DOI: 10.1111/clr.13979

CLINICAL ORAL IMPLANTS RESEARCH WILEY

ABSTRACT

EPOSTER PRESENTATION WITH DISCUSSION

BASIC RESEARCH

EAO-313 / PO-D-01 | In vitro evaluation of metal particles of implantoplasty

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Background: Implantoplasty affords favorable clinical and radiological outcomes; however, some shortcomings and complications related to this technique have been described. The effect of the release of metallic particles in the peri-implant tissues has been largely overlooked.
Aim / Hypothesis: To analyze the expression of proinflammatory, and anti-inflammatory genes and cytokines induced by Ti6Al4V particles released during implantoplasty and by as-received commercially pure Ti particles. Secondarily, to evaluate the expression of osteogenic biomarkers induced by these metallic debris.
Material and Methods: A macrophage cell culture (THP-1) was carried out to analyze proinflammatory (CCR7, TNF-α and IL-1β) and anti-inflammatory (CD206, TGF-β and IL-10) genes by RT-qPCR. The release of proinflammatory and anti-inflammatory cytokines was quantified using ELISA kits. We analyzed Runx2, ALP, OC genes in human bone marrow mesenchymal stem cells (BM-MSCs) culture. Lastly, ALP activity was quantified using a colorimetric method. The Kruskal-Wallis test and Mann-Whitney U-test were used for statistical analysis.
Results: Macrophages stimulated with Ti6Al4V particles obtained by implantoplasty and with as-received Ti particles showed an increased proinflammatory expression of TNF-α and a decreased expression of TGF-β and CD206. Regarding cytokine release, there was an increase in IL-1β, while IL-10 decreased. Ti6Al4V extracts showed a significant decrease in Runx2 and OC expression compared to the controls and Ti extracts. There were no relevant changes in ALP activity.
Conclusion and Clinical implications: In cell cultures, implantoplasty particles increased the expression of pro-inflammatory genes, and significantly reduced the expression of osteogenic markers. Further in vivo studies are required to confirm the inflammatory and osteogenic response of metal particles released during implantoplasty.
Disclosure of Interest: None declared
Keywords: Biocompatibility, Dental implants, Peri-implantitis

EAO-442 / PO-D-02 | Biofilm removal on contaminated dental implants using self-propelling diatom colloids microbubbler

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Background: Dental implants have been considered the most effective clinical approach to restore structures and functions of lost teeth. Despite the high survival rate of a dental implant, the prevalence rate of peri-implantitis continues to increase. Manganese oxide nanozyme-doped diatom microbubbler (DM), a recently developed material, moves while continuously generating and ejecting oxygen bubble in the hydrogen peroxide solution, resulting in penetration and mechanical removal of biofilms.
Aim / Hypothesis: The purpose of this study is to evaluate the effect of DM in removing biofilms from peri-implant-affected implant fixtures (PAIF) extracted from patients with severe peri-implantitis.
Material and Methods: The physicochemical characterization of DM was analyzed. Biofilms of Porphyromonas gingivalis formed on titanium disks, and the specimens were treated with phosphate buffered saline (PBS group), 0.12% chlorhexidine (CHX group), 3% H2O2 (H2O2 group), and co-treatment of 3 mg / mL of DM and 3% H2O2 (DM group) for 2 min. The biofilm removal effect was analyzed by crystal violet assay and the results were visually observed using SEM. PAIF diagnosed as hopeless were extracted, and rheological properties of biofilms obtained from the implants were measured by rheometer. The biofilm removal force of DM was measured by using FITC-BSA-loaded artificial biofilms with a different elastic modulus (0.7–31.5 kPa). The effect of DM on removing mature multispecies biofilms on PAIF was evaluated. Non-treated PAIF and DM-treated PAIFs were placed in femurs of rabbits. Four weeks later, the tissue slices stained with Masson-Goldner's Trichrome and bone-to-implant contact (BIC) ratio was calculated.
Results: Elemental analysis through SEM and TEM images revealed that MnO2 nanozymes were uniformly doped on DM. The P. gingivalis biofilms formed on the titanium disks were effectively removed in the DM group. The PAIF biofilms exhibited viscoelastic properties, with the elastic modulus (or shear modulus) ranging from 1,208 to 1,747 Pa. The DM group removed the artificial biofilms with an elastic modulus ranging from 0.7 to 7.4 kPa. These results theoretically

prove that DM treatment can effectively remove the biofilm of PAIF. Multi-species biofilms on the surfaces of PAIF extracted from patients were effectively removed by treatment of DM. BIC was not observed around non-treated PAIF, but the DM-treated group showed a BIC rate of 39.5%, indicating that re-osseointegration occurred.

Conclusion and Clinical implications: DM effectively removed biofilms from the surfaces of dental implants affected by peri-implantitis. The DM-based therapeutic approach will be a promising alternative to resolve the clinically difficult aspects of peri-implantitis treatment.

Disclosure of Interest: None declared

Keywords: Biomaterial, Bone regeneration, Peri-implantitis

EAO-463 / PO-D-04 | The bone regenerative potential of RANTES / CCL5 in the calvarial defects of rat

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Background: Bone regeneration has been an interesting research topic for clinicians and basic medical scientists. Among the various regeneration methods, cytokine therapy using like BMP-2 and amelogenin has been suggested as the most predictive future bone regeneration method. However, the potential of other various cytokines has not yet been studied. Recently, a novel protein, chemokine ligand 5 (RANTES / CCL5), has been proposed to be a strong candidate to promote migration and activation of PDLSCs.

Aim / Hypothesis: However, it is necessary to find out the appropriate concentration of CCL5 for optimizing the regeneration. The objective of the present study is to compare the bone regenerative potential of CCL5 soaked to the collagen matrix according to the various concentration in the calvarial defects of rats.

Material and Methods: A total of 53 rats were prepared for the experiment. Circular defects of 6 mm in diameter were made using trephine bur in calvarium of the rat. The defects were randomly allocated to the five groups: (i) negative control (no grafting) group; (ii) positive control (collagen matrix only) group; (iii) low-CCL5 (0.1 μg/ml) group; (iv) moderate-CCL5 (1 μg/ml) group; and (v) high-CCL5 (10 μg/ml) group. The samples were collected at 2 weeks and 8 weeks postoperative. Histometric analysis was performed to measure the % of newly bone formation (%NB) within each defect. Kruskal-Wallis test was conducted to determine the differences between the groups, and p value < 0.05 was considered statistical significance and Mann-Whitney test between each two groups, and p value < 0.001.

Results: There were no adverse reactions in any of the specimens. Histomorphometry at 2 weeks revealed that the low-CCL5 (18.69 ± 5.04%) and moderate-CCL5 (21.63 ± 4.86%) groups demonstrated significantly higher %NB than the negative control group (8.33 ± 3.35%; p < 0.005), whereas the positive control and high-CCL5 groups did not show significant difference compared to the negative control group. At 8 weeks, however, there were no statistical difference in %NB among the five groups.

Conclusion and Clinical implications: It was found that CCL5 showed a higher regenerative potential in the early healing stage when it was soaked to the collagen matrix with the concentration of 0.1 μg/ml and 1 μg/ml. This finding needs to be further verified by a periodontal defect model experiment with a larger animal as well as a clinical research.

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2020R1A2C2008053).

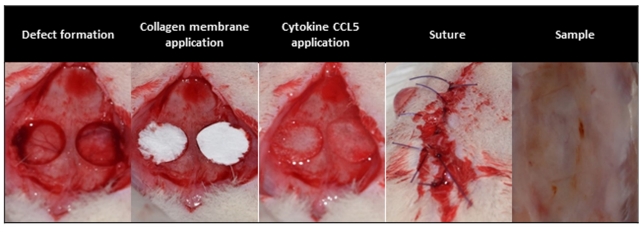

Figure 1.
Surgical procedure of rat calvaria defect formation and application of collagen membrane and cytokine CCL5 in each concentration.

FIGURE 1

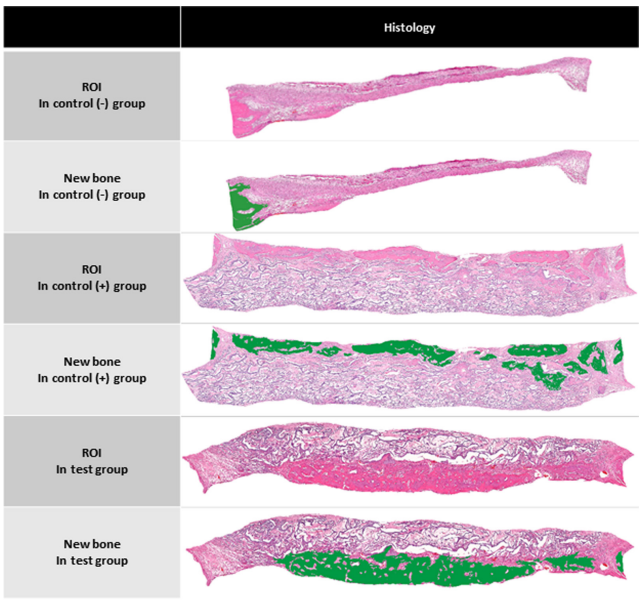

Figure 2.
Histology analysis of ROI and new bone formation in defect with each cytokine CCL5 concentration.

FIGURE 2

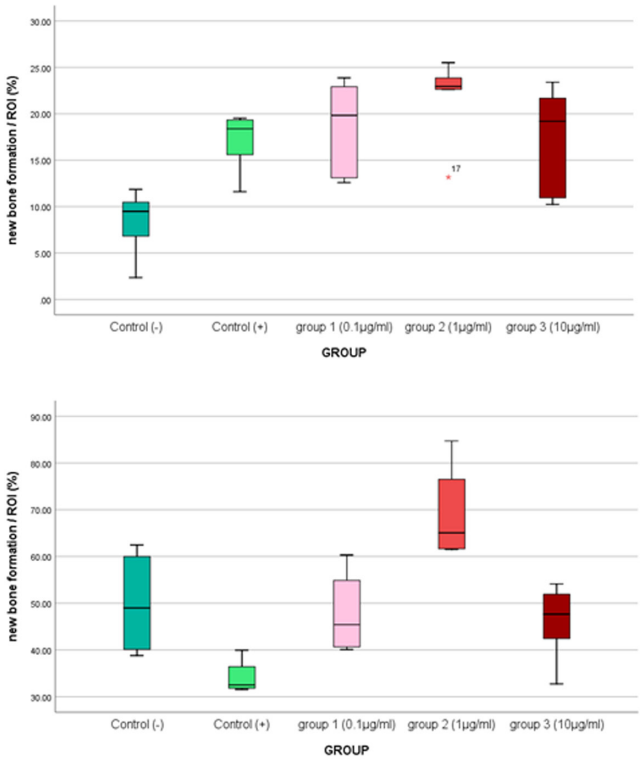

Figure 3.
(a)The ratio of New bone formation in ROI (%) in each groups in 2 weeks
(b)The ratio of New bone formation in ROI (%) in each groups in 8 weeks

FIGURE 3

Disclosure of Interest: None declared.

Keywords: Biomaterial, Bone regeneration, Histology.

EAO-530 / PO-D-05 | Organic remnant debris on drills cleaned after patient use in private settings. A SEM investigation

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Background: Drills are used in every day practice for implant placement; manufacturers recommend disposing them after 20-30 times because of wear. After every patient, the reusable drills are cleaned and sterilized; they are ready for the next treatment. The issue of how effective are the cleaning steps performed in private practices, to completely remove the organic remnant debris between patients, has been scarcely investigated.

Aim / Hypothesis: To: (1) characterize the drills of different implant systems, (2) check under scanning electron microscope (SEM) the presence of remnant debris on drills that underwent a routine cleaning-sterilization process at high level private practices.

Material and Methods: Drills from 4 distinct worldwide distributed implant systems, Nobel Biocare, tapered (NT) and NobelActive (NA), Straumann (S), MIS (M), and Zimmer-3i (Z), were characterized according to aspect, surface treatment and geometry. Reusable drills that have been routinely cleaned and sterilized were obtained from 13 different private practices belonging to the following 5 countries: France, Germany, Greece, Israel, Spain. They were observed under SEM (x 12-2000 magnification); the organic and mineral residues were characterized by energy dispersive X-ray spectroscopy (EDS), a chemical microanalysis technique used in conjunction with the SEM that enables identification of the chemical elements found on the surface of the drills cleaned in these high level practices.

Results: Aspect of the drills varied between implant systems; they were metallic grey (S,M,Z) and black (amorphous diamond coating, NT,NA). Their geometries were 4-spade (NT) or twisted (S,M,Z,NA). Depth indication was evidenced by notching (NT,NA), laser-etching (S,Z) or both (M). Laser-etching was strong (S) or moderate (M,Z); 2 implant systems had an apical hole (NT,Z). Three drills, pilot, medium and large from each practice were selected and a total of 75 drills originating from 13 distinct practices were investigated; several settings had distinct implant systems in use. Cleanliness of the drills varied highly among practices; amount of residues varied from limited blood remains (Ca,S,Cl,K,Na,Mg) to larger surfaces covered with bone (Ca,P) debris. Contamination of non-organic debris involved Si,Ca,Ti,Al and even Cu and Zn. Mineralized tissue was preferentially found in apical holes, at notches, and on the strongly laser-etched surfaces. No drill was completely free of biologic remnants.

Conclusion and Clinical implications: Cleanliness varied considerably among practices but no drill was completely free of organic debris. Strongly laser-etched surfaces developed for depth marking and holes were more prone to retain organic residues. The way to attain zero organic debris is either to involve strong chemicals and demanding cleaning procedures that don't suit the conventional safety conditions of dental clinics or use disposable drills for each patient.

Disclosure of Interest: R. Kolerman: None declared, T. Chakartchi: None declared, G. Slutzkey: None declared, S. Szmukler Moncler Conflict with: Director of Research, MIS.

Keywords: Biomaterial, Dental implants.

EAO-531 / PO-D-06 | Saline-stored super-hydrophilic surface promotes early osseointegration of Titanium gr. 23 implants

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Background: Storage of commercially pure titanium sandblasted and etched implant surfaces in a NaCl isotonic saline solution has shown to: (1) maintain initial super-hydrophilicity, (2) generate surface nanostructures, (3) increase bone apposition at the implant surface during the early stages of bone healing. Surface characterization

and early bone apposition on a titanium grade 23 surface that was similarly sandblasted, etched and stored in isotonic saline has not been reported so far.

Aim / Hypothesis: To characterize the wet and super-hydrophylic (SAE+) and non-hydrophilic (SAE) implant properties in terms of surface hydrophilicity and generation of nanostructures; to analyze the bone-implant contact (BIC) after 2 weeks of implantation in the mini-pig mandible and maxilla.

Material and Methods: SAE and SAE+ cylindrical implants with defined bone chambers (BoC) were prepared (MIS Implants Technologies). After wet storage, hydrophilicity of the surfaces was measured on disks (n = 6) with a contact angle goniometer. Generation of nanostructures was characterized on the implants with a high resolution microscope (HR-SEM) at x 25k-200k. After tooth extraction of all PM4 and M1 and a 2-month healing period, 3-4 implants per hemi-arcade were placed in the mandible and maxilla of 2 mini-pigs. They were left to heal in a submerged way for 2 weeks. Twelve SAE implants, 6 in the mandible and 6 in the maxilla and 13 SAE+, 6 in the mandible and 7 in the maxilla were placed. The BIC of each BoC was measured and their values were further determined for each implant. Implants were harvested, treated for undecalcified histology and central bucco-lingual / palatal sections were obtained and stained. The BIC within the BoCs were measured and compared with the Wilcoxon signed-rank test.

Results: Contact angle of the SAE and SAE+ implants was 99.5 ± 3.6 and 0.0 ± 0.0 degrees, respectively; this demonstrated that the SAE+ surface maintained its pristine super-hydrophilicity over time. Under HR-SEM, the surface of the SAE+ implants showed an arrangement of densely packed nanostructures. The BIC of the maxillary and mandibular implants of the SAE and SAE+ groups were not statistically different; therefore, they were further pooled. The median BIC at 2 weeks of the SAE and the SAE+ groups was 6.79 % and 16.46 %, respectively. The 2.4 times difference was highly significant (p = 0.0024).

Conclusion and Clinical implications: Storage of the present implant surface made of titanium grade 23 (MIS Implants Technologies) in a NaCl isotonic solution was able to maintain its pristine super-hydrophilicity and generate a densely packed arrangement of nanostructures. This wet super-hydrophilic surface enabled more bone apposition 2 weeks after implantation when compared to the non-hydrophilic standard implant surface. This study shows that this saline stored super-hydrophilic implant surface promotes early osseointegration.

Disclosure of Interest: I. Binderman: None declared, A. Schifter: None declared, F. M. Muñoz Guzon: None declared, S. Szmukler Moncler Conflict with: Director of Research, MIS.

Keywords: Dental implants, Implant surface, Osseointegration.

CLINICAL INNOVATIONS

EAO-273 / PO-D-07 | Construction of AI system to identify the dental implant system from radiographic images

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Background: In Japan, patients treated with implant is increasing; however, the patients' implant information will be lost when they move into nursery home due to their aging or the implant clinic where the patient was treated is closed. Hence, it is often difficult to identify the details of implant information, when such patients require treatment. If we could construct non-invasive method that identified the inserted implants information precisely, we will be able to provide treatment for the implant.

Aim / Hypothesis: The aim of this study was to identify the system of dental implants using deep learning for radiographic images. To construct the AI system of discriminating the implant system from radiographic images will increase the possibility of solving problems of treatment for unidentified implant.

Material and Methods: Radiographic images data from Tokyo Medical and Dental University were used as training data. In this study, a two-step identification system was used to obtain different results for the first and second identifications. The first identification is performed to detect and trim the implant area in the image and extract only the implant area. The second identification recognized the shape and other characteristics of the implant and identifies the type. At first, we created annotation data using the same label (class) name "implant" from panoramic and periapical radiographic images of implants about 1000 images, and created and trained a data set. Then, in constructing the second identification, approximately 1,300 radiographic images were used for our provided training data that were incorporated into the system. Under certain conditions, the relevant type of implant in the image data for evaluation was identified and classified.

Results: To confirm the effectiveness of the two-step discrimination, 10 panoramic radiographic images were prepared and tested for implant body detection. Seven out of ten images were detected, indicating that the use of two-step discrimination improves the detection rate of implants even in panoramic radiographic images where teeth and implants coexist. At this point, ensemble identification methods were incorporated to improve identification accuracy. To evaluate the constructed AI system, image data from 23 different implant bodies, 54 in total, were identified and evaluated. Although there was bias in the images of implant systems that could be prepared for evaluation, the detection rate of the implant part by the

first identification was 100%, and the implant systems that provided more than 90 radiographic images for evaluation had the best detection rate in the second identification, with 100% or high percentage among the candidates.

Conclusion and Clinical implications: In constructing the AI system, the number of provided radiographic images exceeding 90 is sufficient for identification accuracy. The implant body detection rate was 100% for the evaluation images used by the two-step identification, and furthermore, the implant type was more clearly identified by using the ensemble identification method.

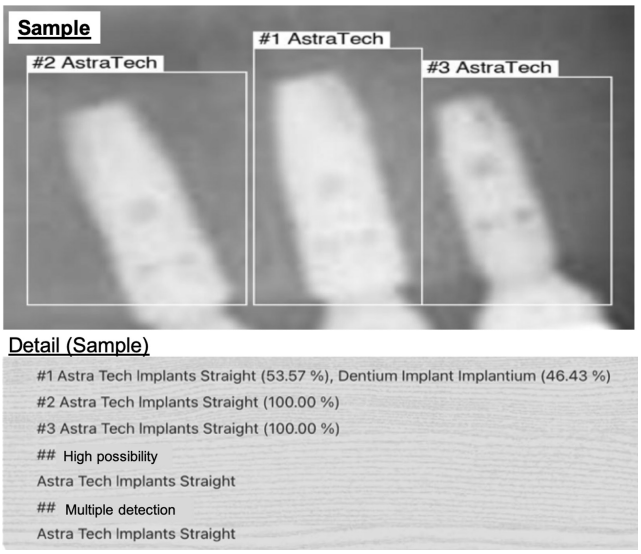

FIGURE 1

Disclosure of Interest: None declared

Keywords: Clinical studies / trials, Dental implants

EAO-237 / PO-D-08 | The effect of a mobile dental application in self-administered plaque control: An RCT

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Background: The most fundamental and basic dental treatment starts with plaque control and the Oral Hygiene Phase. This influences the treatment planning, overall prognostication and maintenance for any patient. Majority of the population in developed countries have access to smartphones. Many mobile dental applications for oral hygiene are available; however, applications specifically for the monitoring of one's oral health through the use of intra-oral photos / videos taken at regular intervals are limited.

Aim / Hypothesis: To evaluate the effectiveness of the use of an artificial intelligence ("AI") driven mobile dental application, Dental Monitoring in the monitoring and promotion of self-administered plaque control.

Material and Methods: 52 adult subjects aged between 21 and 65 who met the inclusion criteria were randomised into either the Control or Test group. The subjects had their medical, dental and social history taken prior to an oral examination (clinical parameters recorded) by a single blinded examiner. All subjects were given personalised oral hygiene instructions ("OHI"), a standard toothbrush, toothpaste and interdental brushes.

The Test group received an additional Dental Monitoring ("DM") Kit and downloaded a mobile dental application onto their smartphones with instructions to monitor their oral hygiene status every 7 days. They had to take a set of intra-oral videos weekly during the study interval.

The study consisted of Visit 1 (Baseline) and Visit 2 (Review) one month apart.

Primary Outcome: Full Mouth Plaque Score ("FMPS")

Secondary Outcomes: Full Mouth Bleeding Score ("FMBS"), Feedback on the DM Kit usage

Analysis: Wilcoxon rank sum test and statistical significance set at p-value < 0.05

Results: (1) 52 subjects (38 females, 14 males) aged between 22 to 65 years old (mean age 42.3) were recruited and there were no dropouts.

(2) At Visit 2 (Review), there was significant reduction of > 50% in the FMPS and FMBS Difference for both the Test and Control groups.

(3) No statistically significant differences for the FMPS between the Test and Control groups.

(4) No statistically significant differences for the FMBS between the Test and Control groups.

(5) The Test group were overall encouraged / motivated and satisfied regarding the use of the DM kit to monitor their oral hygiene status but the majority were "unsure" for its usage in the long-term.

*Study Results Table Legend:

- FMPS Difference = Difference between FMPS1 (Visit 1) and FMPS2 (Visit 2)
- FMBS Difference = Difference between FMBS1 (Visit 1) and FMBS (Visit 2)

Conclusion and Clinical implications: (1) Personalised OHI alone in the Oral Hygiene Phase (of 1 month) will significantly reduce full mouth plaque and bleeding scores prior to dental treatment

(2) Dental Monitoring, an AI-driven mobile dental application, had no added benefit in the promotion of self-administered plaque control but showed comparable efficacy when used in conjunction with Personalised OHI

(3) Modifications to the mobile dental application and improved design of the DM kit for ease of usage may encourage long-term use

	Control		DM		
	Median	IQR	Median	IQR	p-value
FMPS1	86.50	(17.67)	87.80	(14.28)	0.305
FMBS1	40.09	(30.95)	39.00	(32.24)	0.791
FMPS2	36.87	(23.14)	35.90	(23.59)	0.481
FMBS2	16.98	(18.59)	14.82	(24.91)	0.942
FMPS Difference	46.89	(19.40)	43.65	(20.13)	0.410
FMBS Difference	16.80	(26.19)	23.22	(13.93)	0.314

FIGURE 1

Disclosure of Interest: None declared.

Keywords: Clinical studies / trials, Patient satisfaction

EAO-470 / PO-D-09 | Autologous dentin graft combined to three resorbable layers membrane in alveolar ridge regeneration

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Background: Alveolar ridge preservation technique is an effective therapy in order to attenuate the physiologic bone reduction after tooth extraction (Avila-Ortiz et al. 2019). The autogenous tooth graft could be use with success because human dentin and bone show the same mineralization, collagen type I presence and growth factors (Minetti et al. 2020). Recently a novel flapless approach to ridge regeneration by using three resorbable layers of hole-punched membrane was introduced (Grassi et al. 2021).

Aim / Hypothesis: This case series aims to evaluate clinical and histological outcomes of the novel flapless approach with the sealing of three reabsorbable layers membrane combined with the use of autologous demineralized dentin graft.

Material and Methods: Five consecutive patients with a mean age of 58,6 years were enrolled in this case series. All the patients showed a post-extractive socket surrounded by three bone walls; socket buccal-lingual and vertical morphology dimensions were recorded at the baseline. The whole extracted tooth was cleaned, cut and inserted in the milling device (Tooth Transformer, Milan, Italy) in order to obtain suitable particle graft biomaterial. The membrane (Osseoguard, Zimmer Biomet) was hole punched to produce three round membrane layers and all membranes cover the defect and only the third superficial membrane was secured with 5-0 PTFE suture. The socket was allowed to heal without primary wound closure to increase keratinized tissue width. Ridge CBCT measurements were taken between 20 and 34 weeks after the surgery. After an average of 25,8 weeks a bone cores biopsies were made for histologic and morphometric analyses.

Results: Clinical outcomes showed a good healing of soft tissue and a predictable horizontal bone regeneration with a good maintenance of soft tissue architecture. In all cases, after about 6 months of healing, the defects were filled by newly formed bone. All sockets showed complete bone filling by clinical and radiographs observation. The healing of soft tissues after grafting procedures was particularly free of complications. In two cases, some residual granules were visible in the most superficial portion in close contact with the apical membrane. The histologic and histomorphometric analysis revealed the absence of inflammatory cells and the 62,78 ± 7,97 % of total volume was occupied by bone tissue. The new bone formation percentage was 57,53 ± 11,16% and f residual graft dentin material percentage was only 5,24 ± 5,82%.

Conclusion and Clinical implications: In the present paper we analyze the new alveolar ridge regeneration procedure with three punch membrane combined with the use of dentin graft treated by the tooth transformer device. The histological results are very promising with high mean values of new bone formation in sites with incomplete bone anatomy. The residual graft is very low and it would appear to be greater in the external surface in respect with the inner part. This fact is probably due to connective tissue infiltration.

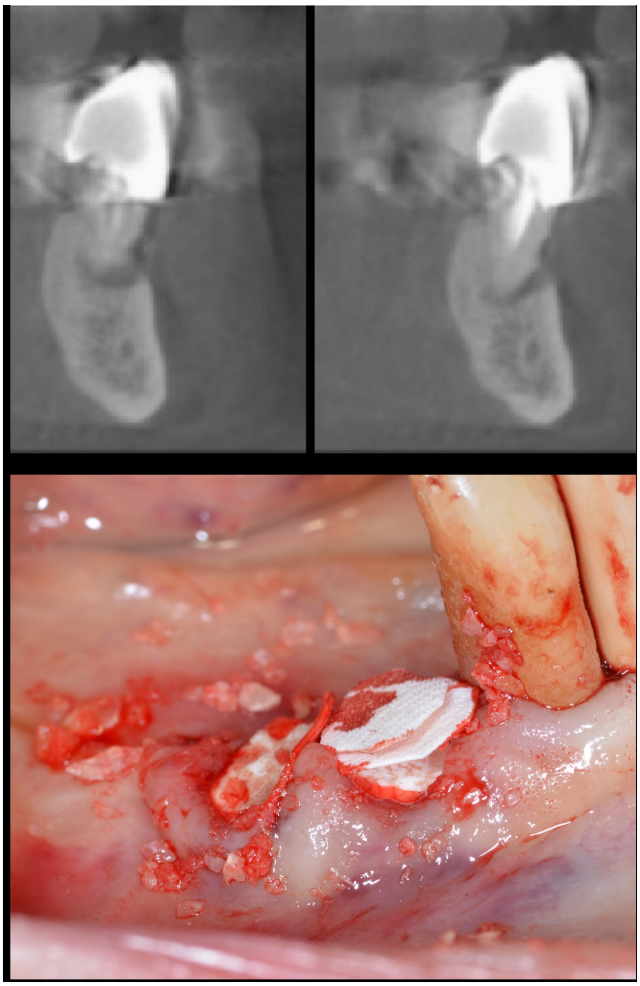

FIGURE 1

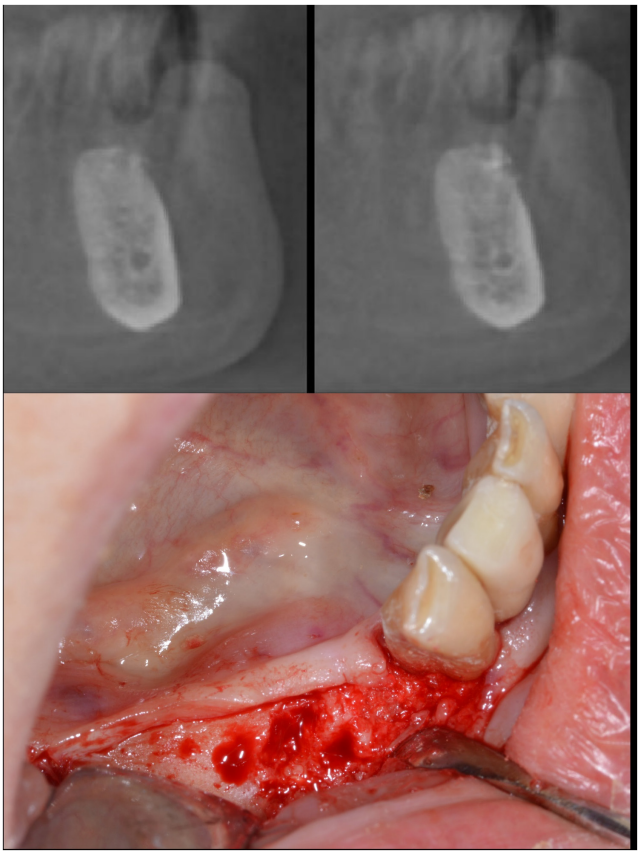

FIGURE 2

Case No.	Total Bone%	New Bone%	Graft residual%	Healing time
1	61,69	61,52	0,17	24 weeks
2	57,15	42,72	14,43	20 weeks
3	66,67	59,06	7,6	26 weeks
4	74,25	72,63	1,62	25 weeks
5	54,14	51,76	2,38	34 weeks
Average ± SD	62,78±7,97	57,53±11,16	5,24±5,82	25,8 weeks

TABLE 1

Disclosure of Interest: None declared.

Keywords: Alveolar ridge preservation, Bone graft, Bone regeneration.

EAO-573 / PO-D-10 | Accuracy of implant surgical robot system compared to computer-guided implant surgical template

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Background: Robots are automatically operated machines that have replaced humans in performing various tasks. With advancements in robotic technology, a robotic system, the da Vinci Robot, has been gaining popularity for helping surgeons deliver a less invasive approach in the medical fields of gynecology, urology, and general surgery. Proven advantages of robot-assisted surgery include precise execution of technically demanding procedures and eliminating human tremors.

Aim / Hypothesis: This study aimed to evaluate the tracking accuracy of a robot-guided implant surgery system and compare the spatial accuracy of robot-assisted implant surgery with the static stent-guided implant surgery in implant placement.

Material and Methods: The tracking accuracy of the robot system was obtained by measuring the discrepancy of the robot arm relative to the actual programmed position. Dental implants were placed on 3D printed human phantom models by static stent guided surgery and robot-assisted surgery. Top, apex, angular, and depth deviations of the seated implant positions were measured from the planned location, and the values were compared between the robot and surgical guide groups. The results were analyzed by the Mann-Whitney U test ($\alpha < 0.05$).

Results: The tracking accuracy of the robot system showed a linear deviation of 0.13 ± 0.04 mm and an angular deviation of 0.77 ± 0.02° at the drill tip. Deviations at the top and apex of the implants were 0.61 ± 0.29 mm and 0.50 ± 0.14 mm for the robot group and 0.49 ± 0.39 mm and 0.72 ± 0.39 mm for the surgical guide group, respectively. Angular and depth deviations were 2.38 ± 0.62° and 0.17 ± 0.12 mm for the robot group and 3.16 ± 2.36° and 0.15 ± 0.11 mm for the surgical guide group. No statistically significant difference was found between the robot and surgical guide group ($p > 0.05$).

Conclusion and Clinical implications: The robot-assisted implant surgery showed a comparable accuracy in implant placement to the static guided surgery. The robot-assisted implant surgery and the static guided surgery tended to show minor deviations at the apex and top of the implants, respectively.

Fig 1. (A)Workflow of robot-assisted implant surgical system and accuracy evaluation procedure, (B)Operation room setting and robot-assisted implant socket drilling while tracking positions of robot end effector and patient's jaw in real-time with robot manipulation software.

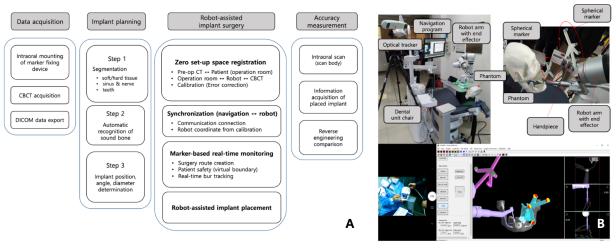

FIGURE 1

Fig 2. Phantom setting for implant placement. (A) Robot-assisted bone removal with haptic feedback of robotic arm and real-time tracking, (B) Drilling with 3D printed implant surgical guide, (C) Accuracy measurement by reverse engineering placed implant through scan body and comparing with planned implant.

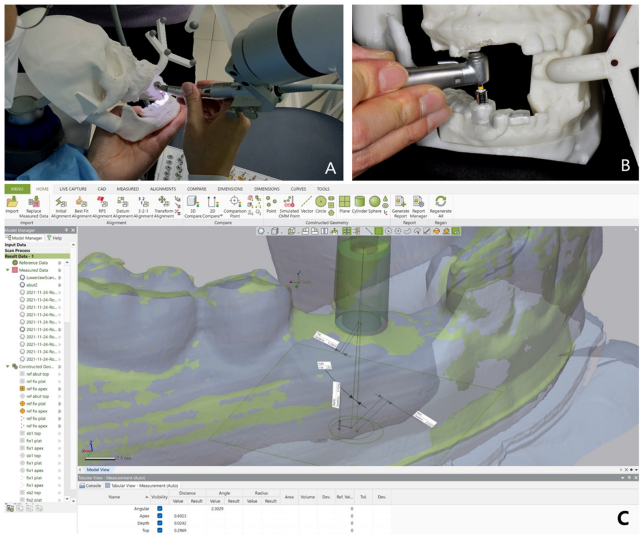

FIGURE 2

Fig 3. Bar graph showing mean and standard deviation of deviations of robot and surgical guide groups. (A) Top deviation, (B) Apex deviation, (C) Angular deviation, (D) Depth deviation.

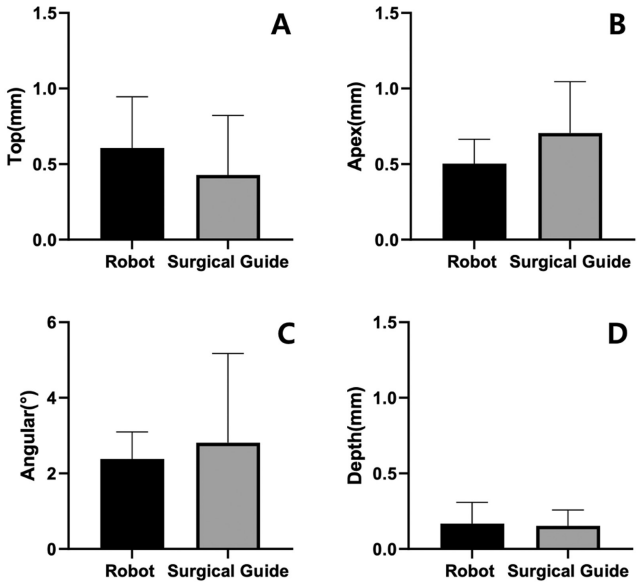

FIGURE 3

Disclosure of Interest: None declared.

Keywords: Accuracy, Digital workflow, Guided implant surgery.

EAO-218 / PO-D-11 | A study on the effective cleaning of healing abutment using healing abutment case

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[3]*Department of Prosthodontics, College of dentistry, Dankook University, Cheonan-si, South Korea*

Background: Healing abutment in implant patients who are not in oral hygiene controlled is likely to act as a mediator to expose the implant to bacteria. The healing abutment is removed and tightened from the oral cavity during implant prosthesis process. The surface of healing abutment is washed simply with alcohol swab in most dental clinics, because of error in positioning and inconvenient keeping. But, the actual situation is that it has not been thoroughly cleaned.

Aim / Hypothesis: The present study aimed to investigate the effective cleaning of healing abutment (HA) using Healing abutment case (HA case) by observing oral microorganisms with phase contrast microscope.

Material and Methods: 32 patients with two or more implants placed in the same jaw, a total of 64 HAs (experimental group 32, control group 32) were selected and the control was cleaned with an alcohol swab. At the first and second visits, each group was observed before cleaning, and the experimental group was additionally observed after cleaning at the first visit. A 400× phase contrast microscope was used for the observation of oral microorganisms for its amounts.

Results: There was no significant difference in the amount of oral microorganisms was found between the groups at the first visit, no significant difference according to gender, maxilla or mandible, and buccal or lingual surface. There was a statistically significant difference in the amount of oral microorganisms according to supra-gingival and sub-gingival ($p < .05$), There was also a significant difference in the comparison before and after cleaning in the experimental group ($p < .05$). There was a significant difference in the amount of oral microorganisms in each group at second visit ($p < .05$).

Conclusion and Clinical implications: Healing abutment cleaning using healing abutment case solution is more effective than simple cleaning with alcohol swab.

TABLE 1

Table 1. Evaluation criteria of the amount of microorganism (unit: n)

Degree	Cocci	Bacilli	Filamentous	Comma/Spiral
0	none	none	none	none
1	1-7	1-7	1-7	1-3
2	8-70	8-30	8-30	4-8
3	>70	>30	>30	>8

TABLE 2

Table 2. Average score of oral micro-organism according to type of bacteria

Type of bacreria	N	Amounts of bacteria
Cocci	512	1.00±0.78[a]
Bacilli	512	0.20±0.53[b]
Filamentous	512	0.18±0.53[b]
Comma/Spiral	512	0.10±0.44[b]

Different letters show statistically significant differences between the groups ($P < 0.05$)

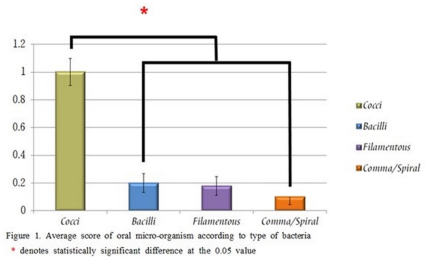

Figure 1. Average score of oral micro-organism according to type of bacteria
* denotes statistically significant difference at the 0.05 value

TABLE 3

Table 3. Average score of oral micro-organism according to groups at second visit

Group	N	Amounts of bacteria
Experimental	512	0.36±0.68
Control	512	0.48±0.80
p value		0.02*

P value is obtained by Mann-Whitney U test

* denotes statistically significant difference at the 0.05 value

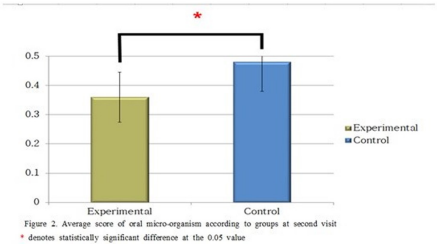

Figure 2. Average score of oral micro-organism according to groups at second visit
* denotes statistically significant difference at the 0.05 value

Disclosure of Interest: None declared.
Keywords: Clinical studies / trials, Dental implants

EAO-585 / PO-D-12 | Comparative evaluation of healing of extraction sockets implanted with novel bone graft & allograft

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Background: Implant placement in atrophic jaws has become the need of the hour. Often lack of adequate bone hinders implant placement from an aesthetic and functional point of view thus increasing the demand for bone augmentation procedures as well as materials. Recent developments in bone grafting materials aim to acquire the unique anatomy, porous structure, and increasingly organized bone morphology. Novel biomaterials and scaffolds that substitute hard tissues more ideally and efficiently is on the rise.

Aim / Hypothesis: The aim was to evaluate the osteogenic activity of a novel eggshell derived bone graft; to evaluate and compare radiographically and clinically, the healing of extraction sockets implanted with egg shell derived bone graft and commercially available allograft.

Material and Methods: Bone graft was prepared using eggshell and chitosan hydrogel, and was subjected to MTT assay using MG-63 osteoblast like cells to evaluate the cell proliferation followed by evaluation of alkaline phosphatase activity. Acridine orange and Von-Kossa staining was carried out to quantify the mineralization. Twenty fresh extraction sockets with intact cortical plates were selected in 10 patients. A double blinded, split-mouth design was used: 5 sockets on the right side of the jaw received eggshell derived bone graft, while 5 sockets on the left side received commercially available bone graft. At baseline, 45 days and 90 days radiographic analysis assisted by grayscale analysis was carried out.

Results: The mean cell proliferation after 72 hrs was seen to be 120.70 for CG whereas 131.10 for the TG. ($p < 0.05$) Alkaline phosphatase activity showed lesser counts of positive cells at the end of 8 days for CG (2.45) whereas 3.37 for TG. ($p = 0.0001$) Acridine orange stain revealed polygonal cells indicating osteogenic activity in the TG, whereas round cells in the CG. Quantification of mineralisation assessed with Von kossa staining revealed multiple foci of calcification in TG when compared to the CG.

After 3 months, mean radiographic bone level was 1.19 with standard deviation of 0.65 mm in the CG, whereas 2.68 with a standard deviation of 0.49 in the TG. The bone density evaluated with the gray scale histogram values were subjected to statistical analysis using independent t test at the end of every 30 days. The resultant $p = 0.0026$, 0.0001, 0.0074 were all found to be statistically significant, implicating an increase in bone density in the TG.

Conclusion and Clinical implications: The combination of Eggshell and Chitosan influenced MG-63 osteoblast like cells by enhancing its proliferation and promoting mineralization thereby making it an effective, economic osteogenic bone graft scaffold. Clinically shown increase in quantity and quality of bone makes it an economic, effective adjunct to implant placement. This research paves the way for future research in the field, confirming eggshell to be a potent bone graft material.

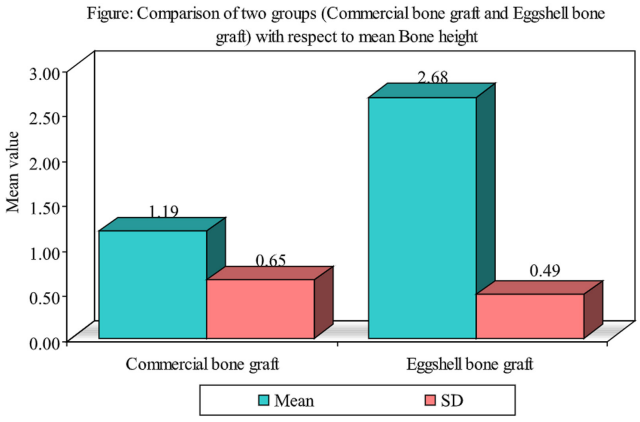

FIGURE 1

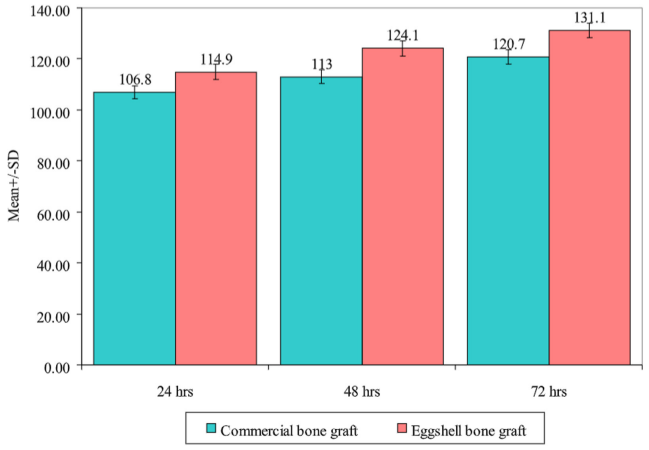

FIGURE 2

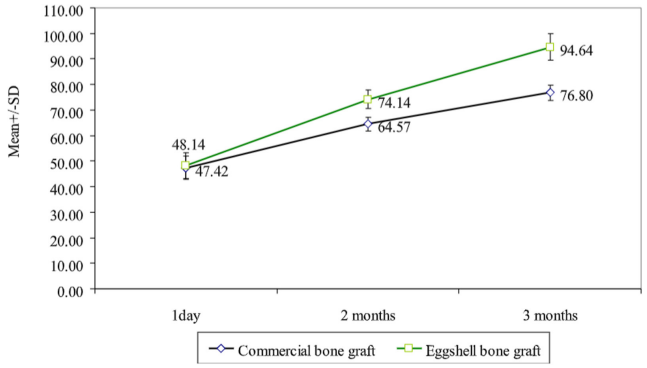

FIGURE 3

Disclosure of Interest: None declared.

Keywords: Alveolar ridge preservation, Bone graft, Bone regeneration.

EAO-616 / PO-D-13 | Developing an artificial intelligence solution to automate digital implant planning

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Background: Assessment of the edentulous area by manual measurement of bone volume on CBCT images is time consuming and is subject to human error. Automatic bone segmentation, with the help of Artificial Intelligence (AI), can be a promising solution to save time and reduce human errors.

Aim / Hypothesis: Our aim is to develop an AI-based model that is able to identify edentulous alveolar bone on CBCT images as the first step of an automated implant planning. Hypothesis: the artificial intelligence automated segmentation is as accurate as the manual segmentation.

Material and Methods: After obtaining the ethical approval, a total of 43 CBCT images were extracted from the database of the University Dental Hospital Sharjah using the Romexis software using pre-defined inclusion criteria. Manual segmentation of the edentulous span was done by two operators using ITK-snap software version 3.8. Out of the 43 labelled cases, 33 were utilized to train the computational model on identifying edentulous spaces in the mandible(training), and 10 were used for testing the model's performance (testing). The Neural Network used was "UNet"; one type of convolutional neural networks (CNNs). This network was trained under supervision from scratch using our data. The training / coding was done using the Python programming language. The degree of overlap between the segmentation made by human investigators and the model's segmentation was measured by the Dice Similarity Coefficient (DSC). DSC produces a score between 0 and 1, with 1 indicting highest level of similarity and reliability.

Results: The most commonly missing teeth in the study sample were molars followed by premolar teeth. The male:female ratio was 1.68 and the dice coefficient yielded an average value of 0.89 for the sample used for training while the average value for testing was 0.78. Furthermore, the highest and lowest values in the testing section were 0.91 and 0.55, respectively. The average dice similarity coefficient for the bilateral cases is 0.73, while the dice similarity coefficient for unilateral cases is significantly higher with an average of 0.91.

Conclusion and Clinical implications: The developed model was able to identify delineate edentulous spans with high accuracy. Artificial intelligence has a promising role in automating digital implant planning with higher efficacy and efficiency compared to current practice. This study presents the preliminary results of an ongoing project. Future work involves a larger variation of the clinical conditions aiming to increase generalizability and accuracy

Disclosure of Interest: None declared.

Keywords: Accuracy, Dental implants, Digital workflow.

Clinical Research – Peri-implant Biology

EAO-479 / PO-D-14 | The effect of ceramic reinforced PEEK abutments on peri-implant tissues–preliminary data

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Background: The use of biocompatible materials with excellent mechanical and physical properties is essential for the long-term success of implant-retained restorations. Titanium and Zirconia are

currently the most widely used abutment materials in implant dentistry. Ceramic reinforced biomaterials based on polyether-ether-ketone (PEEK), such as BioHPP (high performance polymer), are promising alternative materials with good biomechanical properties and optimized surface modification.

Aim / Hypothesis: The objective of this study is to determine the effect of BioHPP abutments on peri-implant tissue in comparison to the standard materials titanium and zirconia and to clarify if ceramic reinforced abutments are equal to these standard materials over an observation period of three years.

Material and Methods: In this randomized clinical trial, 60 patients are treated under an institutional review board. Three months after implant insertion (baseline), all implants receive screw-retained individual computer-aided design (CAD) / computer-aided manufacturing (CAM) abutments (ceramic reinforced PEEK *n* = 20, titan *n* = 20, zirconia *n* = 20) and are restored with screw-retained CAD / CAM technology designed "High Impact Polymer Composite" (HIPC) crowns. A block randomization sequence is used to assign the abutments. Clinical and radiographic assessments of peri-implant soft tissue, marginal bone level (MBL), bleeding on probing (BOP), plaque index (PI), abutments and crowns are recorded after 3, 6, 12, 24 and 36 months. Statistical analysis includes group comparison (one-way analysis of variance) and Kruskal Wallis test for unrelated samples.

Results: So far 36 patients participated in this randomized controlled clinical trial. 22 patients (BioHpp: 9, Zirconia: 8, Titanium: 5; groups, respectively) were already examined one year after baseline. Statistical analysis revealed no significant differences between study groups regarding the assessed parameters: PI (p = 0,472), BOP (p = 0,276) and MBL (p = 0,834). The reinforced polyether-ether-ketone (PEEK) test group showed comparably consistent and stable results.

Conclusion and Clinical implications: Preliminary data analysis revealed no significant differences in any evaluated parameter. Thus, it appears that ceramic reinforced polyether-ether-ketone (PEEK) seems to be a reasonable alternative abutment material to titanium and zirconia. However, long-term results are necessary for its final approval.

Disclosure of Interest: None declared.

Keywords: Abutment, Biocompatibility, Clinical studies / trials.

Clinical Research – Prosthetics

EAO-660 / PO-D-16 | Factors associated with prosthetic complications with individualized abutments: Real-world data

Giacomo Fabbri[1]; Tristan Staas[2]; Ian Lane[3,*]; Alberto Pitino[4]; Edoardo Fossati[4]; Ali Aghasadeh[5]; Florian Kübler[6]
[1]*Studio Odontoiatrico Specialistico, Cattolica, Italy;* [2]*Staas & Bergmans, s'Hertogenbosch, Netherlands;* [3]*Queensway Dental, Teesside, UK;* [4]*Pitino Clinic, Torino, Italy;* [5]*Praxis Dr. Aghasadeh, Wuppertal, Germany;* [6]*Nobel Biocare Services, Zürich, Switzerland*

Background: A key advantage of individualized implant abutments over stock abutments is that they offer a greater restorative flexibility to allow optimal emergence profile to promote healthy soft tissue development, superior support of more complicated rehabilitations, and improved crown retention. In addition, many individualized abutments are made from zirconia or titanium, offering a quality solution with clinically demonstrated long-term survival.

Aim / Hypothesis: This real-world data analysis aimed to assess prosthetic complications with individualized abutments and identify factors associated with higher complication rates.

Material and Methods: A retrospective chart review was conducted to identify consecutive patients who received at least one individualized abutment at one of the participating clinics. Implants had a conical, trilobe, or external hex connection while the final abutments were NobelProcera ASC abutment, NobelProcera FCZ implant crown, NobelProcera Abutment Zirconia, or NobelProcera Abutment Titanium (Nobel Biocare AB, Göteborg Sweden). Data extraction included patient demographics, implant and implant site characteristics, indication and loading protocol, type of prosthetic restoration, and the timing and type of complications. To identify factors associated with prosthetic complications, a Cox regression hazard ratio (HR) was calculated using jaw, indication, connection type, platform, loading time, treating clinician, and implant type as dependable variables. In addition, general patient and clinician satisfaction with the esthetic outcome at the last follow-up visit was also assessed.

Results: This study included 290 patients who received 463 abutments to restore single teeth (n = 408) and partial edentulism (n = 55). 64.1% implants were placed in the maxilla. Implant-abutment connections were conical (n = 343), trilobe (n = 92) or external hex (n = 28). Implants were loaded immediately (n = 84), early (n = 36) or delayed (n = 273). The final prostheses were ASC abutments (n = 117), FCZ implant crowns (n = 105), and CAD / CAM abutments zirconia (n = 146) or titanium (n = 95). The mean follow-up was 3.6 years. Overall, 8 abutments had to be replaced, yielding the cumulative prosthetic survival of 98.1%, and 8 additional abutments had prosthetic complications such as chipping and screw loosening. Short bridges, conical connection, regular platform, early / delayed loading, and abutment placement by a prosthodontist associated with fewer complications (HR > 4.0). Implant type and jaw

did not impact complication rate. Most patients (96.5%) and clinicians (98.3%) were satisfied with the restoration.

Conclusion and Clinical implications: Industrially manufactured individualized abutments offer excellent prosthetic survival and a low rate of complications while delivering patient and clinician satisfaction with the esthetics of the restoration. Regular implant platform, conical connection, early and delayed loading, short bridges, and placement by a prosthodontist associated with fewer prosthetic complications.

Disclosure of Interest: G. Fabbri Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662). Dr Fabbri serves as a scientific advisor and lecturer for Nobel Biocare, T. Staas Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662). Dr Staas serves as a scientific advisor and lecturer for Nobel Biocare., I. Lane Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662)., A. Pitino Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662)., E. Fossati Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662)., A. Aghasadeh Conflict with: This study was supported by Nobel Biocare Services AG (grant 2019-1662)., F. Kübler Conflict with: Florian Kübler is an employee of Nobel Biocare Services AG.

Keywords: Abutment, CAD / CAM, Prosthetic complications.

EAO-824 / PO-D-17 | Computerized occlusal implant management of immediately loaded posterior mandibular implants

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[1]*Department of Prosthodontics*; [2]*Depatment of Oral Surgery*; [3]*Department of Periodontology, School of Dental medicine, University of Belgrade, Belgrade, Republic of Serbia*

Background: In implant dentistry, it is believed that creating the stable occlusal scheme, with proper force loading on implant-supported restorations, could have a significant effect on their long-term success.

Aim / Hypothesis: The aim of this study was to assess the computer assisted occlusal analyses to determine localization, distribution, timing, and quality of occlusal contacts in bilateral immediate loading of implants in the posterior mandible.

Material and Methods: This was a randomized, controlled clinical trial, with a split mouth design including 24 patients in need for two implants in the posterior mandible. Following bilateral placement of bone-level implants, each patient was rehabilitated with abutment level screw retained temporary crown (TC) in the test group (TG), and with an implant-level screw-retained TC in the control group (CG) fabricated according to the digital impression. Three months later, a digital impression was performed (3Shape Trios 3, Germany) and TC were replaced with definitive monolithic zirconia crowns (DC). Prior to implant placement, all patients were examined with conventional clinical occlusal analysis, followed by quantitative computerized occlusal analysis with T Scan III System (TS). The same recordings were performed at the TC delivery, as well as three months and six months post-loading with DC.

Results: At three- and six-months patient follow-ups, no mechanical or biological complications were reported. Both clinical occlusal analysis and computerized analysis showed no statistically significant differences in the presence of premature occlusal contacts between the examined groups at all four time periods. The timing of establishing occlusal contacts in both groups for all the evaluated time periods was in the range of a clinically recommended time range of 0.2-0.3s.

Conclusion and Clinical implications: Computerized analysis is a valuable tool for occlusal adjustments and for establishing the desired occlusion pattern to avoid excessive loading and complications with implants and restorations, that were maintained through the osseointegration period. The follow-up of this study could reveal long term effects of the stable occlusion.

Disclosure of Interest: None declared.

Keywords: Dental implants, Digital workflow, Immediate loading.

EAO-496 / PO-D-18 | Clinical reliability of immediate loaded narrow diameter implants in complete-arch restorations

Claudia Lorenzi[1,*]; Paolo Carosi[1]; Fabrizio Lio[1]; Andrea Laureti[1]; Vincenzo Mazzetti[1]; Piero Papi[2]; Claudio Arcuri[3]
[1]*Department of Chemical Science and Technologies, University of Rome Tor Vergata*; [2]*Department of Oral and Maxillo-Facial Sciences, University of Rome La Sapienza*; [3]*Department of Clinical Sciences and Translational Medicine, School of Dentistry, University of Rome Tor Vergata, Rome, Italy*

Background: Treatment of edentulous patients are always hard challenge for clinicians, in terms of restoring both aesthetic and function. Removable dentures are a noninvasive option for the treatment of edentulism and avoid a surgical procedure for the patient. Long-time edentulism or presence of hopeless dentition may enhance significant atrophy of the alveolar crests in both jaws. Narrow diameter dental implants were introduced to overcome the need for bone augmentation procedures.

Aim / Hypothesis: The aim of this retrospective study was to evaluate clinical reliability of fixed screw-retained complete-arch restorations supported by 4 narrow implants loaded immediately.

Material and Methods: The retrospective analysis included all patients treated in one single rehabilitation center for complete arch restorations with fixed full-arch screw-retained prostheses supported by four narrow diameter dental implants loaded immediately between January 1, 2012, and December 31, 2021, with at least 1 year of follow-up after definitive prosthesis delivery. The bone volume was accurately assessed for a safe and prosthetically driven implant placement. New prostheses were realized to reestablish correct prosthetic offset in edentulous patients and, after duplication, were used as radiographic templates during the CBCT exams.

Implants were positioned in prosthetically driven way and loaded immediately with a fixed prosthesis without cantilevers. Definitive prostheses with titanium bar and acrylic teeth with cantilevers were realized for each treated arch. Patients were recalled every 4 months for professional oral hygiene and every 12 months for annual examination.

Results: A total of 30 arches were restored with 120 narrow implants from 2012 to 2021. 70 Straumann Narrow CrossFit Bone Level and 50 Straumann Narrow CrossFit Bone Level Tapered were positioned. 1 implant did not achieve osseointegration during the healing period and was removed and successfully replaced by a longer implant with the same diameter. 3 implants showed peri-implantitis after 5 years in function. No other implant failed or reported fracture of body or neck zone, accounting for an overall implant survival rate of 99.2 %. During the entire follow-up period, no definitive prostheses failed accounting for a prosthetic survival rate of 100%. However, 8 complications occurred (3 acrylic veneering fractures and 2 screw loss) accounting for a prosthetic success rate of 83.3 %. All patients were treated with the original protocol and no deviations occurred, accounting for an overall treatment success of 100%.

Conclusion and Clinical implications: Within the limitations intrinsic in its retrospective nature, summary conclusions and clinical implications could be drawn. Narrow implants showed a similar clinical behavior to standard diameter implants in restoring complete arch. Actually, the complications occurred were not related to the diameter of implants. Narrow implants could represent a valid alternative option to bone augmentation procedures when restoring edentulous jaws with reduced bone width.

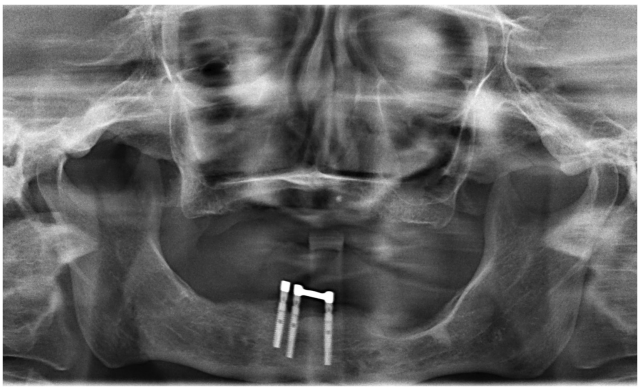

FIGURE 1

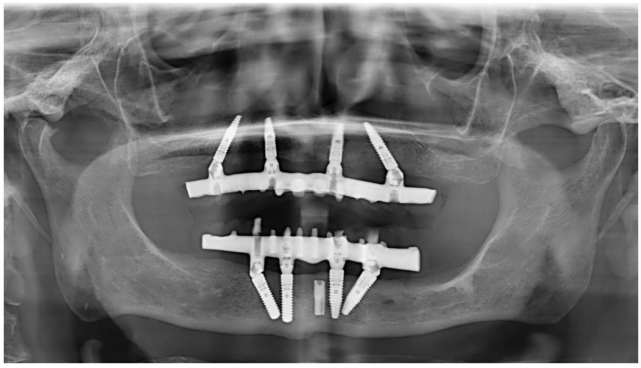

FIGURE 2

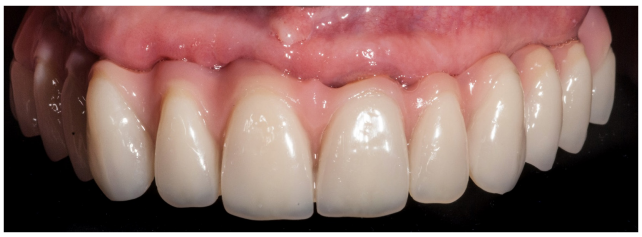

FIGURE 3

Disclosure of Interest: None declared.

Keywords: Biomechanical stability, Immediate loading, Prosthetic complications.

EAO-265 / PO-D-19 | Cemented vs. screw-retained single implant crown in the maxilla: Up to 11 years' follow-up

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Background: Dental implants have become a well-established treatment with predictable long-term success in partially edentulous patients. One of the most important clinical decisions in implant treatment is the choice of retention type (cemented or screw-retained).

Aim / Hypothesis: To compare cemented and screw-retained single implant crown in the maxilla in terms of clinical, radiographic, technical, and patient-reported outcome.

Material and Methods: This retrospective study includes consecutive patients treated between 2009 and 2020. Patients with either cemented (CG) or screw-retained (SG) single crowns in the maxilla were included. MBL, technical and clinical (bleeding on probing, plaque index, probing depth) parameters were evaluated. Patient-centered outcome measures were assessed by OHIP-G 14. The independent T-test was used to assess the difference between the two groups.

Results: A total of 33 partially edentulous patients received 62 implants. After a mean period of 46.9 months, the incidence of

suppuration was 6.2% in the screw-retained group. Mean marginal bone loss between 0.31 (CG) – 0.41 mm (SG) showed no significant difference between the groups. BOP and PI were significantly higher for screw-retained than for cemented (p = 0.066, p = 0.011, respectively). Technical complications were only shown in the cemented group (6.7%). The mean OHIP-G 14 score was 3.3 ± 4.7 in the CG and 2.7 ± 3.5 in the SG.

Conclusion and Clinical implications: Screw-retained retention was associated with a higher rate of positive inflammatory parameters (BOP and PI) and a higher incidence of peri-implant diseases. The retention type had no significant impact on the patient-centered outcome in the maxilla.

Disclosure of Interest: None declared

Keywords: Cement-retained, Screw-retained

Clinical Research – Surgery

EAO-484 / PO-D-21 | Complications after tooth extraction and implant surgery in patients under antithrombotic therapy

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Background: Antithrombotic therapy is inevitable in patients who have risk or history of thromboembolic disease. Prior to dental minor surgery, patients are instructed to stop antithrombotic drug to prevent postoperative bleeding. However, cessation of the drug increases the risk of cardiovascular events. Recent guidelines suggest continuing the drug or minimizing duration of cessation of the drug in dental minor surgery.

Aim / Hypothesis: The aim of this study is investigating the difference of postoperative complications in two groups: 1) continuing antithrombotic drug during dental procedure and 2) discontinuing the drug prior to dental procedure.

Material and Methods: In total, 2,544 patients under antithrombotic therapy who underwent tooth extraction or dental implant surgery were enrolled in this retrospective study. Postoperative complications were reviewed based on medical records. Included medications were antiplatelet drugs(aspirin, clopidogrel, cilostazol, ticagrelor, prasugrel) and anticoagulant drugs(warfarin, new oral anticoagulants). Patients who kept bleeding more than 1 hour or revisited clinic after dental procedure due to bleeding were considered as delayed bleeding. Patients were divided into two groups: patients who underwent dental procedures with or without preoperative cessation of antithrombotic drugs. The chi square test was used to assess the difference between the groups. p values of < 0.05 were considered statistically significant.

Results: 2,324 occasions of tooth extraction and 934 occasions of implant surgery were included. 487 occasions of tooth extraction and 178 occasions of implant surgery were classified in continuing group. In the group taking antiplatelet drug, post-extraction bleeding was higher in continuing group(6 / 389, 1.54%) compared to discontinuing group(14 / 1,140, 1.23%), but the difference was not statistically significant. After implant placement, postoperative bleeding was higher in continuing group(6 / 147, 4.08%) compared to discontinuing group(7 / 519, 1.35%), and the difference was statistically significant(p = 0.034). In the group taking anticoagulant drug, postoperative bleeding was higher in continuing group but the difference was not significant in both tooth extraction and implant surgery. 11 patients underwent cardiovascular events in discontinuing group. 5 patients were hospitalized, 2 patients were managed for cerebral infarction and 2 patients underwent percutaneous coronary intervention.

Conclusion and Clinical implications: Within the limits of this study, preoperative cessation of antithrombotic agents did not significantly affect the postoperative bleeding. As the number of antithrombotic drugs is increasingly used by the elderly or medically compromised patients, it is sometimes inevitable to continue taking antithrombotic drugs to prevent cardiovascular disease during dental procedures. Therefore, more effort for bleeding control, such as fine suture or use of local agents, should be considered.

Disclosure of Interest: None declared.

Keywords: Dental implants, Retrospective study

EAO-462 / PO-D-22 | Diabetes mellitus and osseointegration: A retrospective study of 186 implants in Greece

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Background: Diabetes mellitus (DM) is a chronic metabolic disease leading to hyperglycaemia and microvascular disease. The adequate implant restoration is implemented for the healthy nutritional habits of diabetic patients and appropriate metabolic control. The estimated relationship between DM and the quality of osseointegration is critical and already studied. Continuous studies are needed due to the increasing prevalence of DM and the macro- and microstructural alteration of the contemporary implants.

Aim / Hypothesis: To investigate the relationship between regulated DM and osseointegration by studying the changes of the implants' stability quotient value (ISQ) of the diabetic and non-diabetic patients from the day of implant placement until the programmed rehabilitation.

Material and Methods: A retrospective study was conducted in a private clinic in Athens. Data collection referred to the period between January 2016 and August 2021 for implants in diabetic and non-diabetic patients. Random case selection was performed under

a protocol of Random Numbers Table Generator. Ninety-three implants were recorded in 36 diabetic patients and 93 implants in non-diabetic patients. All surgeries were performed by the same surgeon. The study determinant was diabetic status, and the study outcome was the Resonance Frequency Analysis (RFA) and the loss of dental implant. RFA measurements were performed to all implants at the time of insertion and the repetitions of the measurements were done four months later. Data were collected from the patients' medical histories and analysed by IBM SPSS 21.0 Statistical Package for Social Sciences. All possible confounders were recorded and eliminated according to multivariate regression analysis.

Results: The mean age was 57.6 years. The 52.6% (n = 41) was women and the 47.4% (n = 37) was men. The 23.1% (n = 18) was smokers while the 76.9% (n = 60) was non-smokers. The bivariate analysis referred to ISQ and: gender, age, maxilla / mandible and location, medication, immediate / placement, biomaterials, medication, systematic health, previous surgeries. The mean value of ISQ at the day of implant placement was 75.97 in non-diabetics and 76.85 in diabetics (p = 0.42). After four months the mean values were 78.92 and 78.44 (p = 0.58), respectively. The mean value of ISQ in non-diabetics increased statistically significantly in the first four months from 75.97 to 78.92 (p < 0.001) and in diabetics from 76.85 to 78.44 (p = 0.011).

According to multivariate analysis, patients without biomaterials simultaneously placed, without prior surgery and with implants in the mandible had better implant stability.

No implant loss was recorded in both diabetics and non-diabetics (p = 1).

Conclusion and Clinical implications: No relationship was found between regulated diabetes mellitus and dental implants stability using RFA. The results agree with the daily clinical practice for implantation in diabetics and the ISQ increased statistically significant four months after implant placement at both diabetics and non-diabetics. Studies with a larger sample and longer follow-up of patients are needed to clarify better the risks and benefits of dental implants in diabetic patients.

Disclosure of Interest: None declared.

Keywords: Dental implants, Resonance frequency analysis, Retrospective study.

EAO-275 / PO-D-23 | Fully guided implant placements in single-tooth gaps: A prospective clinical in vivo investigation

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Background: With healthy adjacent teeth, implant-supported (IS) single-crowns (SCs) are a reliable alternative to fixed dental prostheses (FDPs). However, technical and biological complications occur and are regularly documented in the literature for IS restorations [1]. These risks can be reduced by considering surgical and prosthetic parameters [2]. Thereby, especially the planned (PIP) and transferred implant positions (TIP) can decisively be influenced by the surgeon.

Aim / Hypothesis: To assess the accuracy of fully guided dental implant placements regarding two different implant systems and planning software (IPS) in a prospective clinical in vivo investigation. The working hypothesis was, that no statistically significant differences will be documented between systems and IPS.

Material and Methods: Cone beam computed tomographies (CBCT) and impressions of patients with healed single-tooth gaps were made. Analogue wax-ups were fabricated and models were digitized. Randomization took place regarding two different implant systems (screw-shaped / conical) and thus two different IPS. Fully guided implant placements were planned and drilling guides were manufactured. After try-ins, surgeries took place according to the manufacturers' protocols. Intra-operative scans were performed with attached scan-bodies and an intraoral scanner (IOS). Obtained Standard Tessellation / Triangulation Language (STL) datasets were superimposed with planning STL datasets in a professional software for 3D quality control. Deviations were reported in a coordinate system (x- [mesio-distal], y- [vestibulo-oral] and z- [vertical] axis) at entry points and apices. Total deviations including the angular deviations were calculated by the software. For statistical analysis, level of significance was set to p < 0.05.

Results: In total, 26 fully guided dental implant placements (13 screw-shaped and 13 conical) were performed in 26 patients (17 males and 9 females). Mean age was 52 ± 16 years (range: 23 to 82 years). All intra-operative STL datasets were superimposed with planning STLs and evaluated. Calculated mean three-dimensional (3D) deviations for screw-shaped implants were 0.61 ± 0.28 mm (range: 0.17–1.08 mm) at implants' entry point, 0.96 ± 0.41 mm (range: 0.31–1.55 mm) at implants' apex and 2.58 ± 1.40° (range: 0.59–4.62°) for implants' angulation. For conical implants, calculated mean 3D deviations were 0.63 ± 0.24 mm (range: 0.24–1.04 mm), 1.04 ± 0.34 mm (range: 0.49–1.80 mm) and 2.89 ± 1.12° (range:

1.06–5.75°), respectively. Statistical analysis revealed no significant differences between implant systems and, therefore, IPS. Significant deviations regarding z-axis, both at entry point and apex ($p < 0.05$) were documented.

Conclusion and Clinical implications: No significant differences could be found between implant systems and IPS. However, significant vertical deviations occurred in both guided protocols. Therefore, drilling depths should be reevaluated before implant installations. Despite most favorable conditions, deviations of up to 1.80 mm were documented between PIP and TIP. Thus, the results strengthen a safety distance of at least 2 mm regarding anatomical critical structures even with fully guided protocols in single-tooth gaps.

Disclosure of Interest: None declared

Keywords: Accuracy, Dental implants, Guided implant surgery

EAO-543 / PO-D-24 | Early soft tissue healing after ridge preservation of damaged sockets: A retrospective clinical study

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Background: It is well known that alveolar ridge preservation (ARP) following tooth extraction guarantees the predictability and efficacy in the intact extraction socket but also in the periodontally damaged extraction socket. Various types of bone substitute have been compared by a number of previous studies; however, how the type of barrier membrane which covers the bone graft material affects the healing especially in the early stage still needs to be more investigated clinically.

Aim / Hypothesis: It was assumed that soft tissue healing over time would vary depending on the type of barrier. The purpose of this study was to compare the early healing of soft tissue of the damaged socket with ARP using collagen sponge, non-cross-linked collagen membrane or acellular dermal matrix.

Material and Methods: The present study was designed in accordance of the Helsinki Declaration (Tokyo ver. 2004) and approved by the Institutional Review Board for Clinical Research at Yonsei University Dental Hospital. A total of 127 sites in 119 patients who received open-healing ARP after the extraction of periodontally involved tooth were included and divided into following 3 groups based on the barrier membrane: CS (collagen sponge) group(N = 55); CM (non-cross-linked collagen membrane) group (N = 44); and DM (acellular dermal matrix) group (N = 28). Using the standardized clinical photographs, the percentage of soft tissue coverage by epithelialization and the early wound healing score were evaluated at 4 different time points (T0: immediately after the ARP; T1: 1-2 weeks post-surgery; T2: 3-4 weeks; and T4: over 6 weeks) by a single examiner. Whether the additional bone graft surgery was needed at the time of implant placement was also assessed. Statistical significance was set $p < 0.05$.

Results: Regardless of the type of resorbable barrier used, all extraction sockets demonstrated favorably healed soft tissue at T4, however, significant differences among the groups were found in the percentage of soft tissue coverage and early wound healing score in the earlier time points. In CM group, wound size was increased (142.39 ± 97.67%) and showed a tendency that wound expand to surrounding tissue compared with other groups (in T1, CS:68.02 ± 40.68%; DM: 88.11 ± 46.58). The healing tendency of the CM group appeared to be more delayed than other two groups, showing a noticeable recession of open-wound margin at T1. Compared to the CS and DM groups, more patients received additional bone graft surgery when the implant was placed in the CM group.

Conclusion and Clinical implications: The early soft tissue healing after the open-healing ARP was different depending on type of barrier. There was a tendency that delayed soft tissue healing in the early stage led to the necessity of additional bone grafting. Whether the difference in the type of barrier results in the long-term bone regeneration after the open-healing ARP needs further well-controlled clinical study.

Supported by the NationalResearchFoundation of Korea funded by the Korea government(MSIT)(No.2020R1A2C2008053).

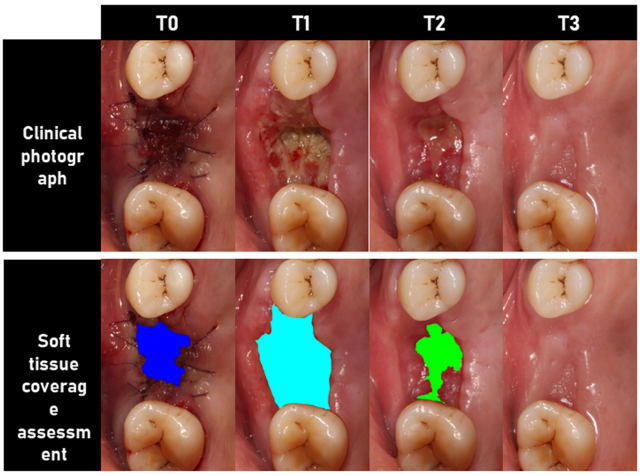

Figure 1.
Clinical photographs of the representative case in ARP with non cross linked collagen membrane (Group 1). Wound healing at the surgical site of alveolar ridge preservation following tooth extraction was shown in the serial photographs: A: immediately(T0), B: 1-2 weeks (T1), C: 3-4 weeks (T2), D: over 6 weeks (T3) after the surgery. In each photographs assessing the ratio of soft tissue coverage: E: immediately(T0), F: 1-2 weeks (T1), G: 3-4 weeks (T2), H: over 6 weeks (T3) after the surgery.

FIGURE 1

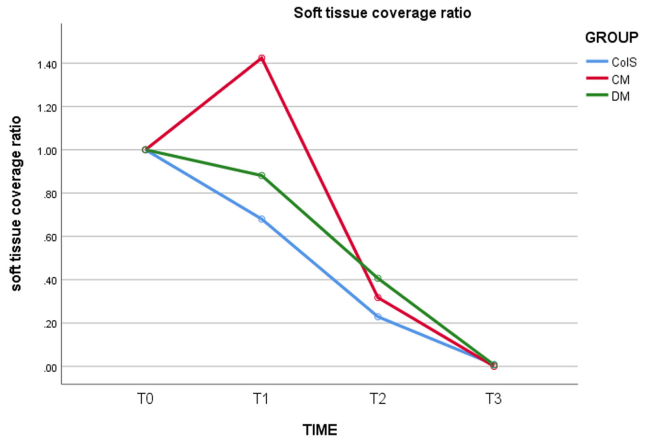

Figure 2
Graph of the soft tissue coverage ratio (remnant area / ROI %) in each time points: immediately(T0), 1-2 weeks (T1), 3-4 weeks (T2), over 6 weeks (T3) after the surgery
Blue line: Group 0 which have ridge preservation following tooth extraction with collagen sponge (ColS)
Red line : Group 1 which have ridge preservation following tooth extraction with non cross linked collagen membrane (CM)
Green line : Group 2 which have ridge preservation following tooth extraction with acellular dermal matrix (DM).

FIGURE 2

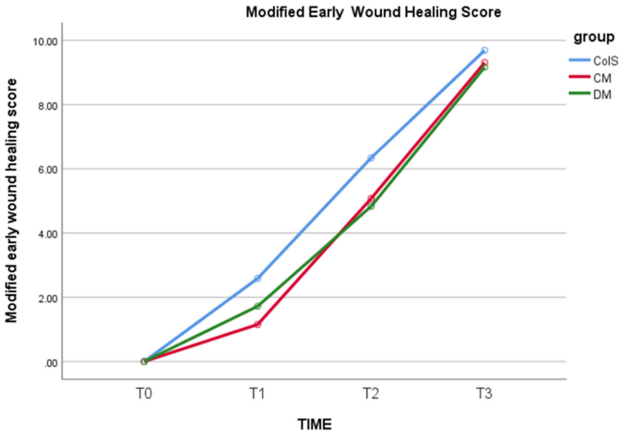

Figure 3
Graph of the modified early wound healing score in each time points: immediately(T0), 1-2 weeks (T1), 3-4 weeks (T2), over 6 weeks (T3) after the surgery
Blue line: Group 0 which have ridge preservation following tooth extraction with collagen sponge (ColS)
Red line : Group 1 which have ridge preservation following tooth extraction with non cross linked collagen membrane (CM)
Green line : Group 2 which have ridge preservation following tooth extraction with acellular dermal matrix (DM).

FIGURE 3

Disclosure of Interest: None declared.

Keywords: Alveolar ridge preservation, Clinical studies / trials

EAO-606 / PO-D-25 | Eight-year review of Buccal Bone stability in the anterior maxilla

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Background: The use of dental implants to replace single teeth in the aesthetic zone is a well-established protocol. Early Implant Placement (6 weeks post-extraction) alongside simultaneous GBR has been well documented and researched.

Aim / Hypothesis: The purpose of this study was to evaluate the stability of the buccal bone and to assess whether the techniques demonstrated in a hospital setting are transferable to the general dental clinic.

Material and Methods: 20 consecutive patients where included in the study. All of the surgeries were completed by the same clinician (D.F.) Surgeries were completed 6 weeks post-extraction using a platform switched implant design. Local autogenous bone was harvested and placed over the implant surfaces, followed by a xenograft layer and non-cross-linked collagen membrane.

18 patients were evaluated with one patient unable to contact. The CBCT analysis of the buccal bone width was completed at three sites, (Shoudler, mid implant and apical thread.) CBCT's were delayed from 6 years of placement due to the COVID 19 pandemic. All implants had a minimum of 8 years of service.

Results: A success rate of 95% was achieved with only one case showing no evidence of buccal bone. Results at the shoulder of the implant had a mean of 1.74 mm with a median of 1.7 mm and a range of 0-3.6 mm. Mid implant mean of 1.93 mm, median 2.1 mm with a range of 0-3.6 mm. Apically the mean was 1.48 mm, median 1.3 mm with a range of 0-3.1 mm

Conclusion and Clinical implications: 1. This study shows that guided bone regeneration in the premaxilla using autogenous and bovine xenograft bone, combined with a collagen membrane provides stable long-term buccal bone.

2. Implants placed in a dental practice can have very similar outcomes to those placed in the seminal papers. With meticulous surgical technique it is possible to emulate the high success rates of those who pioneered the technique.

Disclosure of Interest: None declared.

Keywords: Alveolar ridge preservation, Bone regeneration, Guided bone regeneration.