Alveolar Ridge Preservation with Beta-Tricalcium Phosphate Bone Graft and Implant Placement: A Case Report

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Various bone grafts, non-vital bone grafting materials, and membranes have been developed to counteract the significant resorption of the alveolar bone following tooth extraction with utilizing principals of guided bone regeneration (GBR). Alloplastic graft material, consisting of the pure phase of beta-tricalcium phosphate (β-TCP) in the preservation of ridge volume after tooth extraction and before dental implant placement, is a well-accepted procedure. In the present case report, β-TCP bone graft was used to preserve and augment the alveolar bone with utilizing the principles of GBR. Quantification of alveolar bone dimensions was done with the help of computed tomography scan of jaw both at baseline, i.e. before extraction and after 6 months just before implant placement.

Keywords: Alveolar ridge, Beta-tricalcium phosphate, Computed tomography scan, Guided bone regeneration

INTRODUCTION

Dental implants for single or multiple tooth replacements are now seen as a viable prosthodontic alternative to conventional removable and fixed partial dentures. However, every patient is not a good candidate for the implant treatment, especially patients with deficient alveolar ridge height or/and width at the treatment site. This alveolar ridge volume discrepancy appears due to progressive resorption of the residual alveolar bone with loss of 0.34-7.7 mm of ridge width and 0.2-3.25 mm of vertical height occurring in the 6-12 months period following extraction.¹ Recent studies have shown that tooth extraction done without alveolar ridge preservation makes implant treatment more challenging with compromised esthetics and overall treatment prognosis.²⁴

The aim of alveolar ridge preservation at the time of extraction is to minimize the alveolar ridge resorption, prevent crestal bone dehiscence and to facilitate placement of an implant with sufficient dimensions. Guided bone regeneration (GBR) procedure with the use of barrier membrane combined with various bone grafts, provides opportunity to place implant successfully at the site, where bone dehiscence have occurred either by periodontal disease or at the time of implant placement.⁵ Various alloplastic materials have been used successfully for the GBR procedures in the past which includes the use of hydroxyapatite, beta-tricalcium phosphate (β-TCP) bone grafts.⁶⁷ Resorbable and non-resorbable barrier membranes used during socket augmentation procedures not only physically protect the graft materials, but also stabilizes the wound.⁸⁴ Because of the disadvantage of the non-resorbable membrane for its retrieval and membrane exposure complication, resorbable membranes are commonly used.¹⁰

In this present case report, preservation of the residual alveolar ridge dimensions were carried out with the use of β-TCP graft at the time of extraction followed by implant placement after 6 months.

CASE REPORT

A 55-year-old female patient reported to with a chief complaint of the mobile tooth in relation to right lower back tooth region since 1 year and pain associated with the same. Patient gave a history of root canal treatment in the same tooth 3 year back. On clinical examination, revealed grossly decayed Grade II
mobile 46 with deep periodontal pocket at distobuccal region of the tooth. Radiographic examination showed diffuse periodontal radiolucency in relation to 46 (Figure 1a and b). After thorough investigation, implant-retained restoration was planned. Treatment was planned in which extraction of 46 was done with minimal trauma followed by socket preservation procedure with β-TCP bone graft along and resorbable barrier membrane. After completion of Phase I therapy, the patient was re-evaluated for plaque control after 1 week, informed consent was obtained and patient taken for computed tomography (CT) scan.

**Surgical Procedure**
Extraoral preparation was carried out with povidone-iodine solution. Patient was asked to rinse with 0.12% chlorhexidine gluconate solution for 2 min. After the administration of local anesthesia, on buccal aspect, crevicular incision extending up to the mesial, and distal aspect of two adjacent teeth was given. The vertical releasing incision made at the mesiobuccal and distobuccal line angle to raise a full thickness mucoperiosteal flap exposing the crestal bone on buccal aspect. Atraumatic extraction of tooth 46 was done with the help of periotome and elevators. After the extraction, surgical curette was used to debride the socket thoroughly to the removal of soft tissue fragments and infected granulation tissue. β-TCP graft was supplied in the form of syringe which facilitated mixing of β-TCP granules with fresh blood by aspirating fresh blood oozing from the socket. This makes particles cohesive and was placed easily inside the socket in increments up to the level of the alveolar crest (Figure 2a and b). A resorbable collagen membrane (BioMesh-S, SAMYANG, Korea) was used as GBR membrane was used to act as a buccal wall and to support the graft material. The flap was coronally advanced, and direct loop interrupted sutures, given using 4-0 vicryl suture material to provide healing by primary intention. To reduce post-operative pain and infections, systemic antibiotic, and analgesic were prescribed which included capsule amoxicillin 500 mg TID for 5 days and tablet aceclofenac 100 mg BD for 5 days and 0.12% chlorhexidine gluconate mouth rinse for 2 weeks. One week recall showed uneventful healing in the operated area. Coe pack and sutures removed at 14th post-operative day and patient kept on the maintenance phase and another CT scan of jaw was done at 6 months post treatment for comparison of alveolar bone dimensions and implant size measurement. Radiographically, the alveolar socket appeared to be filled with uniform radiodense bone (Figure 3a and b).

**Ridge-Mapping Parameters**
Ridge dimensional analyses were performed on the CT scan images:
1. Buccal and lingual cortical bone height: With the help of inbuilt software, virtual three-dimensional image of the jaw bone was constructed and in the coronal view, vertical height of buccal and lingual socket wall. As cementoenamel junction (CEJ) taken as a reference point, a horizontal line (X1) was drawn from CEJ to CEJ of the adjacent teeth. From the most apical position of cortical bone, a line (Y1) was drawn coronally toward the horizontal reference line (X1). To make this measurement repeatable in the second CT scan a second horizontal line (X2) was drawn from either of reference points up to the meeting point of X1 and Y1 (Figure 4).
2. Buccolingual width of alveolar bone: It was measured at mid crest region in an axial view at crest of the ridge (0), 1 and 5 mm apical to the crest recorded to the nearest millimeter (Figure 5).

**CT Observations**
I. Vertical bone height in mm (Table 1 and Figure 6)
II. Buccolingual bone width in mm (Table 2 and Figure 7).

**Implant Placement**
At 6 months, the patient returned for implant placement. Radiographic examination showed adequate bone height in relation to 46 (Figure 3b). After administering local anesthesia to block inferior alveolar nerve, a mid-crestal incision was given to elevate full thickness mucoperiosteal
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**DISCUSSION**

Dental implants for single-tooth replacements have evolved into a viable prosthodontic alternative to conventional fixed bridgework, resin bonded restorations or removable partial dentures. Studies have shown long-term successful osseointegrated implant with the satisfactory esthetic outcome can be achieved when applied with alveolar ridge preservation after extraction.\(^1\)\(^,\)\(^2\)\(^,\)\(^3\) Whereas, studies conducted in the past by various authors have also shown that the socket without graft has significant resorption rate in both vertical as well as buccolingual dimensions.\(^1\)\(^,\)\(^2\)\(^,\)\(^3\) In the present case, due to the dehiscence of the buccal cortical bone, there

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**Table 1:** Vertical bone height (mm) (Figure 6)

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<th>Lingual (mm)</th>
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<td>Post</td>
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**Table 2:** Buccolingual bone width (mm) (Figure 7)

<table>
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<tr>
<th></th>
<th>At 0 mm</th>
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**Figure 4:** Buccal and lingual cortical bone height

**Figure 5:** Bucco-lingual bone width, (a) pre-operative, (b) post-operative

**Figure 6:** Vertical bone height pre-operative (a-buccal, b-lingual) and post-operative (c-buccal, d-lingual)

**Figure 7:** Bucco-lingual bone width, (a) pre-operative, (b) post-operative

**Figure 8:** Implant placement (a) crestal incision, (b and c) during procedure, and (d) postoperative intraoral periapical
would have been a collapse of the soft tissue which was prevented by the use of pure phase of β-TCP and resorbable collagen membrane. 6 months result showed alveolar ridge preservation to nearly original dimensions. The present study is in accordance with study conducted recently using β-TCP (RTR cone, septodont) where only slight horizontal bone resorption was seen with no change in the vertical dimension of the alveolar ridge.14

β-TCP bone graft is a synthetic alloplastic material, has been successfully used with satisfactory clinical and histological results in both animal models and human trials. β-TCP is a resorbable osteoconductive material, which is expected to be resorbed within 3-6 months after placement and will be replaced by newly mineralized bone tissue without fibrous tissue proliferation.15 Biodegradation of β-TCP particles occurs by chemical dissolution by tissue fluids and also by osteoclast cells.16 In the present study, a solid new bone was present with only some amount of loose β-TCP particles at a crestal level, which facilitated adequate size of implant.

Ridge preservation using the GBR technique has been shown to improve ridge height and width dimensions when compared to tooth extraction without graft.16 The membrane maintains the stability of the wound, and prevents epithelium and non-bone-forming connective tissue from invading the extraction socket. The membrane enables osteoblast to migrate inside the alveolus and produce new bone.16 Increased bone volume will facilitate placement of adequate implant with successful long-term outcome.

CONCLUSION

The present case report showed that β-TCP bone graft is effective material in alveolar ridge preservation technique. Formation of new bone of acceptable quantity permitted the placement of an osseointegrated dental implant with superior esthetic results, which was confirmed clinically and radiographically with CT scan. Adequate volume of alveolar bone facilitated the placement of desired dimensions of the implant with better treatment prognosis.

REFERENCES


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