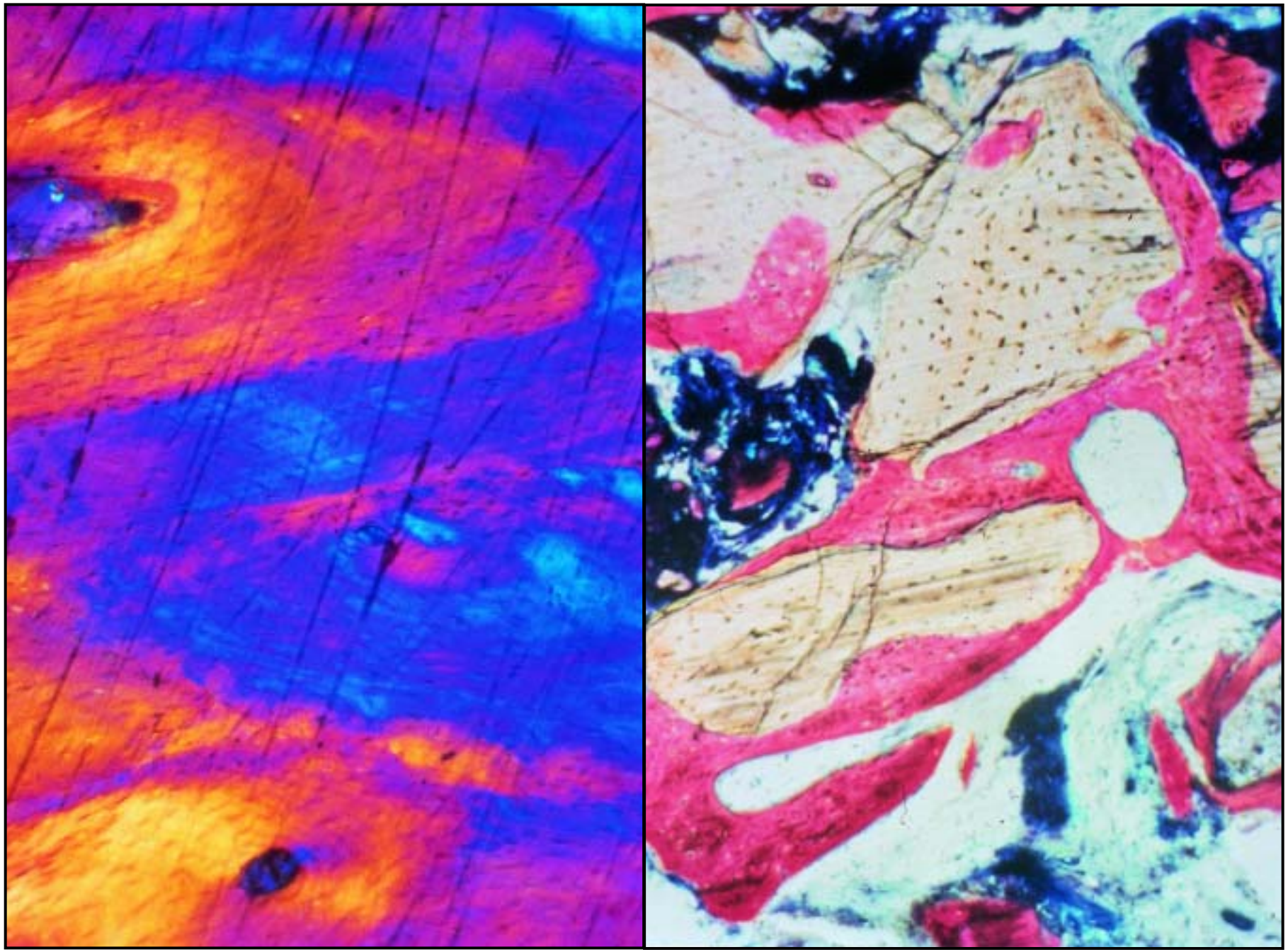

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A Clinical and Histologic Evaluation of a Block Onlay Graft in Conjunction with Autogenous Particulate and Inorganic Bovine Mineral (Bio-Oss): A Case Report

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This article describes a clinical case report in which an autogenous intraorally harvested block graft was used in combination with particulate autogenous and inorganic bovine mineral for localized alveolar ridge augmentation. No barrier was used above the graft material. Clinical evaluation revealed excellent integration of the graft material to the recipient site, while histologic analysis indicated that the block graft was vital and undergoing an active remodeling process. Excellent integration of the inorganic bovine mineral with the newly formed bone was also observed, suggesting that this material can be used as a filler for onlay grafting procedures. (Int J Periodontics Restorative Dent 2002;22:567–573.)

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After dental implants were accepted as a valid treatment modality for the completely[1,2] or partially[3,4] edentulous patient, a variety of bone grafting techniques have been proposed to place implants in patients lacking adequate bone volume. Even though the use of xenografts,[5–8] alloplastic bone grafts,[9,10] and allografts[11,12] has provided positive results, the use of autogenous bone grafts represents the gold standard for onlay bone grafting procedures. Autogenous bone grafts can be harvested extraorally[13–16] or intraorally[17–22] and can be used in the form of a block that is secured at the recipient site with fixation screws[17–20] or dental implants,[13–16] or in particulate form in which a membrane barrier[18,21,22] is typically used to secure the graft particles in place.

The purpose of the current case report is to provide clinical and histologic results of a case in which an intraorally harvested intramembraneous block graft was used for localized alveolar ridge augmentation in conjunction with an autogenous cancellous bone graft and inorganic bovine mineral.

Fig 1 *Initial panoramic radiograph shows inadequate bone height for the placement of root-form implants in the area of the maxillary right first molar to first premolar.*

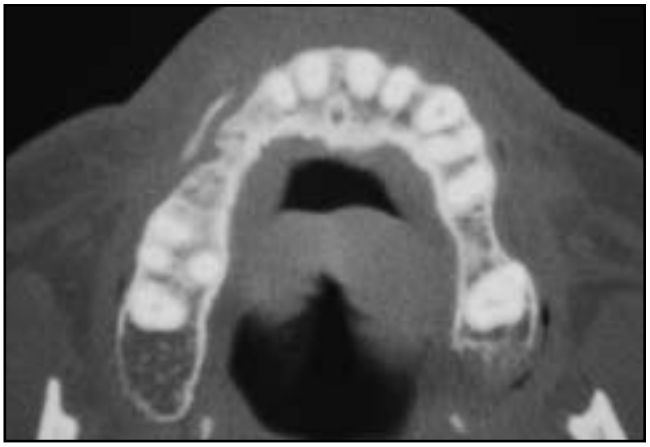

Fig 2 *Computerized tomography demonstrates inadequate bone width in the area of the maxillary right premolars.*

Case report

Clinical report

A 67-year-old man presented at the Center for Prosthodontics and Implant Dentistry at Loma Linda University seeking treatment for his partial edentulism in the area of the maxillary right first molar to first premolar (Fig 1). Clinical and radiographic examination revealed inadequate bone height and width for the placement of root-form implants (Fig 2). After discussing the various treatment options, the decision was made to proceed with an inlay/onlay bone graft in the edentulous area and place three root-form implants.

For the inlay bone graft, the Schneiderian membrane was elevated after full-thickness buccal flap reflection and after performing a circular osteotomy with a round bur (Fig 3).[23,24] Inorganic bovine mineral (Bio-Oss, Osteohealth) was placed into the sinus (Fig 4).[25,26]

For the onlay bone graft, an autogenous block graft was harvested from the right ascending ramus area according to the technique described elsewhere (Fig 5).[19] Briefly, the incision followed the direction of the ramus, and a vertical releasing incision was placed distal to the area of the mandibular right third molar. Full-thickness buccolingual flaps were reflected. Under copious irrigation and by using a fissure bur, a block graft was harvested. Additional bone marrow in particulate form was harvested from the donor site with a curette; a collagen hemostatic agent was placed (Avitene, Alcon Pharmaceuticals), and the area was sutured.

The autogenous block graft was secured at the recipient site with a fixation screw (Osteotram, Osteomed) (Fig 6). Autogenous particulate bone graft was then mixed in a 50%:50% ratio with inorganic bovine mineral and placed around the block graft (Fig 7). The buccopalatal flaps were then sutured after performing periosteal releasing incisions to facilitate primary closure.[27,28]

The implant placement was performed 1 year after the bone grafting procedure. The fixation screw was removed, and three hydroxyapatite-coated root-form implants were placed (Steri-Oss, Nobel Biocare) (Figs 8 to 10). By using two 2-mm-internal-diameter trephine burs, two biopsies were taken from the grafted area. One biopsy was taken from the autogenous block graft, and the other was taken from the area of the onlay graft, where particulate graft had been used around the block. The patient signed an appropriate informed consent form approved by the Institutional Review Board at Loma Linda University to provide permission for the biopsies.

The second-stage surgery (uncovering) was performed 8 months after implant placement. All three implants appeared

Fig 3 *After performing a circular osteotomy, the Schneiderian membrane is elevated.*

Fig 4 *Bio-Oss is placed as an inlay bone graft.*

Fig 5 *Ascending ramus is used as the donor site for the autogenous bone graft.*

Fig 6 *Block graft is secured with a fixation screw at the recipient site.*

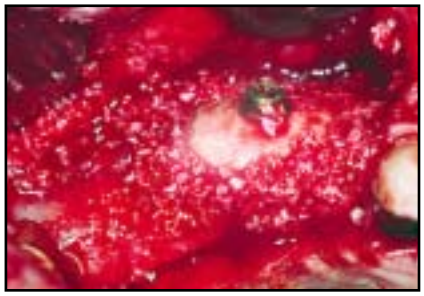

Fig 7 *Particulate bone graft is placed around the block. The particulate consists of a mixture of autogenous cancellous bone graft and Bio-Oss.*

Fig 8 *During the reentry surgery for the placement of the implants, excellent incorporation of the bone graft is identified.*

Fig 9 *Three hydroxyapatite-coated root-form implants are placed.*

Fig 10 *Postoperative panoramic radiograph.*

osseointegrated. The implants were loaded with a temporary implant-supported screw-retained fixed partial denture. Postoperative periapical radiographs were taken at 3-month intervals after loading the implants.

Histologic processing

The histologic processing and analysis was performed by the Hard Tissue Research Laboratory, University of Oklahoma. The specimens were fixed in 10% buffered formalin, dehydrated in alcohol, and embedded in specialized resin (Technovit 7200 VLC, Heraeus Kulzer). Initial midaxial sections of 200 µm were made by means of a cutting-grinding system (Exakt Medical Instruments). The sections were then ground to 40 to 50 µm and stained with Stevenel's blue and Van Gieson's picric fuchsin for light microscopy.[29,30]

Results

Clinical findings

The healing of both the grafting procedure and implant surgery was uncomplicated. During implant surgery, the grafted maxillary area appeared to have a type II bone quality.[31] The autogenous block graft was in tight contact with the recipient buccal plate. The particulate bone graft had a firm consistency. The Bio-Oss particles appeared to be incorporated within the newly formed alveolar ridge. Primary stability of the implants was achieved. No radiographic bone loss or clinical sign of pathosis had been noted 8 months after the implants had been loaded.

Histologic findings

The specimen harvested from the block graft represented very dense cortical bone (Fig 11). Different stain qualities were observed within the block graft (Fig 12). An area of dark red staining around a marrow space indicated new bone formation (modeling). The different shades of red/pink indicated bone of different ages, emphasizing the remodeling pattern of the block graft and providing evidence that the autogenous block graft was possibly vital when the biopsy was harvested. Interestingly, no soft tissue appeared to invade the graft area, despite the fact that no membrane barrier had been used. Evaluation of the specimen under polarized microscopy (Fig 13) emphasized the active remodeling status of the block graft.

The histologic specimen harvested from the area corresponding to the particulate bone graft demonstrated excellent incorporation of the Bio-Oss particles to the surrounding bone (Figs 14 to 16). The Bio-Oss particles appeared to be in tight contact with the surrounding bone along the majority of their external surfaces (Figs 14 and 15). Some particles appeared to be totally surrounded ("amalgamated") by bone (Fig 15). In some instances, newly formed bone was observed within the Haversian canals of the Bio-Oss particles.

Discussion

The significance of the current case report is that it provides histologic evidence that autogenous intramembraneous block grafts may have the potential to maintain their vitality and be in an active remodeling state. Cortical bone autografts are subject to slow revascularization, and most of the interior of such grafts is never revascularized.[32] A histologic analysis of autogenous block grafts harvested from the iliac crest demonstrated the presence of devitalized bone tissue within the bone graft area.[33] However, in these studies, extraorally harvested autogenous bone grafts had been used. Several authors[34–38] have shown that extraorally harvested endochondral bone grafts have a slower remodeling process compared to intraorally harvested intramembraneous bone

Fig 11 *Histologic overview of the autogenous bone block (original magnification × 4).* **[AU: Please list stain(s) used in Figs 11, 12, and to 14 to 16. (Stevenel's blue –Van Gieson's picric fuchsin?)]**

Fig 12 *At higher magnification, the staining quality of the autogenous bone block shows that this is very mature, remodeled bone. Each slightly different shade of red/pink indicates bone of a different age (original magnification × 10).*

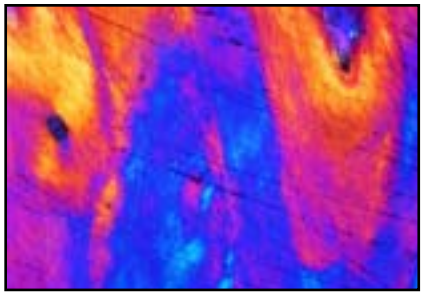

Fig 13 *Same area shown in Fig 12. Under polarized microscopy, the different remodeling patterns of the bone are emphasized (original magnification × 10).*

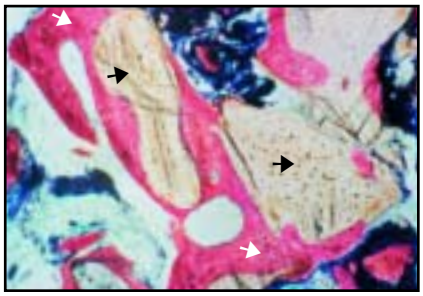

Fig 14 *Biopsy harvested from the area where particulate bone graft had been used demonstrates excellent incorporation of the Bio-Oss particles* (black arrows) *with the surrounding bone* (white arrows) *(original magnification × 10).*

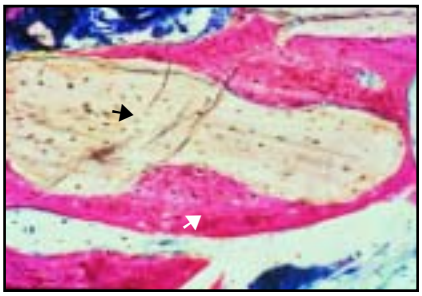

Fig 15 *Bio-Oss particles* (black arrow) *appear to be in tight contact with bone* (white arrow) *along the majority of their perimeter; some particles appear to be amalgamated into the newly formed bone (original magnification × 20).*

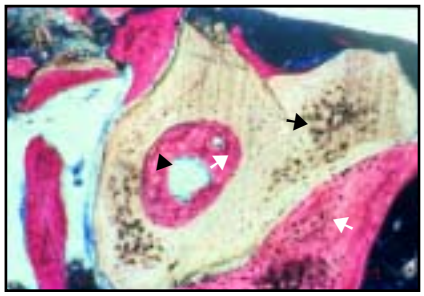

Fig 16 *New bone formation* (white arrows) *is observed within the Haversian canal* (black arrowhead) *of the Bio-Oss* (black arrow). *An intimate contact of the bone with the Bio-Oss particle is observed (original magnification × 10).*

grafts because of their embryogenic origin. Kusiak et al[36] demonstrated complete vascularity in an intramembraneous bone graft 14 days after the bone grafting procedure, while endochondral bone grafts had minimal vascular ingrowth. Similarly, others[38] found early vascular ingrowth in intramembraneous bone grafts.

An animal study demonstrated the potential of block autografts harvested from the mandible to maintain their vitality when the recipient site receives proper preparation (decortication or perforations).[39] However, histologic evidence in humans regarding the vitality of intramembraneous block autografts is minimal. Urbani et al[20] demonstrated signs of vitality in humans on autogenous block grafts.

In the current case, no barrier was used above the graft material. Nonresorbable membranes[18,21,22] are the most commonly used barriers. However, no study has evaluated the necessity of those barriers; their mechanical rigidity may protect the graft material from mechanical external forces. The current case provided histologic evidence that bone augmentation can be achieved without using any barrier. It can be hypothesized that the block graft provided the necessary mechanical support to the surrounding particulate graft material. Nonresorbable membranes have been associated with the presence of a thick layer of connective tissue above the regenerated bone.[21,22,40,41] In addition, infection occurs if the membranes

become exposed, compromising the final result of the bone grafting procedure.[18,21,22] Raghoebar et al[42] reported that the use of membrane barriers is not necessary when mandibular bone grafts are applied because they exhibit minimal resorption[34,35,37] and a high rate of remodeling.[32,36–38] A feasibility study is needed to assess the need for a membrane barrier in localized alveolar augmentation procedures and to confirm the histologic findings of the current case report.

Inorganic bovine mineral (Bio-Oss) was used in the current case. The use of Bio-Oss for sinus grafts has been well-documented,[25,26,43,44] while little is known about the potential of this graft material as an onlay bone graft. Some animal studies[5,7] and human case reports[6,8] have shown results similar to the current case report, in which newly formed bone appeared in tight contact with the residual Bio-Oss particles. Jensen et al[43] described the "seeding phenomenon" for Bio-Oss as an onlay graft, in which the particles serve as a scaffold for new bone formation. On the other hand, other animal studies[45] and clinical case reports[46] have failed to demonstrate any bone formation when Bio-Oss is used as an onlay bone graft. These studies supported the hypothesis that bone regeneration around Bio-Oss particles occurs when autogenous particulate bone graft that will provide the necessary induction for new bone formation is added. Further research is needed to assess the potential of Bio-Oss as an onlay bone graft material.

This case report provides histologic evidence of the potential of intraorally harvested cortical autogenous block grafts to maintain their vitality and attain a remodeling state after fixation at the recipient site. It also provides histologic evidence of new bone formation around Bio-Oss particles mixed with particulate autograft when no membrane barrier is used. A clinical study is needed to confirm the suggestions provided by the findings of this case report.

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