Relative cell viability on MWCNTs-coated dish was slightly lower than that on collagen-coated dish and their proliferation rates were almost similar. Fig. 2 shows the image of SEM, the cells attached on MWCNTs-coated dish. Cells were widely spread on MWCNTs coated surface. In addition, Cell adhesion to MWCNTs-coated dish was extremely higher than collagen-coated dish.

**Discussion:** With using the carboxylated MWCNTs, the homogeneous coating of MWCNTs was obtained. The cell affinity of MWCNTs-coated dish was equal to the collagen-coated dish. MWCNTs-coated dish had high cell adhesion.

**Conclusions:** MWCNTs-coated dish showed good cell affinity and high cell adhesion property. Therefore,

it would be applicable for the functional cell culturing substrate, e.g., substrate of lowly adhesive cells. At present, we apply MWCNTs to titanium (Fig. 3) dental implants.

#### 14. EFFICACY OF CITRIC ACID AND CHLORINE DIOXIDE FOR DECONTAMINATION OF *PORPHYROMONAS GINGIVALIS* ON RECRYSTALLIZED HYDROXYAPATITE-COATED TITANIUM

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This work examined the decalcifying effects of citric acid on *Porphyromonas gingivalis* (*P. gingivalis*), one of the causative agents for periodontal disease, cultured on the surfaces of recrystallized hydroxyapatite-coated titanium materials (RCHACT), and carried out analyses of the decalcified surfaces by energy-dispersive X-ray spectroscopy (EDS). Furthermore, the sterilizing potency of chlorine dioxide (ClO<sub>2</sub>) was also tested. A thick growth of the bacteria on the RCHACT was dramatically withered as a result of decalcification through the agency citric acid. When the citric acid treatment was given intermittently, the entire surface of the titanium was decalcified completely in 15 minutes. *P. gingivalis*-tainted RCHACT and decalcified RCHACT were thoroughly sterilized in 30 seconds by ultrasonic irrigation using ClO<sub>2</sub>.

#### 15. RELATIONSHIPS BETWEEN GONIAL ANGLE AND MANDIBULAR BODY MORPHOLOGY IN DENTULOUS JAPANESE SUBJECTS: MORPHOMETRIC ANALYSIS USING PANORAMIC RADIOGRAPHS

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<sup>1</sup>The Nippon Dental University, School of Life Dentistry at Tokyo, Japan. <sup>2</sup>Misaki Dental Clinic, Takaoka, Japan. This study was designed to clarify the relationships between gonial angle (GA) and mandibular body morphology. For these purposes, panoramic radiographs of 234 dentulous subjects with GA below 120 degrees (LGA) or above 125 degrees (HGA) were used. Morphometry was performed to obtain mandibular body height (MBH), alveolar bone height (ABH), basal bone height (BBH), trabecular basal bone height (TBBH), mandibular cortical width (MCW), panoramic mandibular index (PMI), mandibular cortical index (MCI), antegonial depth (AD) and antegonial angle

(AA). MBH, ABH, BBH and TBBH were significantly larger in the group of HGA than LGA, but the contrary was recognized with MCW, AD and PMI. MCI distribution was mostly symmetrical in both angle groups. Angle size should, therefore, be considered when evaluating panoramic radiographs for any morphological changes in mandibular body.

#### 16. A PRECAUTIONARY NOTE BEFORE IMPLANT SURGERIES. A REVIEW BASED ON PATIENT HISTORY AND HISTOPATHOLOGICAL FINDINGS

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A majority of implant therapy is being performed by general practitioners in Japan. Many times the surgery is being performed without proper examination and diagnosis. The patients end up with much discomfort after implant treatment consequently. Such treatment very rarely produces mortality and hence practitioners tend to be callous. Therefore creation of a thorough protocol for evaluation before implant treatment is indispensable. In particular, we propose an assessment by biopsy test to further expand on the diagnosis. When analyzed according to the criteria based on a patient history and clinical histopathological finding that Katagiri (2002) proposed, the validity could be confirmed through 3 case presentations.

#### 17. A CASE OF IMPLANT PLACEMENT FOLLOWING HORIZONTAL BONE AUGMENTATION BY EXTENSION CREST

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In recent years, the application of bone augmentation techniques has expanded indications for implant treatments. A 39 year old female with horizontal bone loss and narrow alveolar crest was treated by Extension Crest on sites 44, 45, 46. Simultaneously, three ITI implants were placed. Four months later, a secondary operation was performed. At this point, the Perio test values were 45 (-2), 46 (-2), 44 (0). The upper structure is bridge type and functional recovery is planned.