

Ridge Expansion and Immediate Implant Placement in the Esthetic Zone

Lakshman Dene, D.D.S., B.D.S., M.Med.Sc., Ph.D.; Spyridon Condos, D.D.S.

Abstract

Implant placement and tooth restoration in the maxillary esthetic zone is challenging. In the case reported here, the treatment site was tooth # 8, which had been extracted one year previously. Available bone in three dimensions was evaluated by computerized tomography. The bucco-lingual bone width at the crest was 3 mm to 4 mm wide, an inadequate width for implant placement. Ridge expansion was accomplished with hand osteotomes, followed by tapered drills. A 4.3 x 13 mm Nobel Biocare implant was placed. Following osseointegration, a PFM crown, supported by an esthetic abutment, was placed. A very pleasing esthetic result was achieved.

IMPLANT PLACEMENT and tooth restoration in the esthetic zone can present a challenge, even to the experienced operator. The fundamentals of esthetics, such as facial and dental midlines, lip line at rest, the smile line, incisal plane, occlusal plane and the buccal corridor should receive attention during the treatment planning stage. More importantly, the gingival biotype, tooth shape, interproximal ridge height, and position and height of the papillae help in determining the treatment sequence and modalities necessary to achieve an esthetic result.¹

The three dimensions of available bone are important determinants of the final result. Bone measurements need to be made in 3 axes: 1. the x axis—mesio-distally; 2. y axis—vertically; and 3. z axis—bucco-lingually. If the bone is present in optimum amounts, a FP-1 prosthesis² can be fabricated. In most instances, the maxillary anterior bone is compromised bucco-lingually. This may be because of the thin cortical plate and 25% resorption of bucco-lingual width of bone and the decrease in height of 4 mm during the first year after tooth loss.² When the bone width

is compromised, augmentation becomes necessary to increase the bone volume. This will enable placement of an implant to achieve a FP-1 prosthesis.

Bone augmentation could be accomplished by onlay grafting with autogenous block grafts or with guided bone regeneration (GBR) using particulate autografts or allografts covered by membranes. Block grafting is accomplished with autogenous grafts, usually obtained from the mandibular symphysis or ramus.^{3,5} This technique requires a second surgical site.

Extraoral sites may also be used to harvest autogenous bone. Problems with extraoral sites include hospitalization, expense and patient morbidity. Block grafting could also be done with bone allografts, such as J-Block (*Puros*). Block grafts and GBR require a period of four to six months prior to implant placement, unless they are done simultaneously with implant placement.

When the bucco-lingual bone width is 3 mm or greater but less than 6 mm, to allow implant placement, augmentation of the alveolar ridge using a ridge expansion technique is a viable option. The 3 mm of



Figure 1. Removable acrylic prosthesis worn by patient. Note: This exerts pressure on buccal gingiva, leading to increased bone resorption.



Figure 2. Buccal gingival tissue at tooth #8. Note depression caused by appliance. Square shape of tooth #9 (central incisor) is also seen.

bone should have at least 1 mm of trabecular bone sandwiched between the cortical plates. That will ensure 1.5 mm of bone (cortical and cancellous) on either side of the split ridge and allow the bone to spread and maintain a good blood supply. Ridge expansion for single and multiple implant sites have been documented.⁶⁻⁹ This will allow either immediate or delayed implant placement.

Clinical Case

The patient was a 28-year-old Hispanic female. Her chief complaint was that she disliked her maxillary anterior removable appliance (Figure 1). She requested a fixed prosthesis, preferably an implant-supported one. Her medical history was non-contributory. Her expectations were reasonable and her psychological profile was good. She was missing tooth #8, which had been extracted one year earlier, followed by the placement of a removable acrylic appliance. Extra- and intraoral examinations were within normal limits, and her dentition was in a good state of repair.

Clinical examination of the alveolar ridge and soft tissues revealed a thick gingival biotype. Tooth #9 was square in shape. There was a buccal defect in the gingiva in the region of tooth #8 due to normal shrinkage, probably exacerbated by pressure exerted from the removable appliance (Figure 2). The periapical X-rays revealed adequate bone height and mesio-distal bone width.

Computerized Tomography

The alveolar bone has three dimensions. Periapical and panoramic X-rays allow visualization of two dimensions. The third

(bucco-lingual) dimension needs to be determined as well. The CT scan allows visualization of this third dimension, in addition to the other two. It also provides information on bone density in Hounsfield units.

The CT scan revealed that the bucco-lingual dimension of bone at the crest was inadequate for implant placement (Figures 3A,B). There was adequate cortical and cancellous bone to allow ridge expansion.

Ridge Expansion: Technique

Preoperative antibiotics were prescribed and the patient was prepared in a sterile environment. A papilla-sparing crestal incision was made and full thickness mucoperiosteal flaps were raised on the buccal and palatal aspects of tooth #8 (Figure 4). Using a surgical guide, the exact position for the implant was scored on the ridge with a round bur. Once this position was acceptable, the osteotomy was started and extended vertically to about 5 mm with a #15 blade. This was accomplished by gently tapping into the bony crest. A sequence of osteotomes of increasing width and shapes were then used (Figures 5 A,B,C).

Tatum's angular osteotomes were used initially and wiggled back and forth in a mesio-distal direction with slight buccal pressure. Tatum's D osteotomes were used next, with the curved portion toward the buccal and the flat portion toward the palatal. This would selectively force the buccal plate outward without expanding the palate. A sequence of round osteotomes (*Summers osteotomes*, *Steri-Oss osteotomes* or *Tatum's round osteotomes*), both pointed and flat ended, were used to continue the bone expansion. The final instruments closely matched the shape of the implant.

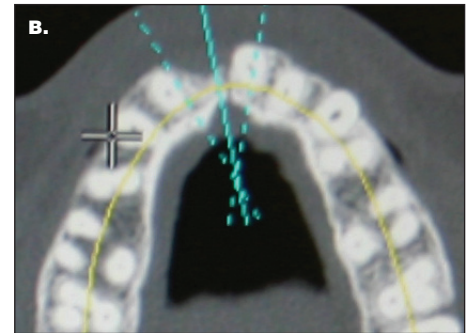
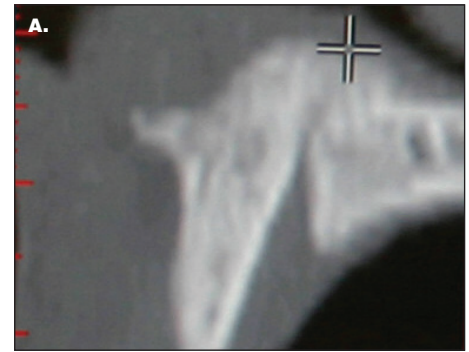


Figure 3. Computerized tomography of tooth #8 area. A: thin crestal ridge; B: bucco-lingual deficiency of crestal bone.

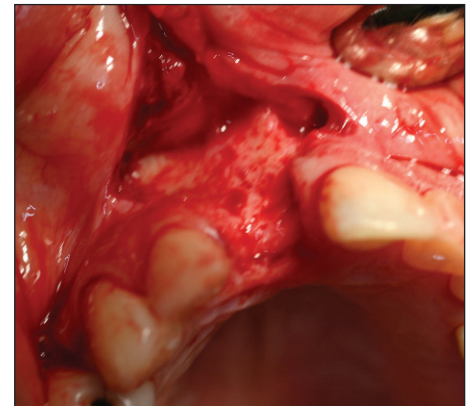


Figure 4. Supra-crestal incision and full thickness mucoperiosteal flap reflection.

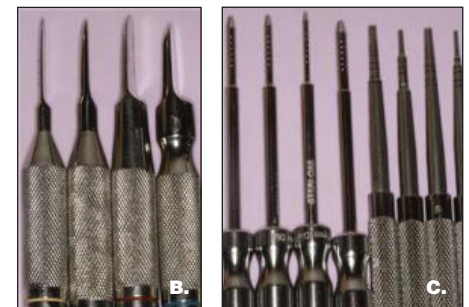
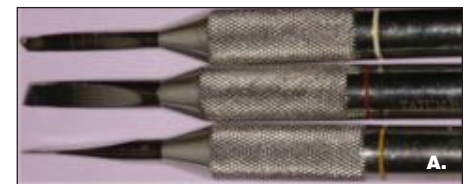


Figure 5. Hand osteotomes used for ridge expansion (A,B,C).



Figure 6. Expanded ridge crest.



Figure 7. Placement of Nobel Biocare Replace Select 4.3 mm x 13 mm implant.

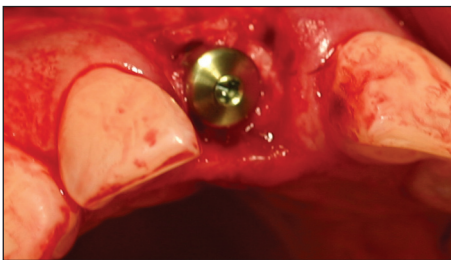


Figure 8. Implant covered by surgical cover screw.



Figure 9. Coronally repositioned flap.

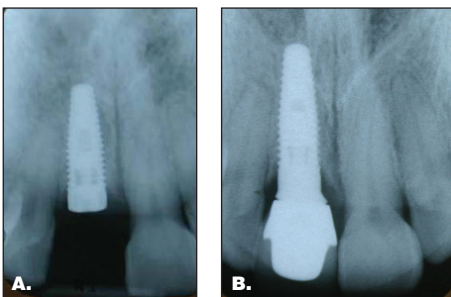


Figure 10. Periapical X-rays of implant (A) following placement and (B) with prosthesis four months later.



Figure 11. Clinical picture of final prosthesis.

The coronal portion of the ridge was expanded (Figure 6).

When the ridge was wide enough, a drill sequence was used to finalize the osteotomy apically to the desired width and length. A 4.3 mm x 13 mm Nobel Biocare Replace Select implant with Tiunite was placed and covered with a surgical cover screw (Figures 7, 8).

The CT scan also showed a radiolucency at the periapical area of the extracted tooth. This area was curetted and the expanded ridge was filled with bone allograft (*irradiated cancellous bone—Rocky Mountain*) and covered with a resorbable membrane (*Biomend Extend—Zimmer*). The flap was coronally repositioned with primary closure (Figure 9).

Second Stage: Uncovery Surgery

The implant was exposed at the crest with minimal flap reflection after four months. Because of the thick gingival biotype, there was no gingival recession. The surgical cover screw was removed and a healing collar was screwed into place. The gingiva was allowed to heal and mature for one month before implant level impressions were taken.

Implant Restoration

An implant level impression was taken with a closed tray technique following placement of an implant transfer post. Heavy body polyvinyl siloxane impression material was used for the impression. The implant transfer post was attached to the implant analog before it was snapped back into the impression. The laboratory made a soft-tissue cast and fabricated a porcelain-fused-to-high-noble metal crown using a 1 mm esthetic abutment (Figures 10A, B, 11).

Discussion

Following tooth extraction, the socket should be preserved by bone grafting. This prevents the socket from decreasing in width by 25% and the loss of 4 mm of bone height in the year following extraction.² A conventional removable prosthesis with a buccal flange exerts pressure on the buccal and palatal gingiva, thereby constricting blood vessels and reducing blood supply to

the area. This commonly leads to increased bone loss and subsequent compromise of tissue form. Ideally, the extraction site should be temporarily restored with a fixed restoration, such as a Maryland bridge or bonded free-hand composite. A removable prosthesis using an ovate pontic without a flange can also be made.¹ This type of pontic maintains good gingival contour and allows for good emergence profile for the final restoration. Fabrication of a removable prosthesis, as seen in Figure 1, should be avoided.

The use of computerized tomography is essential for several reasons. The level of distortion is minimal at 1.8% with the CT scans. In comparison, panoramic X-rays have a 23.5% distortion; with periapical X-rays, it is 14%.¹⁰ The CT image also provides the third dimension—the buccolingual. This dimension is critical to implant placement.

Following implant placement, 1.5 mm to 2 mm of bone should remain on the buccal and lingual aspects of the implant at the bone crest. This measurement allows the operator to determine if adequate bone is available to sustain this requirement. In the patient whose case is reported here, it was evident from the CT scan that there was insufficient bone to satisfy this criterion (Figures 3 A, B).

When the bone width is < 3mm, only grafting with autogenous block grafts³ or an allograft is necessary. An increase in bone width using distraction osteogenesis,¹¹ piezoelectric surgery¹² and the Meisinger split control bone expansion¹³ has also been reported, but is less predictable for single implant sites.

There are significant advantages to using ridge expansion rather than onlay grafting. These include simultaneous implant placement and grafting, lower cost, lower possibility of cross-infection from graft materials and lower morbidity. This technique has greater predictability, since the area that is grafted is essentially a five-wall bony defect, with excellent blood supply.

Onlay grafts are by definition used for one to three wall defects, with the predictability of the graft going down with fewer walls. It is important to note that the

entire ridge was not split in this case, only the coronal portion, which was too thin. The apical portion of bone was not split; it was treated in the traditional manner with drills and osteotomes. This area of bone was used to stabilize and support the implant.

There are several disadvantages to this technique. It cannot increase height, only width. It is a very difficult and operator-dependent technique, with a substantial learning curve. And it is more difficult to perform on a single tooth than on entire ridges, where the operator can take advantage of the elasticity of a long ridge of bone. The author has successfully taken large ridges in the maxilla 2 mm wide and expanded them to 5 mm to 6 mm wide. If an increase in height is desired, other techniques, such as onlay grafting, subantral augmentation, distraction osteogenesis or nerve repositioning, must be used.

In the case reported here, there was between 3 mm and 4 mm of bone coronally, which did not allow implant placement. There was trabecular bone with cortical

bone on either side. This was an ideal case for bone expansion.⁷⁻¹⁰

Conclusion

This report has demonstrated the successful use of hand osteotomes in expanding the alveolar ridge at a single implant site. It also shows that this technique allows for immediate implant placement. Most importantly, from the patient's perspective, a very pleasing final esthetic result was achieved. ■

Queries about this article can be sent to Dr. Dene at lakshdene@hotmail.com.

REFERENCES

1. Sclar AG. *Soft Tissue and Esthetic Considerations in Implant Therapy*. Carol Stream, IL: Quintessence Publishing Co. 2003.
2. Misch CE. *Contemporary Implant Dentistry*. St. Louis, MO: Mosby Elsevier Publishing Co. 2008.
3. Garg AK, Morales MJ, Navarro I, Duarte F. Autogenous mandibular bone grafts in the treatment of the resorbed maxillary anterior alveolar ridge: rationale and approach. *Implant Dent* 1998;7(3):169-176.
4. Gungormus M, Yavuz MS. The ascending ramus of the mandible as a donor site in maxillofacial bone grafting. *J Oral Maxillofac Surg* 2002;60:1316-1318.
5. Kaufman E, Wang Peter D. Localized vertical maxillary

- ridge augmentation using symphyseal bone cores. A technique and case report. *Int J of Oral & Maxillofac Implants* 2003;18:293-298.
6. Duncan JM, Westwood M. Ridge widening for the thin maxilla. A clinical report. *Int J Oral Maxillofac Implants* 1997;12:224-227.
7. Elian N, Jalbout Z, Ehrlich B, Classi A, Cho Sang-Choon, Kahtani Fahaed-Al, Froum S, Tarnow D. A two stage full arch ridge expansion technique. Review of the literature and clinical guidelines. *Implant Dent* March, 2008;17(1):16-20.
8. Guirado JL, Yugero MR, Carrion del Valle MJ et al. A maxillary ridge splitting technique followed by immediate placement of implants: a case report. *Implant Dent* 2005;14(1):14-20.
9. Koo S, Dibart S, Weber HP. Ridge splitting technique with simultaneous implant placement. *Compendium Contin Educ Dent* March 2008;29(2):106-110.
10. Sonick M, Abrahams J, Faiella R. A comparison of the accuracy of periapical, panoramic and computerized tomographic radiographs in locating the mandibular canal. *J Oral and Maxillofac Implants* 1994;9(4):455-460.
11. Takahashi T, Funaki K, Shintani H, Haruoka T. Use of horizontal alveolar distraction osteogenesis for implant placement in a narrow alveolar ridge. A case report. *Int J of Oral & Maxillofac Implants* 2004;19:291-294.
12. Vercellotti T. Piezoelectric surgery in implantology. A case report. A new piezoelectric ridge expansion technique. *Int J Periodontics Restorative Dent* 2000; 20:359-365.
13. Siddiqui AA, Sosovicka M. Lateral bone condensing & expansion for placement of endosseous dental implants: a new technique. *J Oral Implantology* 2006;32(2):87-94.