A Bovine-Bone Mineral Block for the Treatment of Severe Ridge Deficiencies in the Anterior Region: A Clinical Case Report

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A bovine-bone mineral block was used to treat a severe horizontal and vertical anterior ridge deficiency. Such a block can be shaped to conform to the defect, and it avoids the need for harvesting autogenous bone or fixation of the block with screws. After a 6-month integration period, an implant was placed. Six months later the implant was restored with a single crown. The case has been followed for 3 years. Slow bone resorption has been observed at the interface between the block and the surrounding bone, but the interproximal bone peaks, important for soft tissue support and esthetics, have been maintained over time. The 3-year follow-up results suggest that bovine-bone mineral blocks may be a suitable bone-replacement material for augmentation of extensive alveolar ridge defects in the anterior region. Int J Oral Maxillofac Implants 2008;23:123–128

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In the restoration of the anterior region of edentulous patients, the surgeon often faces severely resorbed alveolar crests and high patient esthetic expectations.[1] During the first 2 to 3 years after extraction, bone typically is resorbed to 40% to 60% of its original volume.[2] This reduces the bone width to less than 5 mm, an insufficient dimension to accommodate implant placement. In such cases, not only lateral bone augmentation but also vertical augmentation is needed. Grafting materials are necessary to provide a scaffold for bone regeneration and stimulate osteogenesis.[3]

Vertical augmentation of the alveolar ridge can be achieved by several methods, including the use of

- Distraction osteogenesis[4]
- Osteotomes in bone spreading[5]
- Bone-splitting instruments in the mandible and maxilla for spreading the bone
- Autologous bone blocks[3,6]
- Commercial bone-substitute material covered with a titanium-reinforced membrane[7,8]

Nonresorbable or slow-resorbing graft materials may be an alternative to autologous block grafts in vertical augmentation and can provide long-term preservation of the interproximal bone height and corresponding esthetics.[9,10]

This case report shows the use of a bovine-bone mineral block in combination with a resorbable collagen membrane to augment a horizontally and vertically deficient ridge.

MATERIALS AND METHODS

A healthy 55-year-old male patient presented with a highly mobile central incisor. The periapical radiograph showed severe bone loss horizontally and vertically around the tooth (Figs 1 to 3).

After tooth extraction, the patient was initially required to complete periodontal therapy prior to a bone-grafting procedure. This therapy included scaling, root planing, oral hygiene instructions, placement of restorations, and occlusal adjustments.

Surgical Procedure

The patient was given 1,000 mg of amoxicillin 2 hours before surgery. One minute prior to surgery, he rinsed with 0.12% chlorhexidine gluconate for 1 minute.

A local anesthetic was administered for pain control. The mucoperiosteal flap was raised with a paracrestal-to-palatal incision, followed by vertical

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Fig 1 Initial situation. Note the visible dehiscence in the middle of the defect, after tooth extraction.

Fig 2 A large vertical defect (a depth of 13 mm from the cementoenamel junction line) with almost total loss of the palatal lamina, a total absence of the buccal lamina, and interproximal bone resorption was diagnosed.

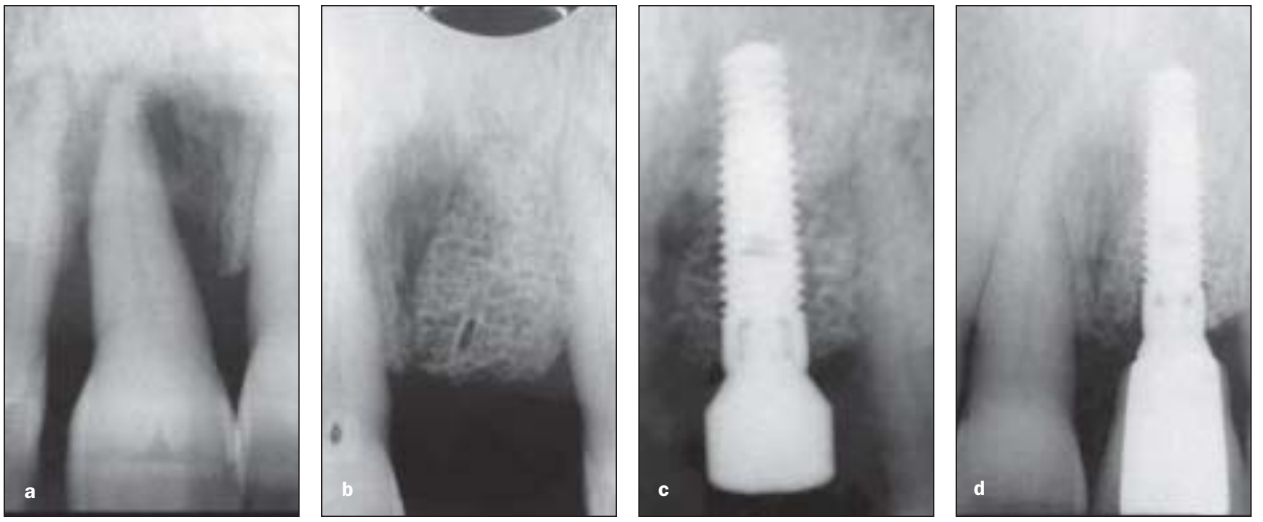

Fig 3 *(a)* The defect prior to augmentation. *(b)* The BBM block after 6 months in situ. *(c)* The site after uncovering of the healing abutment. *(d)* The site after 1 year in function, with detectable slow resorption.

releasing incisions 1 tooth mesial from and distal to the augmentation site. All that remained of the ridge was a 2-mm-wide palatal bone bridge, which contained a palatal fenestration. The buccal bone plate was completely resorbed. The vertical defect from the cementoenamel junction line of the neighboring teeth was 13 mm (Fig 1). The size of the vertical defect suggested the use of a block graft for augmentation.

No decortication was done. The standard procedure of stabilizing an autogenous bone block with screws was not attempted because of the severe risk of fracturing the remaining palatal bone. Instead a 1 × 1 × 2-cm bovine-bone mineral (BBM) block (Bio-Oss spongiosa block; Geistlich Biomaterials, Wolhusen, Switzerland) was shaped extraorally with rotational instruments to fit the defect. It was then placed, restoring the ridge to a width and height that would enable placement of a dental implant. The BBM block was fixed with compression only because of the risk of fracture of both the palatal bone and the BBM block (Fig 4).

After filling the gaps around the block with BBM particulate material, the graft was covered with a collagen barrier membrane (Bio-Gide; Geistlich Biomaterials). This was stabilized by means of buccally placed titanium pins. On the palatal side, the membrane was maintained in position by the palatal mucoperiosteal flap. Primary, tension-free soft tissue closure over the block was achieved by means of a split-thickness flap and interrupted sutures (Fig 5). A periapical radiograph was obtained immediately after surgery, and written oral hygiene instructions were given. The flap sutures were removed 15 days postoperatively. The site was allowed to heal for 6 months.

Fig 4 Block friction fixation after extraoral modeling of the graft.

Fig 5 Interrupted sutures after flap repositioning.

Fig 6 After 6 months, block integration was observed with no vertical resorption. The resultant ridge was 6 mm wide.

Fig 7 Final implant position, slightly palatal to the line connecting the incisal margins of the adjacent teeth.

Implant Surgery

Measurement of the hard-tissue gain was made using the same procedure used to measure the available bone prior to treatment (ie, periapical radiographs). The alveolar ridge width and height appeared suitable for implant placement.

The flap was raised with crestal incisions, and releasing incisions were made 1 tooth mesial from and distal to the augmentation site. For the reopening, a full-thickness flap was elevated. The BBM block graft showed no signs of resorption. Excellent clinical integration was present at the block margins (Fig 6). This was also evident in the radiographs (Fig 3b).

A 3.7-mm-wide, 13-mm-long screw-type implant (Tapered Screw Vent; Zimmer, Carlsbad, CA) was placed. The implant dimensions were limited by the available bone between the nasal floor and the apex of the defect.

After insertion of the implant into the block graft and the 4 mm of local bone apical to it, primary stability was evident. Cover-screw fixation and interrupted sutures were used for primary closure of the soft tissue (Fig 7).

Uncovering

After a 6-month healing period, the bone and soft tissue conditions at the site appeared healthy (Fig 8). The implant was surgically exposed. Papillary reconstruction was performed to correct the uneven soft tissue height between the implant and the adjacent distal tooth (Fig 9). The healing abutment was attached to the implant (Fig 10), and its position was checked radiographically (Fig 3c). After 1 week, the patient received a provisional nonfunctional crown for soft tissue development. The definitive porcelain-fused-to-metal crown was inserted after 3 months (Fig 11).

Fig 8 Healthy bone and soft tissue conditions after the osseointegration period. A lack of local soft tissue height is evident distally.

Fig 9 After distal papillary reconstruction, the healing abutment was placed to help keep the soft tissue in position.

Fig 10 Buccal view of the prepared healing abutment. Note the healthy condition of the keratinized gingiva.

Fig 11 Cement-retained single-tooth metalloceramic definitive restoration.

RESULTS

The initial periapical radiograph (Fig 3a) showed a 13-mm bone defect around the central incisor. Six months after augmentation of the defect, good marginal adaptation between the block and the surrounding bone was observed (Fig 3b). The bony defect was eliminated, bringing the ridge up to the same level as that of the adjacent teeth. Figure 3c shows the implant in its definitive position, with the healing abutment in place. No resorption of the block graft can be seen on the crestal margins.

The 1-year follow-up radiograph (Fig 3d) shows minor (less than 1 mm) vertical infrabony resorption along the implant. However, no resorption is evident at the crestal bone peak. The BBM material shows complete integration in the surrounding bone (Fig 3d). After another 2 years in function, no additional changes in the local bone height were observed. At the interface between the BBM block and the surrounding native bone, the radiograph reveals remodeling and incorporation into the natural bone. Overall, it could be observed radiographically that the BBM block changed in structure so as to more closely resemble that of the surrounding native bone.

DISCUSSION

This case report demonstrates the use of a BBM block graft to augment an alveolar ridge deficiency without fixing the block graft with screws.

In a review by Tolman of 107 published articles,[8] the author concluded that overall survival of block grafts was 92% when implants were placed immediately and 84% when implant placement was delayed. Nonvascularized free autogenous corticocancellous block grafts are usually the most common choice to repair bone deficiencies in combination with dental implant placement.[1,11] These autologous block grafts are easily stabilized in combination with endosseous implants or fixation screws. However, treatment becomes more difficult if the palatal bone plate cannot support the fixation. Such defects can be treated using titanium meshes[12] or distraction osteogenesis. The first option is technique-sensitive, however, and the second is difficult to apply for single-tooth implants and leaves an unfavorable mark on the soft tissue after removal of the device.[4]

Theoretically, autogenous bone grafts have osteoinductive and osteoconductive properties, leading to fast osseointegration of the bone-augmentation material. However, in practice they resorb quickly—by up to 100% in 3 years.[13] The loss of marginal bone height around these implants ranges between 2 and 3 mm over the first 3 years.[14] The rate can be decreased by correctly immobilizing the block on the deficient alveolar ridge or by covering the autogenous block with a membrane or a protective layer of BBM particulate.[15,16] Nevertheless, if large deficiencies are treated, there remains a threat of losing the initial bone volume before implantation and loading of the implant.

BBM is a natural deproteinized anorganic bone mineral with a high degree of biocompatibility.[17] The material is reportedly resorbable and is structurally highly similar to cancellous bone.[18] This is said to explain the early and effective bone apposition observed in areas augmented with this material.[17,19] As BBM undergoes slow remodeling over time and becomes incorporated into the native bone,[20] it maintains its volume over a long period of time. This ensures stability of the interproximal bone height of the augmentation site until the implants are functionally loaded and natural remodeling takes place.

CONCLUSION

Within the limitations of this clinical report, the results suggest that BBM blocks may be a suitable graft material for augmentation of severe anterior alveolar ridge deficiencies, providing stable long-term bone height. Long-term follow-up and further study are required to determine whether this treatment leads to predictably positive results.

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