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EDITOR'S NOTE: Credited reviews were prepared by graduate students enrolled in the Implant Program at Loma Linda University, Jaime Lozada, DDS, director.

BONE GRAFTING

"Alveolar Distraction Osteogenesis vs Vertical Guided Bone Regeneration for the Correction of Vertically Deficient Edentulous Ridges: A 1-3 Year Prospective Study on Humans," by M. Chiapasco, E. Romeo, P. Casentini, L. Rimondini. *Clin Oral Implant Res*, 15:82-95, 2004.

This study compared the efficacy of 2 techniques to correct vertical defects. One group of 11 patients (group 1) was treated with vertical guided bone regeneration (GBR). The other group of 10 patients (group 2) was treated with distraction osteogenesis (DO). In group 1, the GBR was performed with particulated autogenous bone covered by a titanium-reinforced Gore-Tex membrane (W. L. Gore, Flagstaff, Ariz). In 6 of these patients, the implants were placed at the time of grafting (group 1A); in the other 5 patients, the membrane was tented with the use of titanium screws (group 1B). In group 1A, the implants were exposed after 6 to 7 months. In group 1B, the membranes were removed at 6 to 7 months, and implants were placed in a 2-stage protocol with uncoverty at 5 months. In group 2 patients, the distraction procedure was achieved by using an extraosseous distractor attached to the surgically created bone segment with the use of miniplates. After distraction, a maturation phase of 2 to 3 months was allowed before implant placement. Implants were allowed to heal for 3 to 6 months before prosthetic treatment. The follow-

ing was recorded for both groups: The bone levels were evaluated before and after implant placement, clinical peri-implant parameters, and the survival and success rates of the implants. In group 1, 3 of the 11 patients had early exposure of the membrane. In 2 of these patients, the membranes were removed prematurely. Group 1 (GBR) patients suffered significantly greater bone resorption than did the DO group. In general, group 1A (immediate implants) suffered greater bone loss than did group 1B (delayed implant placement), although these differences were not always significant. In addition, 8 of the 25 implants in group 1 had bone loss that was greater than what is considered acceptable for implant success. In contrast, only 2 of 34 implants in group 2 suffered bone loss greater than accepted limits. The differences in implant success rates between group 1 and 2 was significant. These results suggest that DO offers greater success than does GBR when correcting vertical defects. However, the low number of patients in this study brings these results into question.

"Alveolar Distraction Before Insertion of Dental Implants in the Posterior Mandible," by A. Garcia-Garcia, M. Somoza-Martin, P. Gandara-Vila, et al. *Br J Oral Maxillofac Surg*, 41:376-379, 2003.

This study reported on the efficacy of 10 alveolar distraction procedures in the posterior mandibles of 7 patients. In all patients,

a ratio of the preoperative crown height (on wax-up) and available bone above the alveolar canal was calculated (preoperative crown-implant ratio) (index A). Only those with a ratio greater than or equal to 1 were planned for distraction. The distraction (using an intraosseous distractor) was performed to increase the bone height by 5 mm. After a consolidation period of 3 months, a total of 20 implants were placed and allowed to heal for 3 months before prosthetic reconstruction. The patients were then followed for 6 months to 2 years postloading. A second ratio of crown-implant length was calculated after treatment (index B). The mean of index A (before extraction) was 1.7. The mean of index B (after distraction and restoration) was 0.7. These differences were significant. These results suggest that distraction was carried out with success in these patients. A shortcoming of this paper was the lack of any clinical data on the success of the implants and any report of treatment complications.

"Clinical Evaluation of Freeze-Dried Block Allografts for Alveolar Ridge Augmentation: A Case Series," by R. Lyford, M. Mills, C. Knapp, E. Scheyer, J. Mellonig. *Int J Periodontics Restor Dent*, 23:417-425, 2003.

This study reported on 3 cases of using allograft bone blocks to augment horizontal alveolar ridge defects. Five defects (1-4 missing teeth) were grafted with 1-cm cubes of freeze-dried cancellous

bone blocks. The ridge width was measured before graft placement. Before placement, the recipient bone bed was decorticated with multiple perforations with a 1/2 round bur. The bone blocks were trimmed to fit the defects and fixated with a bone screw. Voids around the bone block were filled with particulate freeze-dried allografts, and the site was covered with a resorbable or nonresorbable membrane. After 6 months of healing, the screws and membranes (if applicable) were removed and the ridge width measured. The gain in ridge width varied between 2 and 4 mm. Three of the sites had 4-mm diameter implants placed. The implants were successful at uncover and restored. The remaining 2 sites had conventional fixed bridges placed on teeth. The authors stated that these 2 areas were originally planned for conventional bridges. These results suggest that allograft bone blocks may be used as an alternative for autogenous block grafts. Further study is necessary.

IMPLANT PROSTHODONTICS

"Influence of Implant Length and Diameter on Stress Distribution: A Finite Element Analysis," by L. Himmlova, T. Dostalova, A. Kacovsky, S. Konvickova. *J Prosthet Dent*, 91:20–25, 2004.

This laboratory study compared the effect of implant length and width on the stress distribution in the surrounding bone by finite element analysis (FEA). To evaluate the effect of length, implant models with a diameter of 3.6 mm and lengths of 8, 10, 12, 14, 16, 17, and 18 mm were compared. To evaluate the effect of width, implant models with a length of 12 mm and widths of 2.9, 3.6, 4.2, 5.0, 5.5, 6.0, and 6.5 mm were com-

pared. Various forces in different directions were applied to simulate average masticatory forces in a natural, oblique direction. The effects of length and width were compared by FEA. The effects of width demonstrated a marked reduction of stress from 2.9 mm to 4.2 mm, with a gradual reduction of stress beyond 5-mm width. When comparing length, a reduction of stress occurred as length increased, but this was much less pronounced compared with the effects of width. These results suggest that increasing implant diameter plays a much greater role in decreasing stress to the surrounding bone than does increasing implant length.

"Peri-implant Mucosal Level in Patients Treated With Implant-Supported Fixed Protheses: A 1-Year Follow-up Study," by A. Ekfeldt, A. Eriksson, L.-A. Johnsson. *Int J Prosthodont*, 16:529–532, 2003.

This study reported on the change in peri-implant mucosal levels at 1-year posttreatment in 20 edentulous patients treated with fixed implant-supported protheses. The protheses were cantilevered fixed detachable devices with either a titanium or gold framework. At the 1-year follow-up appointments, the protheses were removed and a new implant model was taken. The presence of keratinized or nonkeratinized mucosa was recorded at the buccal and lingual of each implant, and clinical appearance of the soft tissues was also recorded. The position of the soft tissues was compared on the new models with those of the original master cast. The results indicated that the gingiva receded a mean of 0.8 mm in the maxillary sites (range –6.0 to +6.0 mm) and a mean of 1.6 mm in the

mandibular sites (range –4.5 to +1.0 mm). In the maxilla, the abutments were visible in 19% of the implants at insertion and in 81% at the 1-year follow-up. The corresponding figures for the mandibular sites were 76% at insertion and 94% at 1 year. These results confirm the results of other studies that demonstrated the occurrence of soft-tissue recession after prosthesis insertion.

"Maintenance Requirements of Implant-Supported Fixed Protheses Opposed by Implant-Supported Fixed Protheses, Natural Teeth, or Complete Dentures: A 5-Year Retrospective Study," by D. Davis, M. Packer, R. Watson. *Int J Prosthodont*, 16:521–523, 2003.

This retrospective study compared the maintenance requirements of fixed implant-supported protheses that were opposed by either fixed implant-supported protheses, natural teeth, or removable protheses. Thirty-seven patients who had fixed protheses for 5 years in function were evaluated. All protheses were cantilevered devices with gold frameworks and acrylic resin teeth. Mandibular protheses were supported by 5 implants, and maxillary protheses were supported by 6 implants. Six patients had their protheses opposed by fixed implant-supported protheses (fixed/fixed), 9 patients had natural teeth opposing the protheses (fixed/natural), and 22 patients had removable dentures opposing the protheses (fixed/removable). The results demonstrated that the fixed/fixed group experienced significantly greater incidences of framework and acrylic resin or denture teeth fracture compared with the other 2 groups. The fixed/natural also experienced significantly greater

incidence of framework fracture and acrylic resin or denture teeth repair compared with the fixed/removable group. There were no differences among the groups regarding screw loosening or fracturing. These results suggest that the opposing dentition plays a crucial role in deciding the maintenance requirements of a cantilevered fixed detachable (hybrid) prosthesis. In particular, those opposed by fixed-implant prostheses are likely to experience catastrophic events such as framework fracture.

ENDOSSEOUS IMPLANTS

"Clinical Evaluation of Short, Machined-Surface Implants Followed for 12 to 92 Months," by G. Tawil, R. Younan. *Int J Oral Maxillofac Implants*, 18:894–901, 2003.

This study evaluated the stability of short Branemark implants (Nobel Biocare, Goteborg, Sweden) after they had been in function for a variable amount of time. One hundred eleven consecutively treated patients received a total of 269 implants that were 10 mm or shorter. The majority of the implants were placed in the mandible (88.8%) and used to treat partially edentulous situations (95.2%) (both screw and cement retained). The majority of the implant sites had type 2 or 3 bone quality. Follow-up after prosthetic loading varied from 12 to 92 months. Fifteen patients (46 implants) were lost to follow-up. Twelve implants were lost for a survival rate of 95.5%. There was no difference in survival when comparing implant length or diameter. The mean bone loss was 0.71 mm, with 8.9% of the implants displaying greater than 1.5-mm loss (range 1.60–3.18 mm). These results suggest that short

implants can be used successfully. The low numbers in the maxilla indicate that these results can be applied only to the mandible.

"Influence of Implant Microstructure on the Osseointegration of Immediate Implants Placed in Periodontally Infected Sites: A Histomorphometric Study in Dogs," by A. Novaes, V. Papalexiou, M. Grisi, et al. *Clin Oral Implant Res*, 15:34–43, 2004.

This study compared the bone-to-implant contact (BIC) between 2 different implant surfaces in a dog model. Periodontitis was induced (by ligatures) in the first to fourth mandibular premolar bilaterally in 6 dogs. After 12 weeks, the teeth were extracted and 3 root-form implants were placed immediately in each quadrant in a 2-stage fashion (36 implants total). The implants placed had 1 of 2 surface treatments: grit blasted/acid etched (group 1) or titanium plasma sprayed (group 2). At 12 weeks after implant placement, the dogs were killed and the hemi-mandibles were removed for analysis. Clinically and radiographically, all implants were successful at sacrifice. Histologically, bone healing up to the implant surface was present in both groups. The histomorphometric study revealed that the group 1 implants had greater tendency for increased BIC compared with the group 2 implants. Group 1 had a mean BIC of 52.7% \pm 11.2% (range 37.0%–66.3%) and group 2 had a mean BIC of 42.7% \pm 15.2% (range 24.1%–61.7%). These differences were not significant. Bone-density analysis also revealed a slight but not significant increase for group 1 implants. These results suggest that in the dog model, the grit blasted/acid etched implants do not significantly improve bony

contact compared with titanium plasma spray surfaces.

"Nonceramic Hydroxyapatite Bone Derivative in Sinus Augmentation Procedures: Clinical and Histomorphometric Observations in 10 Consecutive Cases," by Z. Artzi, C. E. Nemcovsky, D. Dayan. *Int J Periodontics Restor Dent*, 23:381–389, 2003.

A synthetic, nonceramic resorbable hydroxyapatite (R-HA) as a sinus augmentation material in 10 consecutive patients was evaluated at 12 months in all sites at the lateral and deep augmented areas. Ten healthy patients (5 women, 5 men) ranging in age from 36 to 66 years who were to receive posterior implant-supported fixed prostheses had maxillary sinus augmented with R-HA material. Eight patients had simultaneous augmentation and implant placement. Two patients had implants placed 6 months after the sinus augmentation because the residual ridge height was 1 to 3 mm. R-HA particles, 300 to 400 μ m, were soaked with venous blood and filled the augmented sites, and a resorbable membrane (BioGide) was applied over the entire area. At the implant uncover time, the buccal flap was further elevated to the previous window area, and a 2.5-mm internal-diameter trephine bur was drilled through the previous lateral window frame upward toward the new location of the Schneiderian membrane. The specimens were stained with hematoxylin-eosin and picosirius red for polarized light microscopy. All implants (n = 36) were clinically stable during the healing abutment placement at 12 months. Morphometrically, mean bone-area fraction at the lateral/external side of the 10 specimens was 28.1% (range 22.3%–38.9%)

and at the medial/deep side was 37.8% (range 30.2%–53.3%). Mean lamellar–woven bone ratio at the lateral/external was 0.15 (1:7.2), and at the medial/deep side was 0.27 (1:4.2). Differences in both mean bone fraction and woven–lamellar bone ratio were statistically significant for lateral/external and medial/deep side. No correlation was observed between bone area percentage and lamellar–woven bone ratio. R-HA is a biocompatible and osteoconductive material in sinus augmentation procedure. Bone-area fraction and remodeling increased in a lateral to medial direction toward the vicinity of the Schneiderian membrane.

“Clinical and Radiographic Evaluation of Soft and Hard Tissue Changes Around Implants,” by J. C. Joly, A. F. Martorelli de Lima, et al. *J Periodontol*, 74:1097–1103, 2003.

The aim of this pilot study was to evaluate the clinical and radiographic changes in the peri-implant tissues around 1-stage implants with varying smooth neck lengths before and after functional prosthetic loading. Four patients with bilateral edentulous posterior ridges were selected. A total of 12 ITI (Straumann AG, Waldenburg, Switzerland) titanium plasma sprayed 1-stage implants 4.1-mm diameter and 10-mm length with machine smooth suprabony portion of 2.8 or 1.8 mm were used. Implant location was randomly assigned to 2 groups of 6: group 1 (2.8 mm) and group 2 (1.8 mm) implants. Manufacturer’s protocol was followed for implant placement with the machine surfaces at the level of alveolar bone. Implants were restored and loaded 4 months after surgery with cement-retained metal ceramic crowns. The parameters of

plaque index (PI), gingival index (GI), probing depth (PD), gingival marginal level (GML), relative clinical attachment level (r-CAL), and optical density (OD) were measured at loading (4 months) and 12 months after implant placement. The radiographic parameter osseous level (OL) was measured at implant placement, loading (4 months), and at 12 months. The results showed significant differences ($P < .05$) for both groups for PD, r-CAL, and OL for intragroup comparisons over time. No significant differences were found for PI, GI, PD, GML, OD, and OL between groups. The results suggest that bone loss will always occur regardless of the transmucosal length and apparently does not inhibit bone resorption. From the results in this study, it is concluded that bone loss was initiated before loading and progressed until the end of the experimental period. The peri-implant soft tissues adapted and were maintained regardless of collar height.

“Clinical Complications With Implants and Implant Prostheses,” by C. J. Goodacre, G. Bernal, K. Rungcharassaeng, J. Y. K. Kan. *J Prosthet Dent*, 90:121–132, 2003.

One of the purposes of this study was to provide data regarding the types of complications that have been reported in conjunction with endosseous root-form implants and associated crowns and prostheses. Another purpose was to identify the most common implant complication. A third purpose was to compare the complications incidences associated with implant prostheses with those encountered with fixed restorations and prostheses. A Medline and an extensive hand search were performed on English-language publications covering the

years 1981 to 2001. The searches focused on publications that contained clinical data regarding success, failure, and complications. The complications were divided into the following 6 categories: surgical, implant loss, bone loss, peri-implant soft tissue, mechanical, and esthetic and phonetic. The most common implant complications were loosening of the overdenture retentive mechanism (33%), implant loss in irradiated maxillae (25%), hemorrhage-related complications (24%), resin veneer fracture with fixed partial denture (22%), implant loss with maxillary overdentures (21%), overdentures needing to be relined (19%), implant loss in type IV bone (16%), and overdenture clip or attachment fracture (16%). Even though it was not possible to calculate an overall complications incidence for implants and their associated prostheses, a greater number of clinical complications appears to be associated with implant prostheses than with single crowns, fixed partial dentures, all-ceramic crowns, resin-bonded prostheses, and posts and cores.

By: Kuo-Yang Liao, DDS

“Early Tissue Reaction at the Interface of Immediately Loaded Dental Implants,” by U. Meyer, H. P. Wiesmann, T. Fillies, U. Joos. *Int J Oral Maxillofac Implants*, 18:489–499, 2003.

The purpose of this study was to investigate the early response of osteoblasts and the extent of mineral formation at the titanium surface of implants that are designed to elicit homogenous physiologic strains at the implant surface. After the extraction of the mandibular second premolars and allowing a healing period of 3 months, 32 implants were placed in the mandibles of 8 minipigs; 16

of the implants were immediately loaded under occlusal contact and served as the test group, whereas the remaining 16 implants were not loaded and served as a control. All the implants healed uneventfully except for 1 that showed signs of tissue inflammation, and the ultrastructural analysis of the specimens showed intimate attachment between the osteoblast and the implant surface at the early stages of day 1. There was no difference in the morphology of the osteoblasts between the test group and the study group, and the electron microscopy and diffraction analysis showed a direct contact of bone minerals over the whole implant surface with no alterations at the crestal bone level. These results indicate that this design of implants can be immediately loaded without causing any alterations to the osteoblastic morphology and attachment characteristics at the early phase of loading and concludes that immediate loading can be performed without disturbing the normal bone biology and healing.

By: Aladdin Al-Ardah, DDS

"Anterior Loop of the Mental Nerve: A Morphological and Radiographic Study," by D. Kuzmanovic, A. Payne, J. Kieser, G. Dias. *Clin Oral Implant Res*, 14:464–471, 2003.

This study determined if a correlation existed between the anatomically dissected path of the mental neurovascular bundle in 22 sectioned human head specimens and their radiographically estimated path by using a rotational narrow-beam panoramic imaging Scanora radiographic unit ($\times 1.3$ and $\times 1.7$ magnification). The specimens were accurately positioned with the guidance of light lines for the

midsagittal, frontal, and horizontal planes, correctly placed relative to the anatomical land. Two calibrated observers interpreted the radiographic exams. Bilateral anatomical dissection was then performed on all specimens. The anterior loop of the inferior alveolar canal was identified only in 6 panoramic radiographs (27%) (range 0.5–3 mm). There was a significant positive correlation between both observers of the radiographs and between the 2 radiographic programs used. Anatomical measurements of the anterior loop of the mental neurovascular bundle revealed its presence in 8 dissected specimens (37%, range 0.11–3.31 mm). Fifty percent of the radiographically observed anterior loops were misinterpreted by observers with both radiographic programs, and 62% of the anatomically identified loops were not observed radiographically. Anatomical dissection also revealed that the mean diameter of the incisive nerve was 1.80 ± 0.46 mm (range 0.9–2.53 mm). Clinicians should not rely on panoramic radiographs for identifying the anterior loop of the mental nerve during implant treatment planning. However, on the basis of our anatomical findings, a safe guideline of 4 mm from the most anterior point of the mental foramen is recommended for implant treatment planning.

By: Olivier Henry-Savajol, DDS

"Morphology and Dimensions of the Mandibular Jaw Bone in the Interforaminal Region in Patients Requiring Implants in the Distal Areas," by M. Quirynen, N. Mraiwa, D. van Steenberghe, R. Jacobs. *Clin Oral Implant Res*, 14:280–285, 2003.

This study evaluated anatomical variations of the mandibular in-

terforaminal region in 210 patients by computerized tomography (CT) analysis. The consecutively selected subjects consisted of patients presenting for implant-supported prostheses in the mandible. The patient ages ranged from 18 to 80 years with a mean age of 55. The vast majority of patients (186 of 210) had partially edentulous interforaminal regions; an additional 4 patients were fully edentulous in this area. Three distinct morphologies of the interforaminal area were noted and termed type I (with lingual concavity), type II (with near-constant width but clear lingual tilt), and type III (with narrowed crestal bone). These morphologies were found in frequencies of 2.4% for type I, 28.1% for type II, and 69.5% for type III. In type I morphology, the lingual concavity had a depth of 6 ± 2 mm, the lingual cortex had a very slight lingual slope (85°), and the maximal bone height superior to the concavity was 10.5 ± 2.7 mm. The lingual slope observed in type II morphology was $67.6^\circ \pm 6.5^\circ$. In type III morphology, the apical third was found to consistently be 1 mm wider than the middle third of the mandible. These results demonstrate that even in partially edentulous mandibular interforaminal areas morphologic variations can frequently be present, particularly a lingual slope (28.1%) and a narrowing crestal ridge (69.5%). The authors postulated that in fully edentulous mandibles the resorption patterns would display a further frequency of type I and type II morphology. The authors note that the use of 3-dimensional imaging, such as CT, would lessen the risk of complications during the placement of dental implants in the interforaminal region.

By: Israel Puterman, DMD