A Simple and Cost-Effective Socket Preservation Technique

Authored by Timothy Kosinski, DDS

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About the Author

Dr. Kosinski is an adjunct clinical professor at the University of Detroit Mercy School of Dentistry, a past president of the Michigan AGD, and the editor of its journal. He received his Mastership and Lifelong Learning and Service Recognition from the AGD. He is a Diplomate of the American Board of Oral Implantology/Implant Dentistry and the International Congress of Oral Implantologists, and he is a Fellow of the American Academy of Implant Dentistry, the American and International Colleges of Dentists, and the Academy of Dentistry International. He is a member of Omicron Kappa Upsilon and the Pierre Fauchard Academy. He has been named the University of Detroit Mercy School of Dentistry Alumni Association’s “Alumnus of the Year.” He can be reached via email at dtkosin@aol.com.

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BACKGROUND

At a minimum, simple socket grafting following the extraction of teeth should be a conventional part of dental treatment. Following extraction of nonrestorable teeth, the remaining socket heals from the apex toward the crest. When nothing is placed into the socket at the time of tooth removal, the infiltration of soft tissue at the crest often results in facial and crestal bone loss. Recent literature reviews have documented horizontal bone loss of 29% to 63%, with vertical bone decreases of 11% to 22% at 6 months, following extraction.1 Frequently, this bone loss impedes ideal implant placement in the future or will require more invasive grafting procedures, often involving autogenous bone grafts. Anatomic concerns of the maxillary sinus and the mandibular nerve make implant placement precarious at times, limiting the general dentist's desire to place implants in compromised situations.

Therefore, socket grafting of extraction sites should become a routine procedure for every dentist, especially considering that more than 45 million teeth are extracted annually in the United States.2 Not only will an implant site be predictably available, but also, even if an implant is not considered in the treatment plan, the healed area will be more aesthetic for an abutment in conventional dental therapy.

Although socket grafting has been investigated extensively, no consensus has been reached to date on the ideal clinical protocol.3 This is likely due to a number of factors, including variations in technique, local and systemic variables, the use and type of biomaterials, and the significant structural and methodological variability across published systematic literature reviews on the subject.4 This paper presents a simple, predictable, and cost-effective technique using the OsteoGen Plugs (Impladent).

One of the issues that compromises the use of socket grafting techniques is the fact that epithelium invagination of the grafted site is much more pronounced than bone healing. The graft material must be protected from the epithelial advance. This is the primary principle behind guided bone regeneration and guided tissue regeneration (GBR and GTR, respectively). The theory of GTR and GBR is centered on the migration of pluripotent and osteogenic cells from the periosteum and adjacent alveolar bone to the defect site while at the same time excluding epithelial cells and fibroblasts from infiltrating and potentially disrupting new bone formation.5,6 In this way, wound healing can be described as a race between various cells to the healing site. Indeed, migration of epithelial cells occurs at rates of up to 1.0 mm per day, and successful bone regeneration is predicated on their exclusion.7

Conventionally, this is accomplished by the use of resorbable or nonresorbable membranes. However, even if a resorbable membrane is used, it must be a long-lasting resorbable membrane. It is imperative to know your products and their resorption rates. Resorbable membranes are placed over the socket site when closure of the facial and palatal tissue is 2 mm or less. A membrane is also used to contain the bone graft particulates in the extraction site. It is imperative that the membrane extend at least 2 mm onto facial and palatal bone to prevent premature exposure and loss of the membrane and graft. It will take a good 4 to 6 months for the grafted site to be replaced effectively by the patient’s own bone. If the membrane is prematurely lost, the prognosis becomes compromised. The grafted site could heal acceptably, but often it does not or is not as predictable in the result.

Nonresorbable membranes are used when closure of the facial and palatal tissue is beyond 2.0 mm. This is often the case in larger tooth sockets. It is important to realize that attached gingiva must be maintained onto the facial aspect of implants; thus one does not want to pull mucosal tissue from the vestibule over the crest of a socket to provide primary closure. The nonresorbable membrane is removed in 4 to 6 weeks, and osteoid material, the precursor to bone, will be created under the membrane. Again, it is critical that the membrane extend a minimum of 2.0 mm onto facial and palatal bone to prevent premature exposure.
These procedures can often be difficult to do for many practitioners, and therefore many dentists do not provide grafting procedures at all for various reasons, despite the well-established physiologic benefits of alveolar ridge preservation noted in the literature. Many dentists do not use a high-quality graft product, or maybe do not understand each product and its routine uses (such as allograft [human bone] or alloplastic materials [synthetic]; or do not protect the graft with a proper membrane and maintain it with proper surgical and suturing techniques. Let's face it, there are a lot of products on the market, and it can be confusing as to what to use and when. Placing a collagen-based clotting material, such as a 100% collagen plug, is not considered simple socket grafting and will do little to maintain bone contours in the edentulous space. Typical collagen plugs resorb in less than 2 weeks and do not provide a sufficient scaffold for the formation of new bone.

**MATERIALS**

The OsteoGen Plugs are a combination of OsteoGen nonceramic bone graft with bovine Achilles tendon collagen. The graft crystals are contained inside of the collagen matrix and therefore cannot wash out after placement like particulate graft materials. This feature allows for socket grafting without the need to use a separate membrane over the site. The mineral and collagen composition of the product mimics the inorganic and organic components of physiologic bone.

The OsteoGen crystals inside of the OsteoGen Plug consist of a bioactive, nonceramic (unsintered), calcium apatite graft with physicochemical and crystallographic characteristics similar to human bone mineral. The production process yields a low-density resorbable bone graft with a unique calcium-to-phosphorous ratio that is neither a beta-tricalcium phosphate nor a nonresorbable dense ceramic hydroxyapatite. Furthermore, it is not a biphasic mixture of these two like many other grafts available. The material has been demonstrated to bridge bone across critical size defects of 8.0 mm while controlling migration of connective tissue. OsteoGen has been used successfully with implants for periodontal treatment, osseous repair, and sinus lift procedures for more than 30 years.

**CLINICAL CASE REPORT**

In this clinical case, a simple and cost-effective graft procedure is demonstrated that all dentists do regardless of their grafting experience when the walls are intact following extraction of a tooth. The OsteoGen Plug material that is demonstrated in this case does not require a membrane and does predictably grow bone in my experience. It is a very simple product to work with and provides a great benefit for the patient.

Step one of the treatment plan was to perform an atraumatic extraction on a nonrestorable mandibular first bicuspid tooth as seen in the radiograph (Figure 1) and the intraoral view (Figure 2). The use of the Physics Forceps (Golden Dental Solutions) engages the lingual surface of the tooth 1.0 to 3.0 mm subgingivally, and the bumper, which serves as a fulcrum, is placed onto the facial aspect as far into the vestibular area as possible. The tooth is thus elevated up and out of the socket, maintaining the facial plate of bone and creating a socket with all 4 walls perfectly intact.

The OsteoGen Plug will be radiolucent on the day of placement. As the crystals are resorbed physiologically by osteoclast and osteoblast activity and replaced by host bone, the site will become more radiopaque. The collagen component promotes keratinized tissue coverage while the graft component promotes new bone formation. As mentioned earlier, this is not just a collagen plug. It is important to understand the difference among the materials available as they are not the same.
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The Physics Forceps design and technique allows the clinician to minimize the fracture of roots and maintain the facial plate of bone, all of which are important to the proper healing of extraction sites. This specially designed forceps is really a modified first-class lever consisting of 2 components that amplify the applied force of the user, resulting in a greater output force and, ultimately, easier extractions. Tension is applied with the beak, or flattened end of the instrument, onto the palatal aspect of the tooth. The second part of the instrument, referred to as the bumper, is placed onto the facial aspect of the tooth as high up the vestibule as possible (Figure 3). The bumper simply acts as a fulcrum, and the working end of the instrument is the beak, which engages the root of the tooth 1.0 to 3.0 mm subgingivally. The handles are held firmly, but never squeezed. They allow for tension to be created onto the palatal aspect of the root, creating a physiologic release of enzyme which breaks down the periodontal membrane. Once the periodontal ligament is destroyed (Figure 4), the tooth is simply elevated up and out of the socket. The instrument is not intended to remove the tooth in total; rather, a tooth delivery instrument is used to remove the tooth from the socket site, leaving a socket with all 4 walls perfectly intact.

Atraumatic extraction techniques as are demonstrated here provide a defect with all 4 walls intact. This creates a “cereal bowl” or “ice cream cone” that can be easily and efficiently filled with grafting materials. Once the tooth is removed, it is imperative to remove any remaining granulation tissue from the socket using a sharp curette (Figure 5).

Here the nonrestorable mandibular right first bicuspid with significant decay tooth is planned for extraction.

Once removed, the decision needs to be made as to what type of socket grafting material should be used. Autogenous grafts consist of bone material from the patient. An autogenous...
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A block of bone could be removed from a site on the patient, such as the symphysis or retromolar pad area. This would involve a second surgical procedure to harvest the bone, which is not always ideal or preferred by the patient. A more popular technique is to use allograft material (bone from the same species [human]), or an alloplast material (synthetic such as calcium phosphate-based materials like OsteoGen), which have both proven to be predictable. Xenografts are made from another species, such as cow bone. All of these materials require the use of a membrane to protect the graft from invagination of epithelial cells. In this case, we used the OsteoGen Plug. Figure 6 illustrates the OsteoGen Plug being inserted into the socket site. The material is compressed, but not crushed. No membrane is needed with this material. The cross-linked sutures (Vilet resorbable sutures [Implant Direct]) were placed to simply hold the material in the socket during the initial stages of healing (Figure 7). Figure 8 shows the immediate postoperative radiograph of the OsteoGen material in place. Following 3 months of healing, a radiograph was taken (Figure 9) illustrating bone turnover. Figure 10 shows the healing of attached gingiva over the defect.

Proper diagnosis for future treatment in this case requires atraumatic extraction of the nonrestorable tooth, cleaning out the infected site, and grafting with a predictable material which will promote bone replacement. Following proper integration, an implant can be predictably placed and the patient restored to a full dentition.

Although there are many options for simple socket grafting today, one must consider techniques that are predictable, simple, and cost effective for you and your patient. OsteoGen Plugs are a great...
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Following proper integration of the grafted socket site, a Hahn dental implant (GlideWell Laboratories) can be predictably placed using a flapless surgical technique. A 2.2 mm pilot drill (Figure 11) allows for proper mesial-distal and facial-lingual angulation of the final implant. A 4.3 tapered osteotomy bur (Figure 12) is used to create the final site prior to implant placement. The bur is fluted and gathers bone material (Figure 13). The design of the tapered implant features prominent, aggressive threads which allows the dentist to torque the implant in the slightly smaller prepared osteotomy site and have great initial stability. A 4.3 tapered osteotomy bur (Figure 12) is used to create the final site prior to implant placement. The bur is fluted and gathers bone material (Figure 13). The design of the tapered implant features prominent, aggressive threads which allow the dentist to torque the implant in the slightly smaller prepared osteotomy site and have great initial stability. Figure 14 shows the implant engaging the osteotomy site and then torqued to 40 Ncm using the torque wrench in Figure 15. We obtained adequate initial stability to place a 3 mm tall healing abutment into the implant (Figures 16 and 17). This healing abutment allows the attached gingiva to contour around the abutment. The healing abutment would be removed following integration of the attached gingiva to contour around the abutment. The healing abutment allows the dentist to torque the implant in the osteotomy site and have great initial stability.

References

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1. Recent literature reviews have documented horizontal bone loss of 29% to 63%, with vertical bone decreases of 11% to 22% at 6 months, following extraction.
   a. True       b. False

2. Socket grafting has been investigated extensively, so consensus has been reached to date on the ideal clinical protocol.
   a. True       b. False

3. Migration of epithelial cells occurs at rates of up to 1.0 mm per day and successful bone regeneration is predicated on their exclusion.
   a. True       b. False

4. Resorbable membranes are placed over the socket site when closure of the facial and palatal tissue is 4.0 mm or less.
   a. True       b. False

5. Nonresorbable membranes are used when closure of the facial and palatal tissue is beyond 2.0 mm.
   a. True       b. False

6. Typical collagen plugs resorb in fewer than 2 weeks, providing a sufficient scaffold for the formation of new bone.
   a. True       b. False

7. With OsteoGen Plugs, the graft crystals are contained inside of the collagen matrix, and therefore cannot wash out after placement like particulate graft materials, allowing for socket grafting without the need to use a separate membrane over the site.
   a. True       b. False

8. Atraumatic extraction techniques, as are demonstrated in this clinical case report, provide a defect with all 4 walls intact.
   a. True       b. False
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