Ridge Augmentation in the Esthetic Zone to Achieve **Prosthetically Guided Implant Positioning**



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Preservation and augmentation of alveolar ridge height and width are essential considerations for optimizing dental implant placement, particularly when screw-retained high-strength ceramic crowns are planned as definitive restorations. These concerns have unique clinical relevance in the anterior esthetic zone since the management of lost, traumatized or thinning cortical bone frequently requires a sequential and delicate surgical approach. When dental implants are planned as replacements for failed endodontically treated teeth that have compromised the alveolar ridge, combining ridge augmentation techniques such as guided bone regeneration (GBR) with connective tissue grafting, as well as delaying implant placement, are strategies to achieve prosthetically guided dental implant positioning. Subsequent management with meticulous fixed provisionalization can then provide for optimal peri-implant soft tissues, enhancing the esthetic outcome for the definitive restorations.

Patient case history

A 53-year-old Caucasian female was referred by her prosthodontist for possible implant placement. The patient reported falling and fracturing her maxillary central incisors at age 8, sustaining blunt trauma to teeth #8 and #9 (#11 and #21, respectively). Endodontic treatment followed by resin bonding restored the Class IV fractures on both incisors.

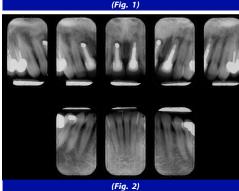
At age 17, a general dentist replaced her composite restorations with porcelain-fused-tometal (PFM) crowns supported by prefabricated, tapered posts and composite core build-ups. In her early 30s, these were replaced with a second set of PFM crowns in order to improve esthetics. Ten years later, the patient sought further treatment by a prosthodontist with the chief complaint that she was unhappy with the exposed metal margins on the facial aspect of her ceramo-metal crowns. These PFM crowns were replaced with butt-joint margin ceramometal crowns, and the patient was delighted with the improved esthetic result. After five years, the patient presented with swelling and a fistula over the apex of tooth #8. She was referred to an endodontist for evaluation. The diagnosis was crown mobility with underlying loosening of the post in tooth #8, and the recommendation was to retreat #s 8 and 9 prior to fabricating new posts and cores (Cosmopost/Whaledent and Empress/Ivoclar) and replacing both existing PFMs with high-strength ceramic restorations (Procera Alumina®/Nobel Biocare). Endodontic retreatment was completed on #8 and tooth #9 was not endodontically retreated, as its post could not be removed. The final crowns were cemented and the patient was satisfied with the result.

After approximately three years, a fistula had again developed on tooth #8 and the patient was referred by her prosthodontist for endodontic evaluation. It was determined that the tooth likely had a fractured root and was therefore hopeless. The adjacent central incisor was also planned for extraction as its long-term prognosis was questionable. Removing questionable

neighboring teeth was recommended prior to placing dental implants.

Shown in *Figure 1* are the appearance of the second set of all-ceramic crowns on teeth #s 8 and 9 prior to referral to our office. Figure 2 is the full-mouth radiographic series from November 2004 displaying periapical radiolucencies on endodontically treated #s 8 and 9 and retrofill





Using an in-situ gingival augmentation technique first described in 1994 by Langer1, the prosthodontist de-coronated the clinical crowns of #s 8 and 9 (Figure 3) with the intent of promoting epithelial migration over the ridge to help obtain primary closure for the intended extraction and simultaneous augmentation procedures to be performed by the periodontist.



Upon the patient's initial presentation to our office two weeks later, her soft tissues had indeed migrated with nearly complete flap closure achieved over the roots (Figure 4). Figure 5 shows the acrylic partial denture fabricated by the prosthodontist.



Ridge augmentation method

A guided GBR procedure to augment the alveolar ridge was performed prior to dental implant placement. Five 1.8-mL carpules of Xylocaine® (Lidocaine Viscous) 2% with 1:100,000 epinephrine and two 1.8-mL carpules Xylocaine® with 1:50,000 epinephrine were administered as facial infiltrations in positions # 6-11, in addition to a nasopalatine block to obtain profound anesthesia in the anterior maxilla. A full-thickness mucoperiosteal flap was elevated with vertical incisions extending apically from the distal line angles of teeth #s 8 and 9 to beyond the

mucogingival junction. Figure 6 shows the loss of facial cortical plate on #8, fistula, and thin facial bone on both teeth. The darkening of the root of #9 is apparent (as in Figure 1 also).



Atraumatic extraction with delicate technique using periotomes is critical in such a situation, in order to preserve the thin facial plate on #9. Figure 7 shows facial and occlusal views of the ridge architecture immediately post-extraction, including the dehiscence-type defect in position #8, and preservation of the thin facial cortical plate in position #9.

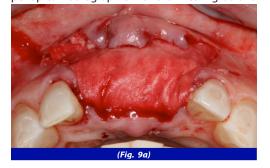


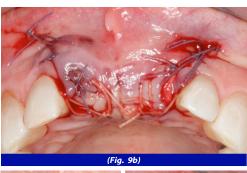


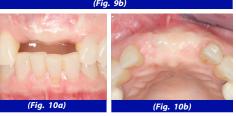
The extraction sockets were then packed with a freeze-dried cortical bone allograft (Musculoskeletal Transplant Foundation, Edison, NJ). Considerable overfill of the graft site was achieved to compensate for settling and remodeling of the graft during the healing period (Figure 8).

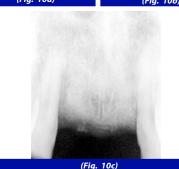


A resorbable type-I porcine collagen membrane (BioGide®; Osteohealth, Shirley, NY) was placed (Figure 9), and secured beneath the soft-tissue margins of the graft site to stabilize the particulate bone graft material and to provide space for selective repopulation of the site with osteoblasts, while excluding the epithelial cell proliferation. Primary closure was accomplished with 5-0 Vicryl® sutures (Ethicon, Raritan, NJ). Figure 10 shows facial, occlusal and periapical radiographic views of healing at two









months postoperatively, demonstrating good preservation of the bony and soft-tissue ridge

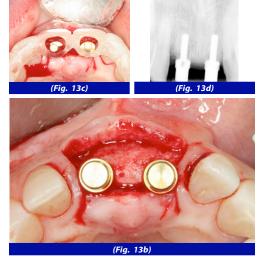
In preparing for the implant surgical phase, a surgical guide from orthodontic resin (Figure 11) was fabricated by the prosthodontist to aid in appropriate alignment of the proposed implants and restorations. A full-thickness flap was elevated facially and palatally, using papillarysparing incisions on teeth #s 7 and 10 to avoid further gingival recession (Figure 12). Excellent consolidation of the bone graft and facial-lingual ridge profile was also observed upon re-exposure of the graft site.





Figure 13 demonstrates 3.5-mm and 4.3-mm guide pins being used in the pilot osteotomies to gauge the distance between the implants and the proximal teeth so as to determine whether 3.5-mm or 4.3-mm diameter implants should be utilized. Regular platform, 4.3-mm X 13-mm Nobel Replace®, Tapered Groovy implants (Nobel Biocare, Goteborg, Sweden) were selected, as enough bone existed to support that implant diameter at the crest. In this case, the appropriate





distance, position and angles were determined to facilitate emergence of the implant through the cingulum area of the proposed restoration form, ie, toward lingual aspect of the incisal edge. Also shown are guide pins seated in inverted positions in the pilot osteotomies to confirm their centralized positions relative to facial and palatal margins of the planned restorations. Figure 14 shows incisal views and a periapical radiographic view of the 4.3-mm 13-mm diameter Nobel Replace® Tapered Groovy implants placed at the level of the newly-augmented ridge (no threads visible) and their alignment with the surgical guide. Finally, a connective tissue autograft harvested from the palate was placed over the implants, and near-primary closure was achieved with 5-0 Vicryl sutures (Figure 15). Figure 16 shows the soft tissues pre-operatively, and at 2 and 4+ months post-operatively after submerging the implants.

Next, the implants were uncovered after 4 months by performing two semilunar incisions.

















The tissue was advanced from the mid-crest toward the facial in conjunction with these incisions, and healing abutments were placed (*Figure 17*). *Figure 18* shows the immediate post-operative facial advancement of the crestal tissue, as well as healing of the facially displaced tissue at 1 week.

The next phase of treatment consisted

















of provisionalization and restoration of the implants. An implant fixture-level impression was obtained (Figure 19a), and at a subsequent appointment, two temporary non-engaging titanium abutments (Nobel Replace RP) were used to convert the acrylic partial denture to a splinted acrylic screw-retained provisional (Figure 19b). The overall goal was to sculpt the tissue for a more natural form and to contour the emergence profile in preparation for the final crowns (Figure 19c). Approximately 3 weeks later, papilla formation was observed, as healing and tissue remodeling progressed (Figure 20). Finally, a white wax mock-up was tried in to determine necessary modifications with the patient's input regarding shape and length. Two individual screw-retained Procera® (Nobel Biocare) zirconia crowns layered with NobelRondo® (Nobel Biocare) veneering porcelain were torqued down to 35 Ncm (Figures 21 and 22).



























Figure 1. All-ceramic crowns (second set), teeth #s 8 and 9 prior to referral to our office.

Figure 2. Full-mouth radiographic series from November 2004; note periapical radiolucencies on endodontically treated #s 8 and 9 and retrofill amalgam, #8.

Figure 3. De-coronated clinical crowns of #s 8 and *9, performed by prosthodont`ist (note persistent* fistula, #8).

Figure 4a. Facial view of migrated soft tissue, with nearly complete flap closure achieved over the roots; Figure 4b, incisal view.

Figure 5. Acrylic partial denture fabricated by the prosthodontist.

Figure 6. Full-thickness flap exposure showing loss of facial cortical plate and fistula, #8, thin facial bone on both teeth, darkening of root, #9.

Figure 7a. Facial view, ridge architecture immediately post-extraction: dehiscence-type defect, position #8, preservation of thin facial cortical plate, position #9; Figure 7b. Incisal view.

Figure 8. Freeze-dried cortical bone allograft, overfilled to compensate for settling and remodeling during healing

Figure 9a. Resorbable type-I porcine collagen membrane placed over allograft; Figure 9b. Primary closure with 5-0 Vicryl sutures.

Figure 10a. Facial, of healing at two months postoperatively, demonstrating good preservation of bony and soft-tissue ridge volume; Figure 10b. incisal/occlusal view; Figure 10c. periapical radiographic view.

Figure 11. Surgical guide (orthodontic resin) fabricated by the prosthodontist, in preparation for implant surgical phase.

Figure 12. Full-thickness flap with papillarysparing incisions on teeth #s 7 and 10; excellent consolidation of bone graft, facial-lingual ridge

Figure 13a. Guide pins (3.5-mm) and in pilot osteotomies to gauge the distance between implants and proximal teeth and assess appropriate implant diameter. **Figure 13b**. Guide pins (4.3-mm); **Figure 13c**. Guide pins (4.3 mm) seated in inverted positions in pilot osteotomies to confirm positions relative to planned restorations;

Figure 13d. Periapical radiographic view, 4.3 mm)

Figure 14a. Incisal view, 4.3-mm 13-mm diameter Nobel Replace® Tapered Groovy implants placed at the level of the newly-augmented ridge; Figure 14b. Alignment with the surgical guide. **Figure 14c**. Periapical radiographic view of implants.

Figure 15a. Palatal connective tissue autograft placed over implants; **Figure 15b**. Near-primary closure with 5-0 Vicryl sutures.

Figure 16a. Soft tissues pre-operatively; Figure **16b**. 2 months postoperatively; Figure **16c**. 4+ months post-operatively, after submerging implants.

Figure 17a. Semilunar incisions;

Figure 17b, Figure 17c. Tissue advancement facially from mid-crest;

Figure 17d. Healing abutments placed; Figure 17e. Periapical radiographic view after soft-tissue repositioning.

Figure 18a. Facial advancement of crestal tissue immediately postoperatively; Figure 18b. Facial view, healing of facially displaced tissue at 1 week;

Figure 18c. Incisal view at 1 week.



Figure 19b. Two temporary non-engaging titanium abutments (Nobel Replace RP) to convert the acrylic partial denture to a splinted acrylic screw-retained provisional;

Figure 19c. Facial view, contouring of provisional crowns' emergence profile in preparation for final crowns; **Figure 19d**. Incisal view.

Figure 19a. Implant fixture-level impression;

Figure 20a. Facial view, papilla formation at 3 weeks; Figure 20b. Incisal view; Figures 20c, 20d. Provisional crowns in place against newlyremodeled tissue.

Figure 21a. Wax mock-up tried in to determine necessary modifications with patient input on shape and length; Figure 21b. Final screw-retained Procera® zirconia crowns layered with NobelRondo® veneering porcelain in place, torqued down to 35

Figures 22a, 22b, 22c. Lipline/esthetic views of final restorations.

REFERENCE

(1) Langer B. Spontaneous in situ gingival augmentation. Int J Periodontics Restorative Dent. 1994; 14(6):524-535.

Discussion and Conclusions

Hard- and soft-tissue esthetic management during tooth replacement with implants often demands a stepwise, integrated treatment approach over time. In this case, GBR was used as a foundation on which to rebuild an alveolar ridge that had become extremely fragile, enabling close-toideal placement of implants. Then, as separate procedures, soft tissue grafting, tissue advancement and provisionalization were used integrally to augment and restructure soft tissue in order to recreate lost gingival architecture. This interdisciplinary sequence highlights the significance of well-planned provisionalization as an integral step in the esthetic tissue remodeling process prior to placement of the final restorations. It also emphasizes the significance of collaboration between the periodontist and prosthodontist in order to obtain an optimal anatomic, functional and esthetic result for the patient.

All restorative dentistry as well as photographs of crowns, provisionals and implant restorations performed by Debra H. Cohn, D.D.S. (Clinical Associate Professor, Advanced Education Department of Prosthodontics, New York University College of Dentistry; Private practice, New York, NY, USA)