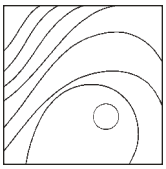
The Bone-Retention Wedge Graft: A New Procedure



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The success of oral restorations supported by dental implants in regenerated bone is well documented, as is the use of bone grafts to augment deficient alveolar bone. This article describes the bone-retention wedge graft, which may be useful for increasing the primary stability of dental implants, preserving bone in postextraction sockets, and covering exposed implant threads. (Int J Periodontics Restorative Dent 2014;34:e30–e35. doi: 10.11607/prd.1965)

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The esthetic expectations of both patients and clinicians demand optimal implant placement to attain the desired prosthetic result.[1] A variety of anatomical conditions may limit or preclude achievement of this goal.

New techniques for placing and loading implants have shortened the time between tooth extraction and placement of the definitive prosthesis.[2] While immediate loading protocols are effective for many patients, the presence of certain conditions make an immediate loading approach inadvisable for others.[3] This has resulted in the development of methods for regenerating both soft and hard tissues at implant sites.

The bone for the bone-retention wedge graft (BRWG) procedure can be harvested from any intraoral site typically used as a source of cortical bone, eg, the chin, ramus, coronoid process, torus mandibularis, or body of the mandible. Because of the proximity of such sites to the surgical zone, less patient discomfort and inconvenience typically results than when extraoral donor bone sites are used.

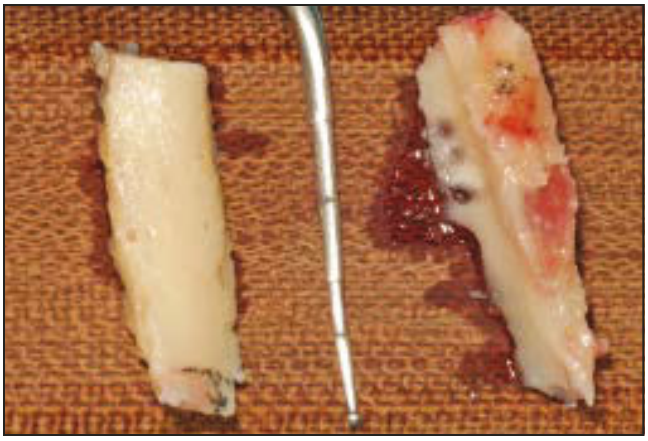


Fig 1 *The harvested bone is shaped into a wedge. In the example shown here, enough bone was harvested to enable placement of two wedge grafts.*

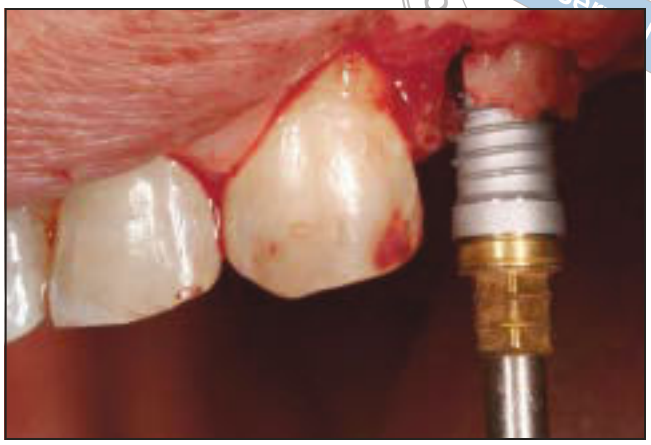
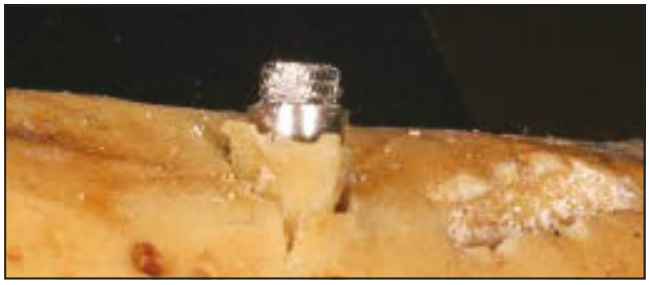


Fig 2 *A tapered implant was inserted next to the bone wedge, and as it was advanced into the osteotomy, the pressure exerted against the socket walls and the graft material gradually increased, thus obtaining primary stability of the implant.*

Fig 3 *A small buccal corticotomy can be created to relieve excess pressure, if necessary.*



Taking care not to damage the neighboring structures, a strip of cortical bone is harvested using a fine bone bur, saw, or trephine. The material should be at least half the length of the implant and at least 1 to 2 mm wider in diameter than the defect being corrected to enable redesign and adaptation.

A handpiece and bone bur are used, along with copious irrigation, to refashion the bone into a wedge shape that can be fitted loosely into the prepared osteotomy (Fig 1). The bone wedge is inserted with the narrow point placed apically. A tapered implant is then inserted into the osteotomy (Fig 2).

As the implant advances into the site, the pressure exerted against the socket walls and bone wedge gradually increases. The use of tapered implants is recommended because the tapered shape allows for a gradual compaction of the graft material. This is not the case when using a straight-walled implant. If the required insertion torque places excessive stress on the osteotomy wall, a very small vertical cut in the buccal cortical bone will allow the osteotomy to expand sufficiently so that both the implant and graft can be accommodated (Fig 3).

After the implant has been positioned at the desired depth, some of the bone graft material may be higher than the residual bone on the lingual side. This is typical in the mandible, where the resorption pattern may result in exposure of the buccal implant threads. If this occurs, once the BRWG is stabilized, it should be trimmed so that it does not exceed the residual lingual height of bone. This helps to avoid sharp edges

Fig 4 *The initial radiograph.*

that may cause a fenestration in the soft tissue covering the graft. If necessary, any remaining void space can be filled with particulate graft material. When performing a BRWG, the author recommends covering the graft site with a resorbable membrane.

The soft tissue is then approximated over the implant and graft material; periosteal incisions may be necessary to advance the flaps with no tension. To avoid plaque formation, 4.0-monofilament suture material is used with mattress sutures to approximate the edges of the flaps. This is followed by interrupted sutures to complete closure of the flaps. The suture material is left in place for 10 days.

Method and materials

There have been 34 BRWGs placed in 30 patients from January 2010 to March 2011. Thirteen of the grafts were placed in the maxilla, while the other 21 grafts were placed in the mandible. Indications for graft placement were the presence of a bone defect greater than the diameter of the implant, implant placement in fresh extraction sockets, the presence of exposed implant threads, and/or lack of primary retention. In all cases, the graft material and implant were placed simultaneously, without prior guided bone regeneration (GBR). Follow-up was conducted through March 2013.

Results

Of the 34 grafts, 14 were placed without using a membrane or adding any supplementary graft material, ie, material other than the harvested bone and bone chips yielded when the bone wedge was shaped to fit the graft site.

At nine of the graft sites, the bone wedge and bone chips collected during shaping were covered with a resorbable membrane.

In the remaining 11 cases, particulate bovine bone was used to fill in void spaces between the osteotomy and implant; resorbable membranes were used to cover the graft sites.

In 32 cases (93.75%), the grafts were judged to be successful at the time of definitive prosthetic fabrication. Although some degree of resorption of the graft block was observed in all 32 cases, all implants were osseointegrated, with no threads exposed.

An acute infection developed at 1 of the 34 sites within 2 weeks of the graft and implant placement. In that case, both the graft and implant were removed, and antibiotics were prescribed. In one patient, a vestibular fistula developed 4 months after implant placement. The site was reentered surgically, and circumferential resorption was noted around the coronal half of the implant. The apical half appeared to be osseointegrated, so conventional GBR was carried out, covering the area of resorption with particulate bovine bone and a resorbable membrane. Both complications occurred in the maxilla, in sites where the wedge graft procedure was supplemented with particulate bovine bone and covered with a resorbable membrane.

The following clinical report illustrates the use of the BRWG procedure to ensure adequate primary stability.

A 49-year-old man with an unremarkable medical history presented with peri-implantitis affecting three implants in the right posterior mandible (Fig 4). He pro-

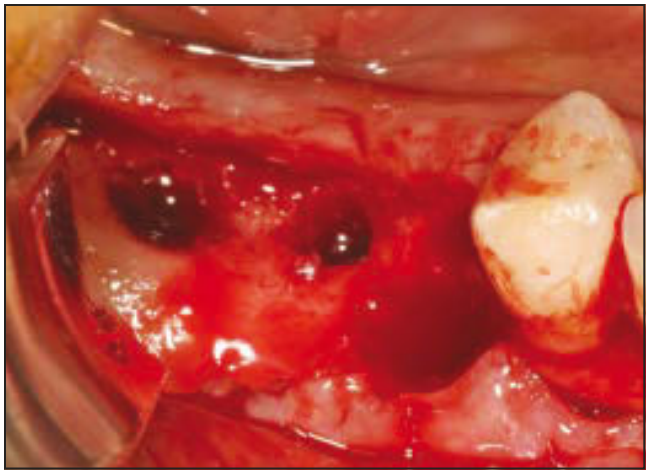


Fig 5 *Significant bone defects were still evident 2 months after removal of the patient's failed mandibular implants.*

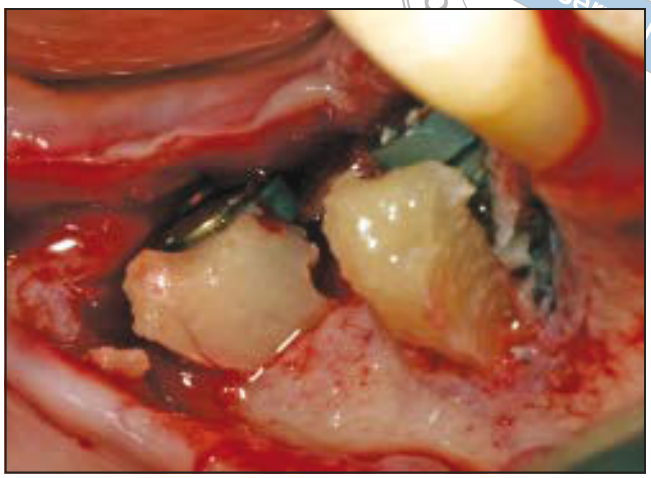


Fig 6 *New implants were placed in the defect sites and stabilized with BRWGs that covered the exposed buccal threads.*

vided informed consent to a treatment plan that called for extraction of the mandibular right third molar and the removal of the three failed implants.

Two months after the three failed implants were removed, a posterior full-thickness mucoperiosteal flap was raised in preparation for placing two new implants. However, the bone defects caused by the peri-implantitis were still evident (Fig 5), so a decision was made to place the implants in conjunction with two BRWGs to ensure adequate primary stability and thread coverage.

Using a 0.5-mm bone bur, a handpiece, and copious irrigation with saline, a monocortical bone block approximately 13-mm long, 6-mm wide, and 4-mm thick was harvested from the edentulous area distal to the mandibular left first molar. This bone was placed in a sterile tray, cut in half length-wise, and shaped into two wedges using copious irrigation. Bone chips generated during this process were also collected.

Osteotomies were created to accommodate two 5 × 10-mm tapered implants (Biomet 3i). As expected, retention of the mesial implant was inadequate because the bone defect was greater than the implant diameter. While the distal defect was smaller, adequate primary stability for the distal implant was also unachievable.

After provoking bleeding around the implant placement sites to increase the supply of osteoblastic cells, one of the bone wedges was placed into the mesial osteotomy along with one of the implants. The implant was advanced into the site, and a final torque of more than 50 Ncm was recorded. The second wedge graft and implant were placed in the distal site, and a similar amount of retention was achieved (Fig 6).

Both bone grafts were trimmed to the height of the lingual osseous crest, and the excess graft material along with the bone chips collected earlier were used to fill in the void spaces between the bone grafts and implants. A resorbable collagen membrane was positioned over the implants and graft material (Fig 7), and the soft tissue flaps were approximated in a tension-free manner.

Six months later, another flap was reflected, and the implants were found to be osseointegrated with viable bone covering the threads (Fig 8). Healing abutments were inserted into the implants, and an impression was made 15 days later. The definitive porcelain-fused-to-metal screw-retained crowns were delivered 7 months after the initial implant placement surgery (Fig 9). Figure 10 shows the radiograph on the day that the definitive restorations were delivered.

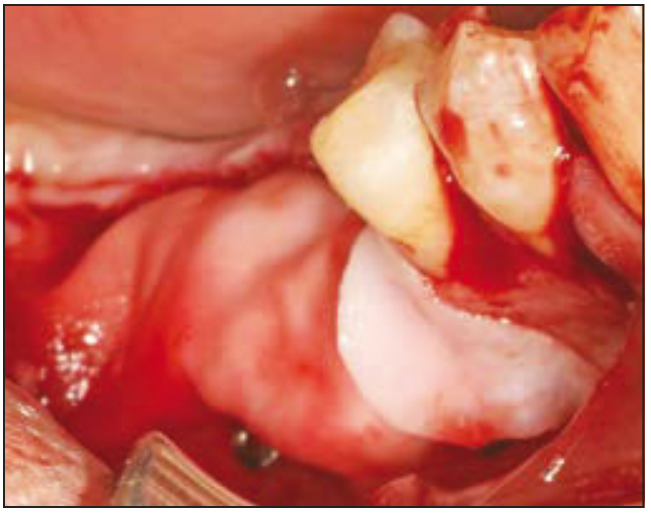


Fig 7 *The resorbable collagen membrane in place over the implants and graft material.*

Fig 8 *Six months later, healing abutments were connected to the implants. Note how regenerated bone now covers the formerly exposed implant threads.*

Fig 9 *The porcelain-fused-to-metal definitive prosthesis after delivery (courtesy of Dr Alvaro Ferrando, prosthodontist).*

Fig 10 *Panoramic radiograph at delivery of the definitive prosthesis.*

Discussion

Dental implants are mechanical devices inserted into alveolar bone to support a fixed or removable prosthesis. Threaded root-form implants initially secure the implant to the bone mechanically and subsequently undergo the biologic process of osseointegration.

Autologous cortical bone block grafts, used to augment deficient bone at implant placement sites, are routinely performed.[4] To succeed, the graft material must be immobilized and placed in close proximity to the native bone at the graft site, with the soft tissue covering the graft material. The grafts described in this article are small wedges of autologous cortical bone held in place by the implant in a manner that respects the biologic parameters and uses

the mechanical properties of the implant design so that the implant and the graft material stabilize one another.

The BRWG differs from traditional cortical bone block grafts in several ways. *(1)* It reduces the number of surgical appointments necessary, as the volume of bone is enhanced at the time the implant is placed. Total treatment time is thus reduced. *(2)* It eliminates the need for bone screws. *(3)* It can be used as a rescue solution when primary stability cannot otherwise be achieved during implant placement due to inadequate bone quality/quantity at the placement site.

In addition to increasing implant primary stability, the BRWG may also be used to cover exposed threads and restore bone lost due to resorption following tooth extraction, such as the buccal cortical bone of the mandible.

When an implant is placed and primary stability is not achieved, common solutions include tilting the implant slightly to improve the retention; using a longer, wider, or tapered implant; and placing autologous particulate bone inside the bed to assist in enhancing retention.[5] If this does not succeed, the option is to close the flap, wait 6 to 8 weeks, and place the implant again.[6]

Conclusions

The BRWG procedure is economical and simple, requires a small amount of bone, and, depending on where the graft material is placed, enables increasing the bone thickness mesially, distally, buccally, or lingually. A disadvantage of the procedure is that a second surgical site is required to harvest the graft material. However, the procedure may be useful for solving problems with achieving good primary stability during implant placement. It also can be used for preserving extraction sockets, increasing bone support for the adjacent papillae, and covering exposed implant threads.

Further study of this procedure is indicated, including periodic measurement of the implant stability using resonance frequency analysis from the time of implant placement to the point when the cortical graft recovers its resistance to loading (approximately 2 years after placement). Finally, the procedure does not violate any of the scientifically established conditions for the use of bone grafts.

Acknowledgment

The authors reported no conflicts of interest related to this study.

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