

Second Harvest of Mandibular Ramus Blocks in Bone Augmentation Procedures: A Case Letter

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INTRODUCTION

It can be a challenge to place implants in severely resorbed alveolar ridges when there is an insufficient height and width of alveolar bone. Several grafting materials and techniques have been described¹⁻⁴ to solve this problem. Autologous bone is the most appropriate grafting material due to its osteoconductive, osteoinductive, and osteogenic properties.^{5,6} Previous studies have demonstrated the occurrence of bone remodeling and revascularization in grafted autologous bone, providing an ideal site to support the occlusal forces of implant-supported prostheses.^{7,8}

Autologous bone graft sites can be extraoral or intraoral. Extraoral sites include the calvarium, iliac crest, and tibia, while intraoral sites are the retromolar region, zygoma, maxilla, and mandible.^{2,9-11} Intraoral grafting provides numerous advantages over extraoral because surgical procedures can be carried out in the clinic and general anesthesia is optional.^{2,9,10} The mandibular ramus area has been described as an ideal donor site because it provides adequate, dense bone with sufficient volume for implant placement and rapid healing time, and is associated with lower morbidity and a low risk of paresthesias.^{1,10-13} Previous studies have demonstrated that reduction in surgical trauma during osteotomy seems to improve the viability of the bone after grafting.¹⁴ However, very few studies have described the postharvesting histologic features of the donor site.¹⁵

The amount of bone harvested from intraoral sites is usually sufficient for dental implant place-

ment. However, additional augmentation may be required in some cases. For that purpose, other areas of the oral cavity or the same sites may be reassessed for further bone harvesting.¹⁶ It has been demonstrated that additional mandibular ramus and symphysis blocks can be reharvested from the same sites in second augmentation procedures.^{15,17} Apart from the studies previously described, there is not much information about clinical evidence and histologic features related to reharvesting of newly formed bone as a donor site for further bone augmentation.¹⁷ Therefore, this case report demonstrated the applicability of newly formed bone after an initial bone graft for additional bone block augmentation and evaluated the histologic characteristics of the bone from the donor site.

CASE REPORT

A 47-year-old man was referred to the Latin America Institute for Dental Research and Education after complaining of an upper removable partial prosthesis (Figure 1). Based on these complaints, the placement of 4 dental implants was indicated to support an implant-fixed prosthesis in the anterior region of the maxilla. However, based on computerized tomography findings, an onlay bone graft was indicated in the anterior region of the maxilla. Tomographic examination (Sirona Bensheim, Germany) was carried out using a polypropylene tomographic guide, which had 0.5-mm steel balls on the surface. The following scanning parameters were used: 85kV tube voltage, 7 mA tube current, high contrast, and voxel size 0.3 × 0.3 × 0.3 mm. The total scan time was 14 seconds. Based on the tomographic findings, the bone tissue in the right ascending mandibular ramus was considered a

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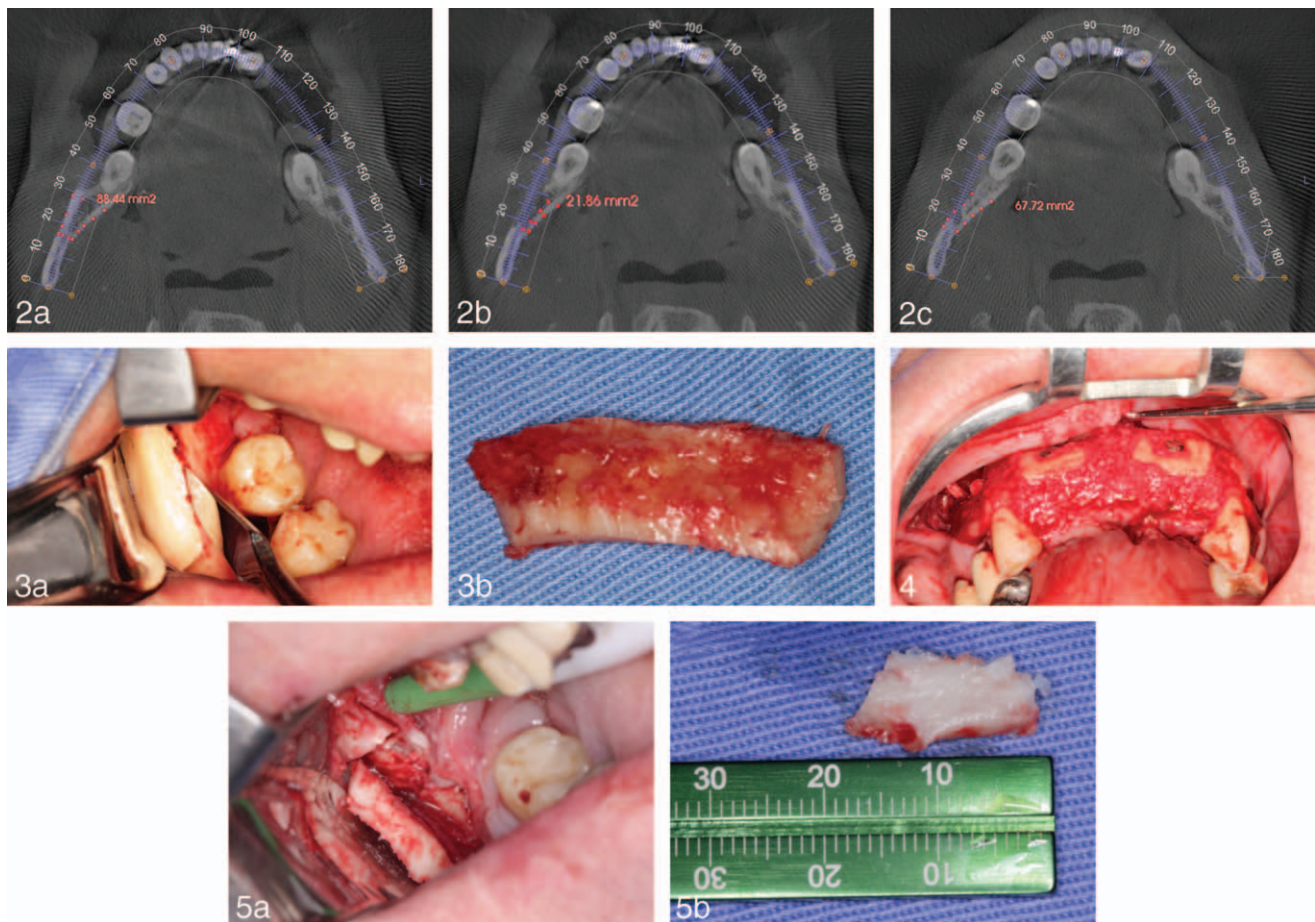
FIGURE 1. Initial intraoral aspect of superior and inferior dental prosthesis.

suitable donor site for maxillary reconstruction (Figure 2a).

Surgical procedures were initiated with a muco-periosteal flap in the anterior region in order to

measure the amount of bone tissue to be harvested. A linear incision was made over the external oblique line and a full-thickness flap was resected to provide access to the harvest site. After resection of the flaps, the osteotomy procedure was carried out with abundant irrigation to harvest the bone tissue. Initially, a horizontal osteotomy was carried out, followed by 2 vertical osteotomies, resulting in a trapezoidal polygon shape (Figure 3). The harvested bone was divided into 2 blocks, and the remaining bone was particulated to fill the gaps. The bone blocks were fixed with screws (2 × 9 mm, Neodent, Curitiba, PR, Brazil), and the gaps were filled with particulated autogenous bone at the donor and receptor sites (Figure 4). Flaps were sutured with nylon 5.0 thread without barriers or membranes.

Eight months after the initial surgery, elevation of the maxillary sinus floor was recommended in



FIGURES 2–5. **FIGURE 2.** (a) Initial tomographic aspect of mandibular ramus before harvesting procedures. (b) Tomographic aspect of mandibular ramus 14 days after harvesting procedures. (c) Tomographic aspect of mandibular ramus 6 months after harvesting procedures. **FIGURE 3.** Clinical aspects of first bone harvesting surgical procedures (a) and the block from the mandibular ramus (b). **FIGURE 4.** Fixation of an onlay block graft harvested from mandibular ramus. **FIGURE 5.** Clinical aspects of secondary bone harvesting surgical procedures (a) and the block from the mandibular ramus (b).

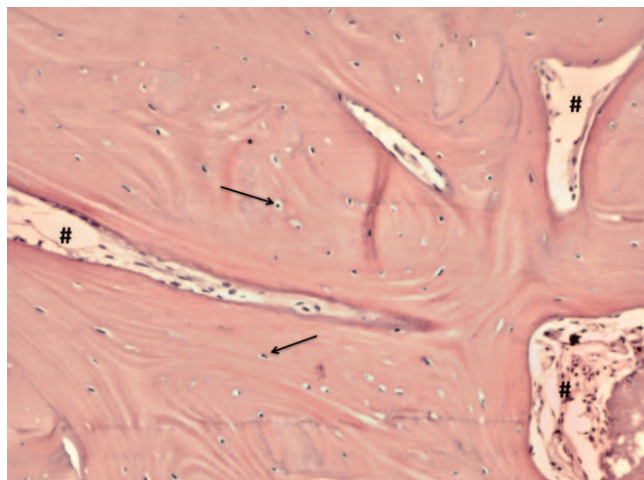


FIGURE 6. Histologic aspects of bone regeneration 8 months after the first harvesting procedures. One can observe the presence of osteocytes (arrows) and blood vessels (#), demonstrating the viability of bone tissue. In addition, the lamellar appearance of the tissue indicates bone remodeling.

order to place the implant in the left maxillary posterior region. A computerized tomography scan was taken using the same tomographic guide that had been used 8 months previously to evaluate the bone healing in the mandibular ramus. Tomographic images were imported to InVivoDental 5.1.6 software (Anatomage, San Jose, Calif). Area measurements were obtained and compared to evaluate bone healing in the donor site. It was found that the mandibular ramus had healed completely.

Due to the possibility of paresthesia associated with harvesting symphysis block and the presence of bone sclerosis in the left mandibular ramus, secondary harvesting of the right mandibular ramus was carried out. Therefore, the same donor site was selected based on tomographic findings that revealed evidence of bone neoformation in the previously harvested region.

The reharvesting of the same donor site in the mandible was carried out in the same way as described for the first harvesting, resulting in a bone block for secondary grafting procedures (Figure 5). A small part of tissue was collected for histologic evaluation. During the second bone harvesting procedure, the clinical appearance and consistency of the tissue was very similar to mature bone (Figure 5).

The fragment was fixed in 10% formalin solution for 7 days. After fixation, the fragment was decalcified for 8 weeks in 18% EDTA, rinsed, dehydrated, and embedded in paraffin. Sections

with a 5- μ m thickness were cut and stained using the hematoxylin and eosin technique as illustrated in Figure 6.

Histologic observations included highly organized collagen fibers, abundant vascularization, and osteocyte lacunae filled with osteocytes in Havers systems. These characteristics demonstrated the presence of vital and mature bone tissue in the donor site 8 months after the first harvesting. The patient reported being very satisfied after the augmentation procedures.

DISCUSSION AND CONCLUSIONS

Dental implants are a safe and predictable alternative for replacing missing teeth; however, there must be an adequate volume of bone for long-term success of implant-supported prostheses.^{18,19} In the presence of severe alveolar bone resorption, bone grafts are considered important procedures for alveolar ridge augmentation, and several grafting materials and techniques are available.¹⁻⁴ Although several studies have demonstrated the applicability of autogenous bone grafts from extraoral and intraoral donor sites,^{20,21} the possibility of secondary harvesting from the same donor region remains unclear. This case report describes regeneration after bone harvesting, which enabled the use of the same region for a second block harvesting.

The tomographic findings revealed a 65.5% increase in bone volume 8 months after the first bone harvesting procedure. Another study²² reported an increase of 63% and 81% in the donor site's bone volume 7.2 and 34.2 months after initial harvesting procedures, respectively, which indicated deposition of newly formed bone in this area.

Based on the increase of bone volume demonstrated in the tomographic examinations, it was considered that the previously accessed donor site had already regenerated 8 months after the first harvesting. Therefore, the same region was used for further bone augmentation procedures. During the second harvesting procedure, a small amount of bone was collected and submitted to histologic analysis, which confirmed the presence of vital and mature bone tissue, characterized by a highly organized lamellar pattern, abundant vascularization, and osteocyte lacunae filled with osteocytes in Havers systems. Therefore, the presence of an adequate amount of mature and vital bone enables

one to use the same donor region 8 months after the first bone harvesting.

Another study demonstrated the possibility of reentering these sites 5 to 6 months after the first harvesting procedure. However, in that study all donor sites were filled with bovine bone material mixed with platelet-rich plasma and covered with platelet-poor plasma or a bio-absorbable collagen membrane after the first harvesting. Histologic evaluation of the donor region collected during the second harvest procedure revealed the presence of biomaterial surrounded by newly formed bone tissue.¹⁷

The results of this study confirmed the possibility of revisiting the same donor site for further bone augmentation when other intraoral regions cannot be accessed.¹⁷ Therefore, intraoral bone sources seem to be a renewable reservoir of bone tissue.¹⁷

Several benefits may be obtained from secondary harvesting, including the use of a gold standard graft material, combined with a relatively simple surgical procedure with known postoperative conditions when compared with extraoral donor regions. However, further long-term studies with computerized tomography evaluations should be carried out to improve knowledge about secondary harvesting procedures for bone augmentation. These findings may contribute to the development of more effective strategies for the rehabilitation of patients with resorbed alveolar bone ridge.

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