Veneer Grafting: A Technique for Augmentation of the Resorbed Alveolus Prior to Implant Placement. A Clinical Report

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Sixty-three patients with inadequate topography of the edentulous ridge were treated with mandibular ramus/body grafts to allow for the placement of endosseous implants. After 4 months of osseous healing, 187 implants were placed in the grafted sites. The mandibular ramus/body grafts remained viable regardless of the age or the extent of alveolar resorption in the patients treated. The ease of harvesting this graft in the office setting, its long-term resistance to resorption, and minimal postoperative morbidity makes this a viable intraoral donor site for horizontal alveolar augmentation. (INT J ORAL MAXILLOFAC IMPLANTS 2000;15:853–858)

Key words: *alveolar ridge augmentation, autogenous bone grafts, endosseous dental implantation, preprosthetic oral surgical procedures*

Because of their long-term stability, implant-supported prostheses have become accepted as a viable, and at times the recommended, treatment for reconstruction of edentulous areas. Dental implants have demonstrated long-term stable and predictable results for the restoration of patients missing single teeth, patients who are partially edentulous, and patients who are completely edentulous.[1–3] However, the lack of internal loading of the edentulous ridge leads to resorption of the alveolus in the horizontal and eventually the vertical dimension, which excludes implants for this patient group. Various methods have been reported for ridge augmentation to facilitate the placement of implants.

Guided tissue regeneration,[4–6] mandibular symphysis grafts,[7] allogeneic demineralized bone powder and hydroxyapatite,[8] and the TIME technique[9] (titanium mesh with bone grafts) have all been reported to be viable methods for the augmentation of horizontally deficient ridges. The technique of veneer grafting is used by the present author(s) for this horizontal augmentation. The ability to harvest flat cortical bone grafts extending 25 to 30 mm in length from the mandibular body and 10 to 20 mm from the mandibular ramus makes this a desirable intraoral donor site. The postoperative perception of the patient is similar to that of an extraction site, and patients are therefore more tolerant of the postoperative edema and necessary home care.

SURGICAL ANATOMY

To fully appreciate the posterior mandibular donor site, it is important to differentiate the mandibular body from the mandibular ramus. The mandibular body, or the buccal shelf, is the more anterior harvest site. It begins at the distal portion of the second molar and ends at the mesial aspect of the first molar. In the dentate patient, the buccal shelf is readily identifiable. It allows harvesting of up to 25 mm of monocortical bone without affecting the viability of the existing teeth. This site is similar in the edentulous patient, as it is the point of insertion of the masseter muscle and therefore does not resorb. Even in the severely edentulous mandible, the buccal shelf will provide an adequate quantity of bone for grafting a single quadrant of the maxilla.

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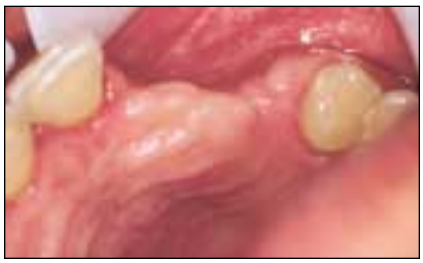

Fig 1 *(Above)* Horizontal alveolar defect that will not allow placement of endosseous implants.

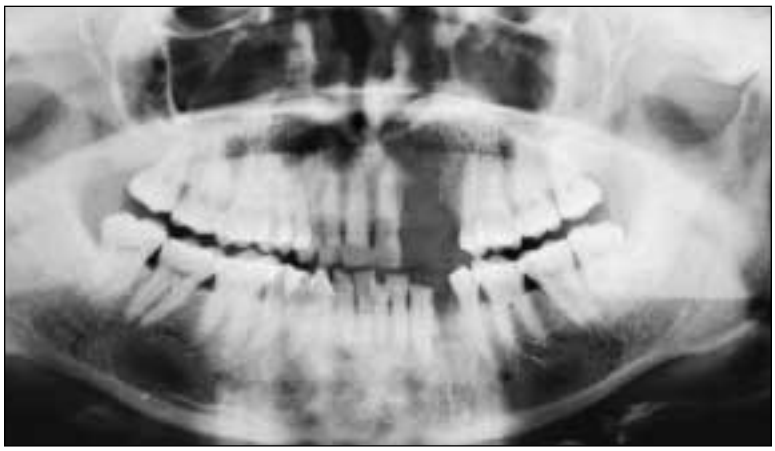

Fig 2 *(Right)* A panoramic radiograph demonstrates adequate vertical alveolar height.

The mandibular ramus is the proximal extension of this harvest site. It extends from the distal aspect of the second molar in both the vertical dimension toward the coronoid process and the horizontal dimension toward the posterior border of the mandible. The mandibular ramus harvest site is at its thickest at the junction of the ramus and the body. The more posterior and superior the dissection is extended, the thinner the bone, because the lateral and the medial cortical plates of the ramus have a minimal cancellous component that makes it difficult to split the bone.

Knowledge of the position of the inferior alveolar neurovascular bundle is essential for the harvesting of this bone graft. The position of the inferior alveolar nerve, as it relates to the medial aspect of the mandibular buccal plate, has been described in the sagittal split osteotomy literature by Rajchel and associates.[10] The thickest portion of the posterior mandibular harvest site is the mid-buccal shelf, which is at the distal aspect of the first molar. From the authors' experience, it is best to evaluate the transition from cortical bone to bleeding cancellous bone during the osteotomy, rather than relying on average thickness data. Once the cortical bone cut has been made and bleeding has been observed, the osteotomy should be considered complete.

Access to the mandibular ramus/body is made using the standard sagittal split osteotomy incision. Sulcular incisions must be avoided to ensure watertight closure after harvesting of the bone graft. The incision begins at the level of the mandibular occlusal plane and is made parallel to the external oblique ridge to avoid exposure of the buccal fat pad or transection of the buccal artery as described by Hall and colleagues.[11] The distal extension of the incision ends in the region of the buccal groove of the first molar. The incision at the recipient site should also be designed to allow for a watertight closure. If the area to be grafted is adjacent to teeth, papillae-sparing incisions should be made to facilitate closure, as well as to avoid blunting the adjacent papillae.

SURGICAL TECHNIQUE

In preparation for bone grafting of a horizontal alveolar defect (Fig 1), a complete implant work-up is necessary; this includes obtaining the appropriate radiographs, including periapical films, panoramic films, tomograms, or computed tomographic scans (Fig 2). An impression of the edentulous area is made, the extent of the horizontal defect is measured, and a mock bone graft is created in wax to include ideal tooth position (Fig 3).

Preoperative administration of 2 g of penicillin followed by a 7-day postoperative course is prescribed. The patient is sedated and the surgical site is prepared and exposed in the usual sterile manner. A papillae-sparing incision is made, exposing the buccal alveolar bone 3 to 5 mm apical to the mucogingival junction. The length and height of the recipient site are measured to ascertain the size of graft needed. A buccal vestibular incision is made to expose the mandibular ramus/body area. The junction of the mandibular body and the mandibular ramus is studied to determine whether a flat surface or an acute angle is present. The buccal shelf is measured, as well as the available ramus, prior to determining the final harvest site. A 1.0- to 1.2-mm fissure bur in a straight rotary instrument is recommended for outlining the osteotomy (Fig 4).

Fig 3 *(Above)* A diagnostic wax-up allows determination of the proper alveolar topography and tooth position.

Fig 4 *(Right)* A 1.0- to 1.2-mm fissure bur is used to outline the osteotomy site at the mandibular ramus/body region.

The initial cut is made anteroposteriorly, followed by proximal and distal vertical cuts. The depth of bur penetration is limited to the buccal cortical plate. Upon completion of the cortical osteotomy, the harvest site is outlined by the blood in the cancellous portion of the bone. The use of rotary instruments is discontinued at this point, and for separation of the graft from the donor site, 5-mm thin, curved and straight osteotomes are used. It is essential that patience be used in "walking" the osteotomes back and forth until the graft base fractures and the graft begins to separate laterally. The use of a mallet is not recommended, as misdirected inadvertent deep seating of the osteotome into the osteotomy site may result in damage to the inferior alveolar canal.

During lateral movement of the harvested bone, special attention must be given to the medial anatomy of the graft. During the controlled outfracturing of the graft, the cancellous separation may involve the canal. There have been occasions where the lateral half of the mandibular canal was a part of the harvested bone. On very rare occasions, the entire mandibular canal can be a part of the harvested bone. Therefore, prior to removal of the bone from the oral cavity, an absolute determination of the outfracture pattern must be made. The atraumatic exposure of the lateral aspect of the inferior alveolar canal, exposing the nerve, does not result in neuropraxia. Dissection of the inferior alveolar nerve trapped in the grafted bone may lead to paresthesia.

The monocortical graft is adapted to the recipient site, ensuring intimate contact between the medial portion of the graft and the buccal plate. Although perforation of the recipient site with a small bur to allow for revascularization of the graft has been recommended,[12] this technique was not used in the patients reported here. Fixation of the bone graft to the recipient site is accomplished using self-tapping titanium miniscrews. The recommended diameter of the fixation screw is between 1.3 and 1.6 mm. Initial stabilization of the graft is crucial. Absolute immobilization is necessary for the complete healing of the bone graft without a fibrous component. At least 2 screws should be placed to eliminate micromovement and rotation of the graft during the healing phase (Fig 5). Irregularities at the peripheral aspect, as well as the medial side of the graft, can be filled with Bio-Oss (Osteohealth, Shirley, NY) prior to soft tissue closure. The use of barrier membranes is not necessary and is in fact strongly discouraged, because there is no biologic foundation for their use in such instances. Complications with the use of barrier membranes have been reported by others.[13]

A watertight closure of the recipient site is absolutely essential (Fig 6). Releasing incisions allow for advancement of the flap over the graft. Horizontal mattress closure of the crestal incision, as well as the papillae-sparing releasing incisions, is accomplished with monofilament sutures. Dehiscence of the surgical wound will result in partial to complete loss of the graft secondary to fibrous union or nonunion with the recipient site.

In the esthetic zone, a removable prosthesis is fabricated and adjusted to ensure no contact or loading of the grafted site. Since the veneer grafts are placed over the buccal plate, no flange on the provisional restoration is fabricated. The alveolar portion of the prosthesis is adjusted for the first 2 weeks to accommodate edema. Once the edema has resolved, soft lining of the alveolar ridge portion of the removable provisional restoration may be permitted.

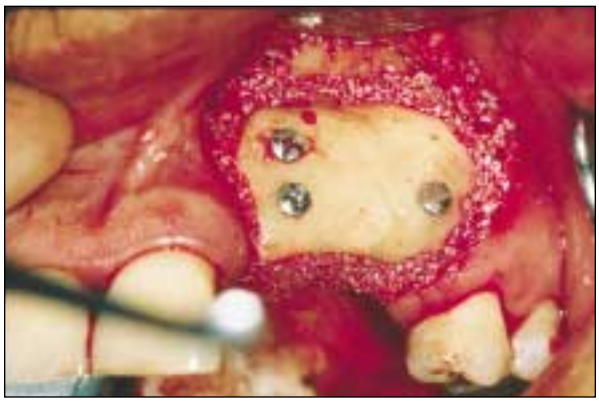

Fig 5 At least 2 screws are needed to stabilize the graft during the osseous healing period.

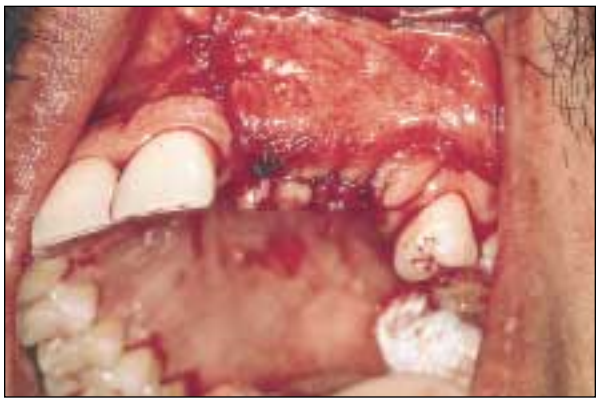

Fig 6 Horizontal mattress sutures are placed to obtain a watertight closure.

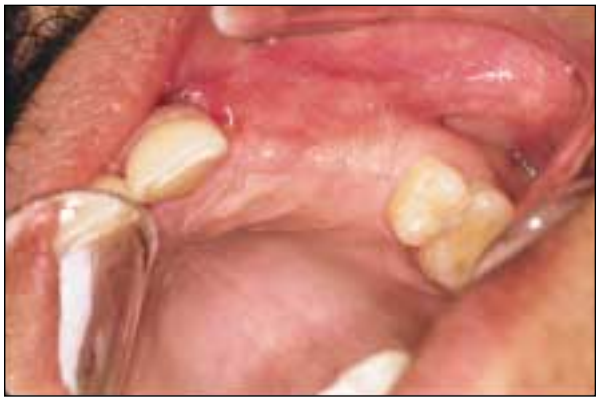

Fig 7 The appropriate alveolar contour is obtained after 3 months of osseous healing.

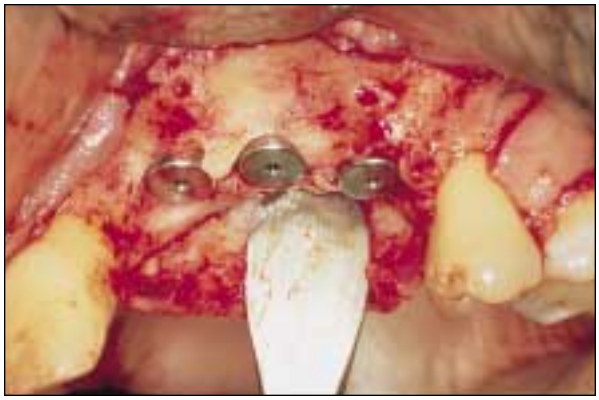

Fig 8 Thirteen-mm Brånemark MkII implants (Nobel Biocare, Göteborg, Sweden) are placed following standard protocol.

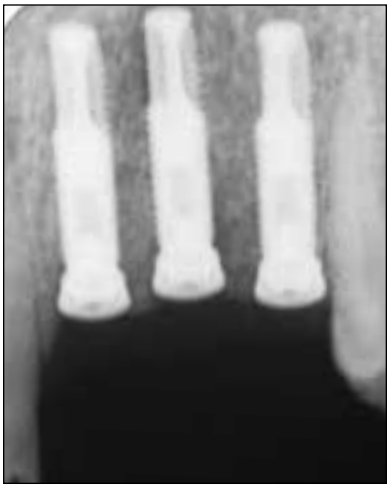

Fig 9 Postoperative periapical radiograph demonstrates the position of the implants.

Four months of osseous healing are allowed. At 3 months, clinical assessment of the augmented site is made (Fig 7). Impressions are made for evaluation of the grafted topography and the occlusion via diagnostic waxed casts. Ideal placement of the implants is dictated by the position of the teeth, which should encourage axial loading of the implants. A surgical guide is then fabricated from the final wax-up. Implants are placed using the Brånemark protocol[14] (Figs 8 and 9). Three months of healing are allowed for osseointegration of mandibular implants and 6 months for maxillary implants prior to second-stage surgery. Restoration of the implants is completed using the biomechanical guidelines described by Rangert and colleagues.[15] The definitive restorations may be cemented or screw-retained (Fig 10).

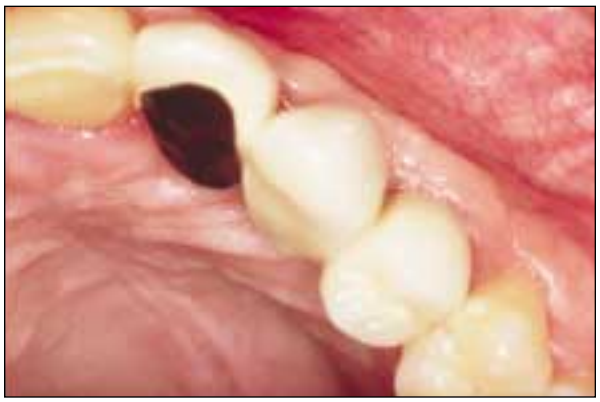

Fig 10 The definitive 3-unit prosthesis is delivered with the proper emergence profile.

Table 1 No. and Location of Graft Sites

Location	No. of sites
Maxillary right quadrant	23
Maxillary left quadrant	22
Mandibular left quadrant	22
Mandibular right quadrant	20
Total	87

Table 2 No. and Location of Implant Sites

Location	No. of implants
Maxillary right quadrant	47
Maxillary left quadrant	49
Mandibular left quadrant	51
Mandibular right quadrant	40
Total	187

Table 3 Dimensions of Implants Used

Implant diameter and length	No. of implants
3.75 × 10 mm	37
3.75 × 13 mm	93
3.75 × 15 mm	22
4.0 × 10 mm	2
4.0 × 13 mm	4
5.0 × 10 mm	13
5.0 WP (wide platform) × 10 mm	3
Total implants	187

TREATMENT

A total of 63 consecutive patients, 34 female and 29 male, was considered in this investigation. This group of patients was diagnosed with horizontal alveolar ridge deficiency that would not permit the placement of implants. The patients treated presented with similar horizontal alveolar atrophy in either 1 or 2 quadrants (Table 1). In both maxillary and mandibular arches, a total of 87 sites was grafted using autogenous mandibular ramus/body grafts (Table 2). After 3 months of osseous healing, each site was examined with periapical and/or panoramic radiographs. A total of 187 implants was placed and allowed to osseointegrate for 3 months in mandibular arches and 6 months in maxillary arches. The size and number of implants placed is shown in Table 3. Temporary paresthesia was seen in 2 harvest sites, with no incidence of anesthesia or dysesthesia.

At second-stage surgery, all implants were not sensitive to percussion and demonstrated no mobility. All 63 patients were restored, with a mean follow-up of 38 months after placement of the definitive prosthesis. There were 34 single-unit and 54 partial prostheses fabricated for these patients.

DISCUSSION

The ability to harvest up to 50 mm of autogenous graft material from bilateral ramus/body sites, the familiarity of surgeons with the anatomy of the mandibular ramus area, and the ease of postoperative care by the patients makes this procedure favorable over a harvest from the mandibular symphysis. The initial placement of a cold pack over the harvest site by the patient in the first 24 hours is critical in limiting postoperative morbidity associated

with this procedure, which includes swelling, ecchymosis, and pain. In contrast with the ramus/body site, the symphysis has considerably less bone available for harvesting. It is also difficult to use a cold pack over the symphysis, as the patient's oral cavity can be blocked by the pack. Compliance with postoperative cold packs is facilitated, as it is similar to placing a cold pack over the cheek after a tooth extraction. Postoperative infection was not seen in any of the patients treated.

The success of osseous healing, predictable implant osseointegration, and stable prostheses, as observed in this patient population, make this procedure a reliable service for partially edentulous patients.

CONCLUSION

Autogenous mandibular body/ramus grafts can be successfully used for the augmentation of horizontal alveolar defects in the maxilla and the mandible. Improved alveolar topography allows for the appropriate placement of endosseous implants and long-term survival of restored implants.

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