Close Encounters of the Nerve Kind

Richard Winter, DDS

INTRODUCTION

Dental implants are being sold in multiple sizes, shapes, and designs from many companies, all of them touting the advantages of their systems and designs. Some reasons for the abundant choices are the realization that many patients won't undergo requisite osseous grafting, ridge spreading, or sinus augmentation. So alternative solutions promulgated in the literature and proven in vivo demonstrate that implants can be successful when they are customized for situations based upon their attributes, given that attention is paid to proper implant number, position, and distribution. This article is a case study of how a compromised solution for unilateral edentulism was addressed.

Factors for Success

When patients are evaluated for an implant restoration, many criteria are evaluated. Some of the factors that affect implant success rely upon patient health factors, which can be systemic or local. The cause of tooth loss can be indicative of the challenges that may present themselves in the surgical and restorative phases of implant rehabilitation. So, it is invaluable to carefully evaluate the existing dentition *and* assess the current occlusal scheme for canine guidance, group function, and parafunction. The etiology of tooth loss can be further broken down into categories, which may include periodontal pathology, occlusal traumatism, trauma, neglect, and failed dental restorations. Restorations that exceed 50% of the isthmus width may result in failure due to the challenges that forces of mastication pitted against extensive restorations, posts, and otherwise weakened tooth structure, can create.

Figure 1. Retracted view in centric occlusion.

Figure 2. Occlusal view of mandibular arch preoperatively.

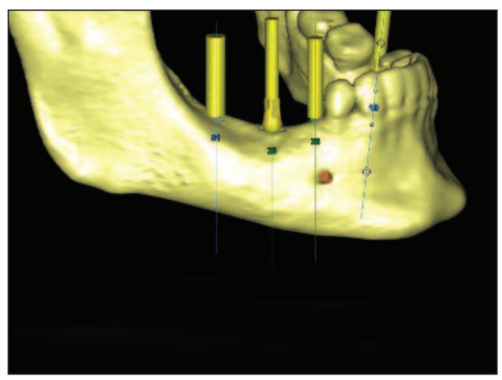

Figure 3. Right lateral view of virtual implant placement with abutments.

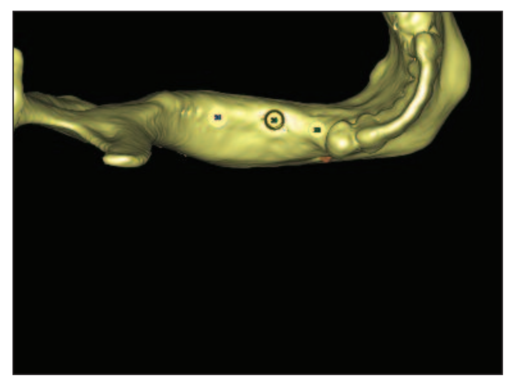

Figure 4. Occlusal view of planned implant placement.

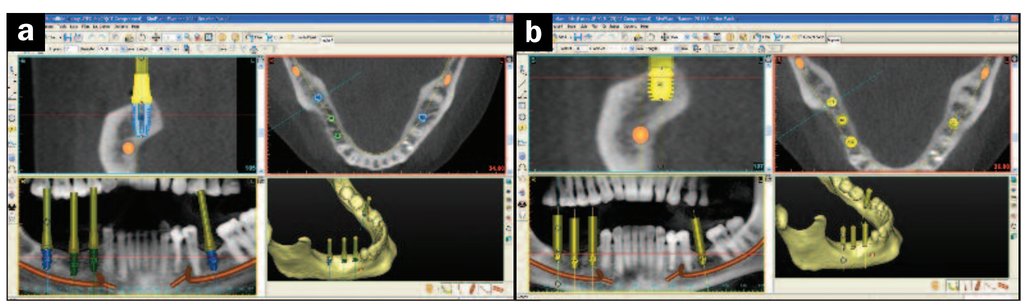

Figure 5a. SimPlant (Materialise Dental) view of parallel-walled implant, axial and panoramic view of planned implant placement.

Figure 5b. SimPlant view of a smaller profile implant system for comparison.

CASE REPORT

Findings and Patient History

This male patient had a Class I malocclusion with a Class III tendency and an open bite in the bicuspid area. He had reported a Class III bite as a teenager and his orthodontic treatment improved the anterior sextant relationship, making his dental classification Class I, but skeletally he remained Class III (Figure 1).

The patient was an engineer, a large 6-foot-plus male, and he was capable of generating significant force factors due to his size and brachycephalic head and jaw structure. He had been in a car accident that resulted in fractured teeth, jaws, the death of his brother, and severe post-accident depression. Rather than save teeth that may have had a good prognosis, he opted to have these teeth removed. The subsequent edentulation and lack of orthodontic follow-up resulted in a jaw asymmetry, malocclusion, and a significant amount of bone loss in the lower right quadrant.

In an ideal world, the patient should have undergone orthodontics to level and optimize his occlusion. Then, he should have undergone block grafting to allow for larger endosseous implant placement to withstand the forces of mastication his occlusion demanded. Due to the psychogenic factors related to his case, he refused to undergo substantial grafting and refused to wear a lower partial denture.

Is Compromise Acceptable?

If patients are made aware of their situation and the costs, advantages, disadvantages, benefits, and risks of treatment are

continued on page 128

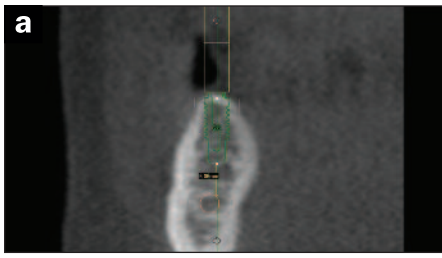

Figure 6a. Implant No. 28 and distance to the nerve.

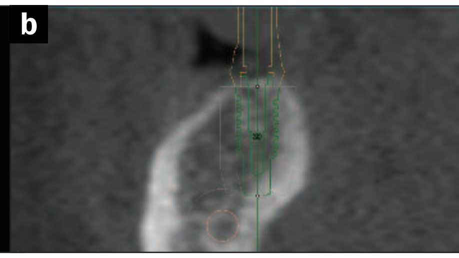

Figure 6b. Implant No. 29, and proximity to nerve and lingual concavity.

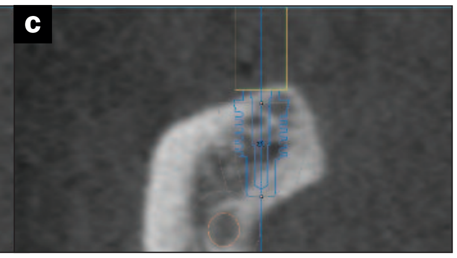

Figure 6c. Implant No. 30 and proximity to lingual concavity.

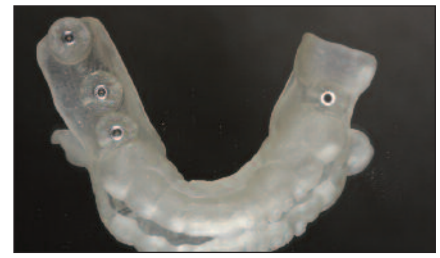

Figure 7. Intaglio of tooth supported pilot drill surgical guide.

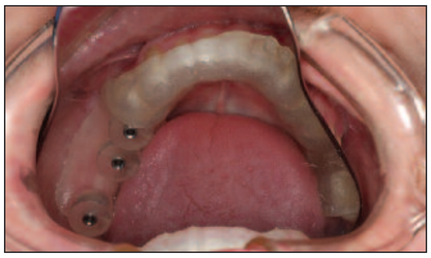

Figure 8. Intraoral occlusal view of seated surgical guide.

Figure 9. Permucosal extensions of implants after healing.

Figure 10. Uncovered implants Nos. 28 to 30 prior to master impressions.

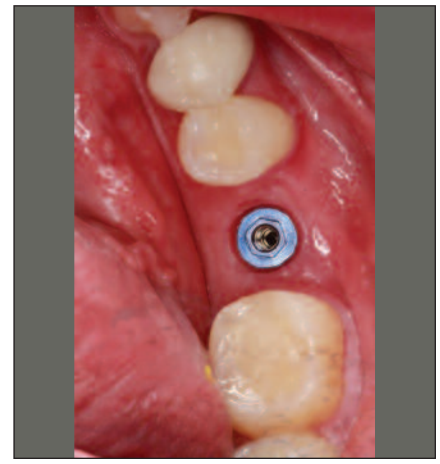

Figure 11. Uncovered implant No. 19.

Once the impression analogs were affixed to the body of the implants, a radiograph was taken....

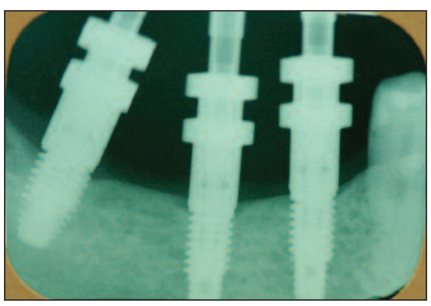

Figure 12. Radiographic verification of impression analogues.

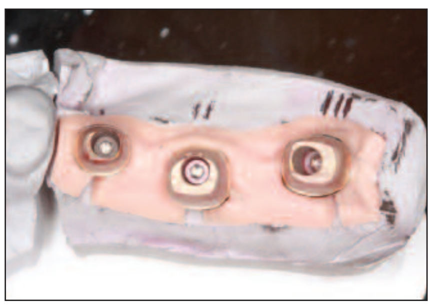

Figure 13. Abutments on cast with soft-tissue model.

Figure 14. Entire arch showing abutments.

Figure 15. Gold fixed bridge and porcelain crown on cast.

Close Encounters of the Nerve Kind

continued from page 126

explained, they are allowed to be a co-partner in the diagnosis and treatment of their situation. In this case, the idea of placing implants in the narrow ridge was discussed after a thorough evaluation of the bone via cone beam (CB) radiograph.

Overall Treatment Plan

A treatment plan was evaluated and agreed upon with the patient to place 3 implants on his lower right and one on the lower left. The 3 implants would be splinted together for strength, and they would be placed in a tripodized configuration, which would increase the strength, stability, and support of the bridge.[1] The patient agreed to nighttime wear of a bruxism appliance to decrease nocturnal parafunction. It should be noted that block grafting would have provided this patient with a more favorable foundation for implant placement, but the patient did not wish to undergo this procedure.

Records and Clinical Treatment Protocol

The records were taken, including study models, face-bow transfer, bite registration, Panorex, CBCT, reformatting by 3DDX (3D Diagnostix), photographs, and a lab-fabricated diagnostic wax-up.

SimPlant software (Materialise Dental) was used to manipulate the images, which were reformatted by 3DDX. This would facilitate placement of different implant systems to see which design, length, and brand would best serve the patient in his reconstruction given his osseous limitations. The company receives the images from the scanning center, and they reformat the images so that different colors can be attributed to teeth, bone, and implants; masks can be fabricated to help isolate and plan the design of the case prosthetically and functionally. Then, surgical guides can be fabricated that are either for the pilot holes of implant osteotomy, full control Universal guides for 3-D placement of implants in the *x*, *y*, and *z* axes with depth control or bone reduction guides with one of the aforementioned guides. Next, the guides are ordered by 3DDX, and after they are fabricated and returned back to 3DDX for a quality control check, they mail the guide, instructions, and drilling keys (if needed) for the desired surgical guide.

Since the posterior mandible is triangular in shape, the base of the available bone will usually be wider than the coronal aspect. This may make the site amenable to ridge spreading, osteoplasty, or augmentation to create a proper foundation for implant placement. In this patient, there is a lack of bone in the buccal shelf area (Figure 2).

The reformatted image of the lower right quadrant shows the proposed implant placement and the abutments (represented by yellow extensions from the osseous crest) (Figure 3). The limited bone height and width, as well as parafunctional nocturnal bruxism, meant that several strategies would be implemented to offset the force factors present. First, utilizing a parallel-walled implant system with reverse buttressing threads, we would increase the bone implant contact, resulting in greater surface area of the implant in contact with the bone as compared to tapered implant designs with non-buttressed threads.

Next, 3 implants would be used to replace 3 teeth (instead of utilizing 2 implants to support a 3-unit bridge). The implants would be offset in a tripod fashion (as space allowed), to further resist lateral forces (Figure 4). The implants would be splinted together to further increase strength, and the occlusal table would be narrowed to decrease occlusal load. Lastly, the material selection for the bridge chosen by the patient was a full-gold fixed partial denture (FPD). This was accepted to further decrease risk of porcelain failure and decrease occlusal forces and wear to the opposing dentition.

The author placed virtual implants with several different implant systems to visualize their anterior-to-posterior spread as well as the dis-

Figure 16. Intaglio of restorations.

tances to vital anatomy (Figure 5). Each implant was measured from the existing teeth, and distances were recorded to verify intraorally at the time of surgery. The individual implant screen shots were taken to appreciate the distance from the buccal and lingual plate as well as the inferior alveolar nerve and mental nerve and lingual concavity (Figure 6).

After the implants were evaluated for maximal surface area and positioning, a tooth-supported pilot surgical guide was ordered from 3DDX (Figure 7). The decision to utilize a pilot surgical guide was made due to the low tolerance for error, given the patient's osseous limitations. A universal surgical guide could have been used, but was deemed unnecessary; this was because the pilot guide would provide the location, angulation, and depth of the pilot drill. These initial osteotomies could then be sequentially enlarged to allow for implant placement in a very specific orientation. The use of a universal guide may have increased the overall accuracy of placement, as it gives more specificity within the x, y, and z axes; this should be considered for clinicians who are more comfortable with the added precision this guide affords. The guide was verified for passive fit on the remaining teeth at the time of surgery and all 4 implants were placed precisely according to the Simplant guide (Figures 8 and 9).

A 4-month healing period was uneventful and the implants were uncovered and permucosal extensions attached to optimize soft-tissue healing (Figures 10 and 11). A master implant impression (BioHorizons External Hex Implants), utilizing an open-tray impression technique, was done to optimize the accuracy of the casting for the splinted fixed bridge. Once the impression analogs were affixed to the body of the implants, a radiograph was taken to ensure the analogues were fully seated and the implants had no bone loss or pathology prior to making the cast abutments and bridge superstructure (Figure 12).

The implant abutments were fabricated to optimize the triangular off-

Figure 17. Seated gold bridge intraorally with narrowed occlusal table.

set (by prescription), and they were delivered with a soft-tissue model and an abutment-seating jig (Figures 13 and 14). This jig was made out of pattern resin (Primotec USA); this resin demonstrates almost negligible shrinkage as compared to other comparable materials. The additional step of a resin try-in was not used, as the accuracy attained in the dental laboratory has allowed the author to forgo this step. It should be noted that a try-in at this stage would allow for sectioning and re-indexing the superstructure, if it were a concern.

Go for the Gold

The 3-unit gold FPD (all-gold bridge on custom cast abutments) and all-ceramic single-unit crown (a PFM bridge with Creation Porcelain) were fabricated with the abutments. At the delivery appointment, the UCLA custom cast abutments were tried in and verified radiographically prior to torqueing them to 35 NCm^2 twice (with a 5-minute rest period in between torqueing). The abutment screw holes were covered with TempoSIL 2 (Coltene) prior to cementing the crowns with Smart Cem 2 (DENTSPLY Caulk) (Figures 15 and 16). Smart Cem 2 was chosen because it is a dual-cure resin cement with low-film thickness. The ability to very briefly light cure the resin allows it to be easily removed in a gel stage prior to its complete polymerization. This helps prevent cement from remaining in the sulcus which can lead to peri-implantitis.

Intraorally, it was evident that the occlusal tables were narrowed to decrease load on the implants in centric occlusion (Figures 17 and 18). The ability to utilize canine guidance provided an extra safeguard in this case, given the patient's jaw asymmetry and lack of bicuspid coupling preoperatively. The final Panorex radiograph

Figure 18. Seated PFM crown with slightly narrowed table.

illustrates the splinted implants and the cemented prostheses (Figure 19).

CLOSING COMMENTS

While implant placement is a wonderful modality that is increasing in popularity, it should be realized that premature tooth loss (and accompanying bone loss) can and will lead to challenges in implant placement secondary to remaining osseous anatomy and proximity to critical anatomy. These implants should only be undertaken with a knowledge and discussion of the optimal foundational support required for these implants. Some clinicians are utilizing small-diameter implants and hybrid (2.9-mm) implants to address these limitations. Others are utilizing advanced ridge spreading, tent-screw, and block grafting, as well as bone morphogenic proteins with titanium mesh.

This case study illustrates one way to address implant restoration in an osseous compromised situation through the use of implant design, placement strategies, and restoration type and design to optimize this patient's treatment within the given parameters of care.✦

Acknowledgement

The author would like to sincerely thank Leszek Rapa, master dental technician, for the technical laboratory work shown herein. It is through the work of dedicated laboratory technicians that doctors can provide optimal care for our patients in an efficient and cost-effective manner.

Reference

1. Bidez MW, Misch CE. Clinical biomechanics in implant dentistry. In: Misch CE, ed. *Contemporary Implant Dentistry*. 2nd ed. St Louis, MO: Mosby; 1999:303-316.

Suggested Reading

Anitua E, Errazquin JM, de Pedro J, et al. Clinical evaluation of Tiny 2.5- and 3.0-mm narrow-diameter implants as definitive implants in different clinical situations: a retrospective cohort study.

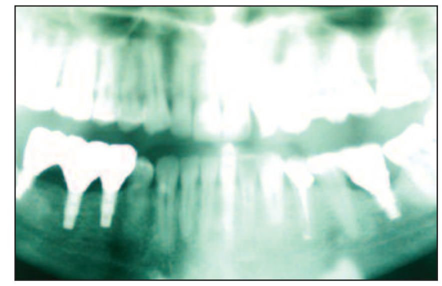

Figure 19. Final radiograph (Panorex) of the seated restorations.

Eur J Oral Implantol. 2010;3:315-322.

Baggi L, Cappelloni I, Di Girolamo M, et al. The influence of implant diameter and length on stress distribution of osseointegrated implants related to crestal bone geometry: a three-dimensional finite element analysis. *J Prosthet Dent*. 2008;100:422-431.

Balshi TJ, Hernandez RE, Pryszlak MC et al. A comparative study of one implant versus two replacing a single molar. *Int J Oral Maxillofac Implants*. 1996;11:372-378.

Bass SL, Triplett RG. The effects of preoperative resorption and jaw anatomy on implant success. A report of 303 cases. *Clin Oral Implants Res*. 1991;2:193-198.

Becker CM, Kaiser DA, Jones JD. Guidelines for splinting implants. *J Prosthet Dent*. 2000;84:210-214.

Blanes RJ. To what extent does the crown-implant ratio affect the survival and complications of implant-supported reconstructions? A systematic review. *Clin Oral Implants Res*. 2009;20(suppl 4):67-72.

De Boever AL, De Boever JA. Guided bone regeneration around non-submerged implants in narrow alveolar ridges: a prospective long-term clinical study. *Clin Oral Implants Res*. 2005;16:549-556.

Eckert SE, Wollan PC. Retrospective review of 1170 endosseous implants placed in partially edentulous jaws. *J Prosthet Dent*. 1998;79:415-421.

Elanchezhiyan S, Vennila K. Narrow ridge augmentation technique for improved immediate oral implant placement. *Journal of Dental Implants*. 2011;1:97-100.

Ganz SD. Restoring a unilateral edentulous space with an implant supported prosthesis. *Implant Soc*. 1993;4:2-6.

Ganz SD. Techniques for the use of CT imaging for the fabrication of surgical guides. In: *Atlas of the Oral and Maxillofacial Surgery Clinics of North America*. Philadelphia, PA: Elsevier Saunders; 2006: 75–97.

Jacobs R, Adriansens A, Verstreken K, et al. Predictability of a three-dimensional planning system for oral implant surgery. *Dentomaxillofac Radiol*. 1999;28:105-111.

Kopp KC, Koslow AH, Abdo OS. Predictable implant placement with a diagnostic/surgical template and advanced radiographic imaging. *J Prosthet Dent*. 2003;89:611-615.

Mordenfeld MH, Johansson A, Hedin M, et al. A retrospective clinical study of wide-diameter implants used in posterior edentulous areas. *Int J Oral Maxillofac Implants*. 2004;19:387-392.

Romeo E, Lops D, Amorfini L, et al. Clinical and radiographic evaluation of small-diameter (3.3-mm) implants followed for 1-7 years: a longitudinal study. *Clin Oral Implants Res*. 2006;17:139-148.

Sahin S, Cehreli MC, Yalçin E. The influence of functional forces on the biomechanics of implant-supported prostheses—a review. *J Dent*. 2002;30(7-8):271-282.

Weinberg LA, Kruger B. Three-dimensional guidance system for implant insertion: Part I. *Implant Dent*. 1998;7:81-93.

Dr. Winter graduated from the University of Minnesota School of Dentistry in 1988. He is a Master in the AGD and a Diplomate in the International Congress of Oral Implantologists, and he holds Fellowships in the Academy of Dentistry International and the International College of Dentists. He has published numerous articles on implant and reconstructive dentistry emphasizing upgradeable dentistry and general dentistry as a specialty. He can be reached via e-mail at rick@winterdental.com for information about his lectures.

Disclosure: Dr. Winter received some material support from 3D Diagnostix.