Bilateral maxillary sinus lift with preserved collagen heterologous bone graft and anorganic heterologous bone graft: a case report with 11-year follow-up

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Description

In 2011, the patient presented himself to our attention requesting a fixed implant-prosthetic rehabilitation at the level of the posterior sectors of the upper arch (Q1 and Q2). CBCT examination showed the presence of extensively pneumatized sinuses that, together with moderate vertical atrophy of the ridge, reduced the available bone to an inadequate volume for implant placement. In agreement with the patient, it was decided to perform a lateral sinus floor elevation in both the first and second quadrant, using in Q1 an anorganic bovine bone graft produced by heat treatment and in Q2 a collagen-preserved equine bone graft obtained through an enzymatic treatment. At 9 months after surgery, we pursued with implant placement and the concomitant histological analysis of the regenerated tissues in order to assess the degree of remodeling of the grafts used in Q1 and Q2. Eleven years later, the same patient required rehabilitation implant at the mandibular level. A new CBCT which, showing also the Q1 and Q2 quadrants, allowed us to evaluate the volumetric maintenance in the long term of both grafts used in the first rehabilitation implantation.

Introduction

Sinus lift with lateral access is one of the most frequent in the rehabilitation of the atrophic posterior maxilla[1] where the residual height of the crest alveolar ridge is less than 4-5 mm. Since its introduction by Tatum[2, 3], Boyne and James[4], the technique has been the subject of numerous studies that have demonstrated its safety, efficacy and repeatability[5-7]. Although autologous bone represents the gold standard as grafting material because of its properties of osteoconduction, osteoinduction and osteogenesis, pneumatization of the maxillary sinus promotes its resorption[8,9]. Therefore, bone substitutes of heterologous origin are frequently used in maxillary sinus lift procedures alone or in combination with autologous derivatives. Grafts of heterologous origin have indeed demonstrated in multiple studies good regenerative capabilities and a good volumetric maintenance[10]. However, the manufacturing process used (by thermal, chemical, or enzymatic routes), affect their regenerative properties. In particular, in a prospective comparative study in patients undergoing sinus lift by the lateral route, at 6 months after regenerative surgery, a collagen-preserved equine bone graft, enzymatically deantigenated (EDEB) showed remodeling kinetics faster than an anorganic bovine bone graft (ABB) obtained by thermal route[11, 12]. The purpose of this case report is to analyze from a clinical, radiographic and histological viewpoint, the remodeling and volumetric long-term maintenance of EDEB and ABB, used in a patient undergoing a bilateral maxillary sinus lift in 2011.

Case report

In 2011, the patient, 71-year-old, non-smoker, presented himself to our attention requesting a fixed implant-prosthetic rehabilitation at level of the posterior maxillary sectors (elements 15-17 and 24-27). From a systemic point of view there were no absolute and relative contraindications to oral surgery. Radiographic examination showed a bilateral atrophy of the maxillary posterior with residual bone ridge of approximately 2.5 mm, which did not allow immediate implant rehabilitation (Figs. 1,2). In agreement with the patient, it was decided to perform a lateral sinus floor elevation in both the first and second quadrant, using in Q1 an anorganic bovine bone graft produced by heat treatment and in Q2 a collagen-preserved equine bone graft obtained through an enzymatic treatment. The patient provided his informed consent to the treatment. The patient underwent presurgical oral hygiene one week before surgery. Since day of surgery he had been performing washes with chlorhexidine 0.2% (Corsodyl, Glaxo-SmithKline) continued for 2 weeks, 2 times daily. One hour before surgery 2 g were administered of amoxicillin/clavulanic acid (Augmentin, Glaxo-SmithKline, Verona). Intraoperatively, dexamethasone was administered dexamethasone sulfate 4 mg/1 ml (Soldesam, Caronno Pertusella). After surgery the patient continued therapy antibiotics for 12 days (Augmentin, Glaxo-SmithKline) along with the intake of NSAIDs for 6 days (Nimesulide, Angelini). The area of surgery was anesthetized using articaine hydrochloride 40 mg with adrenaline 1:100000. For both sides, a full-thickness flap was lifted and the posterior maxilla was skeletonized in order to gain access to the surgical site. Then, the antrostomy access to the sinus was created (Fig. 3); the membrane of Schneider was peeled back and raised in order to place the heterologous bone graft. In both cases a collagen membrane was inserted to protect the Schneiderian membrane. Both grafts were supplemented with concentrated platelet (PRGF) (Figs. 4a, 4b). At the level of the first quadrant approximately 5 cc of macro granules of anorganic bovine bone (1-2 mm) obtained by thermal (ABB, Bio-Oss, Geistlich Pharma) were placed. At the level of the second quadrant, approximately 5 cc of macro granules (2-4 mm) of collagen-preserved equine bone deantigenated by an enzymatic route (EDEB, Oste-OXenon, Bioteck) was positioned (Figs. 5a, 5b). The antrostomy was protected with resorbable collagen membranes (Biocollagen, Bioteck) (Fig. 6). No perforations of the Schneiderian membrane occurred. A closure of the flaps by first intention was achieved using mattress sutures with a non 5-0 resorbable suture (Monomyd, Butterfly). No prostheses in compression of the surgical sites were inserted. At 9 months after regeneration, the CBCT showed a volume sufficient for the insertion of the implants in both quadrants (vertical increments of 17 mm and 15 mm, respectively, for ABB and EDEB). Therefore, 6 implants (Xive, Dentsply Sirona) were inserted at positions 15, 16, 17 (Q1) and 24, 25 and 26 (Q2) (Figs. 7a, 7b). In the preparation of the implant tunnels, bone biopsies were harvested by means of a core drill (diameter 3.8 mm) to assess the degree of remodeling of the grafts by histological and histomorphometric analyses (Figs. 8a-8d). The stability of the implants allowed provisional prosthesis at 12 months and definitive at 16 months after regenerative surgery (Fig. 9a). In 2022 the patient presented again to our attention requesting implant rehabilitation at the mandibular level, we appreciated the maintenance of the aesthetic result of the previous prosthetic restoration of the maxillary

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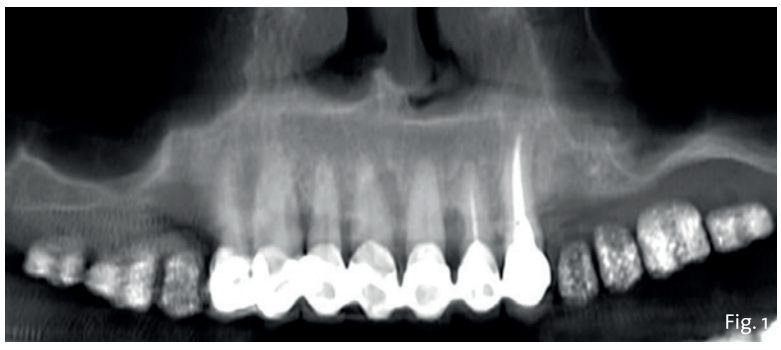


Fig. 1 - Pre-operative CBCT showing atrophy at the Q1 and Q2 quadrants.


Fig. 2 - Clinical appearance before surgery. Note the presence of the radiographic template.

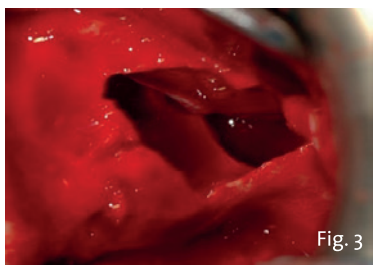
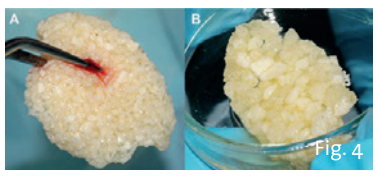
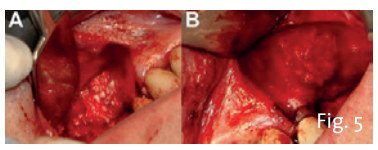


Fig. 3 - Sinus access osteotomy. Note the presence of a modest septum and detachment of the membrane.


Figg. 4a, 4b - Appearance of the mixture between PRGF and ABB (a) or EDEB (b).


Figg. 5a, 5b - Placement of ABB (a) and EDEB (b) in the two maxillary sinuses.

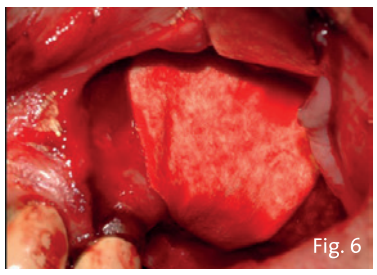
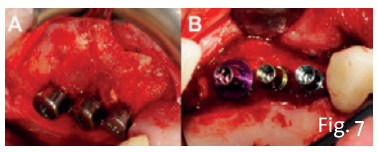
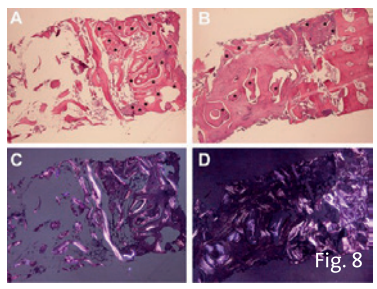


Fig. 6 - Apposition of membranes made of collagen to protect the access window to the sinus.


Figg. 7a, 7b - Insertion of three implants in each regenerated quadrant (a: Q1, b: Q2)


Figg. 8a -8d - Histological examination of biopsies taken contextually at 9 months after regeneration in Q1 (left) and Q2 (right). The tissue of the sinus grafted with ABB (8a) the presence of a certain amount of residual biomaterial is evident (*) and, as shown by the pattern of collagen fibers visible in polarized light (8c), by vital bone tissue undergoing maturation. The tissue of the sinus grafted with EDEB (8b) shows a low amount of residual biomaterial (*) and a higher amount of newly formed bone, characterized by a higher level of collagen fiber organization visible in polarized light (8d).

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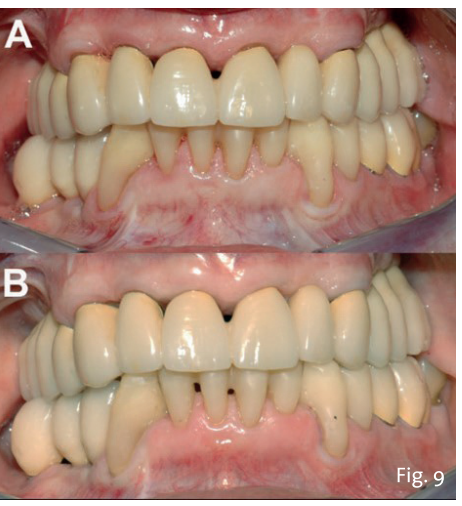
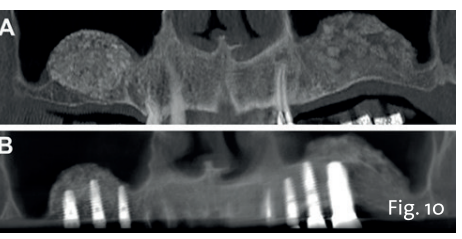
upper jaw (Fig. 9b). Therefore, a new CBCT was performed that allowed us to assess the volumetric preservation and the degree of remodeling of the grafts used in the 2011 regenerative surgery (Figs. 10a, 10b).

Discussion and conclusions

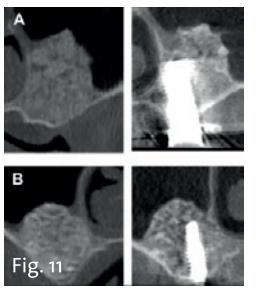
Histological analysis of the biopsies retrieved at 9 months from the regenerative procedure, revealed that EDEB was in an advanced state of remodeling, with a good percentage of viable bone organized in osteons and a reduced amount of biomaterial residual (Figs. 8b, 8d). Differently, ABB showed a greater amount of residual biomaterial and the newly formed bone was less organized compared with EDEB (Figs. 8a, 8c). This is in line with what has been reported in the literature[13] and in particular in sinus lift[11, 12], where EDEB has demonstrated a faster kinetics of regeneration than ABB. From a radiographic point of view, at 9 months after regeneration and before implant rehabilitation, it was observed a different radiopacity of the two heterologous bone grafts (Figs. 10a, 10b). While ABB appeared to have a rather intense radiopacity, EDEB, had a radiopacity very similar to that of the basal bone. This is probably due to two factors: on the one hand the different remodeling kinetics of the two materials, with EDEB being replaced faster than ABB by new viable bone, on the other hand the different deantigenation processes: while ABB is obtained through a heat treatment that modifies partially its mineral component, resulting in its pronounced radiopacity, EDEB is produced through an enzyme-based process that allows the preservation of the mineral component in a native state (hence a less pronounced radiopacity and the possibility of monitoring its replacement over time as the similarity radiographically to the basal bone). CBCT at a distance of 11 years showed adequate integration and good volumetric maintenance of the grafts in both maxillary sinuses (Figs. 10a-11b). Radiographically, it is possible to observe how EDEB shows adequate integration and resulted in originated a more regular bone texture with a radiopacity more similar to the bone basal bone, suggesting how the volume bone was maintained mostly by viable regenerated bone tissue. The results of this case report confirm and complement what has previously observed in a case series on sinus lift by the lateral route performed with the Tulasne technique using EDEB graft, where an excellent volumetric maintenance and a high percentage of implant survival (98.1%)[14] at 7-year follow-up was obtained.



Figg. 9a, 9b - Clinical appearance at prosthetic placement (a) and at 11 years (b).



Figg. 10a, 10b - A: CBCT at 9 months after regeneration. Note how the radiopacity of EDEB (right) appears to be very similar to that of the basal bone, while in ABB (sx) is stronger. B: CBCT at 11 years after rehabilitation implantation. Note the excellent volumetric maintenance in both quadrants. The sinus grafted with EDEB (right) shows a bone texture more regular and, in contrast to the image on the left, the radiopacity of the tissue in contact with the implants is similar to the basal bone.



Figg. 11a, 11b - CBCT cross section of the Regenerated sinuses at 9 (left) months and 11 years (right): A: sinus grafted with EDEB. B: sinus grafted with ABB. Note the excellent volumetric maintenance in both quadrants.