

REHABILITATION OF SEVERELY ATROPHIED MANDIBLE USING FREE ILIAC CREST BONE GRAFTS AND DENTAL IMPLANTS: REPORT OF TWO CASES

Orhan Güven, DDS, PhD

The purpose of this study was to reveal the improvement in facial esthetics and maintenance of mastication in severely atrophied mandibles with inadequate alveolar ridges in 2 patients. Bone graft harvested from iliac crest was used for the reconstruction in the first case, followed by the application of 2 dental implants after 6 months. A free iliac bone graft and 2 dental implants were also used simultaneously with a 1-stage surgery in the second case; the patient had previously had a mandibular reconstruction with a rib graft. Both of the patients achieved remarkably functional and esthetic improvements after treatment. Free iliac bone graft is considered to be a favorable alternative for the maintenance of satisfactory functional and esthetic results in patients with severely atrophied alveolar ridges.

Key Words: bone grafting, iliac bone, rib graft, dental implants

INTRODUCTION

Prosthodontic rehabilitation requires sufficient hard and soft tissues. This aspect is of particular importance when the relationship of various anatomic units such as lips, mandibular vestibule, floor of the mouth, and mucosa of the alveolar process is considered following reconstructive surgery.

Defects due to severe trauma, such as gunshot wounds, in the floor of the mouth and the mandible have particularly long-lasting, detrimental effects on masticatory function. Hence, reconstructive measures have to be considered for regaining functions such as mastication and articulation, in addition to restoring esthetic integrity. Ensuring a soft-tissue

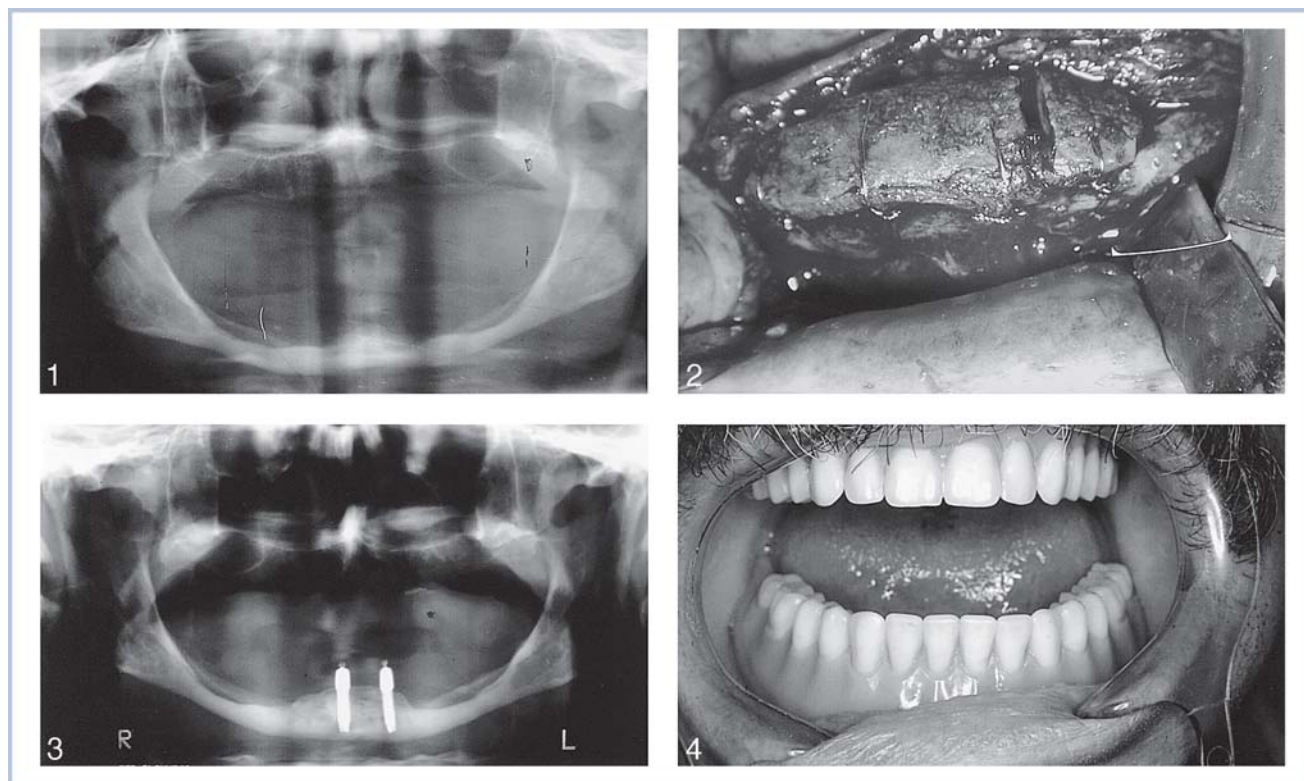
lining, adequate oral intake, provision for a prosthesis, and satisfactory esthetic rehabilitation should be the major goals of reconstruction.

In cases of severe trauma or excessively resorbed mandibular alveolar ridges, preservation or reinstatement of chewing ability makes a major contribution toward a certain degree of enjoyment of life.¹ This rehabilitation not only necessitates transferring tissue to repair the defect but also enables prosthetic care.

Despite the great progress in microsurgically anastomosed reconstructive graft surgery, these reconstructions often have extensive financial costs due to time and technical support and have their limitations as a result of restricted medical capacity or through a lack of compliance.² Reconstructive procedures using free grafts, which have been known for many years, remain as an alternative to these modern concepts. Osteointegrated implants are also well known for the rehabilitation of maxillofacial defects.

This article describes rehabilitation of 2 cases by free iliac bone grafts and dental implants. The first patient has

Orhan Güven, DDS, PhD, is a professor in the Department of Oral and Maxillofacial Surgery, School of Dentistry, University of Ankara, Besevler, Ankara, Turkey. Address correspondence to Dr Güven at Yesilyurt Sokak, No. 24/15, 06690 Asagi Ayranci, Ankara, Turkey (e-mail: oguven@dentistry.ankara.edu.tr).



FIGURES 1–4. FIGURE 1. Severely resorbed mandible. FIGURE 2. Iliac graft was placed on the alveolar crest and fixed by circumferential wiring. FIGURE 3. Placement of the implants after 4 months. FIGURE 4. The illustration shows the clinical postoperative status of the mouth.

a severely resorbed mandible, and the second previously had a mandibular reconstruction by free rib graft.

CASE REPORTS

Patient 1

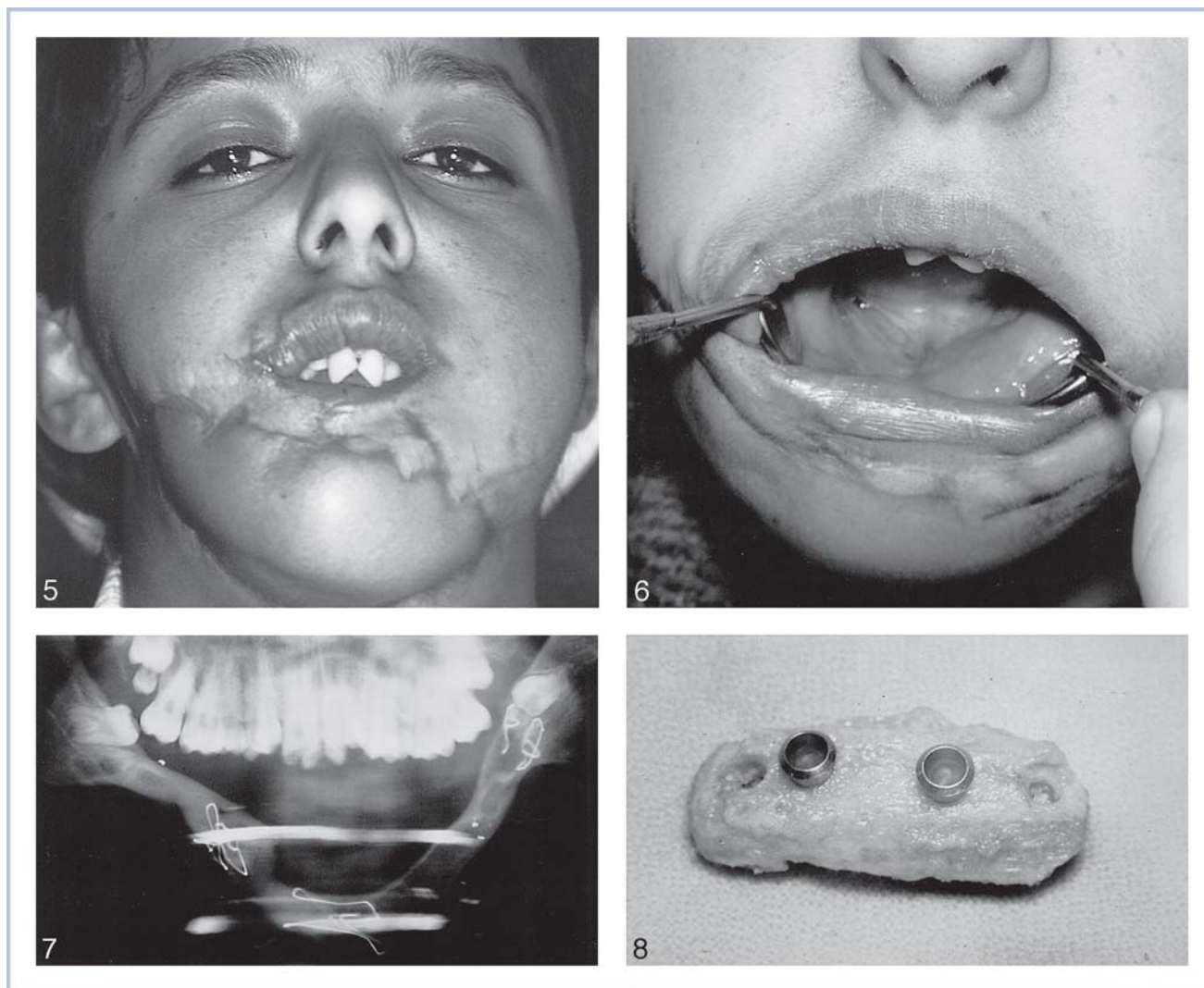
A healthy 60-year-old man with a severely resorbed mandible was admitted to our department with a request for an implant-supported lower denture. X-ray examinations revealed a severely resorbed mandible (Figure 1). The operation was performed under general anesthesia. The implant site was exposed, and the vertical height of the alveolar crest was noted as inadequate for implant placement. The graft was harvested from the ilium in accordance with the approach described by Keller and Triplett.³ The graft was placed on the alveolar crest and fixed by circumferential wiring (Figure 2). Six months later, after remodeling of the iliac graft, 2 MIS implants were placed under local infiltration anesthesia in 2-stage surgery. After 4 months of osseointegration (Figure 3), a satisfactory prosthodontic rehabilitation was achieved (Figure 4).

Patient 2

A 15-year-old girl was referred to our clinic from the departments of plastic surgery and prosthodontics for rehabilitation of mastication, articulation, and facial

esthetics. The patient's history, clinical examination (Figures 5 and 6), and radiographic examination (Figure 7) revealed a huge bony defect of the mandible, due to an accidental gunshot, that had been previously reconstructed by rib graft. The floor of the mouth and the anterior part of the mandible had been reconstructed by skin grafts. The mouth opening was limited, and obtaining a prosthodontic impression was difficult due to the thickness of the soft tissues around the oral cavity.

Implant placement on the reconstructed mandible by rib graft was planned. With the patient under general anesthesia using the nasotracheal procedure, following a commissuroplasty to have a wider mouth opening, dissection was extended to the anterior crest of the mandible. Contrary to the radiologic view revealing a sufficient alveolar bone height (Figure 7), the alveolar crest reconstructed by rib graft was noted to be too narrow buccolingually for implant placement without a bone graft. Therefore, another source of bone was considered to augment the crest. Bone harvested from the ilium and two ITI implants were placed on the graft under sterile conditions (Figure 8). Then the iliac graft with 2 implants was placed on the alveolar crest previously reconstructed by rib graft (Figure 9) and secured by 2 mini screws (Figure 10). The implants and graft were allowed 8 months for



FIGURES 5–8. FIGURE 5. Facial view of the patient. FIGURE 6. Preoperative intraoral view. The illustration reveals limited mouth opening and reconstructed floor of the mouth. FIGURE 7. Bone defect of the mandible due to a gunshot wound and reconstruction by rib graft. FIGURE 8. Placement of the ITI implants on the iliac bone graft on the operating table.

integration and remodeling, and satisfactory esthetic, masticatory, and psychologic rehabilitation were achieved (Figure 11).

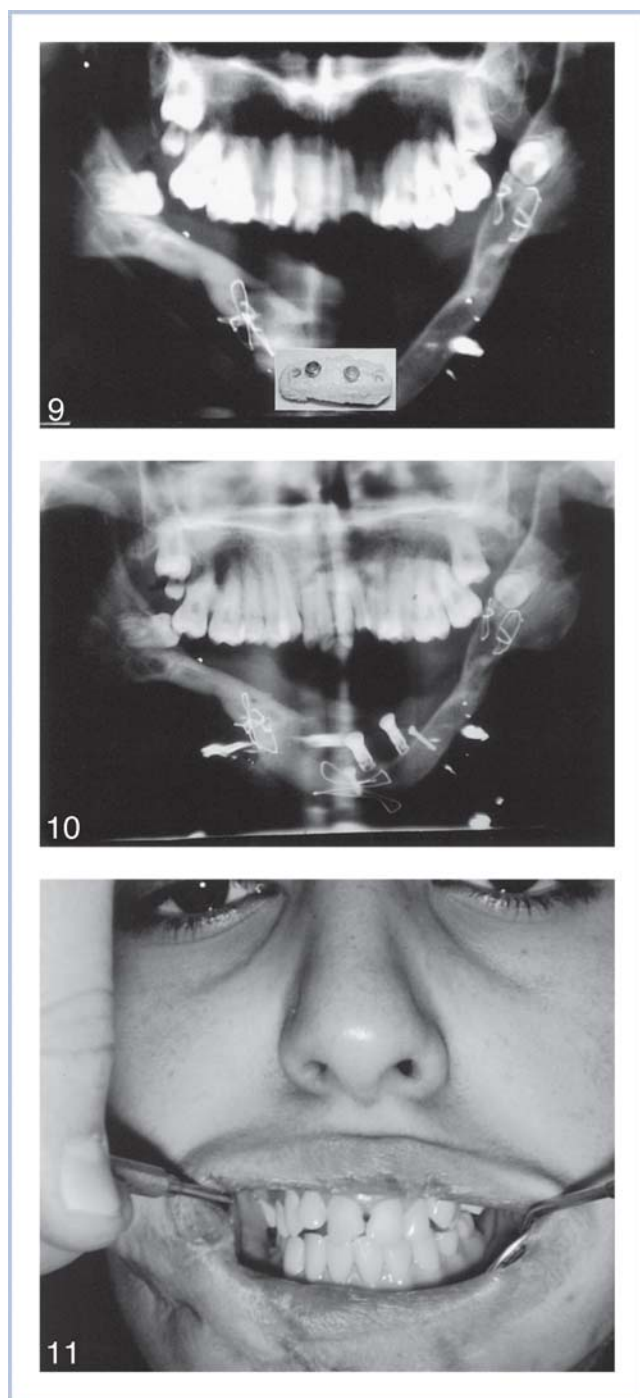
DISCUSSION

Rehabilitation of severely atrophied and defective mandibles is a therapeutic challenge. The most advanced surgical reconstruction techniques are required for patients with minimal basal bone. The use of free onlay and inlay bone grafts in combination with implant surgery is considered to be an appropriate approach for reconstruction of bone deficiencies.

Several materials have been introduced and tested as bone graft substitutes that can function as replacements for autogenous bone, which remains the “gold standard” for maxillomandibular reconstruction. Au-

togenous bone has osteoinductive and osteoconductive properties and is immunologically safe.^{4–6}

The success of alveolar ridge rehabilitation using endo-osseous implants is directly related to bone quality and quantity. There are various alternative donor sites for bone reconstruction in the body: the ilium, rib, calvarium, tibia, maxilla, and mandible. Intraoral bone harvesting is usually accomplished under local anesthesia in a routine dental office setting or on a hospital outpatient basis. A variety of donor sites in the intraoral cavity have been introduced. The lateral aspect of the mandibular ramus is a source of cortical bone.^{5,7} The mandibular symphyseal area has been used in secondary alveolar cleft repair and sinus lifting.⁸ Bone grafts taken from the maxillary tuberosity have been used to fill alveolar defects before dental implant placement.^{5,9} The coronoid process has



FIGURES 9–11. FIGURE 9. Planning for the placement of the bone graft with 2 implants on the alveolar crest reconstructed by rib graft. FIGURE 10. Orthopantomogram reveals placement of the iliac graft with 2 implants and fixation by mini screws. FIGURE 11. Facial view after prosthetic rehabilitation.

been used in reconstruction of the orbital floor.¹⁰ Bone harvested from the zygomatic eminence and arch has been used in maxillary step osteotomy and interdental osteotomy gaps.¹¹ Usage of the zygomatic bone in

alveolar bone reconstruction was reported by Kainulainen et al.⁵ Limited amount of available bone is the major disadvantage of intraoral donor sites for autogenous grafting. Possible complications with intraoral donor sites include altered sensation of teeth, neurosensory disturbances, and infections.⁵

Cases with significant bone defects such as cleft palate, gunshot wounds, or severely resorbed mandibles, as presented in this article, require a large volume of bone grafts, preferably from the ilium or rib. Iliac bone transplants have been widely used for mandibular reconstruction. Due to their resistance to infection and large volume of bone that can be transferred, these grafts can be used to repair large bony defects and can also accept dental implants.^{12–14} The cortical bone of the iliac crest is thickest at the “intermediate line,” but all parts of the iliac crest are thick enough to accept dental implants. Contrarily, rib grafts are not thick enough for the same purpose. That is why iliac bone is still one of the best sources for large bone grafts.¹⁴ The patient in the second case presented in this article had had a reconstruction by rib graft. To support the buccolingually insufficient bone and to augment the crest, an iliac graft was preferred. Both cortical and cancellous bone can be obtained from the iliac crest. Preparation of the recipient site should be done before harvesting of the bone graft. This allows for determination of the amount of bone graft needed and the final selection of the appropriate donor site.

Survival of the implants placed into bone grafts is another crucial matter. According to the reports of Keller et al,¹⁵ 60% to 70% of implants placed into onlay grafts survive.

Implants in the patient in the first presented case were placed in a 2-stage procedure, and implants were placed in a 1-stage surgery in the second patient. Experimental and some clinical data reveal that a 2-stage surgery may be advantageous and may have an acceptable survival rate.^{16–18} However, Branemark et al¹⁹ reported high success rates with use of onlay grafts in a 1-stage approach.

Optimal timing for the placement of implants after bone grafting is currently controversial.⁶ Authors have generally suggested a healing period of 5 to 6 months. However, there is no agreement as to the period of time necessary between graft surgery and implant placement in the literature reviewed for this study; the period varied from 3 to 8 months depending on the type of reconstruction and graft used.^{15,20–23} The first patient presented in this study was treated by a classical 1-stage surgery, and 6 months were allowed for the healing period. To the author’s knowledge, the extraoral placement of the implants on the iliac graft and placement of the iliac graft including implants onto

the mandible reconstructed by rib graft in a 1-stage surgery has not been previously reported. In the second case, because of the poor quality of the recipient bone and the immediate placement of the implants, a longer healing period was preferred for both remodeling of the bone and integration of the implants.

CONCLUSION

Today restoration of masticatory ability and esthetic appearance by wearing dentures is widely regarded as a therapeutic goal in patients who have severely resorbed alveolar crests, bone defects due to trauma, and congenital malformations. This provides the patients the ability to regain self-confidence and almost the same quality of the life as before. Endosseous implants and the use of bone grafts will improve prosthetic rehabilitation in patients with deficient or severely atrophied bone.

REFERENCES

1. Maurer P, Alexander W, Eckert W, Schubert J. Functional rehabilitation following resection of the floor of the mouth. *J Craniomaxillofac Surg.* 2002;30:369–372.
2. Futran ND, Alsarraf R. Microvascular free-flap reconstruction in the head and the neck. *J Am Med Assoc.* 2000;284:1761–1763.
3. Keller EE, Triplett WW. Iliac bone grafting: review of 160 consecutive cases. *J Oral Maxillofac Surg.* 1987;45:11–14.
4. Block MS, Kent JN, Kallukaran FU, Thunthy K, Weinberg R. Bone maintenance 5 to 10 years after sinus grafting. *J Oral Maxillofac Surg.* 1988;48:56:706–714.
5. Kainulainen VT, Sandor GKB, Oikarinen KS, Clokie CML. Zygomatic bone: an additional donor site for alveolar bone reconstruction. Technical note. *Int J Oral Maxillofac Implants.* 2002;17:723–728.
6. Laine J, Vahatalo K, Peltola J, Tammisalo T, Happonen RP. Rehabilitation of patients with congenital un-repaired cleft palate defects using free iliac crest bone grafts and dental implants. *Int J Oral Maxillofac Implants.* 2002;17:573–580.
7. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant placement. *Int J Maxillofac Implants.* 1977;12:767–776.
8. Lundgren S, Moy P, Johansson C, Nilsson H. Augmentation of the maxillary sinus floor with particulated mandible: a histologic and histomorphometric study. *Int J Maxillofac Implants.* 1996;11:760–766.
9. ten Bruggenkate CM, Kraaijenhagen HA, van der Kwast WAM, Krekeler G, Oosterbeek HS. Autogenous maxillary bone grafts in conjunction with placement of ITI endo-osseous implants. *Int J Maxillofac Implants.* 1992;21:81–84.
10. Mintz SM, Ettinger A, Schmamel T, Gleason MJ. Contra-lateral coronoid bone grafts for orbital floor reconstruction: an anatomic and clinical study. *J Oral Maxillofac Surg.* 1998;56:1140–1144.
11. Wolford LM, Cooper RL. Alternative donor sites for maxillary bone grafts. *J Oral Maxillofac Surg.* 1985;43:471–472.
12. Stoler A, Hill T. Part 1. Reconstruction after total mandibulectomy with free cranial and micro-vascular iliac crest grafts as preparation for implants. *J Oral Implantol.* 1992;18:36–44.
13. Kovacs AF. Influence of the prosthetic restoration modality on bone loss around dental implants placed in vascularized iliac bone grafts for mandibular reconstruction. *Otolaryngol Head Neck Surg.* 2000;123:598–602.
14. Shimizu T, Ohno K, Matsuura M, Segawa K, Michi K. An anatomical study of vascularized iliac bone grafts for dental implantation. *J Craniomaxillofac Surg.* 2002;30:184–188.
15. Keller EF, Van Rockel NB, Desjardins RP, Tolman DE. Prosthetic-surgical reconstruction of the severely resorbed maxilla with iliac bone grafting and tissue-integrated prosthesis. *Int J Maxillofac Implants.* 1987;2:155–156.
16. Cawood JI, Howell RA. A classification of the edentulous jaw. *Int J Oral Maxillofac Surg.* 1988;17:232–236.
17. Blomqvist J, Alberius P, Isaksson S. Sinus inlay bone augmentation: comparison of implants positioning after one- or two-staged procedures. *J Oral Maxillofac Surg.* 1997;55:804–810.
18. Kahnberg KE, Nilsson P, Rasmusson L. LeFort I osteotomy with inter-positional bone grafts and implants for rehabilitation of severely resorbed maxilla: a 2-stage procedure. *Int J Oral Maxillofac Surg.* 1999;14:571–578.
19. Branemark P-I, Higuchi KW, de Oliveira MF, eds. *Complex Cleft Palate and Craniomaxillofacial Defects: The Challenge of Bauru.* Chicago, Ill: Quintessence; 1999.
20. Sailer HF. A new method of inserting endo-osseous implants in totally atrophic maxillae. *J Craniomaxillofac Surg.* 1989;17:299–305.
21. Misch CM, Misch CE, Resnik RR, Ismail YH. Reconstruction of maxillary alveolar defects with mandibular symphysis grafts for dental implants: a preliminary procedural report. *Int J Oral Maxillofac Surg.* 1992;7:360–366.
22. Misch CM, Misch CE. The repair of localized severe ridge defects for implant placement using mandibular bone grafts. *Implant Dent.* 1995;4:261–267.
23. Lekholm U, Wannfors K, Isaksson S, Adielsson B. Oral implants in combination with bone grafts. *Int J Oral Maxillofac Surg.* 1999;28:181–187.