# Tooth Extraction—An Opportunity for Site Preservation

Michael Sonick, DMD

*Director of Sonick Seminars*
*Private Practice*
*Periodontics and Implant Dentistry*
*Fairfield, Connecticut*
*Phone: 203.254.2006*
*Email: boomerdent@aol.com*
*Web site: www.sonickdmd.com*

*Board Member*
*Contemporary Esthetics*

Debby Hwang, DMD

*Private Practice*
*Fairfield, Connecticut*
*203.254.2006*
*Email: debby@sonickdmd.com*
*Web site: www.sonickdmd.com*

For a patient, the loss of a tooth induces not only emotional trauma but also physical deformity. Removal spurs bone resorption, which increases over time. As the soft-tissue drape follows the osseous contour, such remodeling may result in a depressed mucosal profile, especially if a thin biotype exists. This becomes a possible visual concern. Immediately after extraction, the socket walls undergo internal and external turnover, resulting in crestal bone loss as well as horizontal reduction. Buccolingual loss overall exceeds that in the vertical direction, though both occur. Several investigations report horizontal and vertical deficits of 3.0 mm to 6.0 mm and 1.0 mm to 2.0 mm, respectively, per site after an initial healing period of 4 months.[1-5]

The newly edentulated jaw exhibits 10 times more resorption in the first year than in those subsequent, with 4 times greater mandibular reduction than maxillary.[6] Up to 25% horizontal and 4.0 mm vertical loss occurs within the first year.[7,8] In 3 years, ridge volume diminishes by 40% to 60%.[8] After 25 years, the mandible loses nearly 8.0 mm of height without teeth. A ridge with long-term edentulism may be comprised of just flat basilar bone.[9-11]

Alveolar bone survives only in the presence of dentition. The existence of intact teeth in a partially edentulous ridge defies or at least delays the sort of severe loss reported above because the bone remains to support them; this is the concept fundamental to the use of overdentures.[8] Despite adjacent teeth, some level of resorption occurs after the removal of 1 tooth, depending on a host of factors. These influencing variables include:

- ***Anatomy.*** A thicker, wider ridge tends to resorb less, possibly because of higher vascularity. As it is typically thinner, the buccal wall diminishes more than the lingual 2 to 4 months after tooth removal. It experiences 56% horizontal resorption compared to 30% vertical and is in a position roughly 2.0 mm apical to its lingual counterpart.[12,13] A naturally thin wall encloses fewer vessels and marrow spaces for regeneration and may be easily broken (see Trauma).
- ***Trauma.*** Fracture of the alveolus sustained before or during extraction will lead to greater osseous resorption. Iatrogenic buccal plate damage from surgery may occur and hinders ideal healing. Removal of an ankylosed tooth often

necessitates extensive preparation around it, again generating further bone loss.

- *Pathology.* Any infective process, including periodontitis and periodontal or endodontic abscesses, destroys bone. Patients with severe chronic periodontitis demonstrate little initial bone around the extracted tooth and adjacent teeth, thus complicating repair and restoration. In addition, cysts, tumors, or congenital disorders may instigate loss.
- *Genetic predisposition.* It is probable that genetics affect the healing sequence but it is unknown how exactly or to what extent. Some patients naturally possess less osteoclastic activity than others.
- *Medical status and drugs.* Metabolic diseases, especially if poorly controlled, alter tissue turnover. Diabetes, for instance, disturbs collagen turnover and bone formation.[14] Habits such as smoking similarly interrupt wound healing.[15,16] Smoking increases the risk for localized alveolitis postextraction as well.[17,18] One class of bone-sparing drugs, IV bisphosphonates, may be associated with the development of osteonecrosis, especially after dental procedures. Current guidelines suggest that patients on these medications cannot undergo elective dental procedures.[19-21]

## Extraction Socket Remodeling

Extraction socket remodeling is complex. But why does bone resorption matter from a clinical standpoint? Is preservation of a site necessary if the patient elects to not have restoration performed? Regardless of the prosthetic plan for the newly edentulous area, it is better to have more bone present than less. A patient with no immediate plans for any type of tooth replacement in the site may change his or her plans as time passes. For those who seek rehabilitation with removable partial dentures, a bulkier ridge improves force distribution as well as mechanical support and retention. A wider pontic site eases restorability and esthetics for conventional fixed partial denture fabrication. Last, a site planned for implant replacement requires a ridge with enough vertical and horizontal proportions for stability and proper mucosal contour. The absolute minimum amount of bone surrounding an implant on the buccal or lingual is 1.0 mm, but in the anterior zone, at least 2.0 mm of facial bone must occur to resist recession.[22]

If retaining as much bone as possible is preferable, how do we combat the natural resorption that occurs postextraction? That is, how do we maintain the bone already present? Termed "ridge preservation" or "socket preservation," this procedure of site maintenance usually involves the major steps listed below. The general goal is to prevent resorption and not necessarily to augment the ridge, though this may be a desired secondary goal. Preservation upholds enough bone to facilitate an uncomplicated Stage 1 surgery (Figures 1 and 2). Most studies on this subject attempt preservation, not enhancement at the time of extraction, and this will be the focus of this article as well.

## Steps for Socket Preservation

1. Flap design—Perform a sulcular incision circumferentially around the tooth with scalpel to sever soft-tissue fibers (Figures 3B and 6B). Try not to raise a flap unless the buccal plate is not intact or surgical extraction is necessary. First, probe to determine the existence of labial bone (Figure 6C). If a flap must be raised, perform an envelope flap (no verticals) by extending the sulcular incision to the mesial or distal of the adjacent teeth. Vertical incisions may compromise the blood supply, but if one is anticipated, place it in the manner demonstrated (Figure 6D).
2. Atraumatic removal of tooth—Remember that atraumatic equals removal of no bone from the extraction site. Section any multirooted tooth with a long carbide bur to separate the roots. Use a periotome to sever the periodontal ligament (PDL) fibers from the tooth. Insert the device into the PDL space at the line angles and palatally, parallel to the root, apply apical force incrementally. The periotome should advance further apically with time. If more mobility is required, elevate the root gently with a small straight or Molt elevator. If a root remains recalcitrant to multiple applications of these methods or if ankylosis is suspected, use of a long, thin diamond bur is suggested. Apply a bur to the PDL space around the tooth. Remove loosened roots with an elevator or forceps.
3. Degranulation—Remove soft tissue and debris with curettes and Neumeyer bur application. This

bur will remove soft tissue but leave hard structures intact. Irrigate with saline or 0.12% chlorhexidine solution.

4. Bone grafting—If the socket does not bleed, decorticate it apically with a small round bur to induce bleeding. Be careful not to fenestrate the buccal or lingual wall or penetrate surrounding structures (eg, teeth, sinus, etc). Place graft material of choice into the socket. Condense gently with a cotton tip applicator or instrument handle. Fill up to the bony crest or further coronally if desired (Figures 3D and 4A).
5. Membrane application—If the buccal wall is thin or not intact, contain the bone graft with a membrane of choice placed on the buccal wall (Figure 7A). Make sure it is at least 1.0 mm away from the necks of the adjacent teeth, though it may contact the roots. If desired, the buccal wall may be built up 1.0 mm to 2.0 mm horizontally with more bone graft material under the membrane.
6. Closure—If vertical incisions were made, primary closure may occur by creating a split-thickness dissection at the thick, apical aspect of the flap (periosteal release). The tissue may be advanced over the socket. If this is the goal, make sure there is no tension of the flap. Perform further periosteal release as necessary. If no vertical incisions were made, place a collagen plug on top of the socket to cover the bone graft. The plug may be flattened to enhance surface area (Figures 4B and 4C). The plug

Each figure contains four panels. Starting from the top left and proceeding clockwise, these are designated from A to D.

**Figure 1**— A: A parulis at the apex of tooth No. 9, which exhibits endodontic failure. B: Socket preservation performed with freeze-dried bone allograft (FDBA) and a collagen plug contained with 4-0 chromic gut. C: Six-week healing. D: Implant placement without need for further grafting.

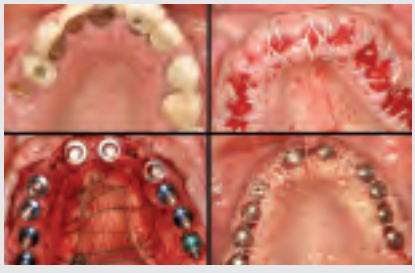

**Figure 2**—A: Maxillary teeth. B: Ridge preservation performed with FDBA and collagen plugs contained with 4-0 expanded polytetrafluoroethylene (ePTFE) sutures. C: Uncomplicated implantation 4 months postextraction. D: Healing abutments placed for one-stage surgery.

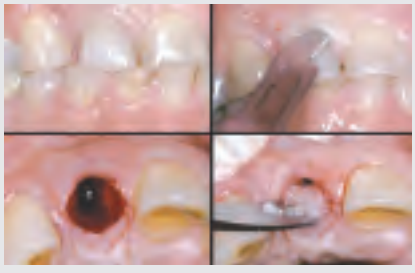

**Figure 3**—A: Tooth No. 7. B: Sulcular incision performed. C: Atraumatic removal of tooth and degranulation. D: Placement of FDBA to the crest of the socket.

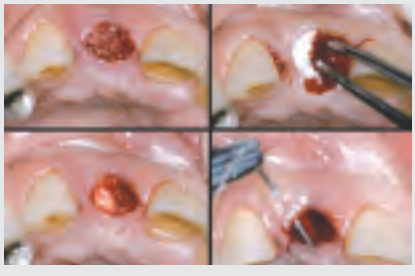

**Figure 4**—A: Occlusal view of FDBA in socket. B: Placement of collagen plug. C. Occlusal view of collagen plug. D: Suturing with 4-0 chromic gut.

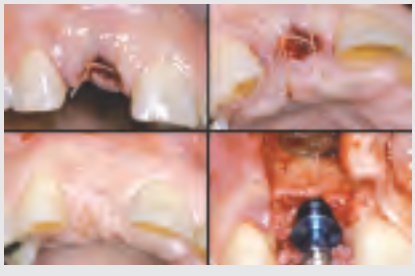

**Figure 5**—A: Horizontal mattress suture placed. B: Occlusal view of preservation. C: Ridge 3 months postextraction. D: Buccal wall stays whole at implantation.

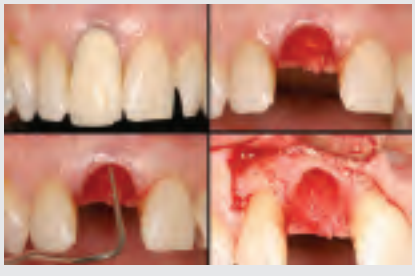

**Figure 6**—A: Hopeless tooth No. 8. B: Atraumatic extraction executed. C: Probing reveals thin buccal plate. D: Vertical incision placed at distal line angle of tooth distal to extraction site. Note termination of the incision is at a 90-degree angle to ease suturing. Tooth No. 8 mesial papilla raised with sulcular extension on buccal to improve visualization.

Each figure contains four panels. Starting from the top left and proceeding clockwise, these are designated from A to D.

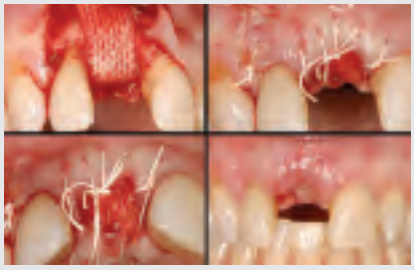

**Figure 7**—A: Absorbable collagen membrane placed over grafted socket. B: Suturing with 4-0 ePTFE material. C: Occlusal view reveals collagen plug placed on top of membrane. D: One-week healing.

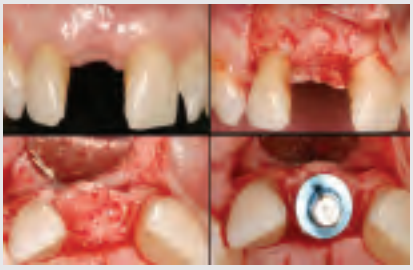

**Figure 8**—A: Three-months healing of tooth No. 8 site. B: Ridge preserved and filled with hard tissue. C: Horizontal bulk maintained. D: Implant placed without buccal compromise.

**Figure 9**—A: Tooth No. 8 exhibits fracture. B: Atraumatic extraction performed. C: Collagen membrane placed at missing buccal plate region. D: Membrane adapted to mimic labial plate with a periodontal probe.

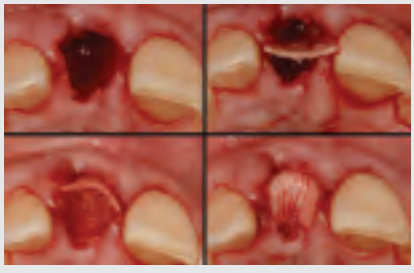

**Figure 10**—A: Occlusal view of extraction socket with nonintact buccal plate. B: Occlusal view of membrane positioning. C: Placement of FDBA in socket with absorbable membrane containing it labially. D: Membrane suture over socket with 5-0 chromic gut.

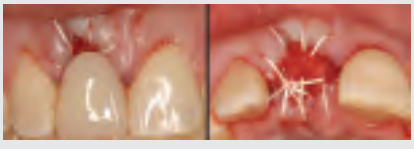

**Figure 11**—A: Interim removable partial denture for tooth No. 8 in place. B: Occlusal view reveals collagen plug placed over membrane and secured with 4-0 ePTFE sutures.

allows for soft-tissue growth over itself. If a membrane was used, ensure that the flap or at least a collagen plug covers it entirely (Figures 7B and 7C). Suture with 4-0 suture material (Figures 4D, 5A, 5B, 7B, and 7C). Use gut if no immediate temporization is anticipated or a nonabsorbable material if there is.

7. Healing–Recall the patient at 1 to 2 weeks, 4 weeks, and 3 months postextraction to assess healing. Sutures may be removed 7 to 14 days after surgery. Healing of bone grafting takes at least 3 months because the host bone must grow into the site, replace graft material, mature, and remodel. If implant therapy is desired, a minimum of 3 months should pass before implantation.

## Material Options

What materials should be used in socket preservation? There is no consensus in the dental literature with respect to graft types and membrane. In general, autografts (self bone) are osteogenic (possess bone-forming cells), allografts (non-self human bone) are osteoinductive (attract bone-forming cells), and xenografts (animal bone) as well as alloplasts (synthetic bone) are osteoconductive (serve as scaffolds for bone-forming cells). Most studies on socket preservation involve allografts and xenografts. Allografts, such as demineralized or mineralized freeze-dried bone allograft (DFDBA and FDBA), appear to work. Because it contains calcium and phosphate salts, FDBA resorbs more slowly than DFDBA, allowing for better space maintenance; a positive attribute for implant site development.[23] Xenografts resorb very slowly as well. In fact, one investigation showed graft particles that lasted 44 months after placement.[24] Despite a potentially greater proportion of graft material that remains, the dental literature does not reflect higher implant failure with the use of xenograft.[25] It is best to use either an auto-, allo-, or xenograft for preservation, because strong evidence does not exist for alloplasts. If the restorative plan warrants a longer-lasting graft, then use FDBA.

The indication for membrane use is in the case of buccal wall dehiscence

or fenestration (Figures 9 through 11). In the former scenario, the most coronal area of the buccal wall is gone; in the latter case, the coronal most portion remains intact, but a window of bone is absent apically. The membrane acts as the missing buccal wall and helps to contain the socket graft material. Both nonabsorbable and absorbable membranes can be used successfully. The advantage of an absorbable membrane is that it does not require removal and may react better if exposed.[26,27] If a buccal wall remains intact and has a surfeit of bone, at least 1.0 mm to 2.0 mm, a membrane may not be necessary.

## Conclusion

Socket preservation using bone grafts with or without membranes appears to arrest vertical resorption entirely and reduce horizontal loss to roughly 1.0-mm to 1.5 mm instead of the 3.0-mm to 6.0-mm reduction seen without intervention.[2,3,28-30] Interestingly, a few studies show a 1.0 mm gain in vertical dimension after preservation.[2,28] Gentle manipulation of tissue is the key. Maintenance of the bony architecture allows the practitioner to fashion the most natural and stable restoration possible, which is something the patient will appreciate.

## References


1. Camargo PM, Lekovic V, Weinlaender M, et al. Influence of bioactive glass on changes in alveolar process dimensions after exodontia. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2000;90(5):581-586.
2. Iasella JM, Greenwell H, Miller RL, et al. Ridge preservation with freeze-dried bone allograft and a collagen membrane compared to extraction alone for implant site development: a clinical and histologic study in humans. *J Periodontol.* 2003;74(7):990-999.
3. Lekovic V, Camargo PM, Klokkevold PR, et al. Preservation of alveolar bone in extraction sockets using bioabsorbable membranes. *J Periodontol.* 1998;69(9):1044-1049.
4. Lekovic V, Kenney EB, Weinlaender M, et al. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. *J Periodontol.* 1997;68(6):563-570.
5. Schropp L, Wenzel A, Kostopoulos L, et al. Bone healing and soft-tissue contour changes following single-tooth extraction: a clinical and radiographic 12-month prospective study. Int *J Periodontics Restorative Dent.* 2003;23(4):313-323.
6. Atwood DA. Reduction of residual ridges in the partially edentulous patient. *Dent Clin North Am.* 1973;17(4):747-754.
7. Carlsson GE, Ragnarson N, Astrand P. Changes in height of the alveolar process in edentulous segments. A longitudinal clinical and radiographic study of full upper denture cases with residual lower anteriors. *Odontol Tidskr.* 1967;75(3):193-208.
8. Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed-longitudinal study covering 25 years. *J Prosthet Dent.* 1972;27(2):120-132.
9. Cawood JI, Howell RA. A classification of the edentulous jaws. *Int J Oral Maxillofac Surg.* 1988;17(4):232-236.
10. Misch CE, Judy KW. Classification of partially edentulous arches for implant dentistry. *Int J Oral Implantol.* 1987;4(2):7-13.
11. Zarb GA, Zarb FL. Tissue integrated dental prostheses. *Quintessence Int.* 1985;16(1):39-42.
12. Araujo MG, Lindhe J. Dimensional ridge alterations following tooth extraction. An experimental study in the dog. *J Clin Periodontol.* 2005;32(2):212-218.
13. Botticelli D, Berglundh T, Lindhe J. Hard-tissue alterations following immediate implant placement in extraction sites. *J Clin Periodontol.* 2004;31(10):820-828.
14. Nevins ML, Karimbux NY, Weber HP, et al. Wound healing around endosseous implants in experimental diabetes. Int *J Oral Maxillofac Implants.* 1998;13(5):620-629.
15. Labriola A, Needleman I, Moles DR. Systematic review of the effect of smoking on nonsurgical periodontal therapy. Periodontol 2000. 2005;37:124-137.
16. Trombelli L, Cho KS, Kim CK, et al. Impaired healing response of periodontal furcation defects following flap debridement surgery in smokers. A controlled clinical trial. *J Clin Periodontol.* 2003;30(1):81-87.
17. Larsen PE. Alveolar osteitis after surgical removal of impacted mandibular third molars. Identification of the patient at risk. *Oral Surg Oral Med Oral Pathol.* 1992;73(4):393-397.
18. Meechan JG, Macgregor ID, Rogers SN, et al. The effect of smoking on immediate post-extraction socket filling with blood and on the incidence of painful socket. *Br J Oral Maxillofac Surg.* 1988;26(5):402-409.
19. Novartis Important Safety Information. September 2005. Available at: http://-www.us.zometa.com/info/patientsafetyinfo.jsp. Accessed August 27, 2006.
20. American Academy of Periodontology Statement on Bisphosphonates. August 2005. Available at: http://www.perio.org/resources-products/bisphosphonates.htm. Accessed August 27, 2006.
21. Ruggiero SL, Gralow J, Marx RE, et al. Practical guidelines for the prevention, diagnosis, and treatment of osteonecrosis of the jaw in patients with cancer. *J Oncol Prac.* 2006;2(1):7-14.
22. Spray JR, Black CG, Morris HF, et al. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. *Ann Periodontol.* 2000;5(1):119-128.
23. Wang HL, Cooke J. Periodontal regeneration techniques for treatment of periodontal diseases. *Dent Clin North Am.* 2005;49(3):637-659, vii.
24. Skoglund A, Hising P, Young C. A clinical and histologic examination in humans of the osseous response to implanted natural bone mineral. *Int J Oral Maxillofac Implants.* 1997;12(2):194-199.
25. Wallace SS, Froum SJ. Effect of maxillary sinus augmentation on the survival of endosseous dental implants. A systematic review. *Ann Periodontol.* 2003;8(1):328-343.
26. Friedmann A, Strietzel FP, Maretzki B, et al. Histological assessment of augmented jaw bone utilizing a new collagen barrier membrane compared to a standard barrier membrane to protect a granular bone substitute material. *Clin Oral Implants Res.* 2002;-13(6):587-594.
27. Moses O, Pitaru S, Artzi Z, et al. Healing of dehiscence-type defects in implants placed together with different barrier membranes: a comparative clinical study. *Clin Oral Implants Res.* 2005;16(2):210-219.
28. Vance GS, Greenwell H, Miller RL, et al. Comparison of an allograft in an experimental putty carrier and a bovine-derived xenograft used in ridge preservation: a clinical and histologic study in humans. *Int J Oral Maxillofac Implants.* 2004;19(4):491-497.
29. Vasilic N, Henderson R, Jorgenson T, et al. The use of bovine porous bone mineral in combination with collagen membrane or autologous fibrinogen/fibronectin system for ridge preservation following tooth extraction. *J Okla Dent Assoc.* 2003;93(4):33-38.
30. Zubillaga G, Von Hagen S, Simon BI, et al. Changes in alveolar bone height and width following post-extraction ridge augmentation using a fixed bioabsorbable membrane and demineralized freeze-dried bone osteoinductive graft. *J Periodontol.* 2003;74(7):965-975.