

**Use of Membrane with or without Bio-Oss For Extraction Socket Preservation: A Case Series**

**Uso de Membrana com ou sem Bio-Oss Para Preservação do Alvéolo de Extração: Uma Série de Casos**

**Uso de Membranas con o sin Bio-Oss Para la Conservación del Alveolo de Extracción: Una Serie de Casos**

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## **Abstract**

The purpose of this case report / case series was to analyze the pattern of alveolar bone repair after extraction with the use of a collagen membrane associated or not with lyophilized bovine bone (Bio-Oss). The sample consisted of six adult patients, aged from 40 to 60 years, with indication of extraction of the upper incisors and subsequent rehabilitation with dental implants, three participants were randomly distributed in the following groups: Test - Bio-Oss associated with collagen membrane absorbable; Control - blood clot associated with an absorbable collagen membrane. Alveoli with significant bone loss, probe greater than 4 mm, uncontrolled systemic changes and smoker were excluded. The less traumatic extractions, followed by anti-inflammatory and antibiotic protocol. Computed tomography images from the preoperative time (T0) and after 4 months (T1) were used to measure bone filling. The data were compared using the T test, considering a 5% significance level. Less resorption was observed in the test group ( $p = 0.002$ ). The technique of preserving the alveolar ridge with Bio-Oss and absorbable membrane was satisfactory to prevent changes in the contour of the tissue.

**Keywords:** Bone regeneration; Growth factors; Bone grafting; Dental implants; Tomography.

## **Resumo**

O objetivo desse relato de caso/série de casos foi analisar o padrão de reparo ósseo alveolar após extração com uso de membrana de colágeno associada ou não ao osso bovino liofilizado (Bio-Oss). A amostra foi composta por seis pacientes adultos, com idade variando de 40 a 60 anos, com indicação de extração dos incisivos superiores e posterior reabilitação com implantes dentários, foram distribuídos três participantes aleatoriamente nos seguintes grupos: Teste - Bio-Oss associado a membrana de colágeno absorvível; Controle - coágulo de sangue associado a uma membrana de colágeno absorvível. Excluídos alvéolos com perdas ósseas significativas, sondagem maior de 4mm, alterações sistêmicas não controladas e tabagista. As extrações foram pouco traumáticas, seguida por protocolo de antiinflamatórios e antibióticos. Imagens de tomografia computadorizada do tempo pré-operatório (T0) e após 4 meses (T1) foram utilizadas para mensurar o enchimento ósseo. Os dados foram comparados pelo teste T, considerando 5% de significância. Menor reabsorção foi observada no grupo teste ( $p = 0,002$ ). A técnica de preservação do rebordo alveolar com Bio-Oss e membrana absorvível foi satisfatória para prevenir alterações no contorno do tecido.

**Palavras-chave:** Regeneração óssea; Fatores de crescimento; Enxerto ósseo; Implantes dentários; Tomografia.

## Resumen

El propósito de este reporte de caso / serie de casos fue analizar el patrón de reparación del hueso alveolar después de la extracción mediante membrana de colágeno asociada o no con hueso bovino liofilizado (Bio-Oss). La muestra estuvo constituida por seis pacientes adultos, con edades de 40 a 60 años, con indicación de extracción de los incisivos superiores y posterior rehabilitación con implantes dentales, tres participantes fueron distribuidos en cada grupo aleatoriamente siendo ellos: Test - Bio-Oss asociado a membrana de colágeno absorbible; Control - coágulo de sangre asociado con una membrana de colágeno absorbible. Se excluyeron los alvéolos con pérdida ósea significativa, con sondaje mayor de 4 mm, alteraciones sistémicas no controladas y fumador. Las extracciones fueron poco traumáticas, seguidas de protocolo con antiinflamatorio y antibiótico. Se utilizaron imágenes de tomografía computarizada del tiempo preoperatorio (T0) y a los 4 meses (T1) para medir la formación ósea. Los datos se compararon mediante la prueba T, considerando un nivel de significancia del 5%. Se observó una menor reabsorción en el grupo de prueba ( $p = 0,002$ ). La técnica de preservación del reborde alveolar con Bio-Oss y membrana absorbible fue satisfactoria para evitar cambios en el contorno del tejido.

**Palabras clave:** Regeneración ósea; Factores de crecimiento; Injerto óseo; Implantes dentales, Tomografía.

## 1. Introdução

The aesthetic success of implant-supported rehabilitation can be influenced by several clinical factors, especially in anterior maxillary area, where the aesthetic result is a challenge (Kan, et al., 2011). Among these factors, the implant placement, soft tissue management, adequate prosthetic procedures and maintenance of the alveolar ridge after extraction can be highlighted (Kan, et al., 2011). The pattern of alveolar bone loss resulting from extractions in the aesthetic region occurs mainly due to reabsorption of vestibular plate (Rico, Méndez & Montoya, 2012). Numerous studies have already been carried out with the objective of finding a technique or material that would prevent this resorption after extraction, however, currently it is only possible to minimize bone losses (Rico, Méndez & Montoya, 2012). The development of techniques and materials that effectively and predictably preserve alveolar bone is still a major challenge for rehabilitation dentistry (Lanza, et al., 2010).

Bone resorption of alveolar ridge occurs mainly in the first 3 months after tooth extraction (Wood & Mealey, 2012), therefore, intervention with biomaterials that minimize

alveolar resorption is very important and necessary for rehabilitation with dental implants (Wood & Mealey, 2012). There are a multitude of materials and techniques available for this purpose, including grafting with a biomaterial, but studies suggest that the use of membranes associated with graft filling leads to better results (Rico, Méndez & Montoya, 2012). The protection of the graft with bioabsorbable membrane tends to decrease ridge absorption, as a support, guiding bone growth, and allowing the migration of bone-forming cells into the created space (Rico, Méndez & Montoya, 2012). The membranes must contain the graft, and it must adequately support the membrane, promoting bone regeneration (Rico, Méndez & Montoya, 2012).

There are several biomaterials that can be used as a graft to preserve the alveolus, such as autogenous bone, allografts, xenografts, and alloplastic materials (Wood & Mealey, 2012). The main expected characteristic of a graft material is biocompatibility, which does not generate an allergic reaction, integrating with host tissues and bringing osteogenesis, osteoinduction and/or osteoconduction as ideal functions (Iyer & Haribabu, 2013). Lyophilized bovine bone (Bio Oss®; Geistlich - Wolhusen, Switzerland) is widely used to keep the alveolar process due to its osteoconductive property, working as a support for bone neoformation and enabling the colonization of osteoblasts (Chackartchi, et al., 2011). It helps maintain architecture edge (Gregori, et al., 1996), and can be used at the moment of implant placement, but the absorption is slow (Gregori, et al., 1996), and its use at the time of extraction is more indicated.

Bio-Oss is composed of apatite, carbon-free and hydroxy groups (Liu, et al., 2013). It has a crystalline structure similar to the human medullary bone (Kao & Scott, 2007), with particle sizes ranging from 0.25 to 1 mm (Kao & Scott, 2007). It has osteoconductive properties and excellent porosity, ranging from 75 to 80%, which allows this material to be incorporated into the tissue, allowing the colonization of osteoblasts that induce bone neoformation (Kao & Scott, 2007), justifying its use in surgeries for alveolar bone maintenance. A systematic review with meta-analysis, evaluating the effectiveness of alveolar ridge preservation procedures, in relation to dimensional changes in tissues, showed that alveolar preservation procedures are effective to minimize bone loss and, in addition, using a membrane has benefits for these procedures (Bassir, et al., 2018).

Clinically, the maintenance of the alveolar ridge in aesthetic regions is a necessity for adequate implant-supported rehabilitation. The technique of preserving the alveolar ridge with Bio-Oss and absorbable membrane is satisfactory to prevent changes in the contour of the tissue. Therefore, the aim of this study was to analyse repair pattern of alveolar bone after

extraction using the collagen membrane associated or not with Bio-Oss.

## **2. Metodologia**

This study was performed after approved by the institution's Research Ethics Committee (protocol 1,209,618).

### **Sample**

Six patients, age ranging from 40 to 60, both genders, with indication of extraction of the upper incisor teeth and subsequent rehabilitation with dental implants, were selected. Patients with uncontrolled systemic changes, smokers and who had significant alveolar bone loss, probing depth > 4 mm, root fractures and infra-bone injuries, evaluated by imaging tests (tomographic, periapical and/or panoramic radiography), were excluded. The patients agreed to participate in the study and signed the free and informed consent form. Patients were randomly distributed into the following experimental groups (n = 3): test - Bio-Oss associated with an absorbable collagen membrane; control - blood clot associated with an absorbable collagen membrane.

### **Surgical Protocol**

Based on the preoperative tomography performed up to 3 months before surgery, care was started with initial registration (Figure 1A), intra and extra-oral antisepsis, followed by local anesthesia with infiltration of articaine hydrochloride with epinephrine 4% 1: 100.000 (Nova DFL - Dentsplay®, Rio de Janeiro - Brasil) due to regional blockage of infraorbital and nasopalatine nerves. Less traumatic surgery were performed with molt and forceps, without fractures on vestibular bone plate (Figure 1B). After extraction, the test group received Bio-Oss, in form of small granules (0.25 - 1.5 mm) (Figures 1C and 1D), prepared and hydrated with saline solution, until complete filling. In both groups, an absorbable collagen membrane (Bio-Guide® - Geistlich - Wolhusen, Switzerland) was adapted and sutured over the opening of the socket with 5-0 nylon thread (Ethicon® Johnson & Johnson, São José dos Campos - Brazil) (Figure 1E).

After the surgical procedure, everyone received prosthetic provisional (Figure 1F) and guidance on diet and postoperative care. Antibiotic, corticosteroid and anti-inflammatory for

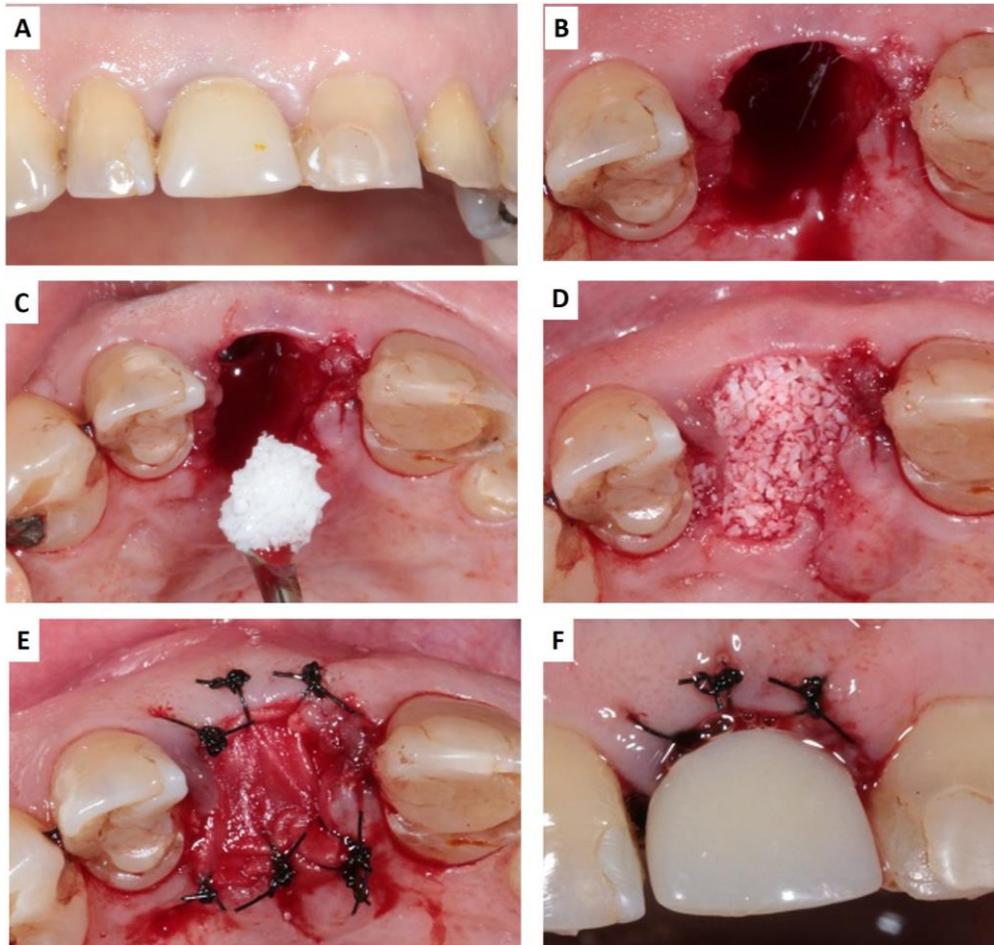
systemic use were prescribed, in addition to mouthwashes with 0.12% chlorhexidine 3 times a day, for 7 days. The sutures were removed after 10 days. Patients were reassessed at 10, 30 and 120 days after surgery, to assess possible postoperative complications.

### **Analysis of changes in the area of the alveolar ridge**

Pre-(T0) and post-operative (T1) tomographic images were obtained with a Cone Beam computerized tomograph (I-Cat®; Kavo - Brazil), with cuts of 1 mm thick and 0.2 mm apart, using 120 kVp and 100 bad. T0 was performed up to 3 months before the procedure and T1 was performed after 4 months of healing. The verification of the intra-examiner error was evaluated previously the study with postoperative images of five randomized cases. The same examiner repeated the measurements of all images three times.

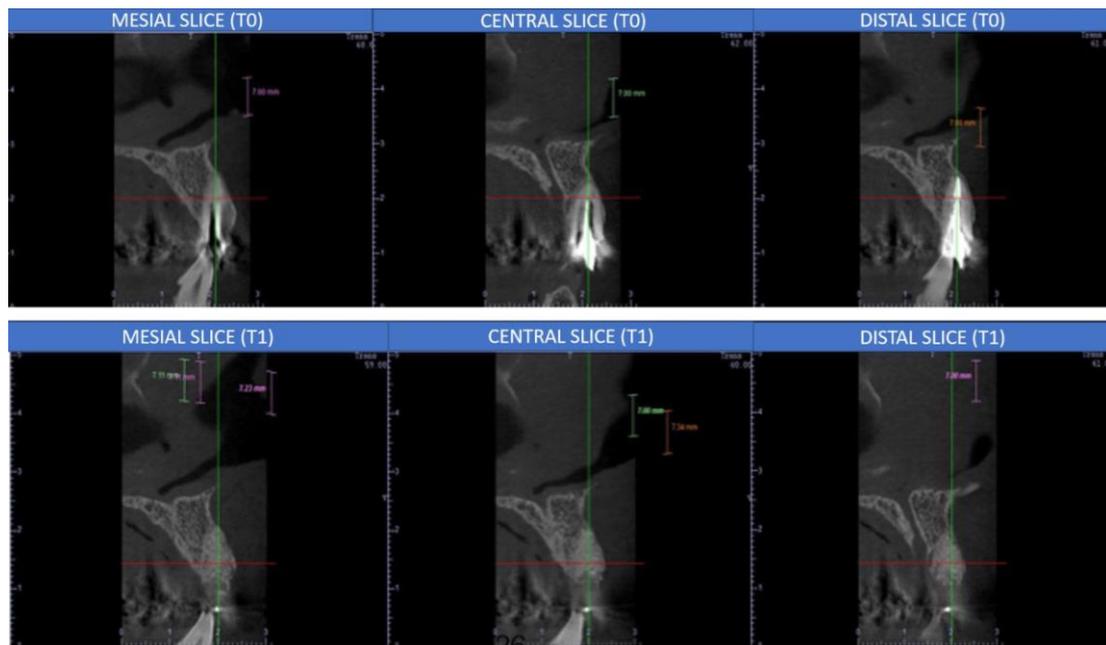
For each patient, 3 sections of T0 and T1 were selected, in sagittal direction, one corresponding to their centre alveolus, the second 1 mm mesial and the third 1 mm distal (Figure 2). At T0, a line was drawn from the lower limit of the buccal plate to the lower limit of the palatal plate. For the upper limit, a line was drawn parallel to the nasal cavity floor, constituting a polygon (Figure 3). At T1, the limits of polygons were obtained through the image of the contour walls of alveolus or the filling materials in lower region, while for upper limit, the same T0 criteria were used. The T0 and T1 images with the defined polygons were imported into the imageJ software (Image Processing and Analysis in Java, National Institutes Of Health, Bethesda, Maryland, USA) for measures.

**Figure 1** - Surgical steps: (A) Initial image of element 11, (B) Image after extraction, (C) Insertion of BIO-OSS, (D) Complete filling of the alveolus, (E) – Membrane adaptation, insertion and suture, (F) – Provisory prothesis.



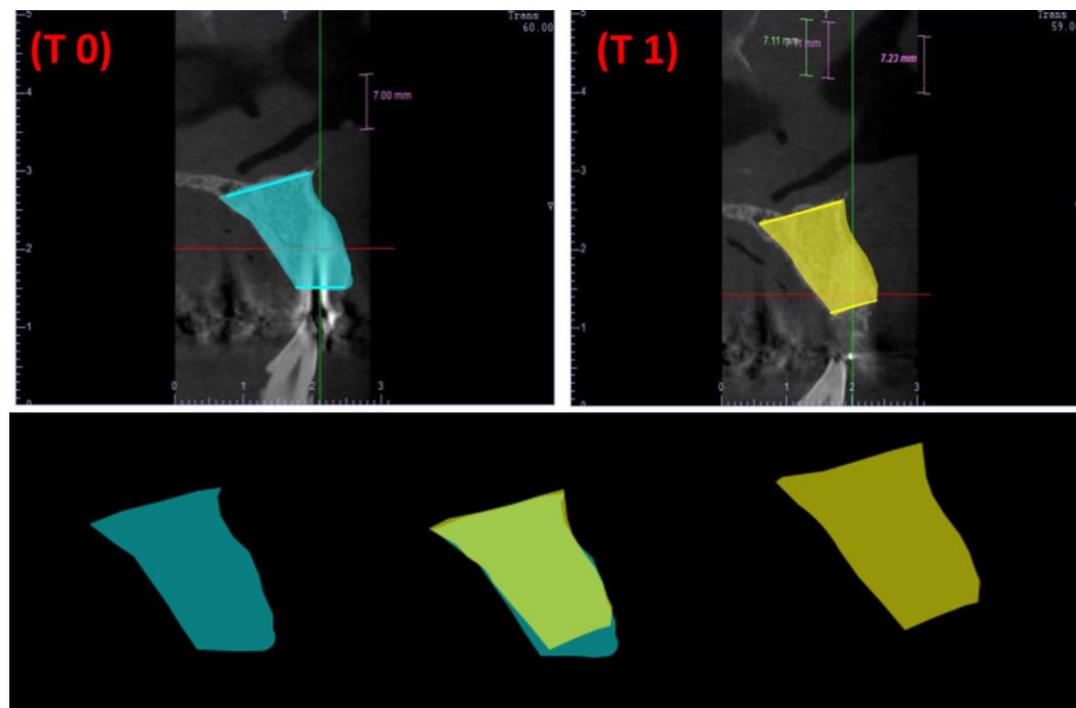
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**Figure 2** – Representative images of the initial (T0) and final (T1) tomographic sections.



Source: Authors.

**Figure 3** – Representative images of alveolar bone resorption area in the sagittal sections from (T0) to (T1).



Source: Authors.

## Statistics Analysis

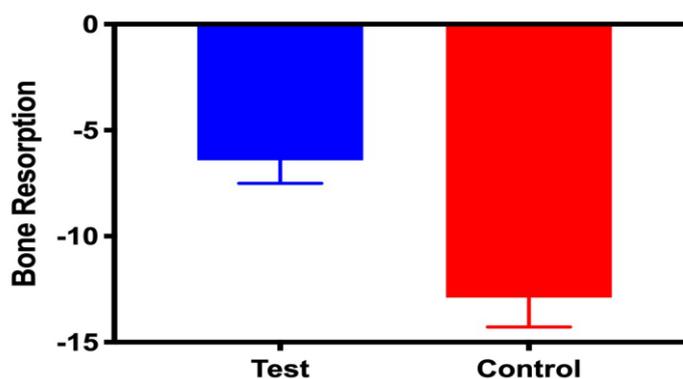
The 3 numerical values of the obtained areas (mesial, central, distal) for each patient resulted in averages of alveolar bone volume. The percentages of bone resorption of each alveolus were calculated  $[(\text{final volume} * 100) / \text{initial volume}]$ . The results obtained were subjected to the Kolmogorov-Smirnov normality test and, subsequently, to the T test to compare the percentage means of the measured region, adopting a 5% significance level. The analyses were performed using the Prism 8 software (v 8.4.2, GraphPad Software, LLC, San Diego, CA).

**Table 1** – Measurement of the area of the alveoli of each patient in the test and control group, before and 4 months after treatment, with calculation of the percentage of reabsorption of the individual ridge and average per group.

Test Group	Pre-operative Tomography (T0)				Post-operative Tomography (T1)				Alveolar resorption (%)	Average resorption (%)
	Mesial	Medial	Distal	Average	Mesial	Medial	Distal	Average		
Patient 1	141	155	170	155	136	154	145	145	-6,65	-6,45
Patient 2	122	107	121	117	107	105	112	108	-7,43	
Patient 3	144	135	158	146	134	125	155	138	-5,26	
Control Group	Pre-operative Tomography (T0)				Post-operative Tomography (T1)				Alveolar resorption (%)	Average resorption (%)
	Mesial	Medial	Distal	Average	Mesial	Medial	Distal	Average		
Patient 1	152	164	186	167	137	146	147	143	-14,34	-12,98
Patient 2	220	218	202	213	192	185	190	189	-11,41	
Patient 3	162	161	177	167	130	144	160	145	-13,20	

Source: Authors.

**Figure 4** – Mean and standard deviation of the overall alveolar absorption rate.



Source: Authors.

### 3. Discussion

The alveolar bone volume must be preserved during extraction, to minimize resorption, improving the aesthetic profile, and to make possible to install the dental implant in the appropriate diameter, position and desired angle (Nevins, *et al.*, 2014). However, during the surgical procedure, the thin and fragile bone plate may be damage (Misch, 2010). And even in cases of atraumatic extraction, a physiological bone resorption occurs during the repair process (Liu, *et al.*, 2013). Therefore, techniques to preserve the alveolus at the time of extraction are indicated to minimize the reabsorption of remaining bone, which may result in atrophy of the alveolar ridge and collapse of the soft tissues, causing aesthetic and functional problems (Iyer & Haribabu, 2013).

To preserve or increase the bone level, some treatment protocols have shown good results, such as the association of xenografts and collagen membrane, presenting classic advantages of not needing a donor area and removal of the membrane (Ayub, *et al.*, 2011). According to Iyer, *et al.* (2014), the advantages of using bovine graft is that it helps to maintain the physical architecture of alveolar bone, is highly biocompatible and it is a type of material increasingly used (Iyer & Haribabu, 2013); and the literature has shown better results when it is associated with a membrane (Rico, Méndez & Montoya, 2012). Absorbable membranes have become the gold standard for many clinical situations (Misch, 2010) as they do not require surgical removal, are easy to handle, assist in haemostasis, cause a low rate of complications and are manufactured and available in standard sizes and shapes, which can be cut out for each situation (Misch, 2010).

Several studies show beneficial effects of the association of Bio-Oss and collagen membrane in socket preservation after extraction (Nevins, *et al.*, 2014), (Mardas, Chadha & Donos, 2010), (Peñarrocha, *et al.*, 2012) and (Pushparajan, *et al.*, 2013). The dimensions, such as width and height, of the bone were preserved by using this association after tooth extraction (Mardas, Chadha & Donos, 2010). Moreover, while in places where the graft was not performed, considerable resorption was observed (Mardas, Chadha & Donos, 2010). The association of bovine bone with collagen membrane showed ideal results for grafting on surfaces where the horizontal increase of the alveolar ridge is intended (Peñarrocha, *et al.*, 2012). In radiographical analyses, the effectiveness of this association shows statistically significant increase in width of the alveolar ridge bone, between the day of surgery and 180 days after, from 2 mm, 4 mm and 6 mm from the ridge, of the studied patients (Pushparajan,

*et al.*, 2013). These results corroborate with the present study, in which greater preservation of alveoli was observed after extraction with the use of Bio-Oss and collagen membrane.

The systematic review with meta-analysis carried out by Giuseppe Troiano, *et al.* (2017) strengthens the present study. The objective was to examine the benefits of the procedures for preserving the alveolar bone ridge in relation to height and width. Studies using allografts and xenografts, covered with absorbable membrane, were compared with spontaneous healing (Troiano, *et al.*, 2018). The 7 randomized clinical studies selected revealed that the procedure with bone grafts covered with an absorbable membrane is able to reduce alveolar absorption when compared to the alveolus without filling (Troiano, *et al.*, 2018).

Considering the effects of alveolus preservation in subsequent rehabilitation with dental implants, the effects of Bio-Oss and absorbable collagen membrane were evaluated on the alveolus and osseointegration preservation (Pang, *et al.*, 2014). Panoramic radiography and computed tomography were used as an analysis method, being performed immediately, 3 and 6 months after the surgery. This study has shown that this technique was effective in preserving the alveolar bone ridge, in addition to not having any negative effects on implant osseointegration. Thomas Starc-Jensen, *et al.* (2020) published a systematic review with the aim of testing the hypothesis that there is no difference in the result of the implant treatment after horizontal increase of the alveolar bone ridge with autogenous bone graft (Starch-Jensen, Deluiz & Tinoco, 2020). The hypothesis cannot be accepted or rejected because the studies available in the databases searched were insufficient, however, long-term studies have shown a gain in the width of the alveolar bone ridge with the use of allogeneic graft, resulting in high implant survival.

#### **4. Conclusion**

Within the limitations of the study, such as the reduced number of participants, it was concluded that the association of Bio-Oss and collagen membrane leads to greater preservation of the socket after extraction.

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conflict of interest.

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