Basic Science and Research

"The Bone Growing Chamber: A New Model to Investigate Spontaneous and Guided Bone Regeneration of Artificial Defects in the Human Jawbone," by P. Trisi and W. Rao. Int J Periodont Rest Dent 18:151–159, 1998.

This study analyzes a new human model designed to evaluate the basis for spontaneous regeneration in the human jawbone. Hollow, open-ended titanium cylinders, 2 mm in diameter and 5 mm in length with multiple 1.3-mm holes, served as the bone growing chambers (BGCs). The authors' most critical objectives were to identify and to retrieve of a site of bone regeneration for quantitative analysis. In the study, they attempted to formulate a model that had consistent dimensions, that was easily retrievable by the clinician, and that was also safe for the patient.

Ten volunteers who were undergoing routine implant surgery were recruited for the study. They were all generally healthy and they consented, in writing, to participate. Sites were prepared with a calibrated drill. BGCs, constructed from grade 2 commercially pure titanium without any surface modification, were then placed into the defects below the level of the osseous crest. Three randomly chosen BGCs were harvested with a calibrated Trephine bur at 1, 3, and 6 months after placement. A small area of surrounding bone was removed with the chamber. Three patients were given 1 g of tetracycline at 15 and at 7 days before BGC removal for double tetracycline labeling. Histologic examination was performed on retrieved specimens.

All patients experienced healing without complications. Eighty percent of the BGCs had been completely integrated at the time of removal. All stable BGCs displayed bone tissue within the growing space. The BGC removed at 1 month demonstrated very little bone penetration into the growing chamber, while the 6-month BGC displayed increased bone density inside the chamber and showed signs of bone matrix with remodeling activity. In general, bone inside the chambers showed aspects of spongy bone with variable density. Tetracycline-labeled specimens displayed areas of label uptake inside the chamber, thus indicating the presence of bone remodeling inside the chambers.

The authors feel that the BGC model presents a well-defined space that is easy to prepare and detect. They feel that the dimensions are uniform and allow for quantitative measurement of bone regeneration inside the chamber. The authors believe that the use of the BGC allows for bone regeneration inside the chamber space and for good disclosure and retrieval of the regenerated tissues. They state that retrieval does not cause serious artifacts in the newly formed tissues and that it allows for precise evaluation. They state that tissues do not affect the regeneration process, since the chamber is placed in a hole below the osseous crest. Suggested applications of the BGC model include use in patients who are undergoing guided bone regeneration (GBR) and implant placement into the harvested site. They feel that this model can also be used for evaluation and comparison of spontaneous bone repair versus GBR, for analysis of bone regeneration induced by different biomaterials, and for evaluation of treated versus untreated titanium surface effect on the percentage of contact with newly formed bone. (E. Gorodinsky)

Implant Prosthodontics

"Telescopic Prostheses for Implants," by H. W. Preiskel and P. Tsolka. Int J Oral Maxillofac Implants 13(3):352–357, 1998.

Because of their versatility, telescopic restorations are firmly established in the prosthodontic protocols for natural teeth. The telescopic approach is now gaining favor in implant prosthodontics as well. Telescopic copings allow for modification of their contours to provide a common path of insertion and correct emergence profiles, and they can eliminate the need for screw holes in the occlusal surfaces of the prosthetic teeth. This article reports on a retrospective study that investigated the outcome of 73 telescopic implant-supported fixed prostheses that had been functioning for from less than 1 year to 4 years. Fifty-four prostheses were entirely cement retained. After 1993, 19 prostheses incorporated a screw-clamping unit. Some of these were a combination of a screw-retained abutment in a series of cement-retained telescopic abutments. The rate of complication with all of the telescopic abutments was low and, in most cases, was minor when present. Cement-retained prostheses involving a distal cantilevered extension required the greatest postoperative maintenance. Despite the small number of combined screw- and cement-retained prostheses, the lack of complications and the ease of retrievability make this approach worthy of further study. (F. DuCoin)

"Alternative Procedure for Making a Metal Suprastructure in a Milled Bar Implant-supported Overdenture," by C. Ercoli, G. N. Graser, R. H. Tallents, and M. E. Hagen. J Prosthet Dent 80:253–258, 1998.

The article presents an alternative procedure for fabrication of metal suprastructure in implant-supported overdentures. The suprastructure is sitting on top of the superstructure (milled bar). This procedure does not require the use of electrical discharge machining process (spark-erosion) to fir the suprastructure. Instead, it incorporates in its design retentive elements that ensure the prosthetic stability at a fraction of the cost.

The clinical procedure consists of the following steps. Before implant placement, the practitioner should record the maxillomandibular relationship and mount it in the articulator. The

denture set-up should be checked, keeping aesthetic and functional considerations in mind. The set-up should be duplicated for use as a surgical guide (keeping in mind the position and dimensions of retentive elements). After stage II surgery, a soft-tissue cast should be made; the cast will include implant and abutment analogues. The cast should be verified with an acrylic resin jig. The face bow transfer should be used to mount a maxillary modified cast in the ariculator. The practitioner should make an interocclusal record of VDO (predetermined at presurgical steps) and should mount the modified cast with aid of the interocclusal record. The denture set-up should be transferred and the occlusion adjusted; the set-up is then adjusted to the patient's mouth. Next, the set-up is reseated on the modified master cast, and laboratory procedures are begun.

The laboratory procedure consists of the following steps. The technician creates a plaster/silicone facial matrix of the set-up, including incisal and occlusal surfaces, as well as a lingual matrix, extending to the neck of the denture teeth. Both matrices are removed from the cast, and the teeth from the set-up are luted to the labial matrix. The labial matrix is placed on the modified master cast using the lingual matrix. The labial matrix is used to make the preliminary bar. A gold cylinder is placed on the abutment analogues, which are secured with wax guide pins. The pattern is created with autopolymerizing acrylic or wax, and the pattern is cut between the abutments to allow for stress release. After 24 hours, the bar components are luted together with acrylic and the cast, with the pattern, is placed on the adjustable cast holder of a surveyor. The pattern is milled to a two-degree taper, and the matrices are placed to verify that adequate space exists for the suprastructure. After milling the bar, two recesses are made in the posterior portion of the bar to accommodate two swivel-lock attachments. The pattern is spurred, the casting is divested, and the bar is tried in the mouth for passive fit. The bar is placed on the milling machine and sprayed with occlude. The taper is refined and the sharp angles of it are polished. The bar is placed on the master cast and the block undercuts. The suprastructure is fabricated with a positive pressure thermoforming machine (4.5 bars are needed), and the sleeves are removed from the bar (1 mm biocryl material). The sleeve is adjusted and placed back on the bar. The sleeve fit is refined with rubber abrasive points, and plastic beads are added to the sleeve and a place is prepared for the attachments. The suprastructure is sprued, invested, and cast with base metal, then divested, place on the bar, and adjusted to fit. The attachments are secured to the suprastructure with acrylic/wax, and the matrix with the teeth is placed on the cast. The teeth are luted to the suprastructure with wax, the denture is removed, and the overdenture is finished for final wax-up and try-in. The overdenture is processed, the suprastructure is opaqued during flasking, and the prosthesis is divested and finish for delivery.

Upon delivery of the prosthesis, the following steps should be performed. The occlusion, aesthetics, and phonetics should be checked. The practitioner should verify the stability and ease of removal of the prosthesis, and should instruct the patient on how to remove the suprastructure as well as on oral hygiene. Recall appointment(s) should be assigned. (M. Katzap)

ENDOSSEOUS IMPLANTS

"Periodontal Implications in Implant Treatment Planning for Aesthetic Results," by A. P. Saadoun and M. G. Le Gall. Pract Periodont Aesthetic Dent 10(5):655–664, 1998.

The predictability of osseointegration in various dental implant systems has taken the field of implantology beyond the initial restoration of function to a point where aesthetics have become a preeminent factor for the patient. Utilization of dental implants in the anterior region is a technique-sensitive procedure. An error in implant positioning or in hard- or soft-tissue management can result in aesthetic failure. Preoperative evaluation, accurate diagnostic evaluation, development of a systematic presurgical treatment plan, and the clinical mastery of the various related therapeutic modalities are of paramount importance in the achievement of an aesthetic and functional implant restoration. Insufficient hard- and soft-tissue height and width can be a repercussion of tooth loss or a result of postoperative healing following implant surgery. Insufficient bone can preclude proper implant positioning, while inadequately treated soft tissue will not exhibit a gingival appearance similar to that of the adjacent teeth. If hard and soft tissues are not corrected by regenerative techniques, the replaced tooth appears long or overly bulky gingivally. In order to create hard- and soft-tissue harmony, an understanding of the biological variables and periodontal implications is necessary. This article reviews in detail the criteria, which must be carefully evaluated and controlled to achieve predictable aesthetic results. In those areas the authors do not explore in depth, their references give adequate guidance for further study. (F. DuCoin)

"Soft Tissue Ridge Augmentation to Correct an Esthetic Deformity Caused by Adversely Placed Implants: A Case Report," by R. E. Goldstein. Int J Periodont Rest Dent 18(3):255–264, 1998.

This case report shows how an aesthetic deformity caused by an adversely placed implant can be corrected by a soft-tissue ridge augmentation. The patient in this case was involved in a motor vehicle accident. As a result, there was an immediate loss of her maxillary left lateral incisor and canine as well as of the alveolar process associated with these teeth. Soon after the accident, the patient lost her maxillary left central incisor, leaving her

with a defect measuring 15 mm mesiodistally, 7 mm buccolingually, and 6 mm coronoapically.

Approximately 1 year after the accident, the patient had two implants placed. After osseointegration, the area was restored with a screw-retained fixed prosthetic with tissue-colored porcelain; the practitioner hoped to mask the underlying aesthetic deformity. The patient was very unhappy with her aesthetic appearance.

In an attempt to satisfy the patient, flat healing screws were placed on the two implants. The patient then underwent three connective tissue grafts to cover the implants. After healing, an onlay-free gingival graft was performed in order to obtain a correct color of gingiva to match the adjacent teeth. After complete healing, a conventional fixed prosthesis was completed to replace the missing teeth. (R. Lebovitch)

"Reconstruction of Residual Alveolar Cleft Defects with One-stage Mandibular Bone Grafts and Osseointegrated Implants," by J. Jensen, S. Sindet-Pedersen, and H. J. Enemark. Oral Maxillofac Surg 56(4):460–466, 1998.

Purpose. The purpose of the study was to test a method for reconstruction of residual maxillary alveolar cleft defects using bone grafting simultaneous with implant placement.

Methods. Sixteen patients, who had residual cleft defects of the maxilla were treated. Fourteen patients had unilateral clefts and two had bilateral clefts. Two of the unilateral cleft patients required two implants to restore the edentulous space, and the remaining 12 patients were treated using only one implant. A total of 20 implants were placed, with lengths ranging from 10–20 mm. The grafts were taken from the mandibular symphysis. The exposed symphysis was prepared and tapped to receive a Branemark implant. A window of bone was outlined around the circumference of the implant preparation. The prepared bone graft was then applied to the edentulous cleft site. The graft was then stabilized with the installed Branemark implants. All patients received prophylactic antibiotics at the time of surgery and continued to receive antibiotics for 7 days postoperatively. Implant mobility, bony support, and peri-implant tissue were observed 3 and 6 months after prosthodontic treatment was completed, and thereafter, follow-up occurred at 12-month intervals. At the donor site, all teeth were examined for pulp vitality, periodontal condition, root resorption, and periapical pathology.

Results. Five patients developed wound dehiscence that resulted in total or partial bone graft sequestration. Two patients developed total bone graft sequestration around two implants. In one patient, the implant was removed due to mobility. The implants and bone grafts had been loaded for periods ranging from 30–63 months. The mandibular donor site at 6-month follow-up showed no signs of damage to teeth or roots and showed no evidence of periapical pathology.

Discussion. Despite the fact that a secondary bone grafting procedure was performed successfully in all patients, some degree of bone graft resorption took place. A high rate of wound dehiscence was recorded, resulting in total or partial bone sequestration. There was also a high degree of bone resorption. The use of mandibular bone as grafting material could be the reason for these problems. Because of the high complication rate, the authors concluded that the one-stage procedure is not ideal for reconstructing residual cleft defects. Further improvements may be achieved by using a two-stage procedure for treating cleft patients with residual alveolar ridge defects. (S. Honikman)

"Report of 302 Consecutive Ridge Augmentation Procedures: Technical Considerations and Clinical Results," by P. A. Fugazzotto. Int J Oral Maxillofac Implants 13(3):358–368, 1998.

This article discusses 302 ridge augmentation cases performed by the author. The procedures included vertical and horizontal augmentation procedures (overall success rate of 96%). Five hundred seventy-four implants were placed in the augmented ridges; 346 of those implants have been uncovered and restored (success rate of 97%).

Materials used for augmentation were all particular: demineralized freeze-dried bone allograft (particle size 500–800 μm); mineralized freeze-dried bone allografts (500–800 μm or 800–1000 μm); resorbable tricalcium phosphate; and porous bone mineral matrix (Bio-Oss). In addition, titanium support screws, expanded polytetrafluoroethylene membranes, and Freos fixation tacks were used. Screw type and TPS-coated fixtures (screws and cylinders) were used subsequent to the augmentation procedures.

Depending on the clinical situation, four types of incision design were used: a midcrestal incision in keratinized tissue followed by four releasing incisions (mesio- and distobuccal and mesio- and distopalatal). A split-thickness palatal incision was also used, which left connective tissue covering the crest of the ridge following reflection of the buccal flap. This connective tissue was then elevated as part of the palatal flap, as described by Langer, and a set of four releasing incisions was again used. Reflection of the Langer flap was followed by the rotation of the connective tissue pedicle from the inner aspect of the palatal flap prior to flap closure. A buccal-vestibular split incision design is coupled with mesio- and distolingual releasing incisions.

Guided bone regeneration was carried out in the following situations: when buccal lingual/palatal augmentation was needed to support an implant in an acceptable restorative position (even if acceptable dehiscence/fenestration would have occurred without the augmentation); during coronal ridge augmentation, with acceptable buccal-lingual dimension to accept an implant of sufficient length to provide long-term support for the

planned prosthesis; during simultaneous buccal-lingual and apico-occlusal augmentation; during buccal ridge augmentation, as described above and in conjunction with sinus augmentation; and during buccal/lingual and apico-occlusal augmentation, as described above and in conjunction with a sinus augmentation procedure.

Success was considered to have been achieved if the implant was immobile, if pain and/or suppuration was absent, if there was no evidence of peri-implant radiolucency, and if the vertical bone loss was less than 1.5 mm in the first year and less than 0.2 mm annually in subsequent years of function. Regenerated ridges were deemed successful if they were hard upon probing (less than 2 mm) and if they could accept an implant of 4-mm in diameter (without dehiscence/fenestration) and of at least 10 mm in length.

The author discusses several principles, including decortication of the residual ridge (though used routinely, it was not evaluated for its effectiveness in this study) and the use of particulate material underneath the membrane. The advent of titanium-reinforced Gore-Tex has significantly reduced space maintenance problems. It was used alone in small defects. For larger defects, the t-GTAM was used with a particulate material. This was done to ensure initial clot stabilization. The particulate should be morphologically suited for the task and should resorb at a predictable rate. At this time, the only particulate used by the author is Bio-Oss.

The author explains that space maintenance used to be a problem, especially in large defects where the membrane used to collapse in areas lateral to the screw heads that were securing it, thus compromising the result of the guided bone regeneration. The use of titanium Gore-Tex virtually eliminated this problem. Membrane stability is ensured with extensive reflection of the flaps. If stability is not ensured, the membrane can move significantly and can compromise results. The author also explains that flap designs, as described above, were used to achieve passive primary closure whenever it was possible. Prolonging the time afforded for regeneration appeared to result in a higher degree of ridge maturity, as discovered during implant placement; thus, unless very small defects were treated, implant placement took place 8–9 months after the augmentation procedure. Finally, the author explains that aesthetic areas were two stage; otherwise, if the implant could have been placed in the ideal position at the time of the augmentation procedure, it would not have resulted in any restorative difficulties or compromise. (M. Katzap)

"Tridimensional Reconstruction of Knife Edge Edentulous Maxillae by Sinus Elevation, Onlay Grafts, and Sagittal Osteotomy of the Anterior Maxilla: Preliminary Surgical and Prosthetic Results," by M. Chiapasco, E. Romeo, and G. Vogel. Int J Oral Maxillofac Implants 13(3):394–399, 1998.

The authors present a method to correct the totally edentulous maxilla with a Class IV residual ridge (adequate height and inadequate width in the anterior maxilla and inadequate height and width of the posterior maxilla because of pneumatization of the maxillary sinuses). Patients with Class V and VI maxillary residual ridges are not candidates for the tridimensional reconstruction described in this article. Three cases are presented and discussed. The anterior iliac crest was the site of the donor bone.

The technique first involved a crestal incision with a half-thickness flap in the anterior maxilla and a full-thickness flap in the posterior maxilla bilaterally. A bilateral sagittal osteotomy was then performed in the anterior maxilla, with autogenous grafting to fill the intercortical space. The sinus lift was then performed, using a combination of autologous bone and hydroxyapatite in a 3:1 ratio. The final step involved correcting the posterior transverse deficit by means of an autogenous corticocancellous bone graft, which was secured in place with titanium miniscrews.

Six months after correcting the ridge deficiencies, each of the three patients received six to eight Branemark titanium implants. Prosthetic rehabilitation was initiated 6 months after implant placement. The mean follow-up period has been 16 months following completion of the prostheses. At present, all the implants are in function. Although the follow-up period has been too short to determine success, the data to this point is encouraging. (E. Demirdjan)

"Implants in Regenerated Bone: Long-term Survival," by M. Nevins, J. T. Melloning, D. S. Clem III, G. M. Reiser, and D. A. Buser. Int J Periodont Rest Dent 18(1):34–45, 1998.

This is a retrospective study, the aim of which was to evaluate the long-term success of implants in function in bone regenerated by guided bone regeneration (GBR) combined with an autograft or allograft. Four study centers were involved, two academic and two private. A total of 526 implants were placed in 352 patients. An expanded polytetrafluoroethylene (e-PTFE) barrier (Gore) was used in all instances. One center used intraoral autogenous particulate bone (APB); one used demineralized freeze-dried bone allograft (DFDBA); one used mineralized freeze-dried bone allograft (FDBA) and autogenous particulate bone; and the last center used DFDBA or FDBA. The implants used were as follows; three centers placed titanium-threaded implants (Nobel Biocore or 31), and one center inserted nonsubmerged plasma-sprayed implants (ITI). The e-PTFE barriers were removed at the abutment procedure or if premature exposure occurred.

The implants were restored with either single crowns (149), fixed partial dentures (353), or overdentures (54). The mean age of the patients involved

was 51 ± 15 years; 42% of the patients were male and 58% were female. One hundred eighty-nine implants were installed with bone grafts placed simultaneously; 337 implants were placed in a staged approach. The mean cumulative bone loss over the 6- to 74-month loading period was 0.64 ± 0.22 mm, with the greatest amount of bone loss occurring during the first year and a half. Bone loss among centers was consistent, with a range of 0.3 ± 0.8 mm, and there was no difference between bone loss measures with the staged or simultaneous approach. Eight of the 526 implants were lost after loading; five cases involving implant loss were associated with overdentures. The overall success rate was 97.5%.

The results of this study suggest that implants placed in bone regenerated by GBR combined with osseous grafts have the same long-term survival as implants placed in nonregenerated bone, which broadens the number of eligible patients who do not have sufficient bone for placement of implants. (S. Sen)

"Implants Placed in Immediate Extraction Sites: A Report of Histologic and Histometric Analyses of Human Biopsies," by T. G. Wilson, R. Schenk, D. Buser, and D. Cochran. Int J Oral Maxillofac Implants 13(3):333–341, 1998.

This report demonstrates that titanium implants with a plasma-sprayed surface could achieve osseointegration if placed immediately into extraction sites. Human volunteers were used, and five implants were biopsied 6 months after placement. Four test implants had been placed in immediate extraction sockets, while one implant was placed in a mature site. The success rate was determined by percentage of bone–implant contact.

The nonloaded control implant had the highest percentage of bone–implant contact. The lowest mean bone–implant contact was observed for the two molar implants, which had horizontal defect dimensions of 4 mm. These implants were placed in a nonsubmerged fashion with the implants perforating a membrane.

The varying degree of bone–implant contact was attributable to the morphology of the peri-implant bone defect present at the time of implant placement. The horizontal component of the defects was most critical in dictating the final amount of bone–implant contact. (J. Wachspress)

Subperiosteal Implants

"Reconstruction of Advanced Mandibular Resorption with Both Subperiosteal and Root-Form Implants," by R. T. Perry. Implant Dent 7(2):94–100, 1998.

The author presents three cases involving use of a tripodial circumferential subperiosteal implant in conjunction with two endosseous implants to rehabilitate severely atrophied mandibles. Each of the three patients had been fully edentulous for at least 28 years. The endosseous implants used in each case were Bicon with O-ring abutments, and the direct bone impression technique was used for fabrication of the subperiosteal implant. Dr. Perry used this technique to avoid the possible complications that are associated with the classical high risk procedures such as use of (1) a subperiosteal implant alone, (2) multiple root-form implants in the symphysis region, with a custom cantilevered bar and completely implant-supported prosthesis, (3) a mandibular staple implant, (4) a transmandibular implant, and (5) a ramus frame implant. He also recognizes that the use of endosseous implants aids in the preservation of bone height in the symphysis.

The technique is composed of six stages, the first four of which are surgical. Phase I consisted of the placement of two root-form implants. Five months later Phase II occurred, which included a direct bone impression and transfer impression. Phase III, consisting of placement of the subperiosteal implant and two root-form O-ring abutments, followed 6 weeks later. The final surgical step, Phase IV, gingival sculpting, was done 3 to 4 months later. Phase V included the fabrication of the prosthesis, and, finally, Phase VII involved maintenance and recall.

Dr. Perry reports two complications to date, both of which were resolved. The first complication was a transient parasthesia, which resolved spontaneously within 4 months. The second complication was a partially exposed autogenous graft in the symphysis. (E. Demirdjan)