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Case Reports

HYDROXYAPATITE AND BETA-TRICALCIUM PHOSPHATE IN THE SOCKET PRESERVATION: PRESENTATION OF CLINICAL CASES

M. Di Girolamo[1], D. Mazza[2], S. Volpe[3], G. Stelitano[3], L. Volpe[4], F. Cecchetti[2]

[1]Department of Biomedicine and Prevention, University of Rome "Tor Vergata", Rome, Italy;
[2]Department of Social Dentistry and Gnathological Rehabilitation University of Rome "Tor Vergata", Rome, Italy;
[3]Private Practice, Roma;
[4]Universidad Europea de Valencia Grado en Odontologia, Valencia, Spain

Correspondence to:
Michele Di Girolamo, DDS
Department of Clinical Sciences and Translational Medicine,
University of Rome "Tor Vergata",
Rome, Italy
e-mail: micheledigirolamo@tiscalinet.it

ABSTRACT

The reduction in alveolar bone volume is a direct consequence of tooth loss. Hard and soft tissue remodelling is part of the normal physiological healing process of the residual edentulous ridge. This remodelling negatively affects the size of the ridge in the buccolingual and apicocoronal aspects. Ridge atrophy after tooth loss has been show to follow specific patterns. In the Maxilla, the alveolar buccal wall tends to reabsorb more rapidly after tooth extraction. The ridge is gradually represented by the palatal wall (centripetal resorption). The purpose of this article is to describe two clinical cases of preservation of the alveolar ridge with the use of a biomaterial and a membrane.

KEYWORDS: *bone, alveolus, ridge, tooth, regeneration*

INTRODUCTION

In a 12-month prospective study, Schropp et al. (1) analyzed 46 premolars and molars extraction sockets from 46 patients and found a 50% ridge loss with an average horizontal loss of 6.1 mm. Two-thirds of this loss of bone volume occurs within the first 3 months. This bone remodelling process may vary according to individual local and systemic factors, but it mainly affects the horizontal bucco-coronal thickness in the anterior sites (2-4). Su et al. observed an average loss of 3.87 mm in ridge width and 1.67 mm in ridge height in the anterior and premolar sites during the first three months after extraction

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(5). The ridge is gradually represented by the palatal wall (centripetal resorption), compromising the sagittal and axial intermaxillary relationship (6-8). This phenomenon appears progressive and often translates into aesthetic and functional challenges during rehabilitation with dental implants.

To minimize the need for bone regeneration during implant placement "Alveolar Socket Preservation" (ASP), has been described in recent decades. This technique was born as a procedure aimed at preventing, or more appropriately limiting, the alteration of the post-extraction bone crest to have an optimal implant-prosthetic rehabilitation. The different alveolar preservation techniques proposed in the literature involve biomaterials, bone grafts, their combination, and barrier membranes (9, 10). The biomaterial used to fill the alveolus should ideally inhibit the growth within the alveolus of the epithelial and connective tissue, stabilize the clot and limit bacterial contamination (11).

In addition to resorbable and non-resorbable membranes, various biomaterials used for soft tissue augmentation, such as autogenous free gingival grafts, dermal allografts and collagen matrix xenografts, were also used to seal the alveolus (12). The purpose of this article is to describe two clinical cases of preservation of the alveolar ridge with the use of a biomaterial and a membrane.

Clinical cases presentation

Both patients underwent a medical history and control of any active pathological process. All therapeutic options were examined with patients, and socket preservation and subsequent implant prosthetic rehabilitation were chosen. Considering the risks and benefits of the proposed procedure, the signature of informed consent was obtained.

Case 1:

A 69-year-old patient complained of pain and mobility of 1.4. Intraoral physical examination revealed grade 2 dental mobility, associated with mesial and distal periodontal probing of about 7 mm with bleeding. The periapical X-ray confirmed the bone loss, which would not have allowed us an immediate post-extraction implantology (Fig. 1).

Under local anaesthesia (Mepivacaine 2% Sain-Maurdes-Fosses, France), the dental element was extracted, and the post-extraction alveolus was thoroughly cleaned and irrigated with a saline solution. The walls of the alveolus were examined to determine the morphology of the defect and the presence of the vestibular bone wall.

The alveolus was filled with biomaterial (Rigenera Biotek S.R.L. Pavolaro di Dueville, Vicenza, Italy) composed of 30% of Slow Resorption Hydroxyapatite (HA) and 70% of Rapidly Resorption Beta-Tricalcium phosphate. To cover the

Fig. 1. *Case 1. Pre-operative X-ray.*

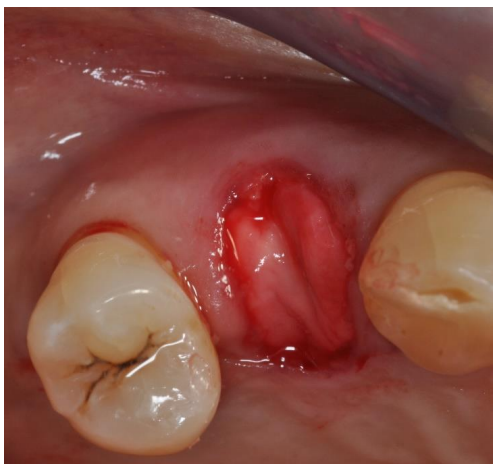

Fig. 2. *Case 1. An occlusal vision of the exposed membrane to obtain second-intention healing.*

Fig. 3. *Case 1. Radiographic control of regeneration.*

biomaterial was inserted a resorbable membrane (Evolution Fine Tecnoss®, Giaveno, Italy) intentionally left exposed according to the socket Preservation technique. (Fig. 2). After 5 months of healing, clinically good preservation was evident. A control intraoral X-ray was performed (Fig. 3), and implant insertion was scheduled.

At the lifting of the flap, we noticed good preservation of the alveolus that allowed us to insert the implant 12 mm 3.75 Ø (Safe BT Biotec srl Povolaro di Dueville (VI) Italy) (Fig. 4, 5). Antibiotics (Amoxicillin 1 gr) were prescribed for 7 days. The patient underwent monthly check-ups to follow the recovery. After 4 months of osseointegration, a full-thickness flap was lifted, and the healing screw was placed (Fig. 6). Subsequently, prosthetic rehabilitation was carried out (Fig.7-9).

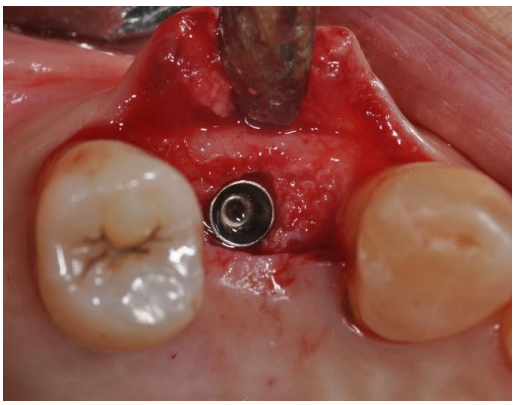

Fig. 4. *Case 1. Occlusal vision at the insertion of the implant (note the excellent preservation of the bone crest)*

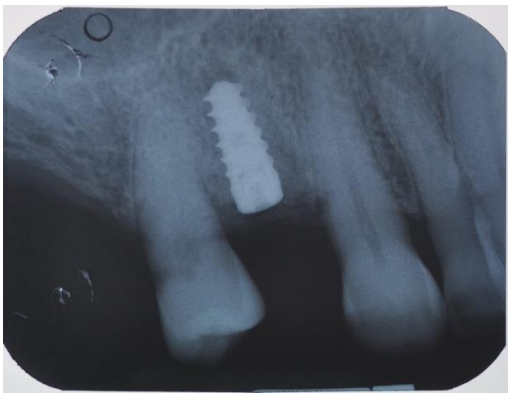

Fig. 5. *Case 1. Control X-ray at 4 months.*

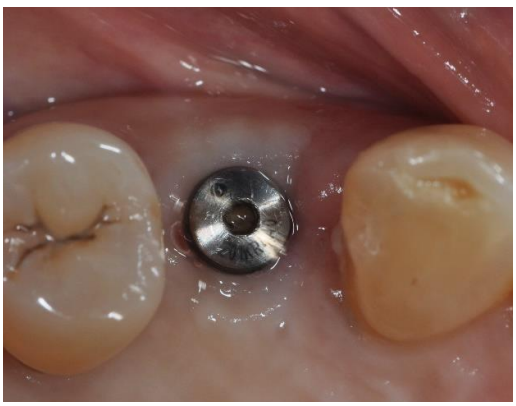

Fig. 6. *Case 1. Insertion of the healing screw (we note how the vestibular draft has been maintained).*

Fig. 7. *Case 1. Prosthetic rehabilitation.*

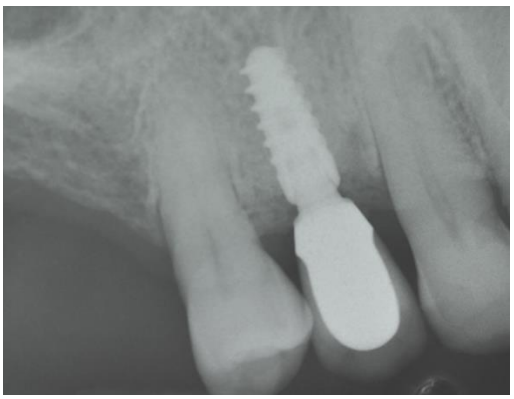

Fig. 8. *Case 1. X-ray post-rehabilitation control.*

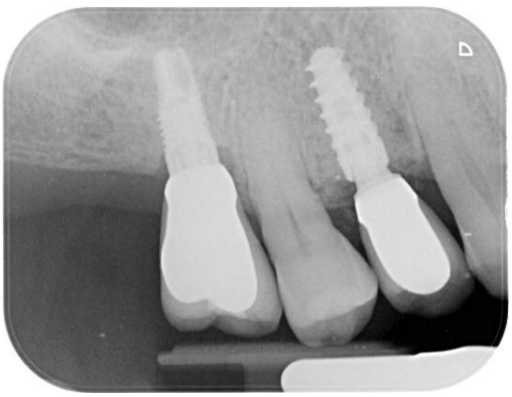

Fig. 9. *Case 1. X-ray follow-up of 2 years.*

Case 2

A 78-year-old man presented to our observation with a vestibular fistulized periodontal abscess of element 2.1 (Fig. 10). Periodontal probing and radiographic examination revealed mesial vertical bone resorption and the lack of part of the vestibular cortex of 2.1 (Fig. 11). With the patient's consent, it was decided to extract the dental element and carry out a subsequent implant-prosthetic rehabilitation.

As in the previous case, at the same time as the dental extraction, a reconstruction of the bone volume was carried out with a biomaterial (Rigenera Biotek S.R.L. Pavolaro di Dueville, Vicenza, Italy) and a resorbable membrane (Evolution Fine Tecnoss®, Giaveno, Italy) was inserted to cover the biomaterial. Due to the lack of much of the buccal plate, evidenced by the probing, a full-thickness pocket was prepared using a sharp blade and a microsurgical elevator. Subsequently, the membrane was shaped according to the "ice cream cone" technique (10) and partially inserted inside the pocket created previously (Fig. 12).

No primary healing intention was sought since the soft tissues would have migrated in the initial healing phase, creating a greater amount of keratinized gingiva. After 5 months, at the time of insertion of a 10 mm 3.75 Ø implant (Safe BT Biotec srl Povolaro di Dueville, Vicenza, Italy), the mucosa and the underlying bone were well represented. (Fig. 13-17). After osseointegration, at 4 months of healing, the prosthetic rehabilitation was carried out (Fig. 18-20).

Fig. 10. *Case 2. Pre-operative image shows a buccal fistula of 2.1.*

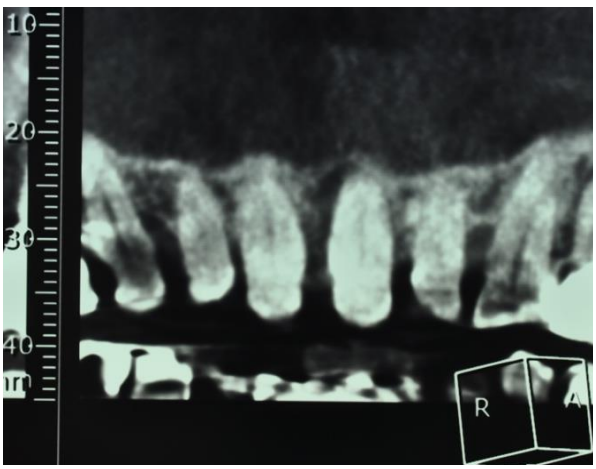

Fig. 11. *Case 2. Pre-operative CBCT shows bone loss mesially at 2.1 due to periodontal abscess.*

Fig. 12. *Case 2. Surgery-curettage of the alveolus and bone reconstruction.*

Fig. 13. *Case 2. Healing after one week.*

Fig. 14. *Case 2. Healing after 2 weeks, the almost complete mucosal closure and the absence of inflammation are evident.*

Fig. 15. *Case 2. The appearance of the completely healed ridge.*

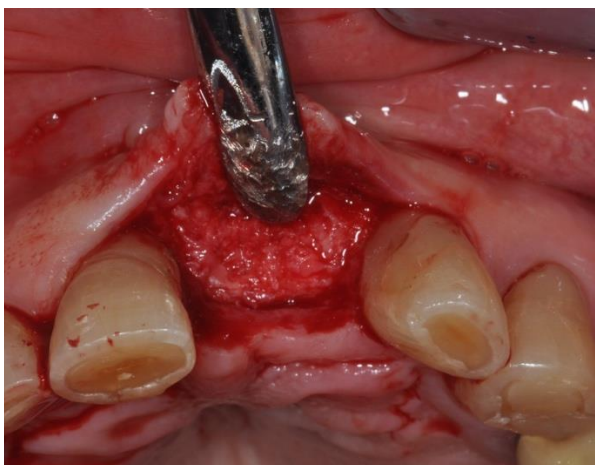

Fig. 16. *Case 2. When the flap is opened, excellent bone regeneration is evident which allowed us to insert an implant in the correct three-dimensional position.*

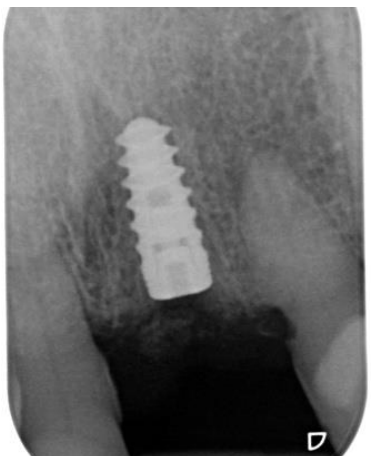

Fig. 17. *Case 2. Post-operative X-ray.*

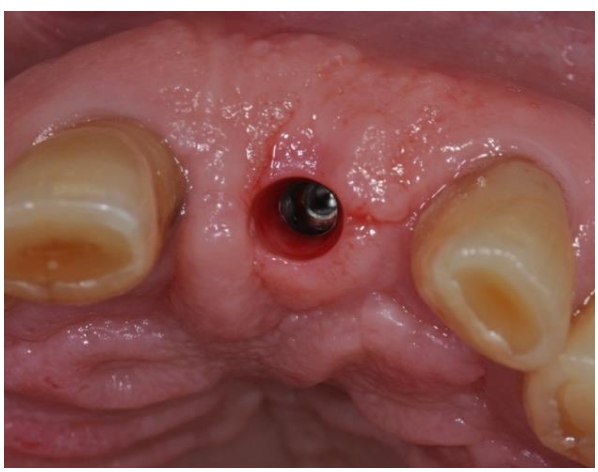

Fig. 18. *Case 2. Detail of the buccal plate and implant position.*

Fig. 19. *Case 2. Prosthetic rehabilitation.*

DISCUSSION

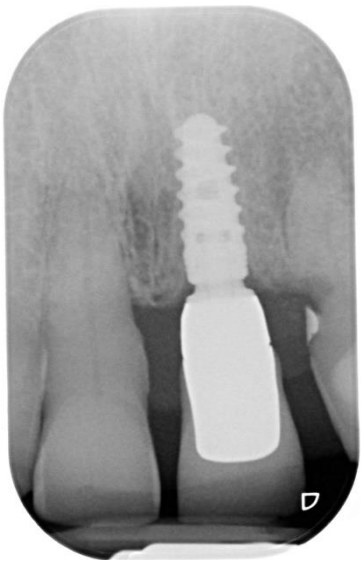

Fig. 20. *Case 2. Final X-ray.*

The alveolus is an anatomical entity linked to the presence of the tooth in the arch. After a dental extraction, physiological healing is followed by a three-dimensional reduction of the alveolar volume (13). The tooth and its attachment apparatus, the root cement, the periodontal ligament, and the alveolar bone establish a functional unit.

The forces developed during the masticatory activity are transmitted from the tooth crown, through the root and attachment apparatus, to the hard tissues of the alveolar process, where they will be dispersed. This alveolar atrophy is the consequence of the teeth loss and the change in conditions inside or around the alveolus, and it will result in a series of adaptive alterations of the edentulous portion of the alveolar ridge.

One research article points out that the cause of the greater degree of reabsorption of the vestibular side is to be connected to the anatomy typical of the alveolar process: the buccal cortex, in fact, essentially consists of fasciculate bone, while the lingual one has a smaller fraction of it (14). The presence of vestibular tissue is functionally related to the dental element itself, and it gradually disappears after extraction leading to the reduction of the vertical and horizontal dimensions of the alveolar ridge. The purpose of socket preservation is to maintain the original alveolar dimensional contours, limiting the natural process of post-extraction resorption. A multicenter study underlined the importance and advantages of the socket preservation technique after tooth extraction of the anterior upper arch (15). These areas frequently have a thin vestibular bone plate, with a small amount of bundle bone that is inevitably lost during tooth extraction resulting in an early collapse of the labial plate and consequent imperfection (16, 17).

In the past years and still today, socket preservation has been the object of multiple studies with the use of different alveolar filling materials. These fall into one of four categories: autogenous bone grafts, allogeneic bone grafts, xenogenic bone grafts and alloplasts. Depending on which of these is used, the process can be osteoconductive, osteopromotor or osteoinductive (18, 19). Among the bone grafts used for alveolar preservation, biomaterials of synthesis present a growing diffusion in dental surgery thanks to their excellent bio-compatibility and the ability to act as a scaffold, stabilizing the clot in the different stages of healing.

Hydroxyapatite is one of the most commonly used biomaterials in bone regeneration techniques. Some authors underlined that hydroxyapatite synthesized in nanomolecular form, with dimensional characteristics similar to the molecules deposited by human osteoblasts, has better bone resorption and better bone new formation than traditional biomaterials (20). Furthermore, if these hydroxyapatite nano molecules are combined with rapidly resorbing substances, better results are obtained in terms of resorption of the nanohydroxyapatite, leaving space for bone regeneration (21, 22).

The material used as a filler in the two clinical cases is Rigenera BCP in 0.25-1.00 mm granules (Biotec S.R.L. Povaloro di Dueville, Vicenza, Italy) composed of 30% slow resorption hydroxyapatite and 70% Beta-tricalcium rapid resorption phosphate. The nanostructured surface promotes blood absorption by entering the granules of proteins and growth factors and promotes cell differentiation (23).

In another study (24), histological examinations were performed 6 months after surgery on bone samples in regenerated sites with materials based on hydroxyapatite, an amount of newly formed bone of 41% indicated a residual biomaterial quantity of 27% and a presence of medullary spaces of about 30%.

A fundamental role is played by the membranes that cover the grafted material. In the last decade, non-absorbable membranes, resorbable membranes, collagen sponges and non-cross-linked xenogenic collagen matrices have been used. The resorbable and non-absorbable membranes can be totally covered with a coronally advanced flap to obtain the primary closure following the biological principles of guided bone regeneration. However, this procedure inevitably changes the gingival architecture and location of the mucogingival junction. To avoid this, today, we tend to use crosslinked collagen membranes with different periods of resorption that can be intentionally left exposed to provide a transient barrier function (25). Histological studies of non-cross-linked collagen matrices in non-submerged or submerged environments revealed

complete integration with mature mucosal and submucosal tissues and membrane revascularization after 3 months (26).

The membrane used (Evolution Fine, Tecnoss®, Giaveno, Italy) is obtained from heterologous mesenchymal tissue and is completely resorbable. Experimental studies have shown histological evidence of the prolonged barrier effect of this membrane, which lasts at least eight weeks, protecting the graft from external agents (27).

The possible beneficial effect on the amount of bone resorption that occurs after tooth extraction with flap or flapless is controversial. Although some studies have shown slightly less pronounced bone remodelling of the alveolar crest after flapless extraction (28), other studies have failed to find significant differences between the flap and flapless tooth extractions (29).

Although it is suggested that wound dehiscence and membrane exposure may cause infection and lack of bone formation, recent studies show that intentional exposure to bioresorbable barriers does not adversely affect alveolar preservation procedures (30, 31).

A study in 2016 showed that the dense collagen matrix Evolution protects the graft from infection in case of membrane exposure, which does not become infected, and the wound heals by second intention (32). In these two clinical cases, we used a flapless approach and left the membrane exposed during healing. Lifting and advancing a full-thickness flap can cause a marginal recession to adjacent teeth, alteration of the shape of the papillae, loss of keratinized mucosa, and greater post-operative discomfort for the patient.

In this study, we observed no adverse effects where membranes were left exposed to the oral cavity and sutures were mainly used to hold the membranes in place.

CONCLUSIONS

Oral rehabilitation with dental implants requires sufficient bone architecture in both vertical and horizontal dimensions. The socket preservation after extraction plays a fundamental role in maintaining the alveolar ridge. The clinical results obtained in these two cases seem to indicate that the use of Beta-tricalcium phosphate as a filler, and a membrane of completely resorbable heterologous mesenchymal tissue, are able to convey and promote bone regeneration.

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