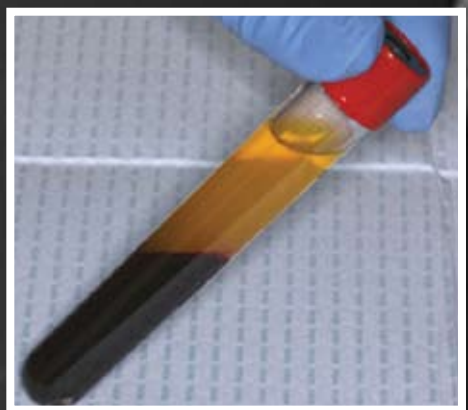
Volume 1, No. 6 September 2009

JIACD

The Journal of Implant & Advanced Clinical Dentistry

Cement Induced Peri-Implantitis



2 Hours of CE Credit

Introduction to Platelet Rich Fibrin

Enhancing Extraction Socket Therapy

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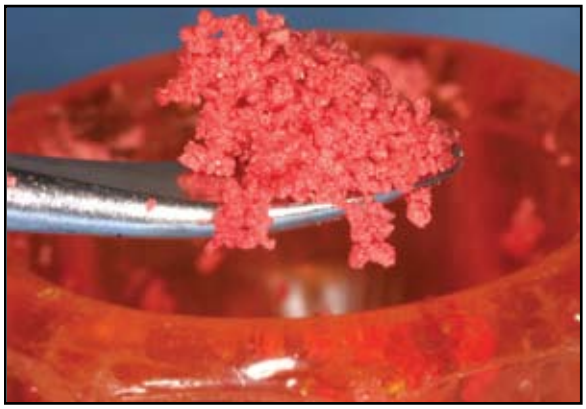
Hari S. Prasad BS, MDT[3] • Ziv Mazor DMD[4]

Abstract



Patients present for extraction of teeth for numerous reasons. Whether teeth are being removed in preparation for orthodontic therapy, malposition or to eliminate dental disease, the sites require reconstruction. Many patients will have restorations placed over or adjacent to these areas of reconstructed bone. In current times, most will have implants inserted in the regenerated bone. For successful maintenance of aesthetic implant-supported restorations, maximal volume in the restored site containing vital bone with keratinized tissue will enable the surgical/restorative team to design functional and aesthetic restorations. In this manner, the patients are returned to an ideal state, maintainable for many years.

KEY WORDS: Site preservation, alloplast, dental implants

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INTRODUCTION

Before a tooth or multiple teeth are extracted, a determination should be made regarding hard and soft tissue volume in the area. Periodontally involved teeth are typically missing supporting bone which must be replaced at the time of extraction. The roots of the teeth also take up space which must be filled in with vital bone to enable osseointegration. Determination of the combined volume of these two defects and if/where there may be missing walls will assist the surgeon at the time of extraction. In the aesthetic zone, forced eruption may be incorporated into the treatment plan.[1] This technique utilizes orthodontic forces to augment, non-surgically, both the alveolar bone and keratinized tissue. In this manner, extraction sites can be diminished in volume prior to removal of the tooth.

More often, patients present for extraction without the luxury of time on the side of the dental team. In many instances, patients require the removal of a tooth or teeth and do not have the ability to wait 3 to 6 months for forced eruption to regenerate gingiva and bone. In these cases, bone and the surrounding soft tissue have to be reconstructed in one or more procedures at the time of extraction. This is accomplished by a combination of bone replacement graft materials, barriers, and in some cases, growth enhancing factors as well.

Previous studies have documented the preservation of alveolar volume utilizing various graft materials.[2,3] These papers demonstrate that placing a biocompatible material will minimize the decrease in socket dimensions after the procedure. Although the height and width of the remaining bone are not significantly altered by using this type of material, the histologic appearance in the socket is different than native alveolar bone.[4]

The materials documented in this case series have been shown in human and animal studies to be completely resorbable in the time normally used between tooth extraction and delayed implant placement, 4 – 6 months. The synthetic beta-tricalcium phosphate (ß-TCP) has no incidence of disease transmission and, as a salt, is dissolved rather than depending on the action of osteoclasts to resorb it.[5] The material has been shown to be equivalent in resorption and vital bone formation to autogenous bone in maxillary sinus augmentation.[5] Calcium sulfate has been used as a bone replacement graft and/or graft enhancer for 100 years.[6,7] This material as well is both synthetic and fully resorbable. The purpose of this article is to demonstrate the use of ß-TCP alone or in combination with calcium sulfate as predictable materials for maintenance and/or enhancement of bone volume after tooth extraction.

MATERIALS AND METHODS

Three cases are presented in which extraction sites and their associated defects were treated with ß-TCP (figure 1). After adequate healing time, bone cores were harvested from the surgical sites at the time of dental implant placement. The trephines containing the bone were fixed in 10% neutral buffered formalin. Upon receipt in the Hard Tissue Research Laboratory at the University of Minnesota Dental School, the specimens were immediately dehydrated with a graded series of alcohols for nine days. After dehydration, the specimens were infiltrated with a light-curing embedding resin (Technovit 7200 VLC, Kulzer, Wehrheim, Germany). Following twenty days of infiltration with constant shaking at normal atmospheric pressure, the specimens were embedded and polymerized by 450 nm light with the tem-

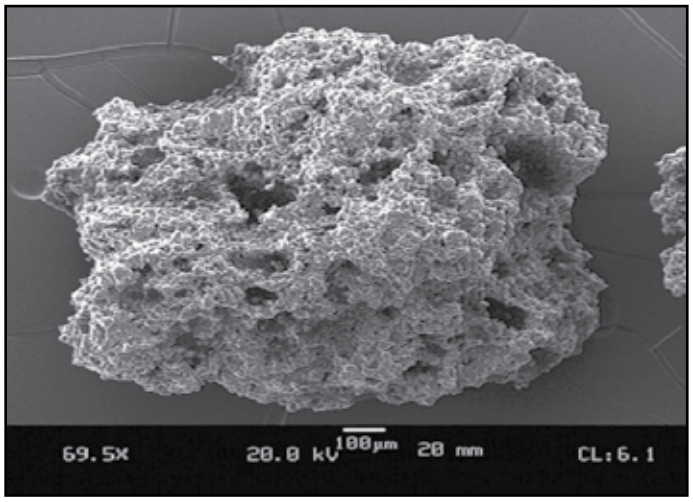


Figure 1: Scanning electron micrograph showing the surface macro and microporosities of β-TCP alloplast.

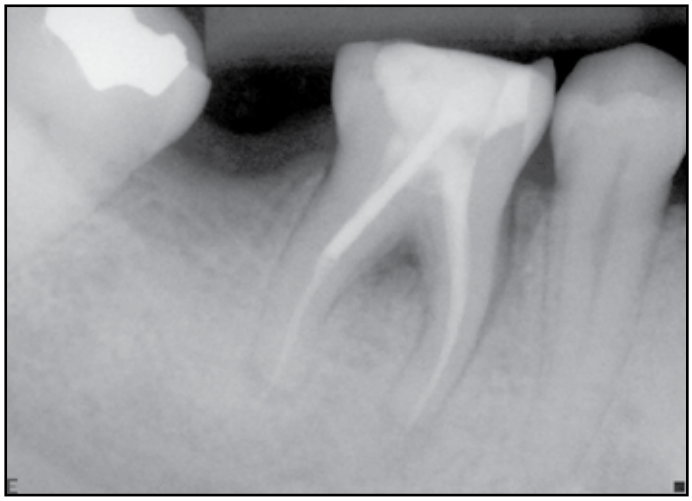


Figure 2: Case 1 presurgical radiograph.

perature of the specimens never exceeding 40°C. The specimens were then prepared to by the cutting/grinding method of Donath.[8,9] The specimens were cut to a thickness of 150 µm on an EXAKT cutting/grinding system (EXAKT Technologies, Oklahoma City, USA). The slides were then polished to a thickness of 45 µm using the EXAKT microgrinding system followed by alumina polishing paste and stained with Stevenel's blue and Van Gieson's picro fuchsin. Following histologic preparation, the cores were evaluated morphometrically. All the cores were digitized at the same magnification using a Zeis Axiolab microscope and a Nikon Coolpix 4500 digital camera. Histomorphometric measurements were completed using a combination of Adobe PhotoShop (Adobe Systems, Inc.) and the public domain NIH Image program (developed at the U.S. National Institutes of Health and available on the Internet at http://rsb.info.nih.gov/nih-image/). At least two slides of each core were evaluated. Parameters evaluated were total area of the core, percentage of new bone formation, and percentage of residual graft material.

CASE REPORTS

Case 1

After a second course of antibiotics prescribed by another dentist, this patient presented to for definitive therapy around tooth #30. She had a history of pain and swelling on the tooth that had endodontic therapy but was never restored with a crown. When a radiograph was taken of the lower right first molar, it was apparent that there was significant bone loss in the furcation (figure 2). Clinical inspection of the tooth revealed a vertical fracture through the remaining coronal portion of the tooth (figure 3).

After administration of local anesthesia, the tooth was sectioned and the individual roots extracted. Minor flap elevation enabled complete debridement of the area and visualization of the sites where the residual buccal plate was very thin (figure 4). To prevent site collapse and to enable the possibility of future implant placement, the site was grafted with Cerasorb® M (Riemser Inc., Research Triangle Park, North Carolina, USA) mixed with the patient's

Figure 3: C ase 1 presurgical presentation.

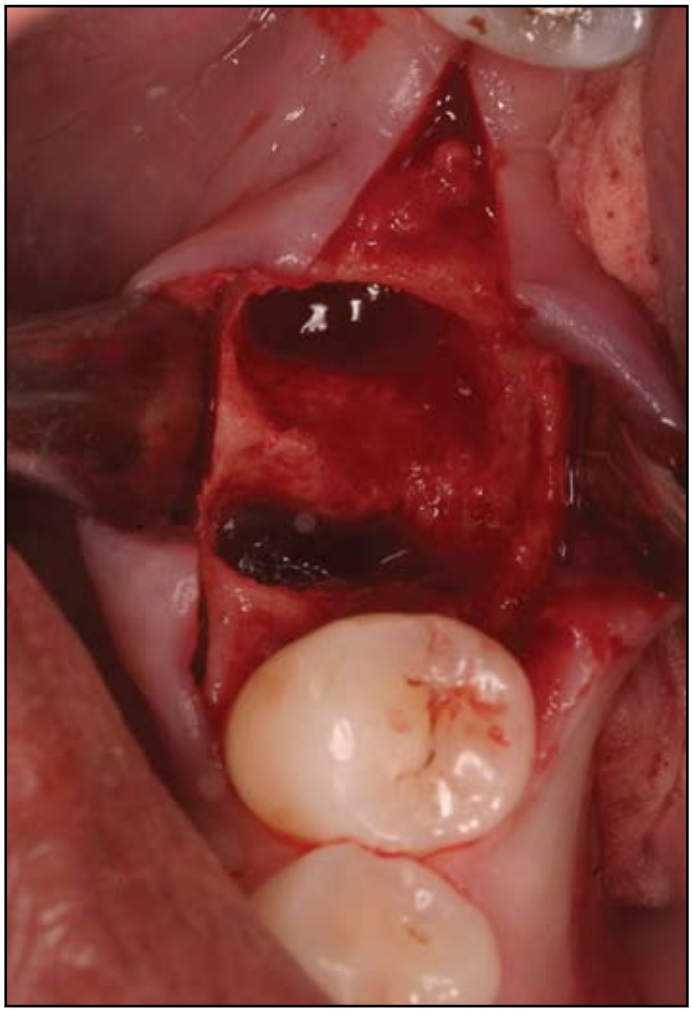


Figure 4: Case 1 atraumatic extraction with maximum osseous preservation.

own blood (figures 5,6). Combining the graft particles with blood from the site enabled the mixture to handle like a gel or putty and kept the material where it was placed in the socket without washing out during the procedure. To enhance guided bone formation in the defect, the graft was covered by a resorbable barrier (EpiGuide®, Riemser Inc., Research Triangle Park, North Carolina, USA). This three layer synthetic membrane has the ability to maintain its' own shape and allow fluid transfer to the graft beneath it. A recent study comparing resorbable barriers has demonstrated that Epiguide® has one of the best abilities to facilitate early osteoblast cell attachment, ideal for promoting maximal bone formation in an extraction socket.[10] The area was closed with sutures, but primary closure was not obtained (figure 7). By the three month postoperative visit, the tissues had fully keratinized and radiographic evidence of bone fill was apparent (figures 8,9).

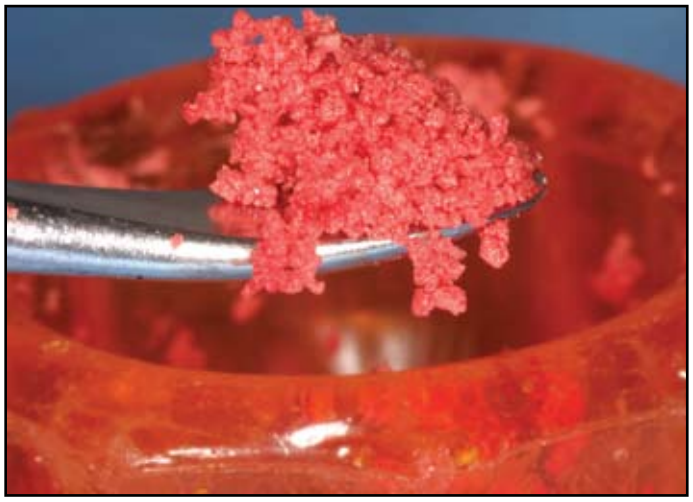


Figure 5: β-TCP alloplast mixed with patient's blood.

Figure 7: Case 1 surgical closure. Note that full primary closure was not obtained and portions of the resorbable membrane are visible.

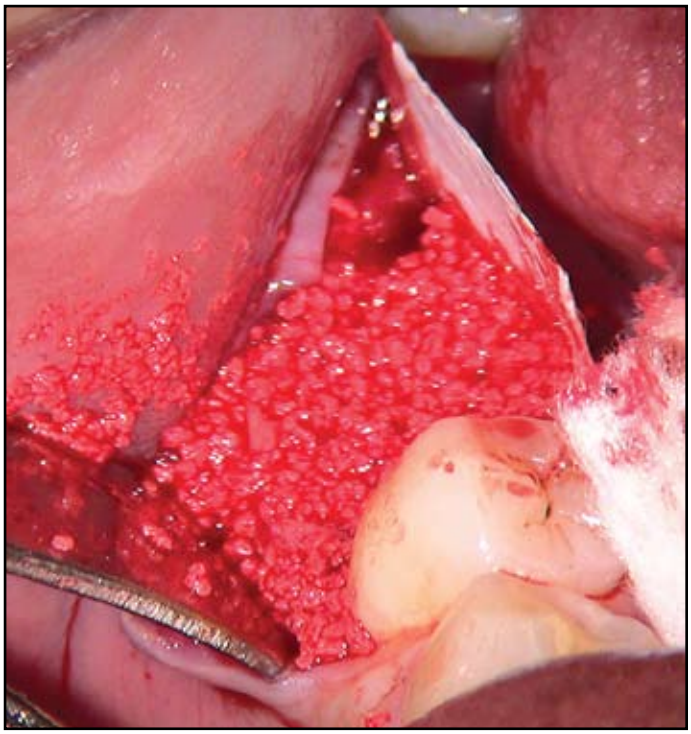


Figure 6: Extraction site grafted with β-TCP. Note resorbable membrane.

Figure 8: Note full soft tissue closure and keratinization of the surgical site in Case 1.

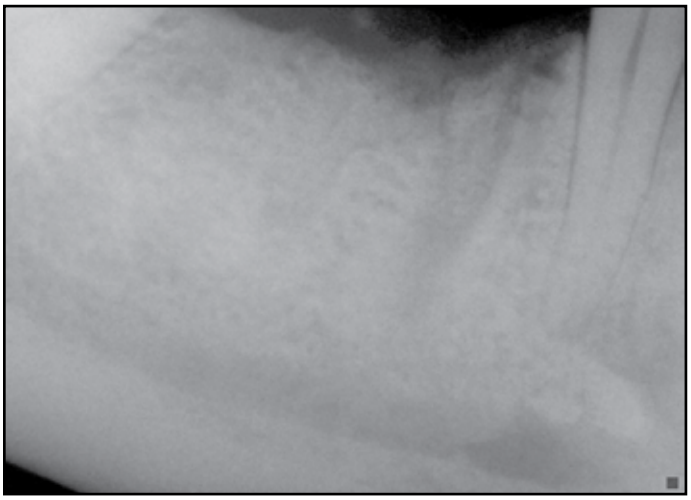


Figure 9: Radiographic evidence of bone fill in Case 1 at 3 months after surgery.

Case 2

This patient presented with pain in a maxillary molar tooth. Though the tooth was vital, inspection revealed a complete vertical fracture through the central portion of the tooth incorporating the distobuccal root (figure 10). To minimize trauma to the alveolar bone, the tooth was sectioned and the other roots extracted utilizing Piezosurgery (Mectron, Verona, IT). Previous papers have shown the effectiveness of this type of instrument as an aid to numerous types of oral surgical procedures.[11] The tooth was extracted with minimal trauma to the bone and surrounding soft tissue (figure 11). Elevation of a full thickness flap was only needed for access to and debridement of the defect on the mesiobuccal region. After careful debridement, the graft material (Cerasorb M) was mixed with a calcium sulfate containing a methylcellulose binder (CalMatrix, Keystone Dental, Boston, MA). This mixture was utilized to give more of a putty-like consistency (figure 12), enabling maximal volume preservation in the mesiobuccal region. The addition of calcium sulfate to the graft material has also been shown in other studies to enhance vital bone formation and turnover of the graft material to vital bone.[12] A recent paper has shown more complete healing when calcium sulfate has been added to ß-TCP.[14] In this animal study, better bone was formed and the bone fill was to a higher level coronally compared to sites grafted without the extra graft additive. For complete graft containment and to further enhance healing,

Figure 10: Case 2 presurgical presentation.

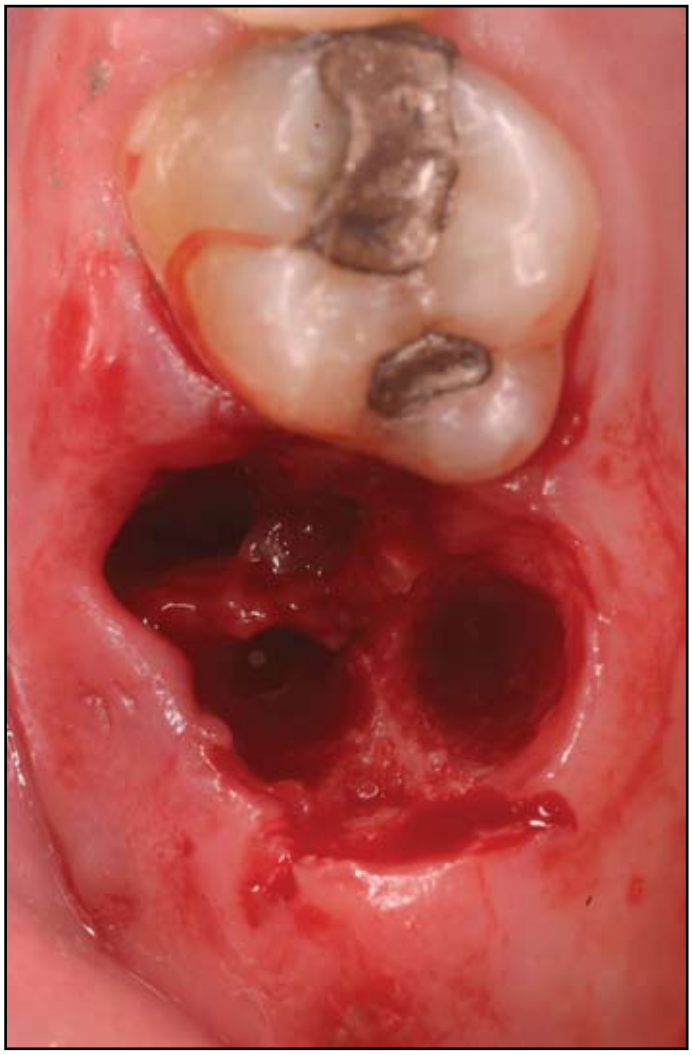


Figure 11: Case 2 atraumatic extraction with maximum osseous preservation.

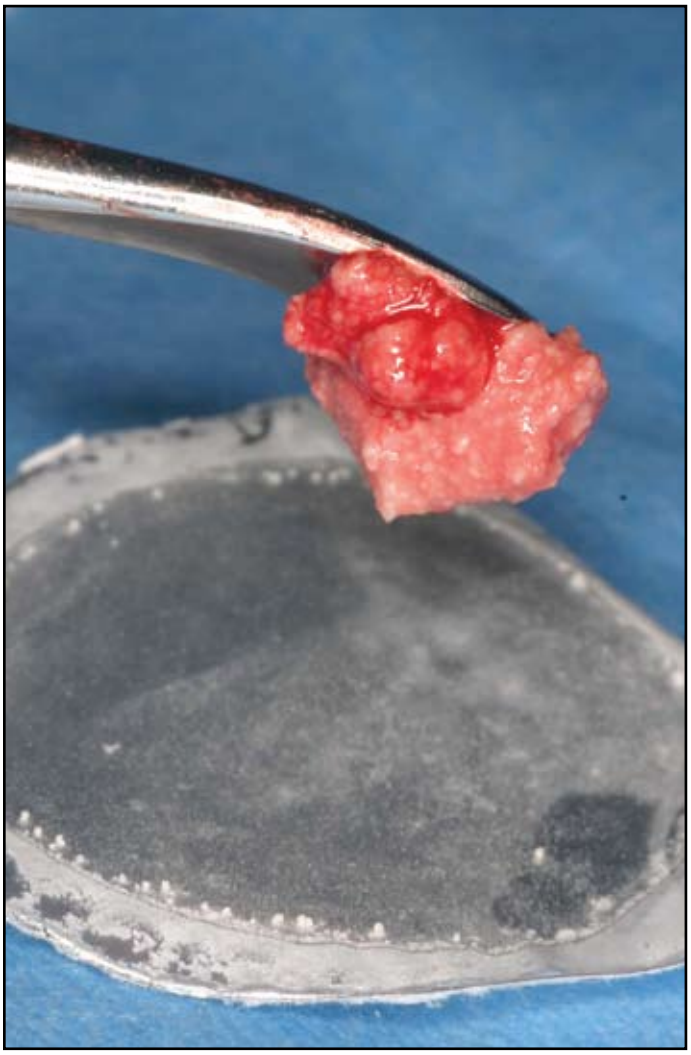


Figure 12: β-TCP and calcium sulfate mixture. Note cohesiveness.

a calcium sulfate barrier (Bone Gen, Orthogen, NJ) was placed over the coronal portion of the graft (figure 13). The flaps were closed, but primary closure was not obtained and sutures were placed (figure 14). An immediate postsurgical radiograph demonstrated alloplastic fill of the extraction site (figure 15).

Over the next two months, the soft tissues fully granulated over the calcium sulfate barrier and closed the coronal portion of the socket (figure 16). Six months after extraction and grafting, the site was opened. Clinical evaluation revealed an absence of graft particles, but full volume and width reconstruction from the surgical procedure (figures 17,18). A one-stage dental implant was placed with an osteotome technique to facilitate the placement of a longer implant and to enable better stabilization at the sinus floor. A 5 year postsurgical radiograph is presented in figure 19.

Figure 13: Extraction site grafted with β-TCP and covered with calcium sulfate barrier.

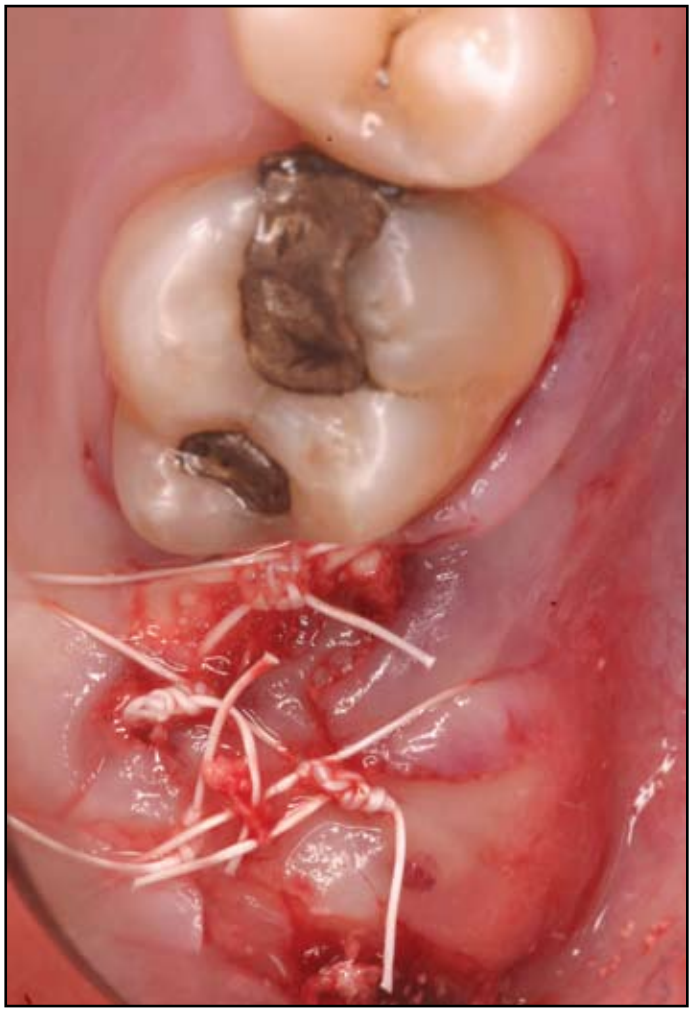


Figure 14: Case 2 surgical closure. Note that full primary closure was not obtained and portions of the resorbable barrier are visible.

Figure 15: (right) Immediate postsurgical radiograph demonstrating alloplastic fill of the extraction site.

Figure 18: (bottom right center) Case 2 radiographic presentation at 6 months after surgery. Note bone fill.

Figure 19: (bottom far right) 5 year follow up radiograph of Case 2.

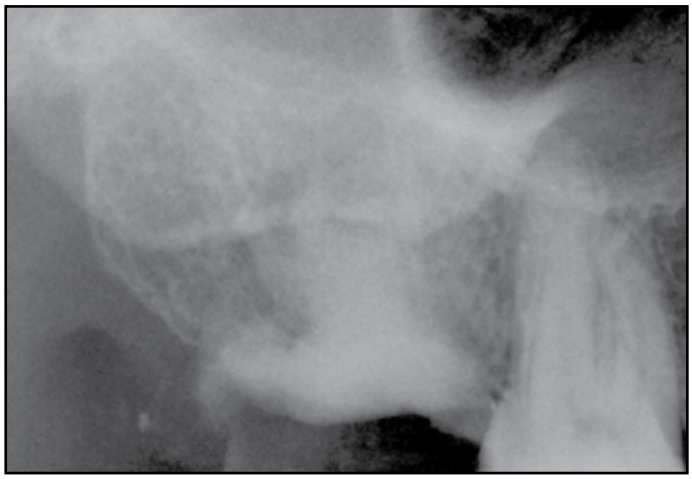


Figure 16: Note full soft tissue closure and keratinization of the surgical site in Case 2.

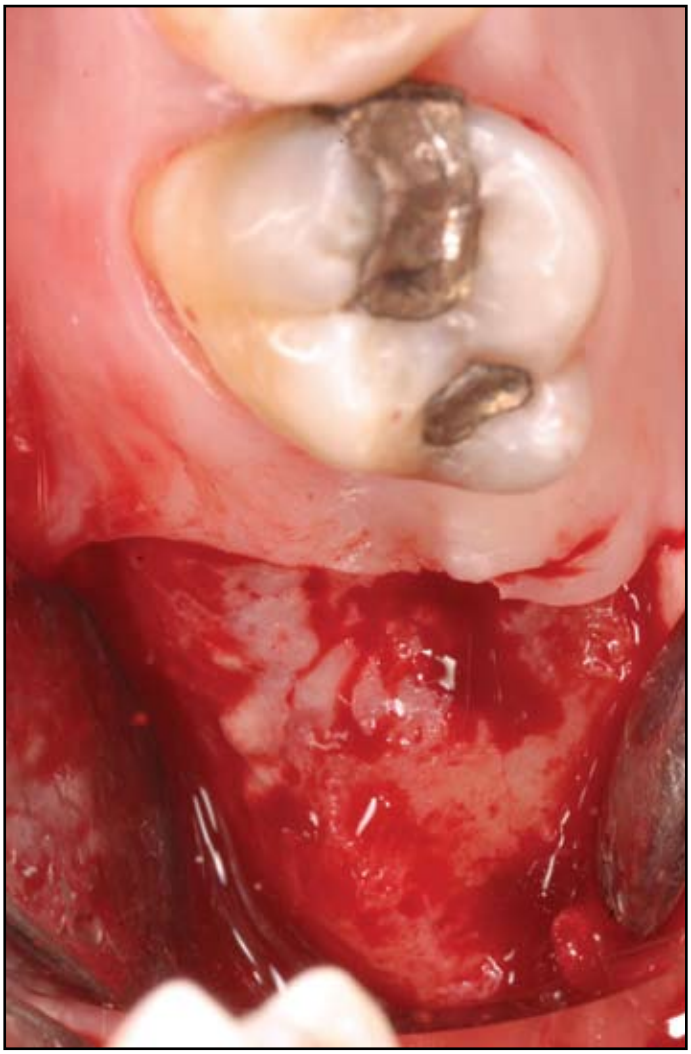
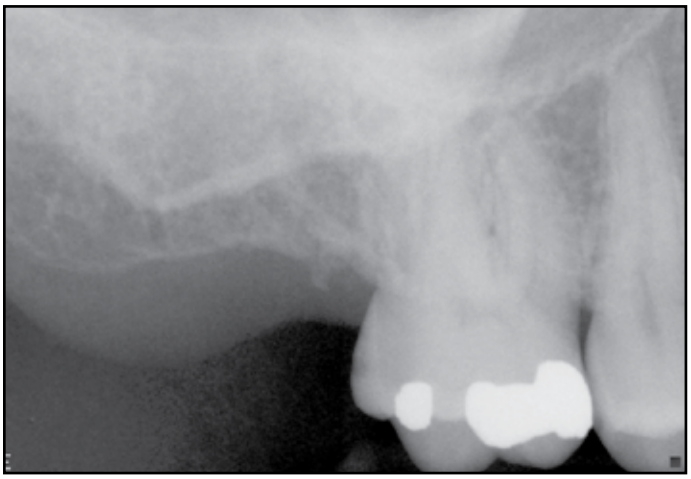
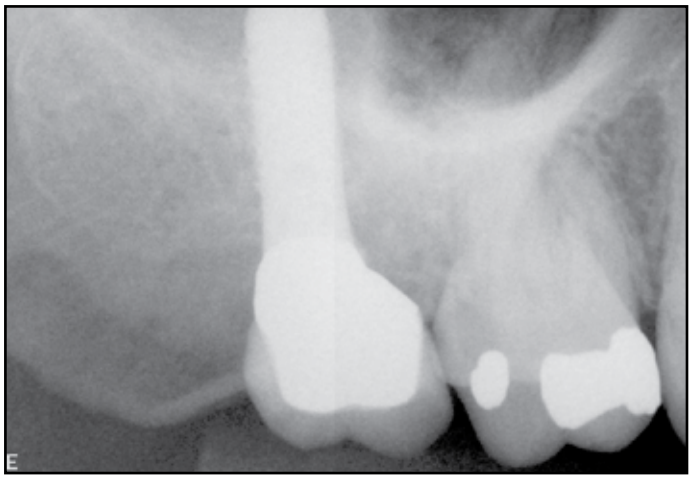


Figure 17: Case 2 clinical presentation at 6 months after surgery. Note bone fill.





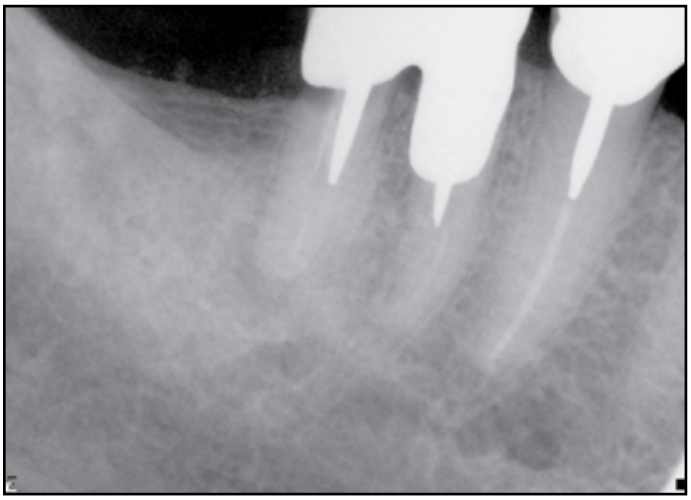


Figure 20: Case 3 presurgical radiograph.

Figure 21: Case 3 presurgical presentation following crown removal.

Case 3

This patient presented with a failing restoration on a mandibular right first molar tooth (figures 20, 21). Upon evaluation, the tooth was deemed to be non-restorable and atraumatically extracted (figure 22). After debridement of the socket, the site was grafted with a mixture of blood from the site and a pure phase, beta-tricalcium phosphate (Cerasorb M) to ideal contour (figure 23). The graft material was covered with a resorbable collagen membrane and the flaps closed.

The site was followed radiographically, observing resorption of the graft particles and concomitant vital bone formation in the site (figure 24). Six months after the extraction, the site was opened for placement of a dental implant. No graft particles were evident on visual inspection of the site. After retrieving a core of the regenerated material for histologic analysis, the implant was placed. The alveolar ridge volume was sufficient to enable placement of a wide body, wide neck one stage dental implant that was fully stable at insertion (figure 25).

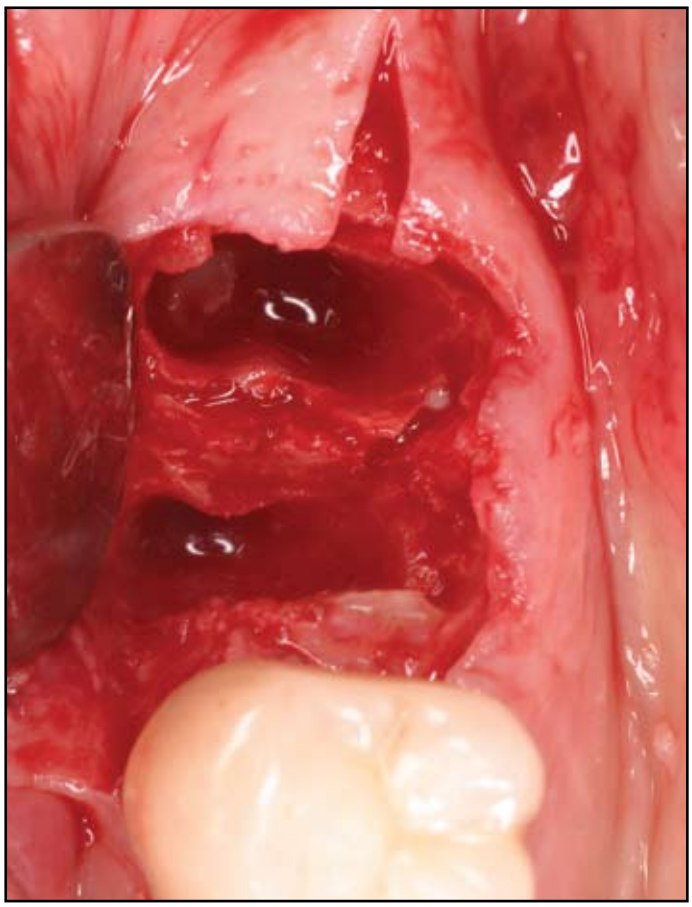


Figure 22: Case 3 atraumatic extraction with maximum osseous preservation.

Figure 23: Extraction site grafted with β-TCP. Note resorbable membrane.

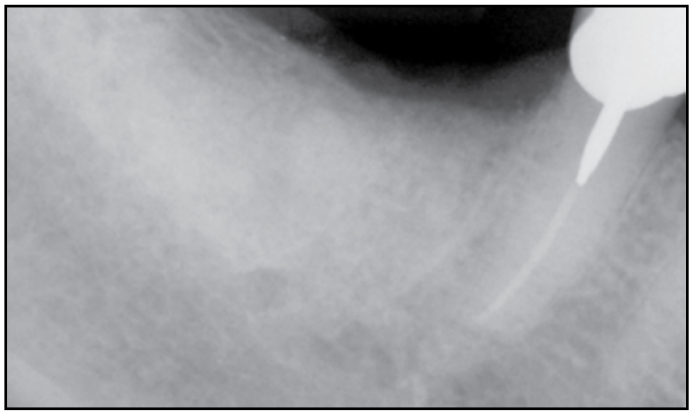


Figure 24: Case 3 radiographic presentation at 6 months after surgery. Note bone fill.

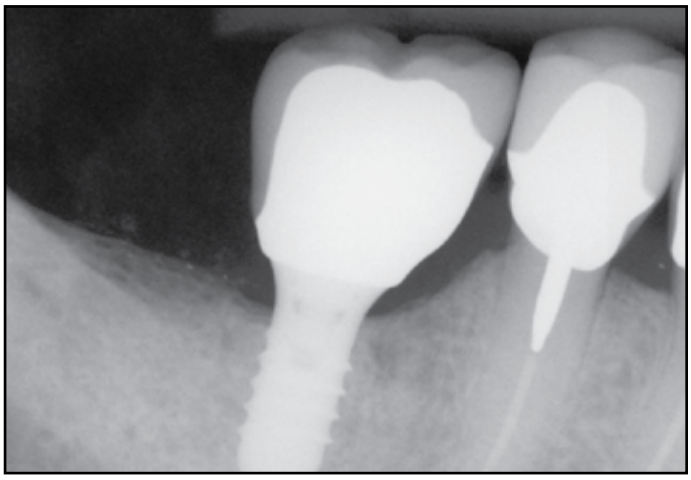


Figure 25: Case 3 radiograph at 14 months after implant delivery.

All Cases

Dental implant fixtures were delivered in all cases. At the appropriate time after implant placement, restorative procedures were performed. The implants were restored with cemented ceramo-metal restorations to return the patients to ideal form and function. Alveolar crestal height was followed radiographically from the time of extraction through placement of final restoration to assist in determination of stability of the crestal attachment apparatus. In all cases, there has been no loss of alveolar bone from the crestal region over the time frame studied (1-5 years). There has also been no change in the level of the facial gingival margin over the same time period.

CONCLUSIONS

The techniques of extraction and simultaneous graft and barrier placement presented in this article are very predictable for restoring volume

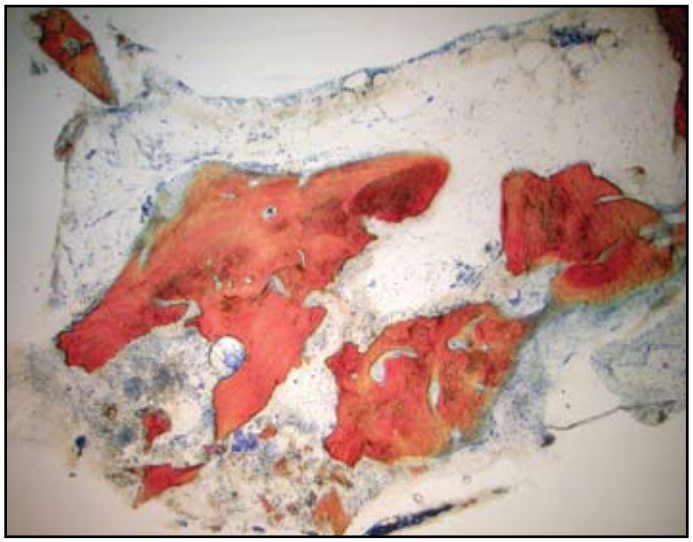


Figure 26: Low power H&E photomicrograph from case 2. Note vital bone and lack of alloplast.

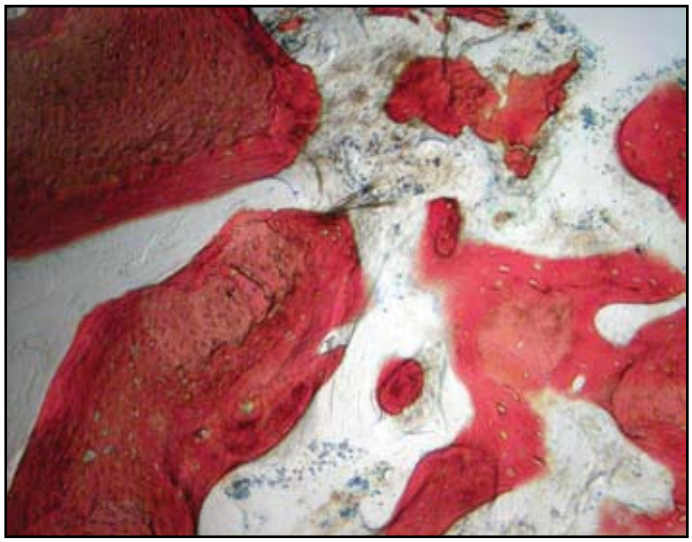


Figure 27: Low power H&E photomicrograph from case 3. Note vital bone and lack of alloplast.

of the alveolar ridge. When resorbable barriers are utilized to cover the graft, certain materials can be safely left partially exposed to the oral environment. The cases shown in this report demonstrated this principle with various materials. If primary closure cannot be maintained leaving a large area exposed, or is not desired, the surgeon may benefit by the placement of a dense PTFE barrier over the grafted site.[15,16]

Synthetic graft materials are advantageous in their ability to be used in any country around the world. The same is not true for all products of human and/or animal origin. Patients must make informed decisions on the materials that surgeons place with respect to the origin of these products and their expected biologic results. In the cases shown in this paper, vital bone was formed in all re-entered, regenerated sites. In the maxillary molar site, 32% vital bone was formed and only 8% residual graft was left (figure 26). In the mandibular molar site, 51% vital bone resulted with less than 1% remaining bone replacement graft material (figure 27). This is in contrast to studies with bovine graft materials where anywhere from 25-35% residual graft has been shown.[17]

The predictable formation of vital bone in the treated extraction sockets of this and other studies has led to 100% success rates in implant placement and loading.[18] Additionally, this bone has maintained radiographic integrity and enabled support of keratinized tissue with no dimensional alterations over time. Additional studies are needed comparing vital bone formation in sockets and in maxillary sinus augmentation with ß-TCP compared to other graft materials.

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Disclosure
Drs. Horowitz and Mazor report receiving an honorarium from Reimser, Inc.

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