Alveolar Zygomatic Buttress: A New Donor Site for Limited Preimplant Augmentation Procedures

Nils-Claudius Gellrich, MD, DDS,* Uwe Held, DDS,† Ralf Schoen, MD, DDS,‡ Thomas Pailing, MD, DDS,§ Alexander Schramm, MD, DDS,¶ and Kai-Hendrik Bormann, DDS‖

Purpose: Augmentation of anterior maxillary alveolar bone defects before placement of endosseous implants still poses a clinical challenge. Previous traumatic loss of upper anterior teeth is often concomitant with significant bone loss. The aim of augmentation is to reconstitute as far as possible the original hard tissue contour. This is a prerequisite for later optimal positioning of the dental implants in accordance with prosthodontic and functional principles.

Materials and Methods: This article describes a new method for the reconstruction of small anterior maxillary alveolar bone defects using donor bone from the zygomatic buttress region.

Results: This region provides harvested bone with a natural convex shape, which is ideally suited for the anterior alveolar process region. Later fibrous tissue transplantation to provide more anterior projection to the anterior dental area is also avoided.

Conclusion: Bone harvesting was done with the piezoelectric device, which avoids trauma to the mucosal membrane of the maxillary sinus.

© 2007 American Association of Oral and Maxillofacial Surgeons

Traumatic loss of teeth in the anterior maxillary region commonly results in significant loss of buccal bone. This leads to reduced esthetics, problems with phonetics, and reduction in function. During the past few years, single incisor tooth replacement increasingly has become an indication for implant-based restoration. This treatment option has shown good long-term prognoses.

Eckert and Wollan1 reported a 5-year survival rate of 95.7% in a retrospective study of endosseous implants in the anterior maxillary region. Esposito et al2 undertook a meta-analysis on the basis of 73 published studies and revealed a 5-year survival rate for single implants of 97.6%. Lindh et al3 showed a success rate of 97.5% after 3 years for single tooth replacement by dental implants, and Haas et al4 calculated a success rate of 97% after 6.5 years for the same indication.

To achieve a good esthetic result and long-term functional stability, positioning of the implant is crucial. This presupposes an adequate amount of bone at the planned implantation site, which after anterior maxillary trauma is often not the case. In such cases, the clinical decision for an augmentation procedure is de facto predetermined. The method of augmentation can vary with respect to the technique and in regard to the material selected. In addition to autologous bone, alloplastic materials are used for hard tissue replacement. Synthetic bone substitutes such as hydroxyapatite, tricalciumphosphate, and bioactive glass, as well as denatured bovine bone and coral structures, are all possible alternatives available for use as augmentation material.5-9 Although the bone substitutes mentioned earlier are already in routine
clinical use, autologous bone is still regarded as the gold standard with respect to intended bone quantity, quality, and an uneventful healing phase with reliable outcome. A sufficient amount of bone surrounding the implant is the sine qua non for successful osseointegration of dental implants. Different autologous bone donor sites can serve this purpose. Small bone blocks harvested from the iliac crest or the facial skeleton (eg, mandibular ascending ramus, chin area, lower border of the mandible or posterior maxillary region) are common alternatives used for alveolar crest augmentation. Block transplants can be distinguished qualitatively from multiple particle transplants by the composition of the healed transplanted bone. Intraoral bone harvesting has the advantage of being performed in the same operative field and requires only local anesthesia.

The aim of this article is to demonstrate the advantages of a new alternative donor site, which, in addition to being less invasive, shows low donor site morbidity such as postoperative trismus, which yields bone of a favorable form (ie, a concave shape). According to our review of the literature, no previous report considers the alveolar zygomatic buttress as a donor site for limited bone augmentation.

**Patients and Methods**

A 53-year-old male patient attended our outpatient clinic complaining of pain and discharge in the upper left maxillary central incisor region. The patient’s general history was unremarkable; however, he had a history of maxillary dentoalveolar trauma 35 years ago involving the upper left central incisor. The incisor was endodontically treated 4 years before and apicocted 2 years later. Intraoral inspection showed well cared for dentition. The tooth was sensitive to percussion, highly mobile, and not thermoreactive. Pus was expressed from the periodontal sulcus on pressure, and periodontal probing revealed pocketing of between 14 and 15 mm around the circumference of the tooth.

Plain dental x-rays revealed periodontal bone loss, which extended up the side of the tooth toward the gingival margin. Extraction of the tooth was clearly indicated, and this was carried out. During the extraction, inflammation related to loss of the buccal cortical plate was noted (Fig 1). Because the placement of an implant had been planned, an augmentation procedure would first be necessary. This was performed 20 days after extraction with the following technique: after local anesthesia of the infraorbital and palatine nerves, and additional vestibular infiltration in the upper left central incisor region, a marginally detached mucoperiosteal flap reaching from the upper left central incisor to the upper left second bicuspid was raised (Fig 2). With the help of piezosurgery, a 1.6-cm² cortical bone transplant was harvested from the ipsilateral caudal end of the zygomatic buttress. No perforation of the maxillary sinus mucous membrane occurred (Figs 2, 3). After curettage of the granulation tissue in the extraction site (Fig 4), the socket was first filled with cortical bone chips harvested with a dental chisel. As a second step, the previously mentioned 1.6-cm² bone transplant from the zygomatic buttress was transfixed with 2 Medartis bone screws (Medartis, Umkirch, Germany), each 1.5 mm in diameter and 12 mm long, to the vestibular surface of the alveolar ridge in the upper left central incisor region (Fig 5). Periosteal releasing incisions of the mucoperiosteal flap allowed tension-
free wound closure with resorbable stitches (Vicryl 3.0; Ethicon, Norderstedt, Germany).

After a healing period of 4 months, placement of the implant was undertaken. This procedure was carried out with the patient under local anesthesia by raising a small trapezoid-shaped mucoperiosteal flap, which included the marginal gingiva around both adjacent teeth. Inspection of the bone graft showed good healing with preservation of size and form. The miniscrews were removed. A 16-mm-long Straumann-implant (Straumann, Freiburg, Germany) with a diameter of 4.8 mm was inserted (Figs 6, 7). Additional borings were placed around the implant shoulder. Finally, the mucoperiosteal flap was repositioned and sutured with resorbable stitches (Vicryl 3.0). After an osseointegration period of 6 months, the implant was exposed and a suprastructure was mounted onto it.

Discussion

Augmentation of alveolar bone defects before dental implant insertion has been discussed recently in several clinical studies. Alveolar crest defects have been particularly scrutinized because they are the limiting factor in optimal implant positioning. If the bony recipient site does not fulfill the later implant-based prosthodontic requirements, failure of the whole treatment is likely to occur. Different augmentation techniques and materials have been investigated. Apart from autologous bone, which is still regarded as the gold standard, a variety of allogenic, alloplastic, and xenogenic bone substitutes have been considered for use in augmentation of the alveolar crest. The clinical application of bone...
substitutes, together with different membrane techniques, with or without bone morphogenetic proteins, transforming growth factors, platelet-derived growth factor, and basic fibroblast growth factors, have also been described. A further popular technique for restoring the vertical bone deficit is osteoinduction.\textsuperscript{29-33} This method might be considered by some clinicians and patients alike to be a rather involved and time-consuming alternative.\textsuperscript{33} Although previously mentioned bone substitutes and augmentation techniques offer viable prognoses for achieving the required amount of hard tissue augmentation, autologous bone grafting is regarded to be superior in terms of postoperative and long-term outcomes.\textsuperscript{10} Autologous bone, because of its osteogenic effect, is still the optimal augmentation material at the present time.\textsuperscript{34} In addition to osteoconductive effects, osteoinductive effects on pluripotent mesenchymal cells are produced by growth-inducing bone proteins, which enter the autologous bone transplant via vasculogenesis.\textsuperscript{53} The transplanted bone volume is gradually remodeled. A further advantage of autologous bone grafting is the absence of graft-versus-host reactions. There is a limitation, however, on the amount of autologous bone that can be grafted without exceeding acceptable donor site morbidity. The choice of individual donor site depends largely on the quality, quantity, and form of the bone required. The amount of time required and the accessibility of the donor site must also be taken into account.\textsuperscript{35-38} Principally, extraoral or intraoral donor sites are to be considered for harvesting autologous bone grafts.

Typical extraoral donor sites are the iliac crest, the outer-table calvarium, tibia, and rib. Schlegel and Neukam\textsuperscript{55} mention that it is important to choose a bony architecture that matches (ie, similar donor architecture to that of recipient bone). Generally, extraoral donor sites allow the harvesting of greater bone volumes and thus are generally reserved for patients who require extensive bone augmentations. These techniques usually require general anesthesia, which has to be regarded as a disadvantage.

Intraoral harvesting of autologous bone can usually be done on an outpatient basis with the patient under local anesthesia. Frequent intraoral donor sites are the symphyseal retromolar angle and the lower border region of the mandible. However, the position of the inferior alveolar nerve must be considered and can limit these techniques. The symphyseal region of the mandible is regarded as having a favorable benefit-risk ratio. The amount of bone available for harvesting is sufficient for defects up to the width of 3 teeth.\textsuperscript{10} However, even here, care must be exercised with regard to proximity of the mental nerves. The access incision must, therefore, be done with great caution to avoid later paresthesia. Additionally, proper repositioning and fixation of the soft tissues, especially the mentalis muscle, is required to avoid a dropping chin.\textsuperscript{10}

In the maxilla, the maxillary tubercle is to date the only recognized area used as a donor site. However, the bone quantity from this site is rather limited and is suitable only for small bony defects. After bone harvesting from this area, postoperative trismus as well as injury to the adjacent soft tissues with profuse hemorrhage can occur.

The advantages of the zygomatic buttress region as a donor site can now be comparatively stated. The donor site offers easy access with excellent visibility and yields good quality bone of correct morphology. The zygomatic buttress is a strong bony pillar that provides pressure absorption and transduction in the facial skeleton. This donor site has the great advantage that no muscles have to be detached, and that the bony structure in this area is especially strong. In the case of an otherwise nontraumatized facial skeleton, a bone graft of 1.5 to 2 cm\textsuperscript{2} taken from the caudal zygomatic buttress zone will not compromise the strength of the lateral midface frame. Limiting factors are the mucous membrane of the adjacent maxillary sinus and the close relationship to the infraorbital foramen. However, direct visualisation of the infraorbital region allows nerve identification and preservation during bone graft harvesting. Ideally, the patient should have a negative history of any sinus problems.

As an additional caution, use of ultrasound-based dissection with piezosurgery (Mectron, Carasco-GE, Italy) further reduces the danger of perforating the sinus membrane.\textsuperscript{39}

The amount of bone we harvested from this donor site was adequate to reconstruct alveolar defects of a breadth of between 1 and 2 teeth. The convex cross-section of the bone graft was ideal for the reconstruction of alveolar projection loss in the anterior maxillary zone. This avoided the need for later secondary.

corrective soft tissue augmentation with fibrous tissue grafts to reconstitute the vestibular projection.40-45

Autologous bone grafts harvested from the zygomatic buttress are suited for reconstruction of bony alveolar crest defects in the anterior maxillary region. They show minimal donor site morbidity, provide good quality bone of favorable form, and therefore provide an excellent basis for successful osseointegration of dental implants. The cost–benefit ratio is good, and the complication rate is very low. This new method is an excellent alternative for the augmentation of anterior maxillary alveolar defects before implantation. Because of the quality and morphology of the bone, the alveolus can be reconstituted to its original contour.

References


