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# Main literary findings on autogenous and xenogenous grafting: A review

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## Abstract

After tooth extractions the alveolar bone reabsorbs due to the lack of mechanical loading of the mastication. Such reabsorption hinders the rehabilitation of edentulous patients due to possible non-adaptation of the prosthesis and lack of height for implants, causing various health damages. To minimize reabsorption grafts can be used at the time of extraction, in the alveolus. These grafts may be autogenous, mainly removed from the patient's mental region, or alogens, extracted from the devitalized bovine bone matrix. The objective of this literature review is to show the advantages and disadvantages of each type of graft.

## Introduction

According to the literature one of the tissues that most remodels is the bone tissue. This tissue, specialized, vascularized and dynamic connective tissue, changes throughout the individual's life [1,2]. One of the most common traumas, ie, dental extraction results in loss of alveolar bone due to atrophy of the edentulous ridge [2,3]. In many circumstances, this is a limiting factor to the rehabilitation with dental implants, due to the insufficient bone volume for its execution, and the use of grafts may be indicated.

In the area of buccomaxillofacial surgery and traumatology, bone is the most commonly required tissue in prosthetic surgeries, in the treatment of congenital defects and dentofacial deformities [3,4]. Although autogenous bone grafts are widely accepted as a standard for the treatment of bone defects, homogenous and heterogenous implants, and synthetic bone substitutes have been widely studied as an alternative to grafts [5,6].

Patients are becoming more and more demanding regarding dental treatments. Treatment as the total prosthesis are no longer accepted [7]. The scientific and technological advances that implantology is currently undergoing have been responsible for improving the quality of life of total or partial edentulous patients. However, some patients, this treatment becomes impracticable, because they do not possess sufficient alveolar bone. For this reason, several studies involving autogenous bone grafts and biomaterials have been developed [8].

The autogenous graft is still considered the best graft for the alveolar bone defects and can be removed from the intraoral regions. The choice of donor area depends on the preference of the dental surgeon, size of defect to be filled and morbidity associated with the surgical procedure. The most used sites with donors are: Mento, Tuber da Maxila and Retromolar [9]. When the autogenous graft is not enough or the patient is resistant in accepting two surgical stores, the biomaterials are excellent options.

The present work had as objective to survey the main literary findings on autogenous and xenogene grafts.

## Methods

A search protocol was developed to identify the evidence related to determinants for autologous and xenogenic grafts. Thus, the study included should relate different aspects and may involve different tissues (bone), surgical techniques, materials and expectations of the patient and relate them with getting a nice aesthetic when rehabilitation involved previous regions. Experimental and clinical studies were included (retrospective, prospective and randomized) with qualitative and / or quantitative analysis. Initially, the key words were determined by searching the DeCS tool (Descriptors in Health Sciences, BIREME base) and later verified and validated by MeSh system (Medical Subject Headings, the US National Library of Medicine) in order to achieve consistent search.

### Mesh terms

The mesh terms were included "Dental Implant", "Bone Graft", "Autogenous Graft" and "Xenogenic graft". For further specification, the "anterior maxilla" description for refinement was added during searches. The literature search was conducted through online databases: Pubmed, Periodicos.com and Google Scholar. It was stipulated deadline, and the related search covering all available literature on virtual libraries.

### Series of articles and eligibility

A total of 68 articles were found involving implantation, anterior and aesthetics. Initially, it was held the exclusion existing title and duplications in accordance with the interest described this work. After this process, the summaries were evaluated and a new exclusion was

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held. A total of 30 articles were evaluated in full, and 24 were included and discussed in this study.

## Literature review

Materials for bone grafting can be classified as osteogenic, osteoinductive and osteoconductive. Osteogens refer to organic materials capable of stimulating bone formation directly from osteoblasts [1-3]. Osteoinducers are those capable of inducing differentiation of undifferentiated mesenchymal cells into osteoblasts or chondroblasts, increasing bone formation at the site or even stimulating bone formation at a heterotopic site [4-6].

The osteoconductive materials allow the apposition of a new bone tissue on its surface, requiring the presence of preexisting bone tissue as a source of osteoprogenitor cells [7]. The ideal graft material should meet the following requirements: 1) unlimited supply without compromising the donor area; 2) promote osteogenesis; 3) do not present immune response of the host; 4) revascularize rapidly; 5) stimulate osteoinduction; 6) promote osteoconduction; 7) to be completely replaced by bone in quantity and quality similar to that of the host [8]. There is no such ideal grafting material, but autogenous bone is enshrined in world literature as the one that can bring features closer to the ideal.

It has as main advantage its potential of integration to the receptor site with bone formation mechanisms of osteogenesis, osteoinduction and osteoconduction [22]. As a disadvantage, there is a need for a donor area, potential for resorption and difficulty of adaptation in the recipient area. The main donor extraoral areas are the iliac bones [22]. The regions of the body, ment, branch and mandible coronoid can also be used, although they provide less bone quantity [23]. In recent years autogenous grafts have been widely used by implantology. It is essential to emphasize that the success of the technique is based on the basis of biological principles, clinical experience and results obtained make it the technique of choice in small oral rehabilitations [19].

This time, the autogenous graft was chosen for the clinical case presented since the amount of bone required for subsequent rehabilitation of the patient was compatible with the donor area, oblique line, besides the numerous advantages previously mentioned, besides being a surgery performed in single session, requiring no prior hospitalization and general anesthesia. Predictability is the main factor in the choice of this type of bone reconstruction material [13,34], since this is the only technique that provides bone-forming cells with bone-building capacity, growth factors, and a bed-like bone structure receptor [13].

### Autogenous graft

There is a wide variety of grafting materials that can be used safely and predictably, either alone or in combination: autografts, allografts, xenografts and alloplastic materials such as calcium phosphates, bioactive glass particles and hydroxyapatite [10]. Bone grafts can produce bone formation by osteogenesis, osteoconduction or osteoinduction [10-12]. While osteogenesis provides osteogenic cells and matrix directly from the graft, osteoinduction postulates that the grafted material is chemotactic to undifferentiated progenitor cells, inducing their differentiation into osteoblasts [10-12].

Osteoconduction is generally known as a three-dimensional process of capillaries, perivascular tissue and progenitor cells from the donor site into a porous-scaffold structure of a graft [13]. Autogenous bone is considered the gold standard for bone reconstruction. As a graft material, it is ideal because it does not elicit an immune response during the remodeling process. Donor sites generally consist of the iliac crest, for bilateral and intraoral approaches, for unilateral approaches [14].

Non-vascularized autogenous bone blocks may undergo partial necrosis and resorption due to prolonged ischemia and insufficient subsequent revascularization in TLSM. Thus, the degree of osseointegration and implant stability in the graft may be limited. The use of particulate autogenous bone is an approach that facilitates cellular nutrition within the graft, initially by diffusion into the clot and subsequently by the newly formed blood vessels. Bone crushing promotes the release of osteoinductive substances in the matrix, which increases bone neoformation [15-17].

On the other hand, small bone particles that cannot be rigidly attached, undergo micromovements that may inhibit bone formation [17]. Autogenous grafts are most commonly used because of their osteogenic, osteoinductive and osteoconductive properties. Thus, its biological activity combines the three properties, as well as the presence of a high number of viable cells and wealth of growth factors, providing the best results in the new bone formation [17], also by the promotion of neoangiogenesis, fundamental in the process of revascularization and bone remodeling [18]. The advantage of using autogenous bone as a graft material is the rapid growth of vessels by their angiogenic potential from the surrounding native bone. This revitalizes parts of the graft and its cells, which will subsequently participate in local metabolism, ie, osteoclastic reabsorption and osteoblast-guided functional remodeling. The integration of the graft into the TLSM and osseointegration of the inserted implant are faster when autogenous bone is added than with the biomaterial only [19].

Among the viable cells are osteoblasts, undifferentiated mesenchymal cells, monocytes and precursor cells of osteoclasts, which in turn participate in the remodeling and formation of new bone processes. Once autogenous bone is transplanted, the graft area is invaded by osteoinductive molecules, such as morphogenetic proteins (BMP), growth factors, and by osteogenic cells [20].

Thus, bone formation is considerably faster than when bone substitutes are used [21]. It is important to note that the osteogenic potential of autografts can vary considerably with age, presence or absence of systemic diseases, the donor area (mandible / iliac crest, cortical / spongy bone) and the bone tissue collection technique (crusher, scraper or sucker with filter), which will result in bone fragments with different sizes [21].

In a study conducted in humans, some authors observed that the origin of the autogenous bone is not important, but rather the amount of cortical bone of the graft, which may imply a faster or slower resorption of the graft, that is, cortical bone behaves like cortical bone, independent of its origin [22].

### Xenogen graft - bone substitutes

Bone substitutes can be used when the supply of autogenous bone is limited [12]. Alternatives such as bone substitutes do not have the necessary elements for osteogenesis and are only osteoconductive - they are synthetic and most of their organic components are removed in the manufacturing process. The use of bone substitutes in bone graft procedures can 1 - keep available space, avoiding tissue growth and barrier collapse; 2 - increase osteoconduction, allowing the growth of osteogenic cells from existing bone surfaces in the grafted material [11], stimulating osteoblasts to form new bone [14], by the formation of a porous framework; 3- preventing contraction of the wound by stabilizing the subsequent clot of the provisional matrix.

A bone substitute evaluated in clinical and animal studies is Bio-oss® (Geistlich Pharma, Wolhusen, Switzerland), which is a deproteinized mineral bovine bone, similar in structure to human bone marrow, both in structural morphology and composition mineral. Bio-oss is one of the most widely used bone substitutes in TLSM for its excellent osteoconductive potential [13]. It has a structure consisting of an ultraporous surface and an interconnected pore system, which acts as a microsponge, providing the entrance of blood cells, osteoblasts, osteoclasts and proteins into their particles, which allows the effective osseointegration of their particles.

It has been argued that deproteinized bovine bone is reabsorbable, however, based on available literature, it must be concluded that it will not be fully reabsorbed over time. As it has a relatively long reabsorption period, graft particles are still present after four years in humans [14]. Some authors have suggested that stability in terms of resistance to resorption is favorable, since the volume of the grafted area is maintained longer [8].

In addition, the reinforcing effect of the Bio-oss® particles on the new bone formed may result in a positive effect on the biomechanical properties a on the ability of the bone to support the implant [8]. In a study in humans, they observed that Bio-oss® particles were incorporated by the newly formed bone, both in the group treated with Bio-oss® alone, and in that treated with a mixture of Bio-oss® and autogenous bone [6]. Occasionally, osteoblast-osteoid formation lines were found in the newly formed bone. Bio-oss particles were found in close contact with neoformed bone, characterizing their osseoconductive properties [12].

## Discussion

The search for surrogates that had the same properties as autogenous bone, in order to reduce the morbidity of surgical procedures, led research to develop synthetic materials, while bone banks became more reliable. Several materials have been developed, among them: homogenous implants, xenogens, biological membranes, bioactive glasses and hydroxyapatite derivatives [1-4].

Vertical reabsorption of the maxilla is four times greater than that of the mandible. In the maxilla, an annual average bone resorption of 0.1 mm after tooth loss is estimated. Atrophy is more pronounced in the first year after the exodontia and becomes less intense in subsequent years [5,6].

Horizontal resorption, in both arches, begins at the buccal surface and progresses in the lingual and palatal direction. During the resorption process it is common to check for insufficient bone (thickness and / or height) for the installation of osseointegrated implants in the anterior region of the maxilla, while in the posterior, sufficient bone thickness and insufficient height are frequently found [7].

Among the indications of use is the repair of bone defects in dental and orthopedic applications; increased alveolar ridge; guided regeneration of bone tissues; bucomaxillofacial reconstruction; repair and replacement of orbital walls; and replacement of the eyeball [8,9].

## Conclusion

Before the review it can be concluded that autogenous grafts are still the first option in the treatment of alveolar bone loss. However, its disadvantages related mainly to the morbidity of the procedure and the small amount of possible donation material limits its use. Thus, xenogenous bone grafts have become commonplace so that the indication and choice of the various types available on the market are directly linked to the advantages and limitations of each, as well as the skill of the dental surgeon and his personal preference.

## Conflict of interest

The authors declare no conflict of interest.

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