RIDGE PRESERVATION UTILIZING AN ALLOPLAST PRIOR TO IMPLANT PLACEMENT — CLINICAL AND HISTOLOGICAL CASE REPORTS

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A calcified copolymer alloplast (Bioplant HTR, Bioplant Inc., South Norwalk, CT) was utilized to fill osseous defects in five patients. Hard tissue cores were obtained from the grafted sites and prepared for biopsy. In one patient, the lining of a soft tissue flap was biopsied 8 months post-grafting. Histological evaluation of the specimens revealed that the copolymer particles placed adjacent to the bony defect walls served as an osteoconductive material in which vital remodeling bone and marrow formed and fused to the surface of the particles. This process of bone deposition and remodeling was present 11 years following grafting.

Key Words: alloplast, copolymer, defect, implant

Significant long-term success has been demonstrated when endosseous implants are placed in bone of adequate volume,[1-3] although ridge deformities caused by extraction, alveolar bone resorption, and trauma reduce the volume of available bone. In addition, the proximity of anatomic structures (eg, the inferior alveolar nerve and maxillary or nasal sinus) may preclude implant placement. In order to address such conditions, bone regenerative procedures have been utilized to restore lost alveolar bone.[4,5] To date, data have indicated that graft- and/or membrane-regenerated bone has the ability to support implants.[6,7] In an attempt to minimize alveolar ridge deformities, socket treatment techniques have been used at tooth (implant) removal. The extraction of a tooth without socket treatment has been shown to initially result in clot formation, followed by connective tissue and bone replacement.[8] Without treatment, alveolar crest resorption will cause significant loss (40% to 60%) of the vestibular plate.[9,10] In instances where there are root pathological changes, thin buccal plate, advanced periodontal disease, or difficulty in extracting the root, greater loss of the buccal plate can be anticipated.

The use of alloplastic materials for ridge augmentation has resulted in clinically successful results.[11] One such material is a synthetic bone alloplast that consists of a calcified copolymer (polyhydroxylethylmethacrylate and polymethylmethacrylate) and calcium hydroxide (Bioplant HTR, Bioplant Inc., South Norwalk, CT).[11] The question remains, however, as to whether the new tissue formed during the healing of an alloplast-treated socket or ridge is able to enhance the site for implant placement and long-term success if the implants are well maintained

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Figure 1. Case 1. Buccal view of the patient's abscessed hemisected mandibular left first molar which served as an abutment for a three-unit fixed prosthesis from tooth #17(38) to #19(36).

over extended periods. This article reports the clinical and histological results from two prospective and three retrospective case reports in which a calcified copolymer was utilized to augment bone for implant placement.

Clinical Case Presentations

Case 1

A 55-year-old female patient presented with a fistulating abscess on the remaining mesial root of tooth #19(36) (Figures 1 and 2), which had a history of endodontic therapy and apical surgery. The tooth was an abutment for a three-unit splint that extended from tooth #17(38) to tooth #19. At the time of extraction of tooth #19, the fixed splint was sectioned and the extraction socket was debrided. The walls of the socket and adjacent bony defect were decorticated with multiple perforations using a #1 round bur. Blood was aspirated from the surgical site and added to the copolymer with the aid of a special filter tip. Following the removal of the aspirating filter tip, the contents of the syringe (alloplast mixed with marrow blood) were deposited into the defect and over the buccal and lingual aspects of the remaining wall. Eight months following augmentation surgery, a flap was reflected to reveal the regenerated tissue.

Three titanium implants (Nobel Biocare, Yorba Linda, CA) were placed in the edentulous area (Figure 3). The most anterior implant was placed in the area of the previous extraction and alloplast socket fill. During implant placement, a core of bone was removed with a trephine (2.8 mm × 10 mm) (Straumann Co., Cambridge, MA) from the previously grafted area. Immediately following implant placement, the same alloplast was again utilized to augment the diameter of the buccolingual ridge. The flap was sutured and the area was permitted to heal. Eight months postoperatively, second-stage surgery was performed to insert the abutments. Concurrently, a biopsy of the underside of the flap (which removed some of the underlying connective tissue and encapsulated particles) was taken of the "whitish" interior portion of the flap. Both biopsy specimens were submitted for histopathologic examination. The patient returned for yearly maintenance, and the implants have been in function for 6 years since completion of the definitive implant prosthesis (Figure 4).

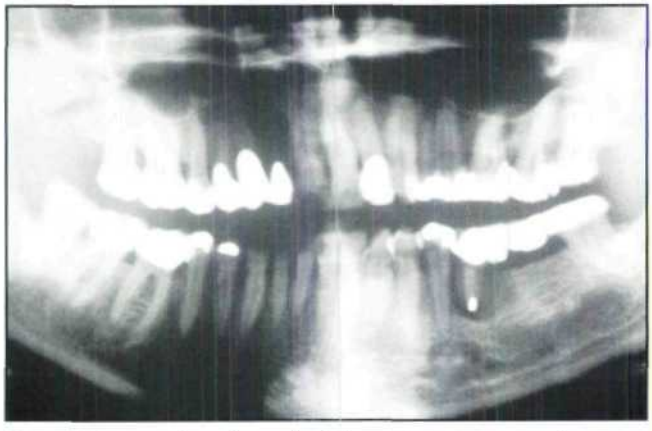

Figure 2. Panoramic radiograph of the patient at presentation.

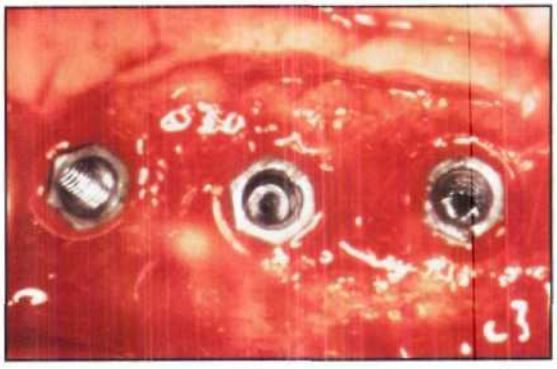

Figure 3. Occlusal view of three implants (two were placed in the grafted ridge area) 8 months following grafting.

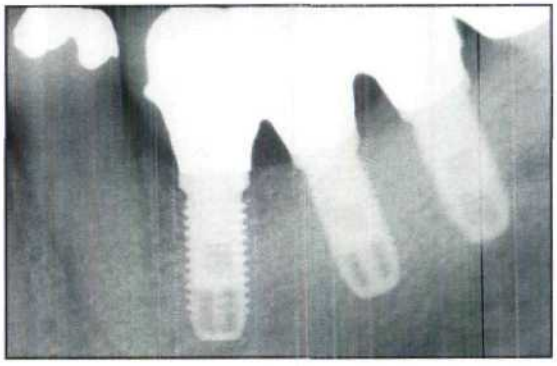

Figure 4. Six-year periapical radiograph of the functioning implants. Note the bone condensation around the cervical area of the anterior implant.

Case 2

A 74-year-old female patient presented with pain and a loose mandibular prosthesis. Clinical examination revealed that the fixed partial denture was supported by severely periodontally involved teeth and a failing blade implant (Figures 5 and 6). The patient was prescribed antibiotics (amoxicillin 500 mg q.i.d.) for 1 week to control the

Figure 5. Case 2. Preoperative view of the restoration, which was supported by a blade implant and endodontically stabilized teeth.

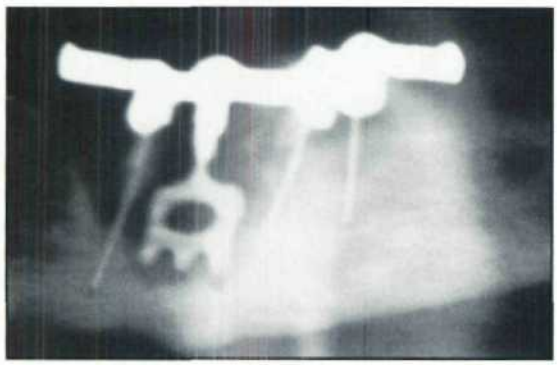

Figure 6. Panoramic radiograph of the patient at presentation.

acute infection and scheduled to return for extraction of the teeth and failing implant. The infection had significantly eroded the anterior mandible, which resulted in a severely resorbed buccal plate and a thin lingual wall. The potential of future prosthetic restoration had been eliminated as a result of an alveolar defect that occurred following extraction of the blade implant, three endodontically stabilized teeth (#22[33], #23[32], and #28[44]), and their resorbed roots. The defect was debrided, and intramarrow penetrations were made laterally and in the remaining socket. The bone defect along the anterior mandible measured approximately 18 mm mesiodistally (Figure 7). An alloplast was prepared for implantation by aspirating blood from the bleeding sockets into the syringe that contained the bone replacement material. The graft was placed within the extraction socket and along the buccal and lingual walls (Figure 8). Approximately 4 months postgrafting, the patient returned for bilateral mandibular posterior ridge augmentation that would provide stability for a provisional denture. The augmented ridge also prevented transmucosal loading of the implants that were placed 9 months following posterior augmentation.

Thirteen months following socket surgery, a full-thickness flap was reflected for stage I implant surgery. Clinically, the osseous surface appeared rough and irregular. At the time of implant osteotomy, a bone core (2.8 mm × 10 mm) was obtained with a trephine from one of the grafted sites. Four machined surface titanium implants (Nobel Biocare, Yorba Linda, CA) were then placed in the anterior mandible (Figure 9). Two of the implants were placed in sites #26(42) and #27(43), which were previously treated with the alloplast. Residual defects surrounding the implants were filled with additional alloplast material moistened with marrow blood from the decorticated bone walls, and primary closure was attained.

The patient was prescribed antibiotics (amoxicillin 250 mg q.i.d. × 2 weeks) and 0.12% chlorhexidine rinses (Peridex, Procter & Gamble, Cincinnati, OH) twice daily for 3 weeks, during which time the denture was not worn. After 3 weeks, the provisional denture was adjusted and relined to prevent excessive pressure on the implants and maintain the grafted ridge. Following 8 months of healing, the implants were uncovered and tested for mobility.

Utilizing the Periotest (Periotest, Gulden-Medizintechnik, Bergstrabe, Germany), all four implants gave readings of −2 to −4. Healing abutments were placed and the soft tissue positioned and sutured 1 mm coronal to the osseous crest. Approximately 2 months following abutment connection (Figure 10), prosthetic reconstruction was

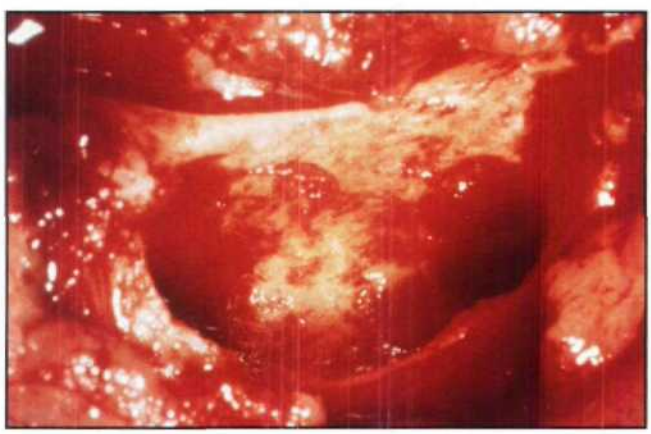

Figure 7. A large bony defect was evident following the extraction of the blade implant and the mobile mandibular teeth (mesiodistal area = 18 mm).

initiated. The four implants were connected with a bar over which the mandibular denture rested. The patient has been radiographically and clinically monitored for 6 years (Figures 11 and 12).

Case 3

A 28-year-old female patient in good general health presented with a chief complaint of a "loose bridge" in the mandibular left quadrant, where teeth #17, #18(37), and #20(35) were missing. A clinical examination revealed a cantileved pontic in tooth #18, with a mobile fixed splint from tooth #18 to #23. The radiographic and clinical examination revealed that tooth #19 had root caries, a Class II furcation, and a fracture (Figure 13). At a subsequent visit periodontal surgery was performed; tooth #19 was hemisected and the mesial root was removed. Following debridement of the socket and remaining root, intramarrow penetrations were performed and a calcified copolymer alloplast hydrated with marrow blood was placed in the socket (Figure 14). The flap was sutured and a provisional fixed splint was placed. Cast posts were placed into the distal root of tooth #19 and tooth #22. Following 6 months of wear, the provisionally splinted tooth demonstrated no mobility and minimal probing depth.

A metal-ceramic fixed splint was placed from tooth #19 to #22 (Figure 15). Approximately 7.5 years later, the patient presented with mobility of the fixed splint; an examination revealed that tooth #19 was fractured. The splint was sectioned distal to tooth #22, and this section and tooth #19 were removed. One machined root-formed implant (3.8 mm × 8 mm, Steri-Oss, Nobel Biocare, Yorba Linda, CA) and one hydroxyapatite-coated cylinder (4.0 mm × 8 mm, Sulzer/Calcitek, Carlsbad, CA) were placed. The anterior implant was placed into the area grafted 7.5 years previously. During implant preparation, a core (2.8 × 10 mm) was taken of the healed grafted extraction socket and preserved for histological evaluation. Four months post implantation, the implants were exposed and the abutments were placed. A fixed implant tooth-supported restoration was fabricated from tooth #22 and included implants at sites #19 and #20 as well as an interlock between tooth #22 and pontic #21(34). This implant-supported prosthesis has been in function for over 5 years (Figure 16).

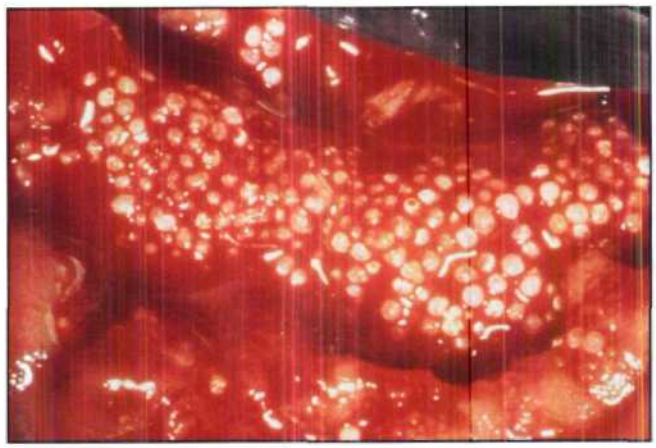

Figure 8. The previously hydrated alloplast copolymer was placed into the defect to augment the ridge.

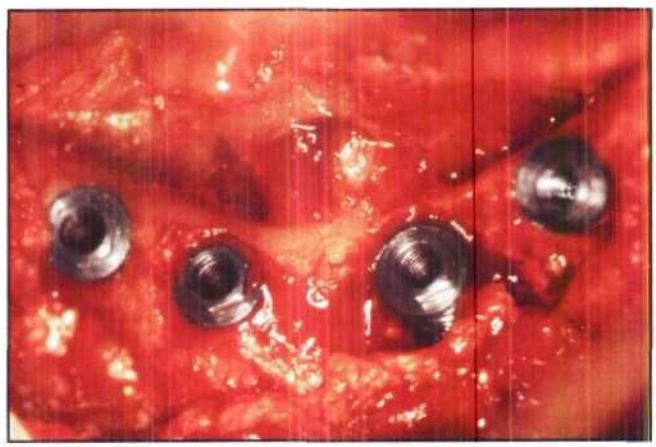

Figure 9. Four implants (two in the grafted ridge defect) were placed 13 months postsurgery. Cores were obtained during implant placement.

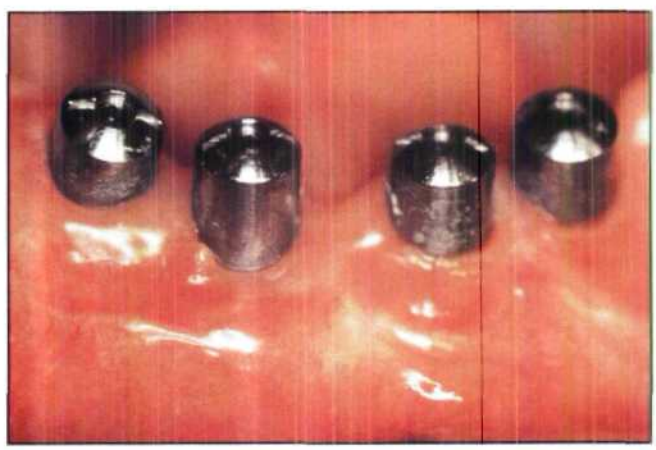

Figure 10. Soft tissue healing continued for 8 months following implant placement and 2 months after healing abutments were connected to the fixtures.

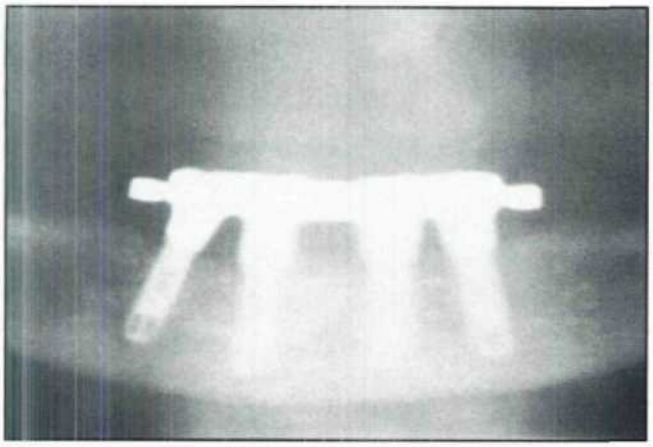

Figure 11. Panoramic radiograph of the definitive restoration, which consisted of 4 implants and a bar overdenture, 6 years following loading.

Figure 12. Periapical radiograph of the 2 implants and surrounding bone 6 years following loading. Note condensation of new bone.

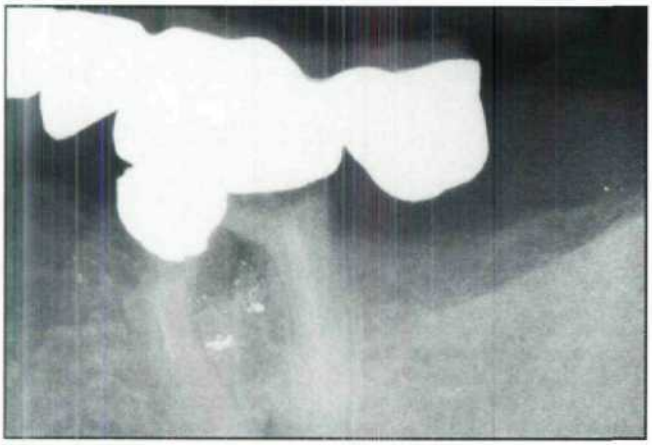

Figure 13. Case 3. The preoperative radiograph demonstrated decay and mesial root and furcation involvement.

Case 4

A 29-year-old female patient presented with multiple infections in the left and right posterior maxilla. Upon questioning, the patient revealed that all of her maxillary posterior teeth had been lost via caries and/or an earlier automobile accident. The patient was premedicated with penicillin (1000 mg per day) for one week starting one day prior to dental surgery. Following reflection of a full-thickness flap, the subperiosteal implants, their respective restorations, and the remaining maxillary anterior teeth (#6[13] through #11[23]) were removed (Figure 17). Following debridement of the defects and decortication with a #1 round bur, a calcified copolymer alloplast was prepared (as described previously) and inserted into the defects (Figure 18), and buccal to the ridge area of teeth #3(16) through #11(23). A provisional denture served as a stent and the patient was placed on a restricted diet for 2 weeks. Three-months postsurgery, the denture was relined with a soft lining that was replaced at 8 months with a hard lining that functioned for 6 years. The patient then requested an implant-supported prosthesis. A crestal incision was made from the distal aspect of tooth #1(18) to the midline. Three vertical incisions were made and a full-thickness flap was reflected. Two implants (Steri-Oss, Nobel Biocare, Yorba Linda, CA) were placed in sites #5(14) to #6(13). At the time of osteotomy preparation, two cores were obtained from the 7.5-year postgrafting site and submitted for histological evaluation. Interrupted silk sutures 3-0 were used to obtain primary closure. Postoperatively, the patient received a corticosteroid and an analgesic. At a separate visit, an additional implant (Steri-Oss, Nobel Biocare, Yorba Linda, CA) was placed in the left maxillary area. Six months following implantation, the implants were exposed and the definitive prosthesis, an implant-supported overdenture, was delivered. The implant-supported prosthesis has been functioning for 5 years and 4 months (Figure 19).

Case 5

A 31-year-old female patient presented with an abscess and root fracture of tooth #20. The tooth had been extracted, which resulted in a large osseous defect. The socket was debrided and prepared with intramarrow penetrations. A calcified copolymer alloplast was prepared and placed into the socket. Beginning on the day

of the surgery, 1 g of penicillin per day for one week was prescribed for the patient. Twelve years postsurgery, the patient presented with a fractured crown on tooth #21 and a porcelain-fused-to-gold splint (#19 through #21) was removed. Since the patient declined treatment with another fixed prosthesis, teeth #19 and #21 were restored individually and the pontic site (#20) was prepared to receive an implant. Following flap reflection, a core of bone was removed during implant osteotomy and processed for histological evaluation. A 3.8 mm × 10 mm implant was placed in this area. At implant placement, the bone had a type 2 consistency. Following implant placement, the calcified copolymer alloplast was added to the buccal and lingual surfaces of bone to improve soft tissue contour of the tissue and increase the buccolingual bone diameter. The flap was sutured, and the aforementioned antibiotic regimen was prescribed for the patient (Figure 20).

Histological Evaluation

All tissues were fixed in 10% formalin, decalcified in formic acid, and processed. Sections of the cores (6 μm thickness) were prepared and stained with hematoxylin and eosin for routine histological analysis. Since the microscopic evaluation of the specimens from all 5 cases revealed similar information, this presentation focuses on the hard tissue specimens from Cases 1, 2, and 5, and on the soft tissue specimen from Case 1.

Case 1: Eight Months Postgrafting

The hard tissue specimen was composed of alloplast microspheres on the surface of the bone surrounded by

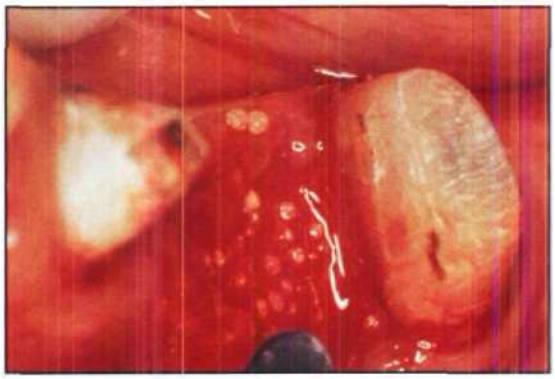

Figure 14. The mesial root socket was filled with an alloplast (Bioplant HTR, Bioplant Inc., South Norwalk, CT) and bleeding marrow.

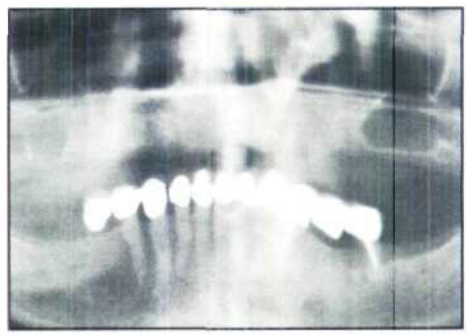

Figure 15. Radiograph of the metal-ceramic fixed split, which was in place for 7.5 years.

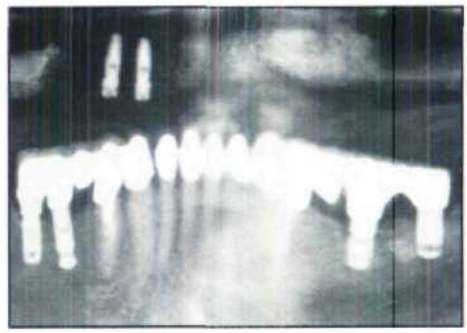

Figure 16. Postoperative radiograph of the definitive implant-supported fixed partial denture (mandibular right), which was in function for 5 years.

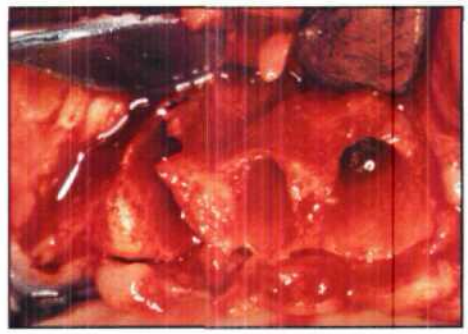

Figure 17. Case 4. Clinical view of maxilla following extraction of teeth #6(13) through #11(23). Note the presence of thin spiny ridges.

lamellar bone (Figure 21A). The surface of the alloplast was in direct apposition to vascular channels and cellular elements of mesenchymal origin with plump nuclei (Figure 21B). These cells appeared to produce osteoid-like material and participate in the formation of lamellar bone. Thus, the tissue reaction to the alloplast was clearly osteogenic in nature. In contrast, examination of the "white layer" beneath the surface of the soft tissue flap revealed microspheres of the alloplast embedded in dense fibrous connective tissue intermixed with residual alloplast (Figure 22A). The alloplast particles appeared

Figure 18. A calcified copolymer alloplast hydrated with marrow was placed into the sockets. Note hemostasis and lack of migration.

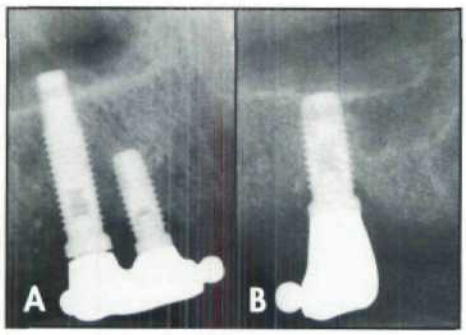

Figure 19A. Radiograph of right maxilla 5.5 years following implant placement. 19B. Periapical radiograph of left maxilla 5.5 years postimplantation.

Figure 20. Case 5. Radiograph of loaded and functioning implant approximately 1.5 years post-insertion and 11 years following ridge grafting.

to be well tolerated with minimal evidence of inflammation. In some areas, there was an increase in the number of macrophages and occasional multinucleated foreign body giant cells; these cells were associated with the removal of breakdown products of the alloplast. At no time were any neutrophils or plasma cells evident.

Case 2: Thirteen Months Postgrafting

The tissue reaction to the calcified copolymer was associated with osteogenesis and bone remodeling (Figure 22B). Close integration of bone to the surface of the alloplast was evident (Figure 23A). Some areas of the microsphere surfaces were covered with vascular fatty marrow, while the hollow portion was infiltrated with vascular tissue. The newly formed bone was fused to or continuous with the surface of the alloplast and bone remodeling was indicated by the prominent reversal lines (Figure 23B).

Case 5: Eleven Years Postgrafting

The hard tissue specimen was composed of alloplast microspheres surrounded by lamellar bone. The surface of the alloplast was in direct apposition to the bone, which was well vascularized and contained healthy osteocytes within the lacunae (Figure 24A). In several areas within the specimen, the alloplast was in direct contact with cellular elements of mesenchymal origin and blood channels (Figure 24B). In these instances, the tissue reaction to the alloplast was osteogenic in nature as suggested by the presence of mesenchymal cells with plump nuclei and osteoidlike material deposited against the surface of the alloplast (Figure 25A). This strongly suggested that the presence of the alloplast within the tissue is associated not only with the deposition of hard bone, but also with continuous remodeling and new bone formation as late as 11 years following grafting. The trace elements of alloplasts were surrounded by activated macrophages, which probably were not only observed resorbing the material, but stimulating osteoblastic activity (Figure 25B).

Discussion

Attempts to preserve the bone support around hopeless teeth or implants following extraction have included the use of membranes, and/or bone replacement grafts. While decalcified freeze-dried bone allograft (DFDBA)

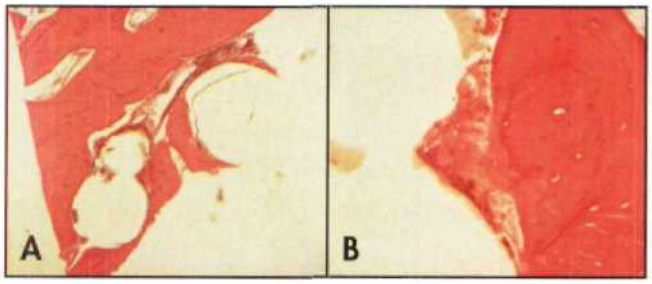

Figure 21A. Alloplast microspheres on surface and surrounded by lamellar bone (Original magnification ×31.5). 21B. Note residual alloplast material lining microsphere walls (×125).

has often been used in ridge augmentation and socket repair,[12] recent studies indicate that DFDBA had no significant advantage over the use of a barrier membrane in promoting bone formation.[13,14] Other investigators have concluded that augmentation of extraction sockets with grafting materials (autografts or allografts) may actually interfere with the normal healing process.[14] Additional investigations focused on the filling of extraction sockets with xenogenic bovine bone (BB), DFDBA, autogenous bone (AG), and human bone morphogenetic proteins have indicated that only the latter was able to produce entire fields of new bone.[15] In addition, the AG, BB, and DFDBA appeared to interfere with normal extraction socket healing. Further study of extraction sockets have demonstrated that sites covered with barrier membranes (albeit without bone grafts) have significantly better ridge dimensions and less alveolar bone resorption than uncovered sites at 6 months.[16,17]

The successful use of a synthetic copolymer in the treatment of the extraction sockets with and without implant placement to achieve ridge preservation by immediate grafting of the socket has also been described.[18,19] The use of a synthetic alloplast copolymer for ridge preservation and augmentation has also been reported. These investigations have found that — with the copolymer bone graft — barrier membranes were not essential for bone regeneration,[20] greater ridge retention is possible,[21] and bone density can be significantly increased.[20,22]

The current case reports demonstrate the use of a calcified copolymer for ridge preservation and augmentation. The data must be viewed as case report data rather than controlled clinical studies. The composite polymer material used in these patients was a microporous (350u) composite of polymethylmethacrylate and polyhydroxylethylmethacrylate with a calcium hydroxide/carbonate surface layer, and a negative surface charge of −10 mV. The material has been found to be osseoconductive in animal and human studies.[19,23,24] The biocompatibility of the alloplast has been the subject of numerous studies,[25,26] which verified its osteogenic potential. The biocompatibility of the alloplast to bone or to titanium implants and its ability to support an implant has been studied histologically and radiographically as well.[21,23] These investigators demonstrated close apposition of the alloplast to newly forming bone and to the titanium implant. The use of a synthetic alloplast copolymer for ridge preservation and ridge augmentation has been recently described. Ashman et al reported on 55 immediate postextraction implants with a calcified alloplast filling the bone voids around the implants, and reported a 98% eight-year success rate with threaded titanium implants.[27] The calcified alloplast has also been used in voids around implants placed in sockets immediately postextraction for ridge augmentation around implant sites.[28]

The reaction to the alloplast in soft or hard tissue when used for ridge preservation and augmentation may be compared with clinical and histological data that utilize the material to treat periodontal defects. Human periodontal case report data demonstrated that the material was well tolerated, and when the copolymer was placed in gingival tissue it was surrounded by fibrous connective tissue. In contrast, particles of the alloplast found in close proximity to the alveolar bone and/or marrow bleeding generally appeared to fuse to the

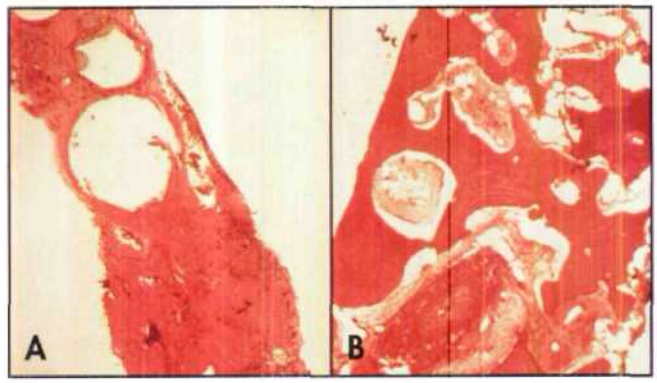

Figure 22A. Soft tissue biopsy of the inner flap. Alloplast particles are surrounded by connective tissue (×31.5). 22B. Bone core contains the copolymer 13 months following grafting (×31.5).

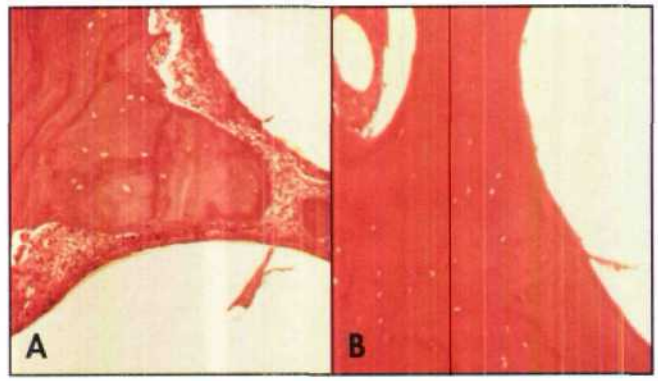

Figure 23A. View of the dense trabecular bone surrounding and fused to the alloplast particles (×200). 23B. Vital dense lamellar bone surrounds the alloplast (×200).

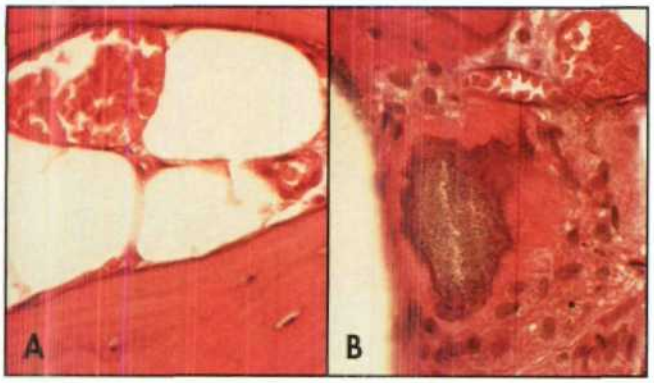

Figure 24A. Healthy osteocytes exist within the lacunae (×200). 24B. The residual alloplast is in contact with acellular elements of mesenchymal origin (×320).

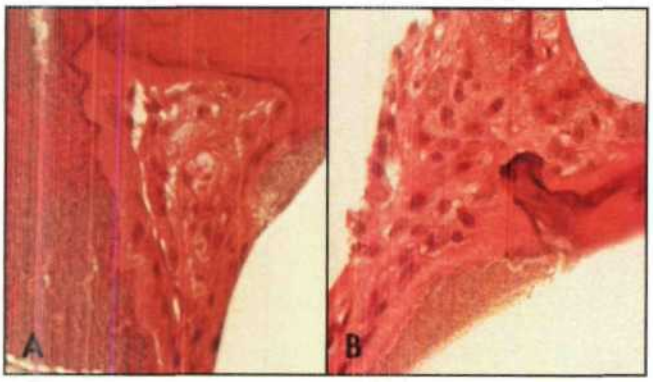

Figure 25A. View of alloplast adjacent to mesenchymal cells. Note plump nuclei and osteoidlike material (×320). 25B. Trace elements of alloplasts are surrounded by macrophages and new bone (×320).

bone.[22,29,30] In the current study, the tissue reaction around the alloplast was similar to that of previous reports with close apposition between new bone and microspheres of the alloplast. The new bone, which generally covered most of the microsphere surface, exhibited active remodeling and did not differ from normal trabecular bone. Portions of the microsphere surface were also covered by vascular fatty marrow. When the alloplast was placed in the connective tissue of the gingiva, however, the reaction to the alloplast was fibrogenic and without significant inflammation. From a clinical standpoint, these histological findings appear to imply two different responses to the alloplast that depend on location. When placed in close proximity to bone, the alloplast particles appear to be osteoconductive. For this process to occur, decortication of the socket or bony ridge is essential to allow the alloplast to be placed in contact with the bleeding osseous walls. This exposes the alloplast to marrow bleeding, which may provide pluripotential stem cells and cytokine growth factors necessary for the stimulation of bone formation. This process may be further facilitated by the significant negative surface charge (−8mV to −15 mV) carried by the alloplast particles that may act as a stimulus for bone formation.[24] Furthermore, this study demonstrated that the presence of the alloplast within the tissues is associated with continuous bone deposition and remodeling — even 11 years postgrafting. This alloplast-regenerated bone has been measured at 2 to 3 times the density of normal alveolar bone.[20] This continuous remodeling may contribute to the success rate of implants placed in tissues augmented by the alloplast. Indeed, there is evidence that the alloplast is being resorbed and replaced by newly forming bone without any connective tissue interface (Figure 25). In contrast, when the alloplast is placed in mature connective tissue, the particles become surrounded by dense collagen. The latter healing response may indicate a use for the alloplast as a filler for connective tissue expansion. Thus, the placement of the alloplast proximal to bone or in connective tissue may dictate the healing response, and the use of the copolymer as a bone or soft tissue augmentation material.

The clinical relevancy of the copolymer is evident from both the clinical outcomes and histological evaluations as represented by the five case reports presented. This material is safe, abundant, and does not produce an antigenic, immunogenic, or inflammatory response. When placed adjacent to bone, this material forms a bone/alloplast complex that supports and maintains the osseointegrated implants in a healthy state with no signs of bone loss. This underscores the nature of the bone formed by osteoconduction around the copolymer particles. The copolymer demonstrates its potential for tissue augmentation without hetertopic bone formation when placed in connective tissues. These responses have been documented without the need for a second surgical site (required by autogenous bone), with no fear of transmitted disease, and with long-term clinical success of functioning implants placed in this bone.

Summary and Conclusions

Ridge preservation at tooth extraction and/or ridge augmentation prior to implant placement is essential for their successful placement in areas of deficient bone volume. A calcified alloplast (Bioplant HTR, Bioplant Inc., South

Norwalk, CT) has been shown to be effective in preserving ridge height and width postextraction, and providing an environment that will allow implant placement. The histopathological evaluation of tissue from five cases of sockets and ridges augmented with a calcified polymer 8 months to 11¼ years previously revealed that the particles were well tolerated and surrounded and fused to new alveolar bone. Little or no evidence of inflammation was present around the alloplast microspheres whether in direct contact with bone or embedded in the tissue flap and surrounded by connective tissue. Two of the cases were followed, biopsies taken 11 years postgraft, and analyzed histologically. These two cases did not greatly differ from 8-month specimens suggesting that bone induction and increased bone density occurs relatively rapidly after implantation of the copolymer and that the new bone-alloplast complex will support titanium implants. Results in these five cases demonstrated that implants placed in socket and ridge deformities that were previously augmented with the calcified synthetic alloplast achieved success and normal function for a minimum of 6 years postloading.

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Continuing Education (CE) Exercise No. 14

14 CONTINUING EDUCATION

To submit your CE Exercise answers, please use the answer sheet found within the CE Editorial Section of this issue and complete as follows: 1) Identify the article; 2) Place an X in the appropriate box for each question of each exercise; 3) Clip answer sheet from the page and mail it to the CE Department at Montage Media Corporation. For further instructions, please refer to the CE Editorial Section.

The 10 multiple-choice questions for this Continuing Education (CE) exercise are based on the article "Ridge preservation utilizing an alloplast prior to implant placement — Clinical and histological case reports" by Stuart Froum, DDS, and Walter Orlowski, DDS, PhD. This article is on Pages 393-402.

Learning Objectives:

This article discusses 5 case reports that utilized a calcified copolymer alloplast to fill osseous defects following extraction. Upon reading the article and completing this exercise, the reader should:

- Identify conditions that may indicate additional alveolar bone loss and compromise bone regeneration.
- Be able to discuss the short- and long-term indications of treatment with a calcified copolymer.
- Have an understanding of treatment protocol and modalities implemented during placement of a copolymer immediately following tooth extraction.

1. Increased alveolar bone loss may occur following tooth extraction when all the following conditions are present EXCEPT:
a. A thin buccal plate.
b. A thick buccal plate.
c. Advanced periodontal disease.
d. Advanced endodontic pathology.

2. When utilizing the synthetic bone alloplast (calcified copolymer) for socket augmentation, the copolymer is hydrated in its delivery syringe with:
a. Sterile saline.
b. Distilled water.
c. Anesthetic solution.
d. Blood from the surgical site.

3. Prior to placement of the alloplast into the socket, the walls of the socket should be:
a. Maintained and irrigated with saline.
b. Debrided and treated with tetracycline.
c. Debrided and irrigated with 0.12% chlorhexidine.
d. Debrided and decorticated with multiple perforations.

4. What treatment protocol is recommended when full removable dentures are indicated following extraction socket treatment?
a. Placement of the denture is postponed for 2 weeks to accommodate for postoperative sensitivity.
b. The denture is hollowed out, a soft liner placed and immediately delivered.
c. The denture is hollowed out and a hard liner is immediately placed.
d. An implant-supported prosthesis is immediately fabricated.

5. The postoperative result following placement of the calcified copolymer in soft tissue includes:
a. Absorption with little inflammation.
b. Coverage by connective tissue and bone with little inflammation.
c. Encapsulation by soft tissue and little or no inflammation.
d. Coverage by new bone with little inflammation.

6. The response of the coploymer when placed in soft tissue may indicate its use for:
a. Bone expansion in combination with bone grafts.
b. Augmentation of soft tissue grafts.
c. Filling connective tissue expansion.
d. Inhibiting resorption.

7. Histological analysis of sockets filled with the copolymer at 8 months and 11¼ years postsurgery indicate:
a. The presence of the copolymer adjacent to vital bone at both time periods.
b. The presence of the copolymer following 8 months of treatment, and complete absorption by 11¼ years postoperatively.
c. The absence of the copolymer at both 8 months and 11¼ years postoperatively which subsequently indicated absorption and replacement by bone.
d. The presence of the copolymer surrounded by connective tissue 8 months and 11¼ years postoperatively.

8. Based on the histology of the copolymer when placed in the extraction socket adjacent to the bony walls, it could be determined that the alloplast is:
a. Osteoinductive.
b. A growth factor.
c. Osteoconductive.
d. A nonreactive filler material.

9. The copolymer has the following property:
a. A positive surface charge of +10 mV.
b. A negative surface charge of -50 mV.
c. Osseoconductive in animal studies only.
d. Calcium hydroxide/carbonate surface layer.

10. The placement of an implant in ridge defects treated with the calcified copolymer was shown in this study to result in:
a. Well-integrated implants that show bone level stability 6 years postloading.
b. Initially integrated implants that lose 20% of bone support by 6 years postloading.
c. Poorly integrated implants with a risk of surrounding bone porosities as the copolymer absorbs.
d. Well-integrated implants which may be more susceptible to peri-implantitis with a risk of surrounding bone porosities as the copolymer absorbs.

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