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Case Report

Reconstruction of Atrophic Maxilla using Xenogeneic Block graft and long-lasting Specific Collagen Membrane, a Clinical Case Report

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Abstract

Introduction: Implant rehabilitation depends on the presence of bone of sufficient height and thickness for fixation and osseointegration of the implants. In cases of hypoplastic premaxillae, several options may be considered to compensate for or correct this bone defect, such as the placement of short implants or the augmentation of bone height and thickness. To increase its volume several techniques could be performed, such as: Guided bone regeneration (GBR), bone block graft, Le Fort I osteotomy with interpositional bone graft, and distraction osteogenesis. The most established technique for increasing alveolar bone volume is GBR associated with autologous, heterologous, or alloplastic grafts. Collagen membranes are commonly used in guided bone regeneration (GBR) procedures associated with exercises due to their biocompatibility. This article is a case report of Guided Bone Regeneration for a bone defect in the anterior maxilla, using an attachment in a bone block of heterogeneous origin associated with PRF and a collagen membrane. Case report: Patient JMLF, 52 years old, presented premature loss of tooth 11 and 21 and was wearing a removable partial denture. We performed the placement of 2 bone blocks of heterogeneous origin of 10X10X5, thus filling the spaces between the block and the recipient bed with particulate bone of heterogeneous origin and covering the grafts with a specific high-resistance collagen membrane of 20x30mm. Conclusion: guided bone regeneration (GBR), using bone block graft of heterogeneous origin associated with Platelet-rich fibrin (PRF) and collagen membrane, for reconstruction of bone defects performed prior to rehabilitation with dental implants, proved to be an effective way to gain volume and bone height in the anterior maxilla.

Keywords: Bone Graft; Guided Bone Regeneration; Collagen Membrane

Introduction

Tooth loss due to carious, periodontal or traumatic processes causes local bone loss, which can lead to aesthetic and functional problems and consequently compromise patients' quality of life [1]. Various rehabilitation options can be used successfully, such as removable partial or total prostheses, which are fixed on teeth or on implants. With the evolution of dental implants, they have become an excellent alternative that can restore aesthetics and function with high predictability and preservation of adjacent dental structures [2].

After tooth loss, a process of bone remodeling begins. This process triggers bone resorption and consequently a loss of volume that can occur in both the mandible and maxilla where the trauma

occurred [3]. Resorption occurs in two directions: horizontal and vertical. Both the mandible and maxilla have horizontal resorption which starts on the buccal surface and progresses towards the lingual and palatal surfaces. Vertical resorption in the maxilla is four times greater than in the mandible, with more pronounced atrophy in the first year after extraction [4]. The literature reports centripetal resorption of the external cortical bone along its entire length in the maxilla, while in the mandible the greatest initial loss is centrifugal [5].

Implant Rehabilitation depends on the presence of bone of sufficient height and thickness for its success. The installation of dental implants requires the presence of viable bone structure for their fixation and osseointegration. In cases of pre-jaw atresia, various options can be considered to compensate for or correct this bone defect 6. Dental surgeons can consider placing short implants or increasing bone thickness and height. Volume augmentation can be carried out using various techniques such as guided bone regeneration (GBR), bone block grafting, Le Fort I osteotomy with interpositional bone grafting and distraction osteogenesis [7].

The most established technique for alveolar bone volume augmentation is GBR associated with autologous, heterologous or alloplastic grafts. In this procedure, the graft must perform osteoinduction and osteoconduction as well as possible 8. Based on these criteria, Carlino*., et al*, 2016 listed the following grafts in descending order of performance: native bone, autologous bone grafts used in the in-lay sandwich technique, autologous bone graft following the on-lay technique, homologous bone, heterologous bone and finally alloplastic bone substitutes [5].

The gold standard for grafts, considering their osteoinductive, osteoconductive and osteogenic properties, is the autologous grafts, which can be harvested from patients' intra- or extra-oral regions. However, due to the need for a donor area, this option brings with it a longer operative time, greater possibility of complications, susceptibility to infections in the donor area, progressive and continuous resorption and high morbidity as it requires two surgical sites [9]. To minimize these problems, heterologous and alloplastic blocks have been widely used as substitutes. They have excellent physical characteristics for bone reconstruction, high biocompatibility, no protein traces, and bone formation signaling agents [10].

Collagen membranes are commonly used in guided bone regeneration (GBR) procedures associated with grafts. They are biocompatible, promote cell exclusion - thereby preventing the invasion of non-osteogenic cells into the bone defect from the mucosa-, and are bioactive, thus favoring the proliferation of osteoprogenitor cells and generating bone tissue formation and promoting wound healing and tissue integration [11,12].

Membranes can be classified according to their resorbability into non-resorbable, synthetic resorbable and collagen-based resorbable. The non-absorbable ones are made of high-density polytetrafluoroethylene (d-PTFE) and high-density PTFE reinforced with titanium. The resorbable synthetic ones can be made of poly-dl-lactic/co-glycolic acid, Polyglactin [9,10]. Polyglycolide/polylactide and those made of Polydl-lactide and solvent (N-methyl-2-pyrrolidone). And the resorbable collagen-based ones can be composed of: Type I collagen derived from cadaveric human skin, Collagen derived from pig skin (Types I and III) and Type I collagen derived from bovine tendon [13].

Liquid fibrin rich in leukocytes and platelets (PRF) is a plasma concentrate obtained by centrifuging blood. PRF has been associated with collagen membranes in GBR and has achieved good results, such as an increase in vertical and horizontal bone volume in both the maxilla and mandible. L-PRF has been found to promote angiogenesis, epithelialization and hemostasis, making it a valuable therapeutic tool for preserving bone volume and quality [14]. In addition, L-PRF is suggested as a personalized alternative, obtained from the patient's own blood, showing favorable biocompatibility, bioresorption and bioactivity in interaction with the biological environment [15].

This article is a case report of Guided Bone Regeneration for a bone defect in the anterior maxilla, using a bone block graft of heterogeneous origin associated with PRF and a collagen membrane.

Case Report

Patient JMLF, 52 years old, had lost teeth 11 and 21 and was wearing an upper PPR. Complementary examinations were requested, and no alterations were observed. The initial Cone Beam Computed Tomography analysis revealed the need for volume gain in bone thickness due to the local bone defect (Figure 1a,1b). 2 bone blocks of heterogeneous origin measuring 10X10X5mm were placed (Lumina Porous Block from Criteria Biomaterials, Brazil). As a preoperative prophylactic measure, 2g of amoxicillin was prescribed preoperatively, along with 4mg of dexamethasone, both 1 hour before the surgical procedure. Blood was also taken for the use of LRPF.

Extraoral antisepsis was carried out with 2% chlorhexidine. The anesthetic technique of our choice was infiltration with Articaine Hydrochloride (100,000:1 dilution). The surgical technique of our choice was trapezoid-shaped relaxing incisions with an inverted base with access in the regions of elements 13 and 23 and the ridge between 11 and 21, followed by divulsion and total detachment of the entire flap (Figure 2). The block was then prepared with a maxi-cute multi-laminate drill in a 1:1 reducer at 1400 RPM, to shape it according to the base of the recipient bed, preparing the recipient area with decorticalization using a 701 multi-laminate drill, making grooves and perforations in the recipient area, with the intention of causing bleeding for nutrition (Figure 3).

The block was drilled prior to the installation in the bed using a 1.3mm diameter helical cutter, installed with a hand wrench, completely passing through the block, placed in the region of element 11, and immediately inserted with 01 1.5X9mm fixing screw (Titanium Fix, Brazil), manually with a slight inclination in its perpendicular axis in order to facilitate installation and establish an axis to retain the block in the direction of the bed (Figure 4a/4b). The spaces between the block and the recipient bed were filled with particulate bone of heterogeneous origin (Lumina bone Porous small granulation from Criteria Biomaterials, Brazil). The grafts were covered with a 20x30mm high-resistance specific collagen membrane (Lumina Dermal from Criteria Biomaterials, Brazil) (Figure 5a/5b). The sutures were sutured using 5-0 nylon thread in a continuous festooned technique and single sutures in the relaxing technique (Figure 6a/6b). We finalized with a mock-up.

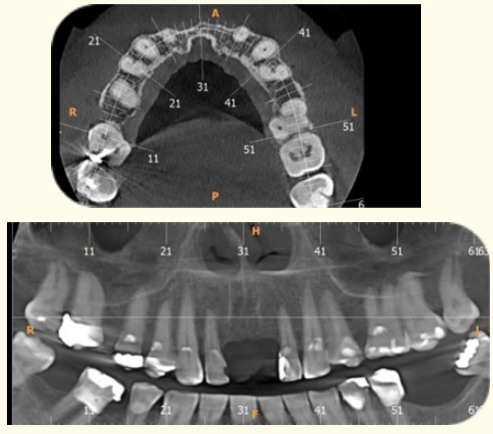


Figure a

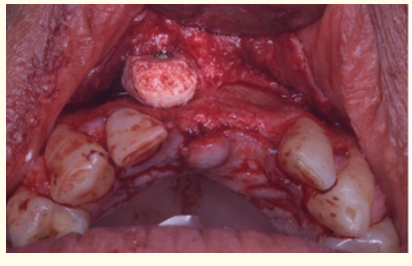
Baseline

Figure 1

Figure 2

Figure 3

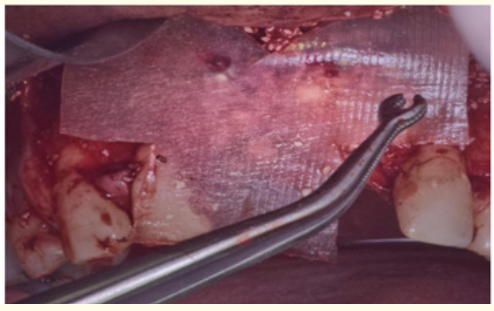
a



b

Figure 4

a



b

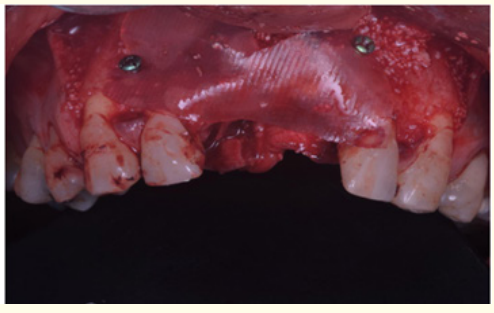


Figure 5

a

b

Figure 6

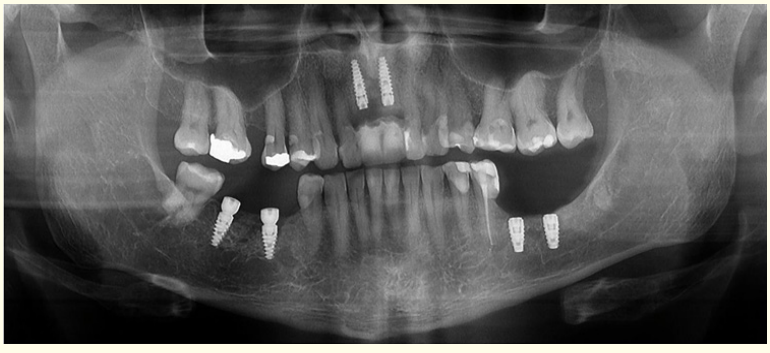


Figure b

Implant Installed, Inicial view

Figure c

Post-reopening vision

Discussion

Schropp et al. reported that there is 50% bone loss in the lingual vestibule area after the loss of a tooth, with only 30% in the first three months, limiting implant installation [16]. For this reason, Ortiz reports that in some cases it is necessary to carry out reconstruction procedures on these bone defects, in order to obtain volume and allow for proper implant installation, thus achieving long-term success and primary stability, as well as aesthetic benefits [2].

Rehabilitation in the field of implant dentistry requires some means of re-establishing bone defects, whether partial or total, in the mandible or maxilla. This rehabilitation will depend on planning and the amount of bone the patient has, both to achieve satisfactory aesthetic results and good osseointegration [17]. For corrections of bone defects related to vertical or horizontal bone augmentation, Leal et al. in 2019 reported that it is necessary to carry out procedures that improve the thickness of the alveolar ridge to later receive the implant [18].

There are different procedures for improving bone damage, the most common being guided bone regeneration (GBR) and the use of autogenous bone blocks. Khoury., *et al*. describe their technique with the use and stabilization of two autologous bone blocks sepa-

rated by microscrews and filling the space generated with autogenous bone chips. These blocks are extracted from the symphysis or mandibular ramus, through piezoelectric surgery or microsaws, in which, after being obtained, the block is divided into two thin sheets. Urbano et al., on the other hand, explain that their technique consists of a mixture of autogenous and xenograft, which must subsequently be coated with a resorbable collagen membrane and stabilized with titanium pins. However, these techniques still have limited comparative information. Some studies report that cases of infection are more frequent with Urban's technique [19].

According to Leal., *et al,* despite its limited use, the deproteinized particulate bovine mineral graft showed good biological properties, greater reduction in surgical time, lower risk of contamination, less trauma to the donor area, and reduced costs. In addition, this material serves as osteoconductive support, both in the migration, adhesion and proliferation of osteoprogenitor cells and in the production of extracellular matrix, due to differentiation into osteoblasts [18]. As the tissue is remodeled, the material is reabsorbed, having less osteoconductive action in lateral or vertical bone defects. In addition, Shiezadeh., *et al*. suggested that absorbable membranes can be used for horizontal bone augmentation, being a sensible choice to avoid new surgical exposure, avoiding the risk of contamination [20].

The membrane, whether absorbable or not, prevents the proliferation of unwanted cells, allowing only bone cells to proliferate. With or without the membrane, autogenous grafting results in excellent gains in ridge width in bone defects, as well as rapid integration of the grafted material [18]. However, according to Marques., *et al*. in 2023, a certain amount of donor area is required. Besides that, there is an increased risk of contamination. Bovine bone, despite its slower remodeling process, results in good stability of the interproximal height of the bone [21].

Freeze-dried bovine bone graft, by means of a three-dimensional osteoconductive matrix, will contribute to neovascularization and cell migration with the aim of promoting osteogenesis [2]. As it is a type of heterogeneous bone graft, it has often been chosen because it overcomes the disadvantages of autologous bone during the surgical procedure. In order to promote gains in regions of bone defects, volumization and the gain to be achieved must be considered [18].

In order to achieve a more predictable GBR, regenerative procedures need to follow a number of principles: primary closure, which makes the area free of microbiota and mechanical forces and angiogenesis to stimulate bone formation, thus guaranteeing different compartments and preventing the biomaterial from collapsing. Besides, it promotes blood clot stability [19]. By following all these principles, it will be possible to obtain good results and reduce the chances of adverse effects.

Conclusion

Considering the bone resorption and consequent loss of volume that can occur in both the mandible and maxilla after tooth loss, there may be a need for reconstruction in regions where there is a considerable bone defect. Therefore, GBR aims to restore bone volume and height in the defective region, as implant rehabilitation depends on the presence of a bone of sufficient height and thickness for its success.

This case report showed that guided bone regeneration (GBR), using a bone block graft of heterogeneous origin associated with PRF and a collagen membrane for the reconstruction of bone defects carried out prior to rehabilitation with dental implants, proved to be an effective way of gaining bone volume and height in the anterior maxilla.

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