GBR and Autogenous Cortical Bone Particulate by Bone Scraper for Alveolar Ridge Augmentation: A 2-Case Report

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Scientific literature describes autogenous bone as the gold standard among graft materials for alveolar reconstructive procedures. Alveolar ridge augmentation has been clinically achieved with different forms of autogenous bone, including autogenous cortical bone particulate (ACBP). However, few histologic studies demonstrating the biologic potential and healing dynamics following the use of ACBP are currently available. This case report presents 2 patients in whom atrophic edentulous alveolar crests were submitted to a vertical/lateral ridge augmentation prior to implant placement. The technique was performed through the use of a titanium-reinforced expanded polytetrafluoroethylene (e-PTFE) membrane with an ACBP graft obtained from the retromolar region with a specially designed bone scraper. Bone biopsy specimens were harvested at 9 months after graft placement. Analysis of the reconstructed bone revealed bone with a lamellar quality characterized by a mature osteonic structure. Sparse particles of grafted bone were evident in direct contact with the regenerated bone. Marrow spaces showed a normal stromal component with limited grafted particles. INT J ORAL MAXILLOFAC IMPLANTS 2008;23:111–116

Key words: alveolar ridge augmentation, autogenous cortical bone particulate, guided bone regeneration

A prerequisite for implant placement is the availability of sufficient alveolar bone to support and retain the endosseous implant. Factors such as infection, cystic lesions, tooth/alveolar trauma, or congenital tooth agenesis can cause a reduction of the alveolar ridge dimensions. A variety of reconstructive procedures have demonstrated efficacy in ridge reconstruction,¹,² and implant survival in reconstructed bone mimics survival in native bone.²–⁵ Surgical protocols for alveolar ridge augmentation include the use of resorbable and nonresorbable membranes,⁶ graft biomaterials,⁷,⁸ and bone morphogenetic proteins.⁹ Among grafting procedures, the use of autogenous bone is considered the first choice because of its osteogenic, osteoinductive, and osteoconductive properties.¹⁰–¹⁷ Autogenous bone can be harvested from intraoral donor sites (mandibular symphysis and ramus, maxillary tuberosity) or extraoral sites (iliac crest, tibia, calvaria).¹⁸ Although a number of donor sites have been described, there is no clear preference indicated in the literature for any specific donor site.

The efficacy of autogenous cortical bone particulate (ACBP) has been reported for both periodontal and alveolar reconstruction; however, few histologic studies showing the biologic potential and the healing dynamics following the use of ACBP are currently available.¹⁹,²⁰ Therefore, the present report histologically evaluates an alveolar reconstructive procedure based on the combined use of ACBP (obtained by means of a specially designed bone scraper) and an expanded polytetrafluoroethylene (e-PTFE) membrane in 2 cases where vertical and lateral alveolar ridge augmentation was to be achieved.
MATERIALS AND METHODS

Case 1
A 55-year-old woman presented with an atrophic edentulous alveolar crest in the mandibular right molar region. The clinical and radiographic examination revealed reduced lateral (5 mm) and vertical (7 mm) dimensions in the area of missing mandibular right molars. Patient medical and dental history included no systemic or local contraindications for surgical therapy.

After periodontal management, reconstruction of the edentulous crest was initiated. A full-thickness flap was elevated, and the buccal cortical plate was perforated. An adequate amount of ACBP was collected from the buccal cortical bone of the ipsilateral retromolar region using a specially designed bone scraper (Safescraper; META, Reggio Emilia, Italy). The harvested bone was positioned to augment the vertical and horizontal dimensions in the region of the mandibular right molars. A titanium-reinforced e-PTFE membrane (Gore-Tex Periodontal Material, W.L. Gore & Associates, Flagstaff, AZ) was positioned to cover the graft.21–25 The membrane was fixed by a mini-screw on the buccal cortical plate. The space-making effect was enhanced using an additional screw inserted perpendicular (vertical) to the bone crest and left exposed above the alveolar crest. This screw created an additional 6 mm of space for site development (Fig 1a). The exposed portion of this screw was entirely covered with the bone particles and submerged by the membrane; thus, the screw provided a reference point for assessment of the vertical augmentation of the bone crest at the surgical re-entry (Fig 1b). The flap was sutured with 5-0 and 6-0 e-PTFE interrupted sutures, and internal mattress sutures were used to ensure membrane coverage.

After an uneventful healing period of 9 months, a full-thickness flap was elevated to place an implant in the mandibular right first molar region. The membrane-supporting screw was completely submerged by newly formed bone (Fig 1c). After membrane and screw removal, a cylindric implant 5 mm in diameter and 13 mm long (Biomet/3i, Palm Beach Gardens, FL) was placed. A biopsy specimen was collected with a trephine bur (internal diameter: 2 mm; depth of the sample: 5 mm) from the reconstructed alveolar crest (Fig 1d). Radiographic assessment demonstrates stability of the reconstructed bone contour 3 years after implant loading (Fig 1e).
Case 2
A 50-year-old woman presented with a transversal and vertical collapse of the edentulous alveolar crest in the maxillary left first premolar region. No systemic or local contraindications for surgical therapy or implant placement were identified. A 2-step approach, bone reconstruction followed by implant placement, was selected.

After full-thickness flap elevation, a 2-mm thin alveolar ridge was evident in the area of the missing first premolar. There was also a 10-mm bone dehiscence on the buccal cortical plate of the second premolar (Fig 2a). After bone perforation, autogenous cortical bone particulate was harvested by a bone scraper (Safescraper) from the left retromolar region and positioned to augment vertically and horizontally the edentulous ridge and bone dehiscence. The bone graft was covered by means of a titanium-reinforced e-PTFE membrane (Gore-Tex). Primary closure of the flaps was ensured by 6-0 polypropylene interrupted and 5-0 e-PTFE internal mattress sutures.

After an uneventful healing period of 9 months, the site was re-entered for implant placement. Vertical and lateral augmentation of the alveolar crest was compatible with the insertion of a cylindrical implant 4 mm wide and 13 mm long (Biomet/3i). The buccal cortical dehiscence of the second premolar was completely reconstructed (Fig 2b). Three biopsy specimens of the reconstructed bone were collected with a trephine bur with an internal diameter of 2 mm during implant site preparation: 2 specimens from the buccal cortical plate, 1 from the alveolar crest (Figs 2c and 2d).

Histologic Analysis
The collected samples were immediately fixed in a 10% formalin solution in neutral pH. Sections 5 to 8 µm thick were cut along the long axis of each specimen. The specimens were stained with hematoxylin-eosin (H&E), Masson’s trichrome stain, and periodic acid-Schiff stain (PAS).

RESULTS
Histologic Observations
Histologic analysis of the autogenous cortical bone, as processed immediately after harvesting, revealed the narrow and lengthened macroscopic structure of the particles, which were about 3 to 4 mm long. These
particles had the appearance of bone shavings. Higher magnifications highlighted the lamellar quality of the bone particles, with vital osteocytes included in lacunae (Fig 3).

In specimens harvested from the alveolar crest and the buccal cortical plate, the reconstructed bone revealed a lamellar quality, characterized by a mature osteonic structure (Figs 4 and 5). Only sparse particles of grafted bone (GB) characterized by a lamellar structure with empty osteocyte lacunae were evident in direct contact with the regenerated bone (Fig 6). In marrow spaces, grafted particles were surrounded by lamellar bone and in direct contact with a normal stromal component (Fig 7).

**DISCUSSION**

The present 2-case report illustrates the reconstructive potential of ACBP obtained by means of a bone scraper in conjunction with an e-PTFE membrane when used for vertical and lateral ridge augmentation. Both presented cases showed substantial reconstruction of the alveolar crest deficiency, which allowed for successful implant placement. At 9 months following the grafting surgery, histologic assessment revealed almost complete replacement of the grafted cortical bone particles with newly formed mature lamellar bone.

In both cases, a specially designed bone scraper was used to collect cortical bone particulate in the form of ribbonlike shavings from the cortical plate at the mandibular retromolar area (ie, the *linea obliqua*). The scraper has a convex blade that enables the harvesting of cortical bone from flat, convex, and concave surfaces. It is also provided with a collecting device that enables the bone particulate to be stored and delivered to the surgical site. The scraper is available in 2 different versions of different diameters and lengths to provide access to constricted areas under the soft tissue flaps. The proposed harvesting technique may have resulted in reduced donor site mor-
Randomized controlled trials and this composite higher resorption, 35,36 Evi-
clinical success of both autogenous and reduced harvesting time compared with Cortical bone particulate har-
Moreover, histologic analy-
shortened healing period. histologically analyzed 9 months after the surgical
In the present study, the regenerated bone was histologically analyzed 9 months after the surgical
In the 2 reported cases, the bone graft was positioned under a barrier membrane. Whether the effec-
guided bone regeneration (GBR) procedures has been demonstrated by previous studies is still a matter of debate. Histology has shown that both autogene-
In conclusion, this case report seems to indicate that the use of ACBP obtained with a bone scraper in conjunction with a barrier membrane represents a therapeutic option for vertical and horizontal alveo-
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REFERENCES


