Use of Crestal Bone for Augmentation of Extremely Knife-edged Alveolar Ridges Prior to Implant Placement: Report of 3 Cases

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A technique is presented for interforaminal lateral augmentation of mandibles with adequate bone height, but extremely knife-edged mandibular alveolar ridges (Class IV of Cawood and Howell's classification of residual ridges), in which the crestal portion of the knife-edged ridge is used as grafting material. Following an osteotomy and rotation of the grafts by 180 degrees, the grafts were fixed to the residual ridge below the osteotomy line by means of miniscrews. All grafts showed only mild resorption after a healing period of 3 months, and it was possible to place 4 implants in the now sufficiently wide host region.
(Int J Oral Maxillofac Implants 1999;14:424–427)

Key words: augmentation, implant placement, knife-edged ridge

The use of endosseous implants for the treatment of edentulous and partially dentate patients with fixed or removable prostheses has been shown to be a viable treatment modality.[1] Normally, the dimensions and the shape of the alveolar ridge determine whether a patient can be treated with implants, along with the position and inclination of the implants. Thus, potential host sites must offer adequate bone volume. However, if the presurgical analysis reveals that a patient has an insufficient amount of bone, the bone deficit must be restored using reconstructive preprosthetic surgical methods. It is recommended that a circular bone cuff of 1 mm be planned to achieve a good long-term prognosis.[2–4]

Progress in the field of osseoaugmentative techniques has made it possible to select implants on the basis of prosthetic and esthetic criteria. Several procedures have been described in the literature for augmentation of the planned host site for endosseous implants in patients with severe alveolar ridge resorption. The simplest method is shortening of the narrow alveolar ridge until the width required for the placement of implants is reached. However, in this method, a loss of valuable bone material is accepted. Furthermore, this technique is only useful if the alveolar ridge is also widened soon afterwards toward basal bone.[5]

In horizontally reduced alveolar ridges, guided tissue regeneration with membranes is recommended to avoid bone deficits and fenestrations around the implant.[6] However, this method involves the risk of membrane-induced infection that may result in loss of the graft.[7] Methods to restore pronounced knife-edged alveolar ridges include alveolar ridge splitting and expansion by means of an osteotome.[5,8]

The methods of choice for treating patients with severe horizontal bone resorption involve the placement of autogenous bone grafts.[5] Different donor sites, such as the calvaria, the tibia, the rib, and the iliac crest, have been described in the literature.[9–12] However, since grafting involves frequent morbidity at the extraoral donor site, the following donor sites have been recommended: the maxillary tuberosity, the palate, the zygomatic arch, the mandibular oblique line, and the

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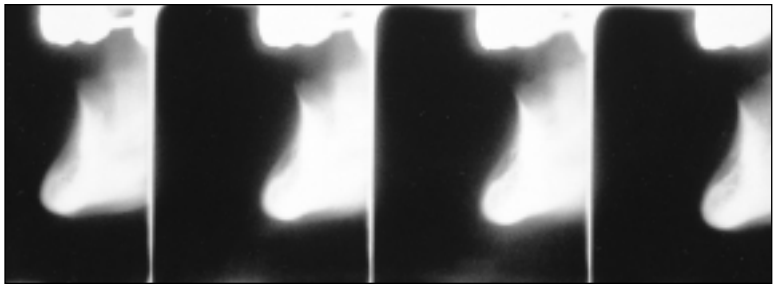

Fig 1 Preoperative labiolingual tomograms of the knife-edged ridge in the mandibular anterior region.

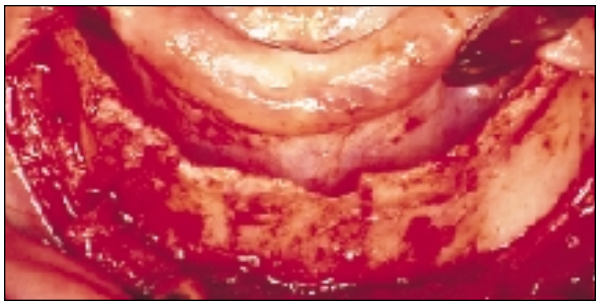

Fig 2 Intraoperative view of the extreme knife-edged ridge in the interforaminal region.

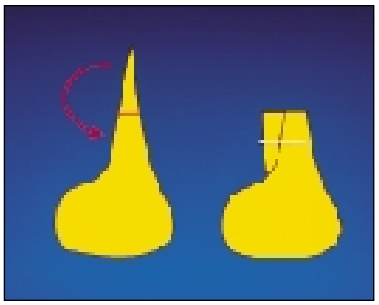

Fig 3 Schematic depiction of the osteotomy and the augmentation procedure used.

chin.[13–16] Furthermore, there is experimental evidence that intramembranous bone grafts that are placed as onlay grafts show better volume stability and less postoperative resorption than endochondral bone obtained from the iliac crest.[17,18]

In extremely high knife-edged ridges, as are sometimes found in the mandibular anterior region after early tooth loss, intramembranous grafts from the identical surgical site would be very advantageous. This study, therefore, presents a new surgical procedure that combines this advantage with a simple augmentation technique.

Patients

Three patients, lacking all mandibular teeth (mean age 60.4; 1 male and 2 females) and with ill-fitting mandibular prostheses, were referred for implant treatment. The clinical, radiographic, and tomographic examinations revealed massive resorption in a buccolingual direction, which had resulted in extremely knife-edged alveolar ridges (Class IV of Cawood and Howell's classification of residual ridges) (Fig 1). The vertical height was almost unchanged. The patients showed an overall mandibular height of 40 to 50 mm and a labiolingual diameter of 5 mm below the crest at 10, 12, and 13 mm, respectively.

Method

Following bilateral inferior alveolar nerve blocks and local infiltration anesthesia in the region of the mental foramina, a vestibular incision was made through the mucous membrane, the mentalis muscle, and the periosteum. A lingually pedicled mucoperiosteal flap was formed, exposing the mental foramina (Fig 2).

The width of the knife-edged ridge was measured in its infracrestal labiolingual expansion at a ridge diameter of 3.5 mm by means of compasses, and using a round bur, the osteotomy was outlined. In the 3 patients, this diameter was found at 5 to 7 mm below the ridge crest and therefore constituted the lower part of the osteotomy. The bone was osteotomized above and medial to the mental foramina, as well as in the middle of the mandible using a microcompass saw (Aesculap, Tuttlingen, Germany), and 2 rectangular bone grafts were obtained after the base had been severed along the line previously outlined using the round bur. The bone grafts were rotated 180 degrees so that the base became the crestal portion (Fig 3). Both grafts were fixed to the residual ridge by means of titanium miniscrews (CMS System, Leibinger, Freiburg, Germany) (Fig 4). The ridge was then smoothed distally to prevent steps and sharp edges.

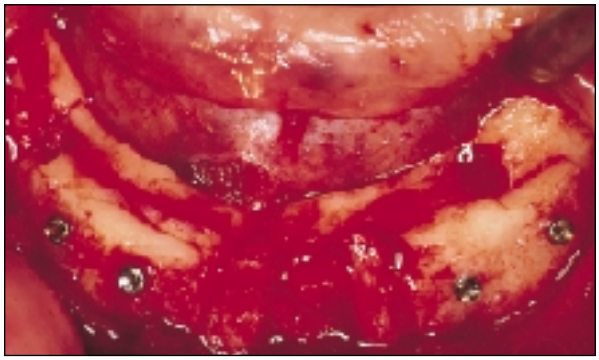

Fig 4 Condition after osteotomy of the knife-edged ridge and labial lateral augmentation.

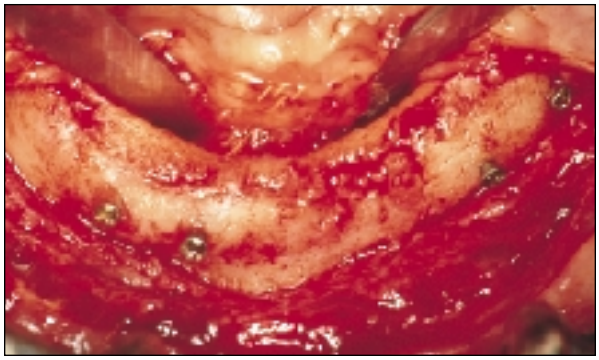

Fig 5 Augmented area after 3 months, immediately before placement of the implants.

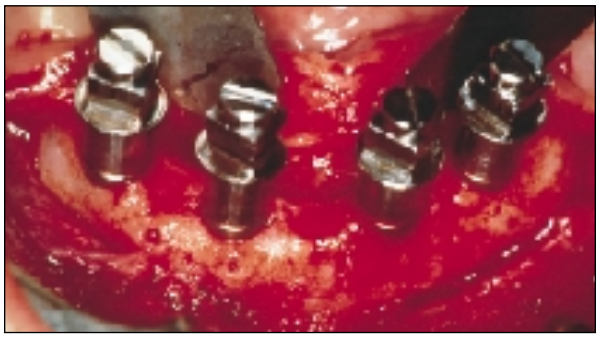

Fig 6 Intraoperative site after placement of the implants.

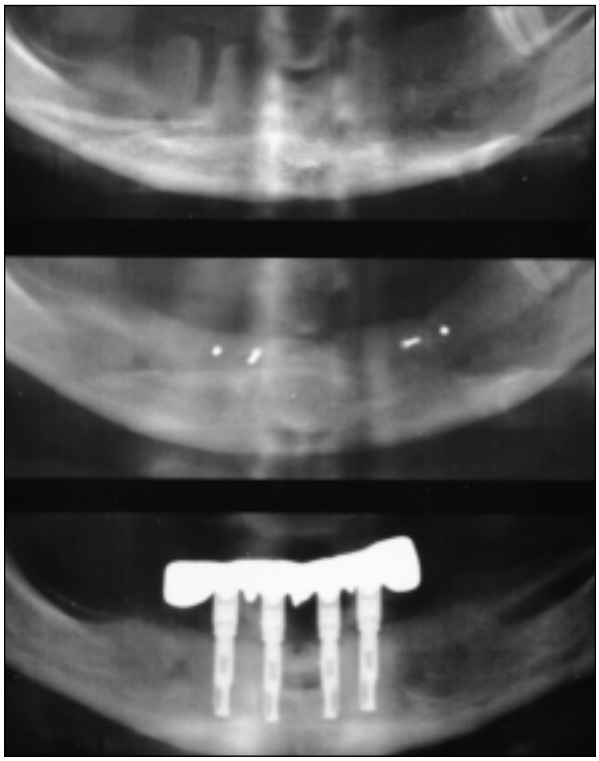

Fig 7 *(RIght) (Top)* Orthopantomogram prior to treatment. Postoperative orthopantomogram. *(Middle)* The 4 miniscrews used for fixation of the graft are clearly visible interforaminally. *(Bottom)* Final radiograph: a 1-piece bar restoration is used in the mandible .

Table 1 Measurements of Ridge Width at the Osteotomy and Resorption at the Level of the Titanium Miniscrews

Patient	Preoperative ridge width (mm)	Postoperative ridge width (mm)	Resorption horizontally (mm)	Final ridge width (mm)
K.E.	3.5	7.0	0.5	6.5
A.L.	3.5	7.0	1.0	6.0
K.F.	3.5	7.0	0.5	6.5

After a healing phase of 3 months, the secondary procedure was carried out (Fig 5). Initially, the extent of graft resorption was analyzed by means of measurements at the miniscrews. The fixation screws were then removed and 4 screw-shaped implants (Brånemark System, Nobel Biocare, Göteborg, Sweden) (mean length 13.66 mm, SD 0.94, diameter 3.75 mm) were placed in each patient (Fig 6). After 3 months of healing, the implants were uncovered and the prosthetic treatment was completed (Fig 7).

Results

The extent of resorption measured horizontally in the secondary procedure ranged between 0.5 and 1.0 mm (Table 1).

Discussion

The described procedure was chosen because recontouring of the alveolar process would have led to a considerable amount of bone loss. However, it would be possible to place implants of adequate length after recontouring the alveolar ridge; the main disadvantage of this procedure seems to be enlargement of the extraosseous parts of the prosthetic restoration, which results in a greater load on the implants when establishing the appropriate vertical dimension of occlusion.

The method of choice in such situations seems to be lateral augmentation. In contrast to the harvesting of bone grafts from the chin region, this method can also be used when there is a weakly developed mental protuberance. The osteotomy in the ridge area involves markedly less strain on the patient than the removal of bone grafts from the chin region, the iliac crest, the tibia, etc. Furthermore, the occurrence of morbidity is much less frequent than in other intraoral or extraoral donor sites. This procedure can be performed entirely without membranes because there is only mild resorption and an exact fit of the graft; this avoids the risk of membrane complications. However, the graft site should be slightly overaugmented to compensate for the mild resorption. The disadvantage of this method is a minor loss of vertical bone height, which is, however, normally of no account in this type of atrophy.

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