Original Article

Long-term Retrospective Study of Implants Placed after Sinus Floor Augmentation with Fresh-frozen homologous block

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Abstract

Aim: The aim of this study was to analyze and follow-up implants placed in the posterior maxillary regions previously grafted with homologous bone. **Materials and Methods:** Forty-one grafts with homologous bone blocks were performed in maxillary sinuses, and 121 implants were placed in premolar and molar regions approximately 6 months after the grafts. Patients were followed up for periods varying from 12 to 124 months after rehabilitation. **Results:** The results showed two implant failures, for a 98.3% success rate during the follow-up period. **Discussion:** The implants placed had an average torque of 40 N-cm, regardless of the, design, diameter, and length of the implants used. **Conclusion:** After following up on the implants placed in this study, we concluded that those placed in regions of the maxillary sinuses previously grafted with homologous bone blocks had high long-term success rates and met the functional masticatory requirements.

Keywords: *Allogenic graft, bone graft, dental implants, maxillary sinus, retrospective study, sinus floor augmentation*

Introduction

Sinus pneumatization associated with alveolar ridge atrophy after tooth extraction alters the characteristics of the posterior maxilla, rendering the placement of osseointegrated implants difficult or impossible. Procedures for lifting the maxillary sinus floor using autogenous bone grafts have been described in the literature since the 1980s and have shown satisfactory results in terms of bone formation, allowing placement of implants and subsequent prosthetic rehabilitation. The technique described by Boyne and James[1] involves the opening of a lateral window to allow access to the sinus cavity, with subsequent displacement of the sinus membrane and filling of the cavity with particulate material to achieve vital bone formation.[2]

However, these procedures still have limitations, including morbidity associated with the harvesting procedure of an autograft. Although this type of grafting is considered the gold standard in bone augmentation, it still involves limitations such as pain, swelling, bruising, and increased surgical time. For these reasons, studies on the use of xenogeneic, allogeneic, and synthetic biomaterials have been conducted and have shown good results in terms of vital bone tissue formation.

Fresh-frozen homologous bone has been described in the literature since the 1990s for the use in bone reconstruction before implant placement and has been found to produce results comparable to those obtained with autografts for different bone defects.[3-9] Owing to their processing method, biomaterials retain their original characteristics, allowing handling and use in the form of blocks and particulates.

A study by Carinci *et al*.[10] using fresh-frozen homologous bone in 69 patients over a 26-month follow-up period showed only four failures in 287 implants placed, therefore, a 98.3% success rate.

Based on this finding, Isidori *et al*.[11] presented a bone grafting technique for maxillary sinuses using homologous bone blocks and crestal access for subsequent implant placement, producing values of 6.08 ± 2.87 mm of bone formation in cases of severe pneumatization.

Although studies with homologous bone have shown good results in terms of bone formation, there are few long-term follow-up studies with implants placed in these regions.

How to cite this article: Rocha LR, Aloise AC, Oliveira Rd, Teixeira ML, Pelegrine AA, Macedo LG. Long-term retrospective study of implants placed after sinus floor augmentation with fresh-frozen homologous block. Contemp Clin Dent 2017;8:248-52.

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Access this article online

Website: www.contempclindent.org

DOI: 10.4103/ccd.ccd_63_17

Quick Response Code:

Thus, the aim of this study was to present an 1 to 11-year follow-up of implants placed in posterior maxilla regions previously grafted with fresh-frozen homologous bone.

Materials and Methods

A retrospective analysis was performed with thirty patients who underwent 41 procedures of sinus floor augmentation and subsequent follow-up of the placement of 121 implants of three different systems (70 implants by Emfils Colosso; Itu, SP, Brazil; 31 implants by BIOMET 3i; Palm Beach Gardens, FL, USA; and 20 implants by SIN Sistema de Implante, São Paulo, SP, Brazil). The bone grafting procedures were performed with fresh-frozen allogenic bone in the form of corticomedullary blocks from the UNIOSS Muscle-Skeletal Tissue Bank (Marilia, SP, Brazil).

The patients were selected according to the following inclusion criteria: absence of posterior teeth, extensive sinus pneumatization, a maximum of 3 mm of residual bone as measured from the bone crest to the lower cortical of the maxillary sinus; patients with a preoperative computed tomography (CT) scan or panoramic radiograph; patients with a postoperative panoramic radiograph or CT scan after bone grafting and before implant placement; 12-month follow-up after delivery of implant-supported prosthesis [Figure 1].

The surgical procedure of sinus floor elevation entailed giving patients amoxicillin with potassium clavulanate (875 mg + 125 mg) and 4 mg of dexamethasone, 2 h before the procedure. The antibiotic was maintained postoperatively for 14 days, twice a day, and 100 mg of the anti-inflammatory drug, ketoprofen, was prescribed for 3 days, also twice a day. Patients received local infiltration anesthesia with 2% lidocaine with 1:100,000 vasoconstrictor (Alpha-Caine; DFL, Rio de Janeiro, RJ, Brazil).

The surgical technique was initiated with a crestal incision, followed by two vertical relief incisions. A full-thickness flap was then dissected to gain access to the bone area. Because of the extensive pneumatization, the bone window was created near the bone crest using full osteotomy to gain full access to the cavity and initiate detachment of the Schneider membrane, according to the technique described by Boyne and James [Figures 2 and 3].[1]

After lifting the membrane, a homologous bone block, previously thawed at room temperature, was prepared with the use of bone drills at low speed under constant irrigation with saline solution, to improve the fit of the block into the cavity and to have it held in place by friction between the bone walls [Figure 4]. After fitting the block, the remaining spaces within the cavity were filled with homologous bone granules, and the site was then covered with a collagen membrane (Bio-Gide-Geistlich, Wolhusen, Switzerland) [Figure 5]. Continuous suture was then placed with 4.0 nylon thread (Ethicon; Johnson and Johnson, São José dos Campos, SP, Brazil).

After 8 months of healing, new panoramic radiographs or CT scans were obtained to assess the tissue gain and plan the implant placement procedure. The same medication protocol and anesthesia technique previously described were used for the implant placement procedure in all cases. The implants were placed with torques ranging from 10 to 80 N-cm, which were measured with the manual torque wrench provided by each implant system used [Figure 6].

The implants remained submerged for 4 months. The prosthetic procedures were then carried out, and the clinical cases completed. On completion of the treatment, a panoramic radiograph was taken of all patients to serve as control over the follow-up years [Figures 7 and 8]. All of the implants analyzed were followed for periods ranging from 12 to 124 full months after prosthetic rehabilitation.

Results

The sinus augmentation procedure and follow-up were both uneventful, allowing the placement of the 121 implants. Only two of these implants failed during the study, yielding a 98.3% success rate. The failed implants were removed, and new implants were installed in the same area.

Of the monitored implants, 48 were placed in the premolar area and 73 in the molar area, and all of them presented the same average torques, exceeding 32 N-cm. However, satisfactory primary stability was not achieved for 13% of the implants, with values under 20 N-cm at the time of placement [Table 1].

Discussion

The procedure for sinus floor elevation has been described in the literature by numerous studies using different materials. Autografts have the disadvantage of their morbidity, which has led to the search for new alternatives. Even though studies have reported favorable results, they focus on assessing bone formation through imaging tests or by assessing the quality of the bone formed through histology and histomorphometry. Few studies report the follow-up on implants placed in the previously grafted regions and in function.

In the present study, a success rate of 98.3% was attained after follow-up periods ranging from 12 to 124 months, with implants in function. Despite having used a biomaterial that is only osteoconductive, the newly formed tissue proved capable of stabilizing the implants, at the time of placement, and supporting subsequent osseointegration, rendering them stable after years. This corroborates the results found by Gapski *et al*.[12] and Xavier *et al*.,[13] who reported similar clinical, histologic, and histomorphometric results when comparing fresh-frozen homologous bone with bone autografts in sinus grafting procedures.

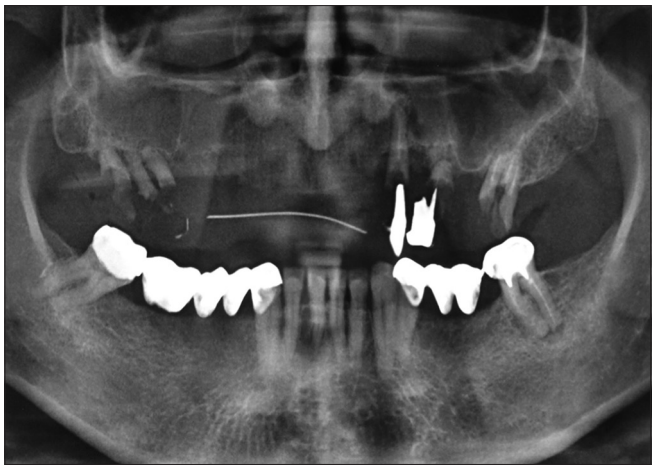

Figure 1: Initial panoramic radiograph of a sinus augmentation procedure, representative of the treatment protocol followed in the study

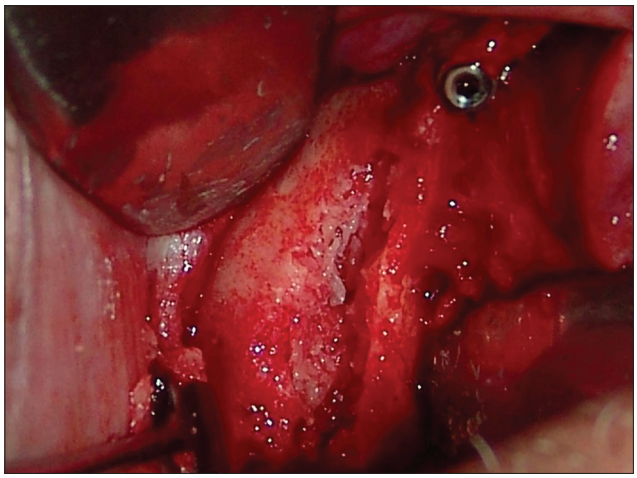

Figure 2: Full-thickness flap exposing bone crest

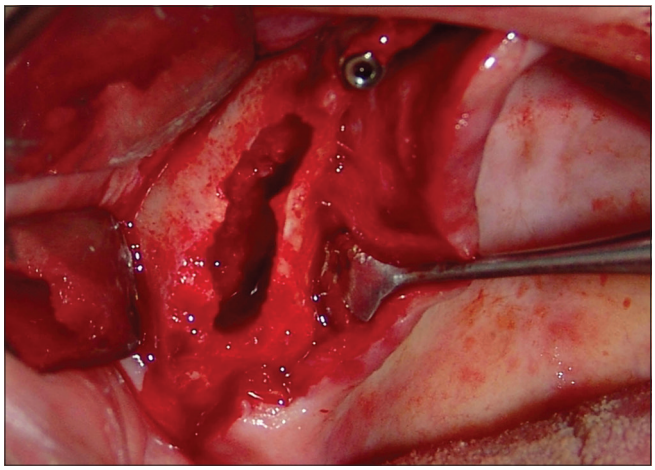

Figure 3: Osteotomy on bone crest and detachment of the sinus membrane

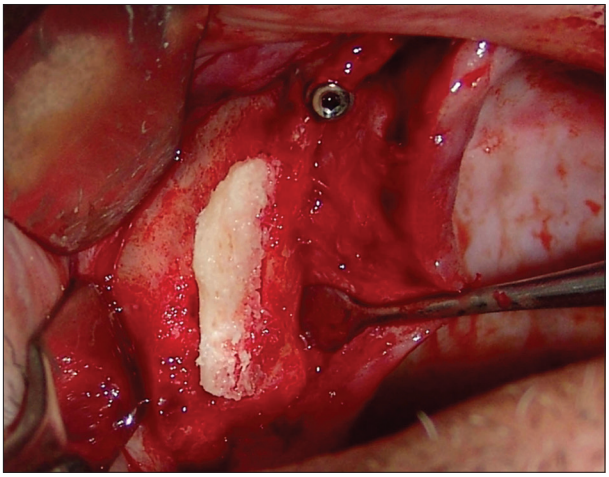

Figure 4: Fitting and fixation of the homogenous bone block

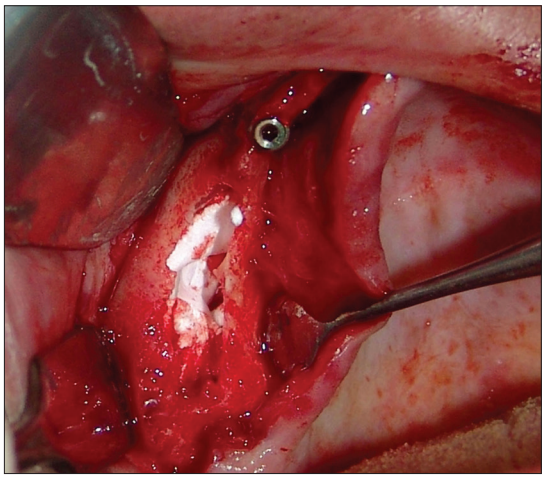

Figure 5: Filling of the cavity with homogenous particulate material and collagen membrane

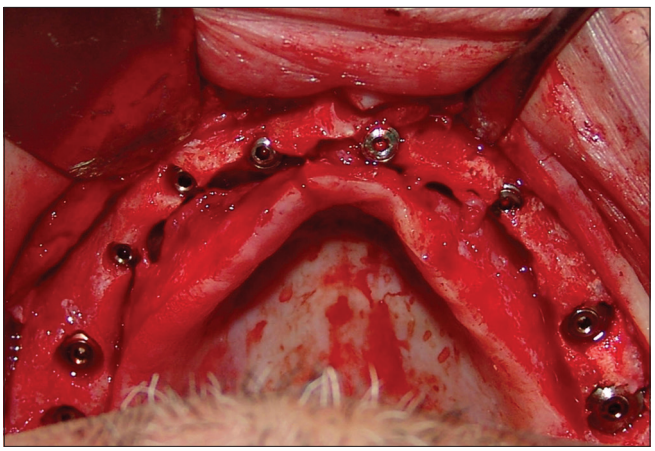

Figure 6: Occlusal view of the maxilla after implant placement

Of the 121 implants placed, only 13% failed to exhibit primary stability with values above 20 N-cm. This shows that the stability achieved in the study was satisfactory, regardless of the implant system used. Literature findings show that, in addition to bone quality, implant design and surgical technique can influence initial stability. Other factors, such as implant diameter, length, and surface treatment, can also contribute to osseointegration

Table 1: Number of implants lost according to implant design and area of implantation after the 44 sinus augmentation procedures included in the study

	Area of implantation		Implant design		Total
	Premolar	Molar	Cylindrical	Conical	
Number of implants (%)	48 (39.7)	73 (60.3)	84 (69)	37 (31)	121 (100)
Number of implants lost (%)	2 (4.1)	0	2 (2.3)	0	2 (1.7)

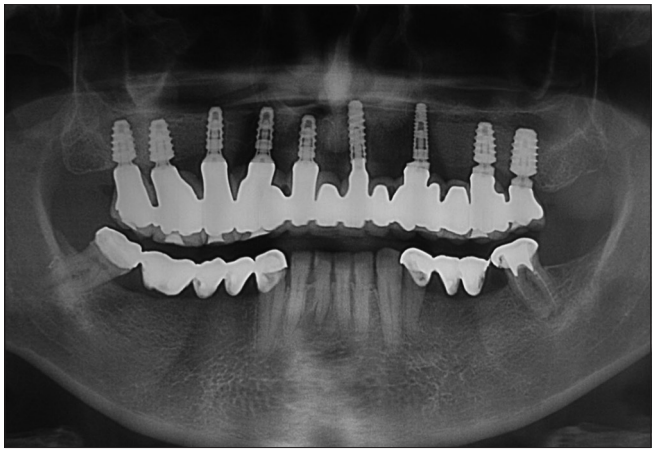

Figure 7: Panoramic radiograph at the end of treatment

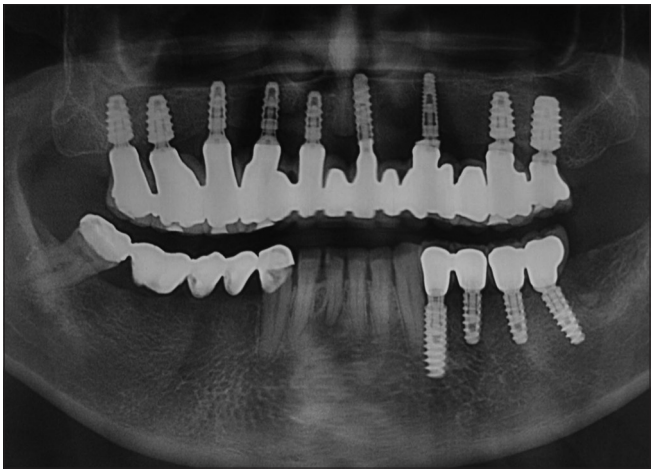

Figure 8: Panoramic radiograph at 11-year follow-up

or secondary stability. In this study, different implants with different designs, diameters, and lengths were used. Nonetheless, no noticeable difference among implant types was observed in terms of clinical behavior, indicating that, regardless of these factors, bone quality is the chief factor involved in the long-term success of the treatment.

Some authors have shown that because the bone formed from biomaterials presents large quantities of residual particles, it can be considered frail, i.e., having less strength and inferior quality compared to the patient's native bone. According to the rationale, the smaller the amount of residual particles, the better the quality of the material.[14-16]

Different studies using frozen homologous biomaterial for different applications have reported histological and histomorphometric results similar to those of autogenous grafts.[10,13,17] It is therefore reasonable to assume that a similar histologic pattern was obtained in the present study, explaining the high success rates of the placed implants.

Regarding other biomaterials, studies comparing various biomaterials (xenogeneic, homologous, and synthetic) with autografts have shown similar results in terms of bone tissue formation.[18] However, Mordenfeld *et al*.[19] reported a 17.3% ± 13.2% residual graft particle rate in biopsies done 11 years after sinus grafts were performed with xenogenic biomaterials, demonstrating that these biomaterials may not be replaced completely over time and may thus interfere with implant longevity.

Regarding the surgical technique, the major complication described in the literature is perforation of the sinus membrane. This may occur in up to 40% of the cases and may lead to the displacement of the biomaterial particles into the sinus cavity, causing infections, with partial or total loss of the graft. In cases of extensive pneumatization, excessive manipulation could increase the risk of these complications, which could lead to further complications, such as partial or total loss of the graft, and even acute sinusitis processes.

Hence, in all of the cases, of the present study a decision was made to follow a procedure similar to the technique described by Isidori *et al*.,[11] in which a block of homologous tissue is fit by friction into the walls of the sinus cavity, serving as a space maintainer to prevent displacement of the membrane, and a maintainer of bone volume during the healing process. In the case of perforation, this technique prevents particles from being displaced into the cavity while maintaining sinus integrity. Despite this, it was possible to identify perforations in almost 25% of cases that was treated with a bioabsorbable membrane to cover open areas before the bone blocks. The correlation with these complications and the failed implants in this study could not be identified.

Conclusion

Based on the results, it can be concluded that the success rate of the implants placed in areas of the maxillary sinus filled with homologous bone blocks was high.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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