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REVIEW ARTICLE

Fresh frozen bone in oral and maxillofacial surgery

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Abstract The aim of the current study was to review the use of fresh frozen bone (FFB) in oral and maxillofacial surgery. We performed a review of the articles published in the literature between 1976 and May 2014 analyzing three medical databases (PubMed, Cochrane Library, and Embase) and using specific search terms. Literature analysis on FFB applications in oral and maxillofacial surgery revealed 47 articles between 1976 and May 2014. There are 46 clinical articles and one review. Clinical articles are represented by 22 case reports and case series and 24 retrospective studies. Classifying the scientific production by year of publication, it is evident that especially during the last 6 years there was an increase of FFB graft use in oral and maxillofacial approaches. The literature analysis on FFB's use shows that its application in oral and maxillofacial surgery began slowly in 1992 with Perrott and since 2006 it had a real development. The recent significant increase emphasizes the importance of FFB for bone regeneration in oral and maxillofacial surgery. This review found consistent evidence of FFB's use increase in oral and maxillofacial surgery suggesting a valid instrument for bone regeneration. To date, risks connected to the infections' transmission and to the immunogenic

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potential are extremely low and could be considered practically absent. So, this is an important alternative in the preimplant reconstructive surgery.

Introduction

Bone reconstruction techniques are extensively used in oral and maxillofacial surgery.[1–5] The most important applications include the maintenance of postextraction alveolar volume, maxillary sinus elevation, restoration of the maxilla and mandible ridge, treatment of odontogenic cysts, and orthognatic surgery.

With the exclusion of the osteogenetic distraction techniques and grafts of vascularized flaps, all the other bone reconstruction procedures involve the use of bone or bone substitute materials.[6–8] Osteogenetic graft material directly stimulates osteoblasts inducing the production of bone tissue, osteoinductive material induces differentiation of mesenchymal cells into chondroblasts and/or osteoblasts, and finally, osteoconductive material facilitates the proliferation, cell migration, and apposition of new bone tissue on its surface or, if it has adequate porous structure, in its interior.[9–11]

The bone grafts can be classified into two major groups: bone blocks and particulate bone. Bone blocks can be subdivided as follows: cortical, cancellous, and cortical-cancellous.[12] In addition, on the basis of their structure, even if with some differences in their mechanical characteristics, all these type of bone can be adequately modeled and adapted to the defects.

The integration of bone grafts is a sequential process involving inflammation, neovascularization, osteogenesis, and bone remodeling in which graft stabilization and vascularization play a pivotal role.[13]

Bone grafts can additionally be classified into heterologous bone if it is transferred from one species to another; autologous bone if it is transferred on the same patient; and bone allografts or homologous bone if transferred between members of the same species.

Autologous bone graft material has always been considered as the gold standard because it showed osteogenic osteoconductive and osteoinductive properties.[14] In addition, no immunological reactions are expected.[15] Nevertheless, it presents some disadvantages, including increased operating time that must include the time of bone harvesting, and an increase in morbidity and postoperative risks in case of extraoral sampling. The autograft is widely used both as particulate and blocks, alone or in combination with osteoconductive materials. Those grafts are implanted either with or without membranes for the guided regeneration or together with preparations intended to improve the regeneration such as platelet-derived growth factors.[16]

Heterologous bone is mainly represented by deproteinized bovine bone and deantigenated equine bone.[17,18] Contrary to autologous bone it is available in unlimited quantities, but it is not osteogenic and osteoconductive.[19] In addition, it is associated with high costs and the possibility of pathogen transmission.[20]

Homologous bone is obtained from cadavers or from patients undergoing hip replacement surgery with removal of the head of the femur. femoral head. It has osteoconductive properties and it is potentially osteoinductive because its matrix contains growth factors such as bone morphogenetic protein (BMP) or vascular endothelial growth factor.[21–23] However, freezing causes almost total loss of cell viability; therefore, it has no osteogenic properties. Nevertheless, some authors showed a residual cell viability.[24]

Homologous fresh frozen bone (FFB) has already been widely used in orthopedic surgery and neurosurgery; recently, its advantages in oral and maxillofacial surgery could be shown.[25–27]

The sterility and the antigenicity represent two critical points. Regarding the sterility, irradiation increases the degree of safety. Regarding immunogenicity, no complications related to histocompatibility have been reported.[28] This could be due to the loss of viable cells by freezing.

The use of homologous FFB represents a promising alternative to autologous bone for bone reconstruction in oral and maxillofacial surgery. The purpose of this study was to review the scientific literature in order to define the state-of-the-art use of FFB in surgery.

Materials and methods

Three medical databases were used to analyze the articles published in the literature until May 2014: PubMed, Cochrane Library, and Embase. The keywords and medical subject headings used were: "*fresh frozen bone, FFB, deep frozen allogenic, maxillofacial, oral, human*".

Publications were divided by year of publication and type of article; the articles were subdivided by:

- clinical trials: these studies included case reports, case series, and retrospective studies;
- review.

For each clinical trial were considered the following parameters:

- patient number;
- bone type used;
- donor site;
- presence of irradiated bone;
- surgical procedure site: upper maxilla, lower maxilla;
- surgical procedure type: preprosthetic surgery with implant rehabilitation;