

The application of bone graft substitutes for alveolar ridge preservation after orthodontic extractions and for augmentation of residual cleft defects

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The use of bone substitute materials in orthodontics is to be considered prior to orthodontic space closure after tooth extraction during the treatment of marked crowding as well as for treatment of residual defects in cleft-lip-and-palate children. In both cases the common objective is structure preservation or augmentation of the alveolar ridge. The demands to be made on the synthetic bone graft substitute comprise not just complication-free and safe use but also the chance of early tooth movement into the treated defect area with sufficient stability of the new tooth position.

Key words: bone graft substitute, orthodontics, indication, requirements

INTRODUCTION

The cardinal symptom of lack of space is a common problem in orthodontics, reflecting a discrepancy between the space needs of the teeth and the space available in the dental arch. As a consequence, teeth erupt outside the regular dental arch, which results in misaligned teeth and disturbed jaw development. Orthodontic treatment aims at the prevention and treatment of this problem. If conservative measures for gaining space, such as transversal arch expansion, molar distalisation, protrusion of front teeth or minimal approximal stripping are insufficient, teeth need to be extracted in the interests of space, with consequent defects in alveolar ridge structure. Cleft lips and palates are found less often among orthodontic patients but frequently among disorders of craniofacial development. Despite timely ortho-

dontic growth promotion and control, they are associated with the more or less severe critical osseous defects which make tooth movements difficult or even impossible. There is a need for application of an efficient bone substitute material in special orthodontic extraction cases for preventive preservation of the alveolar ridge as well as for cleft defects or tertiary augmentative measures.

Problem definition

Tooth eruption during the first and second dentition leads to three-dimensional development of the alveolar process. Similarly, tooth extractions, with an associated loss of function in the affected area, result in vestibulo-oral and crestal-basal bone resorption subject to certain temporal principles, with bone morphology in the extraction area depending on many biological and treatment factors [2].

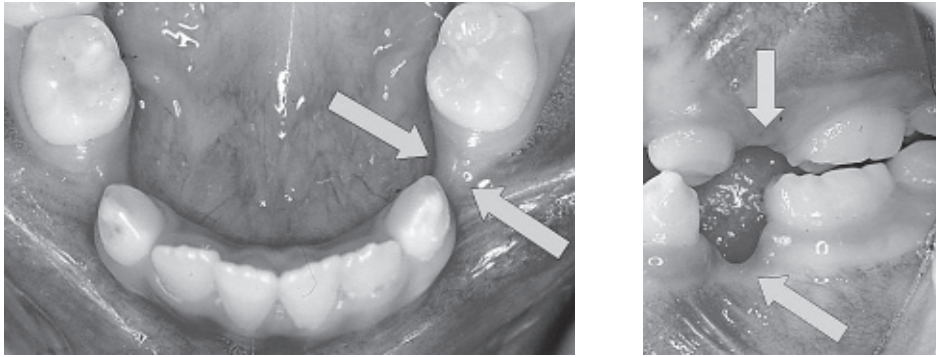


Figure 1. Typical vestibulo-oral and crestal-basal bone defect after premolar extraction.

Since any orthodontic tooth movement requires a sufficient bone supply within the therapeutic target area, bone loss is undesirable in the extraction region. It is, therefore, generally acceptable to move neighbouring teeth into this area immediately after extraction in order to preserve the vertical and buccolingual bone dimension to the greatest possible extent. In large extraction wounds, after osteotomy, after tooth removal following a marked periapical process or tooth removal within an aesthetically sensitive area, or if instant tooth movement into the extraction area is not indicated for orthodontic reasons, immediate application of bone replacement material in the defect area appears reasonable for prevention of a multi-dimensional bone defect or for preservation of the alveolar ridge structure [4].

Clinics

As early as immediately after tooth extraction, atrophy of the alveolar process is initiated associated with a shape change and a multi-dimensional loss of bone substance, which is particularly marked in the first year following extraction (Fig. 1). Most unfavourable is a traumatising surgical technique or digital compression of the extraction alveolus. Particularly in the anterior maxilla, including the first or second premolar, but also in the lower front, the mucosal and bone configuration is of special relevance to aesthetics. Beside an atraumatic surgical technique during tooth extraction and the so-called "guided bone regeneration" (GBR) technique, the variety of bone substitute materials is another pillar of the alveolar ridge-preserving concept [3]. Immediate insertion of a bone graft substitute (here: Nano-Bone® of Artoss GmbH, Rostock) into the fresh extraction alveolus appears to fulfil a structure-preserving function (Fig. 2).

DISCUSSION

Within the scope of a preventive concept for preservation of the alveolar structure, the indication of bone graft substitutes may be extended in certain orthodontic extraction cases or if ridge structure is to be kept as unchanged as possible, especially in terms of red aesthetics. This extension makes great demands on the biological properties of the respective bone substitute material. In particular, the question arises as to what extent the original alveolar ridge structure can be better preserved compared to instant tooth movement towards the extraction alveolus, taking into account healing and remodelling times in the grafted area [1]. Primary defect size and the individual capability of tissue regeneration and remodelling will certainly play an important role. The right timing of tooth movement into a grafted area, the appropriate forces and the expected risks and complications are issues that need further clarification from the orthodontist's point of view. Therapy of cleft patients usually includes insertion of autogenous bone during osteoplastic care. Circumscribed use of bone graft substitutes depending on defect size and morphology may be considered during secondary osteoplasty, for example before the eruption and alignment of canines, in the absence of upper lateral incisors prior to implant prosthetic care or in residual ridge defects before orthodontic space closure. Thus orthodontic demands on an appropriate bone substitute material include a simple complication-free and safe application, the possibility of early tooth movement into the grafted defect area and a secure stable tooth position in the former defect area. An essential advantage of bone graft substitutes compared to augmentation using autogenous bone is avoidance of a second operation for bone graft harvesting.

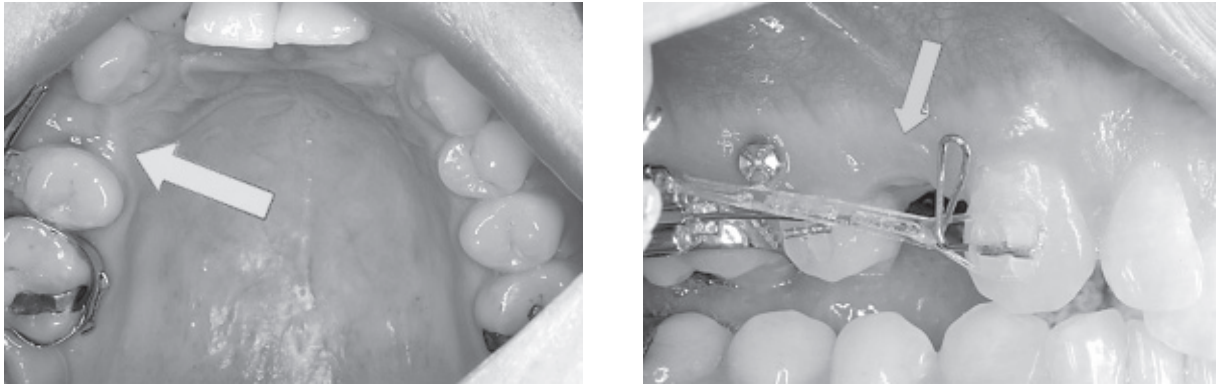


Figure 2. Alveolus treated with Nanobone® immediately following extraction. Alveolar ridge structure is largely preserved in the horizontal and vertical directions.

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