Palatal Core Graft for Alveolar Reconstruction: A New Donor Site

Federico Hernández-Alfaro, MD, DDS, PhD[1]/Carlos Martí Pages, MD[2]/Eloy García, MD[3]/
Guadalupe Corchero, MD[4]/Carlos Arranz, MD[2]

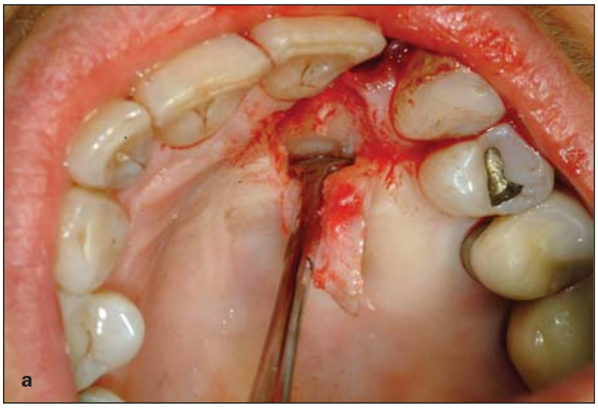
Purpose: *A simple technique is described for alveolar reconstruction in cases where resorption has already occurred. The palatal core graft allows immediate regeneration of vertical, horizontal, and combined defects at the alveolus with minimal donor site morbidity and time consumption.* ***Materials and Methods:*** *Seventeen patients (10 female and 7 male) were treated over a 1-year period. Bone core grafts from the palatal vault were harvested with a trephine and used for alveolar reconstruction in the esthetic zone. Patient age and gender, type and location of the defect, size of the graft, simultaneous tooth removal, simultaneous implant placement, need for soft tissue coverage, and postoperative complications were recorded.* ***Results:*** *Mean length of the grafts was 12.5 mm (range 9 to 14 mm). Mean width was 7.3 mm (range 5 to 9 mm). In 11 cases, simultaneous tooth removal was performed and a connective tissue flap with posterior pedicles was used. Patients did not experience discomfort in the donor area. Sixteen cases were successfully restored with single implants and crowns* ***Discussion:*** *Material for osseous reconstruction should ideally be autologous and easy to harvest and provoke minimal morbidity. The palatal core graft compares favorably with previously described techniques and donor sites for alveolar reconstruction.* ***Conclusion:*** *In this preliminary report, experience with a new technique for alveolar reconstruction is presented. The "palatal core graft" for alveolar reconstruction is effective and easy to harvest and has low donor site morbidity, allowing 3-dimensional restoration of alveolar defects.* INT J ORAL MAXILLOFAC IMPLANTS 2005;20:777–783

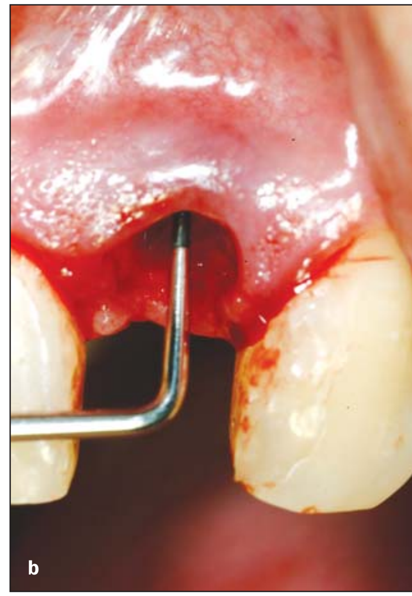
Key words: *alveolar reconstruction, bone grafting, immediate implant placement*

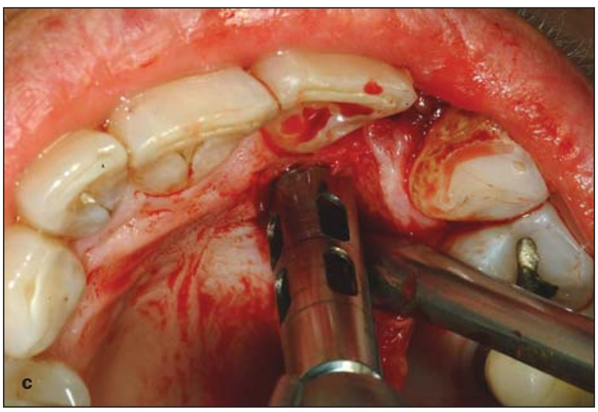
Implant rehabilitation in the "esthetic zone" constitutes a challenge to the implant surgeon because of the atypical anatomy frequently encountered in this region. Loss of teeth in the anterior maxilla inevitably results in resorption of the alveolar bone unless implants are placed immediately.[1] Even then, previous periodontal compromise may render the alveolus insufficient to allow adequate positioning of an implant, thus compromising final esthetics. Alveolar ridge defects can be classified according to Seibert and Cohen[2] as horizontal, vertical, or combined. Etiologic factors producing suboptimal architecture in the anterior maxilla include trauma, periodontal disease, and disuse. Remodeling processes with osteoclastic predominance are responsible for variable amounts of alveolar bone loss starting at the time of tooth removal or avulsion.[3] In many instances, periodontal disease has aggressively destroyed bone by the time of tooth extraction. Several authors have advocated the convenience of immediate implantation at the time of extraction, the argument being that healing processes within the alveolus would favor implant osseointegration.[4] Small peri-implant defects can be left without reconstruction as long as the sockets are intact, a favorable defect morphology is present, and an implant with an appropriate surface is used.[5,6]

[1]Clinical Professor, Oral and Maxillofacial Surgery, International University of Catalonia; Chief, Department of Oral and Maxillofacial Surgery, General Hospital of Catalonia and Institute of Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.
[2]Associate Professor, Oral and Maxillofacial Surgery, International University of Catalonia; Staff, Department of Oral and Maxillofacial Surgery, General Hospital of Catalonia and Institute of Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.
[3]Staff, Department of Oral and Maxillofacial Surgery, General Hospital of Catalonia and Institute of Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.
[4]Visiting Fellow, Department of Oral and Maxillofacial Surgery, General Hospital of Catalonia and Institute of Maxillofacial Surgery, Teknon Medical Center, Barcelona, Spain.

Correspondence to: Dr Federico Hernández-Alfaro, Instituto de Cirugía Maxilofacial, C/ Vilana, 12. Despacho 185, 08022 Barcelona, Spain. Fax: +34 93 393 3085. E-mail: director@institutomaxilofacial.com







Figs 1a to 1c *(a)* A posteriorly pedicled full-thickness flap provides access to the donor site. *(b)* Vestibular wall dehiscence after removal of a periodontally compromised lateral incisor. A periodontal probe demonstrates the depth of the defect. Preservation of existing soft tissues is essential. *(c)* To engage the cortical bone, a trephine is initially oriented perpendicular to the vault. In-depth trephination has to proceed parallel to the roots to avoid them.

However, there are situations where hard and soft tissue defects remain that it is beyond the biologic ability of the host tissue to heal spontaneously without compromising normal crestal anatomy. A number of regenerative techniques have been proposed for these situations.[7–16] In most of them, reconstructive needs are fulfilled with either foreign materials (ie, membranes, xeno- and allografts), or autogenous bone grafts from distant sites.

A simple technique for alveolar reconstruction is presented herein with autogenous bone from the same surgical field as the defective site. The palatal core graft allows immediate regeneration of vertical, horizontal, and combined defects at the alveolar level with minimal morbidity and time consumption.

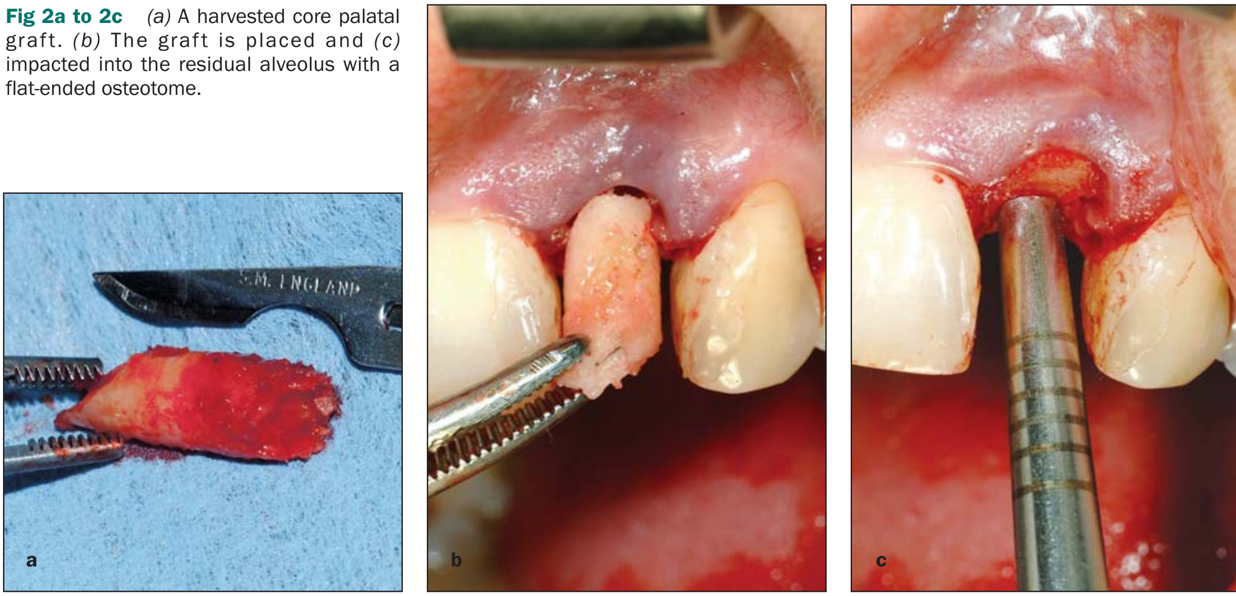
MATERIALS AND METHODS

Between January 2003 and January 2004, 17 patients (10 female and 7 male) were consecutively treated by the same surgeon (FHA) in the Department of Oral and Maxillofacial Surgery at General Hospital of Catalonia and Teknon Medical Center, Barcelona, Spain. To be included in the study, the patient had to have a horizontal, vertical, or combined alveolar defect at a site that was to be restored with a single implant.

Preoperative studies included thorough periodontal probing of the area to be reconstructed as well as a lateral cephalogram to determine the height of the palatal vault in the anterior maxilla. In 5 cases, a computerized tomographic (CT) scan was used to precisely measure the available bone.

Patient age and gender, type and location of the defect, size of the graft, simultaneous tooth removal, simultaneous implant placement, need for soft tissue coverage, and postoperative complications were recorded. All procedures were performed under local anesthesia (2% lidocaine with adrenaline 1:100,000). When tooth removal was part of the procedure, it was done first, followed by thorough curettage of the alveolus. The soft tissue surrounding the alveolus, including the papilla, was not modified (Fig 1a). A palatal para-marginal incision was made from 1 tooth posterior to 1 tooth anterior to the planned reconstruction. An anterior relieving incision allowed elevation of a full-thickness flap, thus uncovering the palatal vault in this area (Fig 1b). In cases where soft tissue coverage of the reconstruction site was needed, a subepithelial connective tissue flap was tailored. A bone trephine of 5 to 9 mm in diameter was then used to harvest a bone core from the palatal vault in the vicinity of the defect. One millimeter was added to the defect width to determine the size of the trephine to be used. A safety margin of 3 mm of bone was left between the

Fig 2a to 2c *(a)* A harvested core palatal graft. *(b)* The graft is placed and *(c)* impacted into the residual alveolus with a flat-ended osteotome.



planned osteotomy and the margin of the crowns or the defective area.

The trephine was placed perpendicular to the vault until it engaged the cortical plate (Fig 1c). It was then angled to reach a direction parallel to the neighboring roots. The depth of the osteotomy varied depending on the reconstructive needs and the precalculated height of the vault. Once trephined, the palatal bone core was released from the trephine or dislodged from the vault with a root elevator. The graft was directly transferred to the defective site. Because of the shape of the vault, the grafts had a wedge shape at one end (Figs 2a and 2b). This end was placed inside the alveolus to be reconstructed. The graft was then tapered inside the defect with a flat-end osteotome (Fig 2c). The flat coronal side of the graft was left at the desired vertical level in relation to the neighboring teeth. Since the size of the graft was predetermined according to the defect to be reconstructed, a tight relation with the remaining alveolar walls was achieved (Fig 2d). There was no need for further fixation of the graft in any of the cases. In situations where tooth removal was performed simultaneously, soft tissue coverage was provided by a partial-thickness subepithelial pedicled flap isolated from the main flap (Fig 3a).[17] The connective tissue flap was sutured in place with 5-0 monofilament sutures (Fig 3b). The epithelial part of the flap was resutured to its original place with resorbable sutures, thus covering the donor area. In the 5 cases where implant placement was performed simultaneously, the core graft was placed before the implant (Figs 4a to 4c). Postsurgery, 500 mg amoxicillin every 8 hours for 7 days and 0.02% chlorhexidine mouthwash were prescribed.

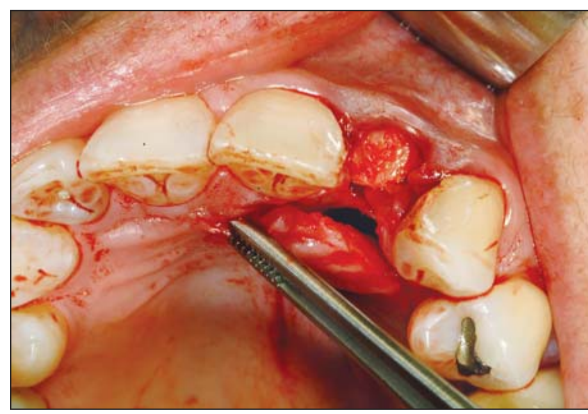


Fig 2d The precalculated diameter of the graft allows a perfect fit with the defect.

RESULTS

One site in each of 17 patients was treated. The technique described was used in the following situations: 3-wall defects (8 cases), 2-wall defects (3 cases), alveolar-implant discrepancy greater than 2 mm (5 cases), and alveolar reconstruction after removal of nonintegrated implants (1 case) (Figs 5a to 5c). Defects were located at the sites of the lateral incisor (8 cases), central incisor (6 cases), and canine (3 cases). Mean length of the grafts was 12.5 mm (range 9 to 14 mm). Mean width was 7.3 mm (range 5 to 9 mm). In 11 cases, simultaneous tooth removal was performed and a connective tissue flap posteriorly pedicled was used.

Patients did not experience discomfort from the donor area. In 1 patient, partial necrosis of the connective tissue flap occurred. Sixteen patients

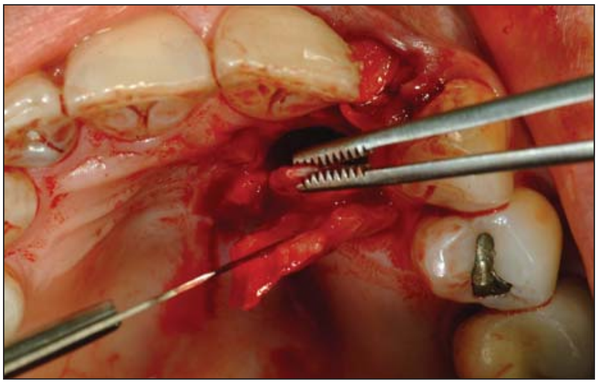


Fig 3a A connective tissue flap is easily created with sharp dissection.

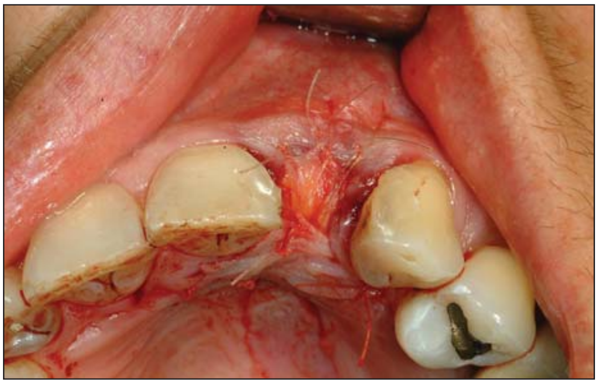


Fig 3b The flap is positioned coronal to the reconstruction and secured into place with 5-0 sutures.

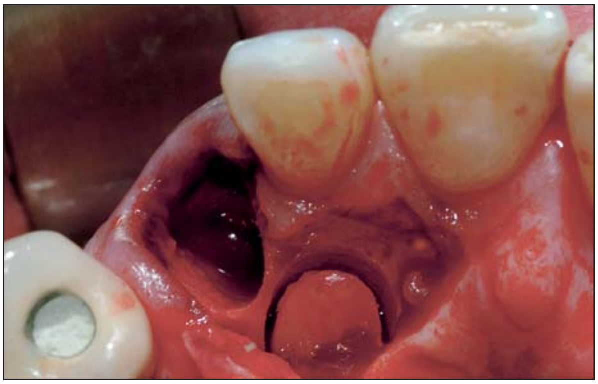


Fig 4a Raising of a palatal flap allows trephination of the vault in a direction parallel to the neighboring roots.

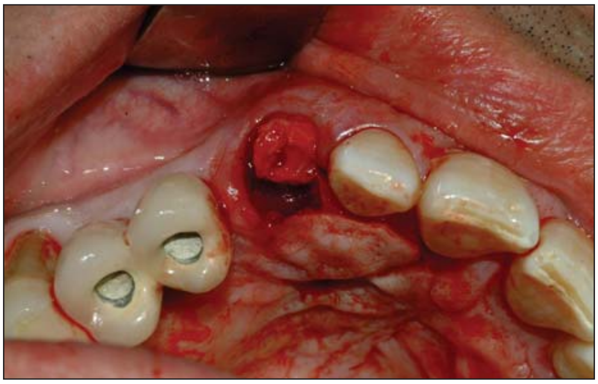


Fig 4b The core graft is removed from the trephine and packed firmly in the alveolus.

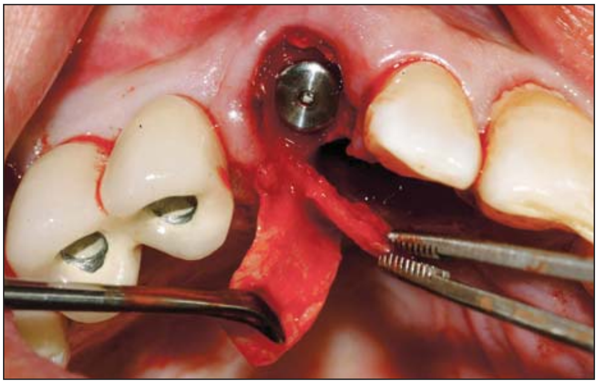


Fig 4c Palatal flap allows trephination parallel to the neighboring roots. Bone grafting and implant positioning are followed by tailoring of the split-thickness flap.

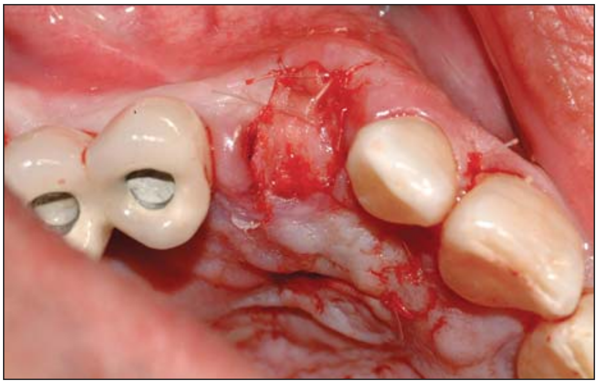


Fig 4d Flap sutures in place. This technique allows simultaneous hard and soft tissue reconstruction in addition to implant placement in selected cases.

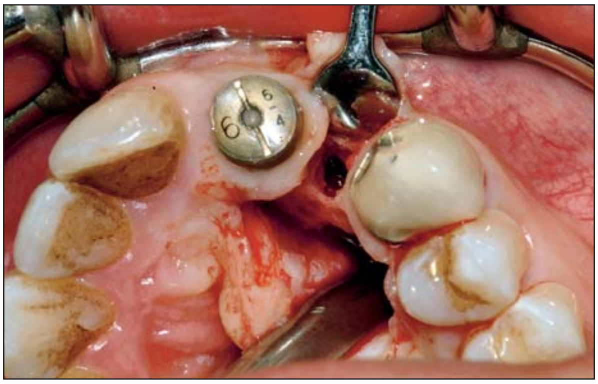


Fig 5a Bone defect after implant removal and curettage. Paramarginal incision allows access to the vault. No flap is designed, since soft tissue coverage is adequate.

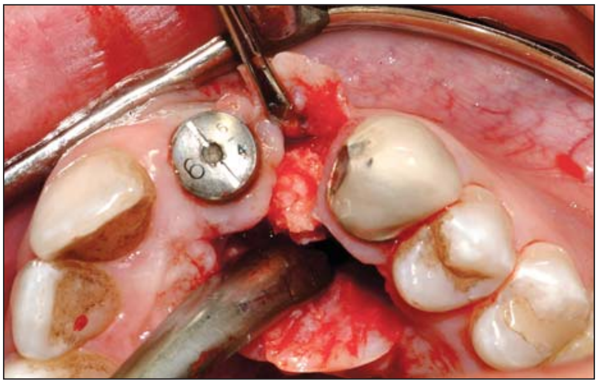


Fig 5b Impaction of graft material in the defect.

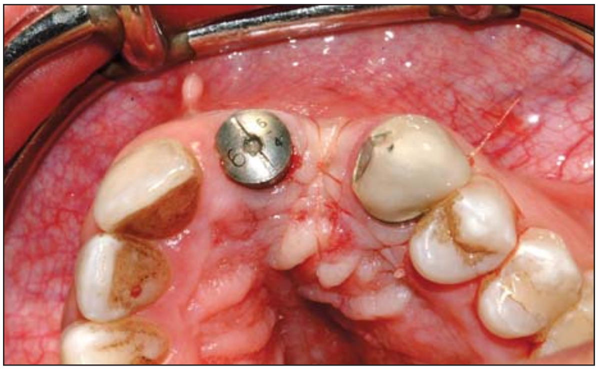


Fig 5c Flap repositioned.

received single implants. One patient currently has a Maryland-type prosthesis and is scheduled for future implant placement. In 5 patients, implant placement was performed at the time of osseous–soft tissue reconstruction. Eleven patients received single implants after a mean period of 77.7 days (range 59 to 94). In 6 cases, implants were placed with flapless surgery. In 16 cases, the implants were successfully restored with single crowns.

DISCUSSION

Alveolar bone resorption can be secondary to trauma, periodontal disease, and disuse after tooth removal. Soft tissue as well as contours of restorations are also affected by these resorptive processes.[13] To achieve ideal implant esthetics in the anterior maxilla, augmentation procedures might be necessary prior to or simultaneous with implant placement. Different techniques have been proposed for the reconstruction of horizontal, vertical, or combined defects in the esthetic zone.[7,12–16]

Both animal and human studies have shown that osseointegration of immediately placed implants in fresh extraction sockets can be achieved with a success rate comparable to that of delayed implant placement.[18] However, when considering immediate implants, the remaining gap between the occlusal part of the implant and the alveolar walls has critical importance.[4] It has been shown that certain infrabony defects and dehiscences can lead to suboptimal regeneration around implant. This fact has an impact both on implant integration and the restoration esthetics, especially in the esthetic zone. A recent study by Schropp and coworkers concluded that 3-wall infrabony defects with parallel width, depth, and perpendicular width greater than 5, 4, and 2 mm, respectively, should be considered for reconstruction.[18] Likewise, Dahlin and associates[19] showed that peri-implant dehiscences associated with implant placement at healed extraction sites and covered by mucoperiosteum were not covered by bone.

All of the cases included in the present study had infrabony defects and dehiscences larger than the limits proposed by previous authors. There is no consensus in the literature regarding which options yield better results in reconstructing the alveolus.[7,9,11,13] However, when evaluating different strategies, issues regarding complexity, morbidity, and predictability should be addressed. Synthetic bone substitutes, membranes, osteoinductive substances, and bone grafting from different sites have been used alone or combined for the restoration of normal alveolar anatomy around implants. Expanded polytetrafluoroethylene membranes have been used for guided bone regeneration with varying results.[19–22] Resorbable membranes have also been used to enhance regeneration around immediately placed implants.[23,24] Allogeneic,[8,9] alloplastic,[7] and xenogeneic grafts[10] have also been proposed for ridge construction. All of these reconstructive materials lack predictability and add considerable cost to the procedure.

The only grafting material with osteogenic, osteoinductive, and osteoconductive properties is autogenous bone. It is considered the gold standard for osseous reconstruction in different clinical situations. Ridge augmentation can be accomplished with autogenous bone harvested from extraoral[25,26] as well as intraoral sites.[14] Extraoral sites usually result in greater morbidity and are rarely the choice for limited alveolar reconstruction. Intraoral sites include body and ramus of the mandible,[27] maxillary tuberosity,[28] and symphysis.[13] Harvesting from these sites is usually accomplished under local anesthesia or sedation. Although it is easier to harvest bone from these sites than from extraoral ones, bone harvesting at these sites still requires a separate approach and thus can create varying degrees of morbidity.[7]

Often patients complain more about the intraoral donor site than about the reconstructed area. The palatal core graft allows the donor and host sites to remain within a single limited surgical field. The symphysis has had wide acceptance as a donor site for intraoral osseous reconstruction because of the relatively high amounts of membranous bone yielded and the easy access. However, dehiscence, loss of mentalis muscle support, loss of vitality of mandibular anterior teeth, and mental nerve injury have been reported with this approach.[29] With the new technique described in the present study, complications secondary to extra access are avoided.

Patient acceptance for bone harvesting procedures depends largely on the anticipated morbidity. Patients in the present patient population were very compliant with the bone harvesting, provided that a single surgical field was used with little extra morbidity.

A limited uncovering of the adjacent palatal vault is sufficient to give access to the trephine. In 11 cases, a connective tissue flap posteriorly pedicled was used to further cover the osseous reconstruction. Raising the flap already provides a small raw bone area for trephination.

When reconstructing the alveolus around implants, bone particles have insufficient stability to ensure the restoration of contours around implants in combined horizontal and vertical defects.[30] Bone cores obtained with the present technique offer better mechanical strength than particulated grafts and are probably more resistant to colonization by fibrous tissue. Since the bone cores are malleted into the alveolus with an osteotome, there is no need for fixation. In cases where horizontal width of the crest was an issue, the palatal core was used as a crestal expander because of its rigidity.

Covering of alveolar reconstructions can be done with a number of techniques, including membranes,[31] free grafts,[32] and vestibular advancement flaps.[33] Pedicled flaps generally have a better prognosis than free grafts.[32] Peri-implant keratinized mucosa influences peri-implant health and soft tissue esthetics.[34] The palatal connective tissue flap compares favorably with membranes and free grafts. It is autogenous, easy to tailor, and vascularized, and it has the capacity to generate keratinized mucosa at the crest, thus maintaining the mucogingival border in the proper place.

Potential complications of this technique include damage to adjacent teeth. This did not occur in this series. Maintaining a 3-mm safety margin from the teeth and trephining parallel to the roots prevents this complication. This parallelism is specially important in deep narrow vaults, which are quite common in dolichofacial types.

CONCLUSION

Based on the authors' experience, the palatal core graft for alveolar reconstruction is easy to harvest, has low donor site morbidity, and allows 3-dimensional reconstruction of alveolar defects. It compares favorably with other reconstructive options proposed to date.

REFERENCES

1. Kohal RJ, Mellas P, Hurzeler MB, et al. The effects of guided bone regeneration and grafting on implants placed into immediate extraction sockets. An experimental study in dogs. Periodontol 1998;69:927–937.
2. Seibert JS, Cohen DW. Periodontal considerations in preparation for fixed and removable prosthodontics. Dent Clin North Am 1987;31:529–555.
3. Carlsson GE, Persson G. Morphologic changes of the mandible after extraction and wearing of dentures. Odontol Rev 1967;18:27–54.
4. Cornelini R, Scarano A, Covani H, et al. Immediate one-stage postextraction implant: A human clinical and histologic case report. Int J Oral Maxillofac Implants 2000;15:432–437.
5. Wilson TG, Schenk R, Buser D, Cochran D. Implants placed in immediate extraction sites: A report of histologic and histometric analysis of human biopsies. Int J Oral Maxillofac Implants 1998;13:333–341.
6. Knox R, Caudill R, Meffert R. Histologic evaluation of dental endosseous implants placed in surgically created extraction defects. Int J Periodontics Restorative Dent 1991;11:365–375.
7. Desjardins RP. Hydroxyapatite for alveolar ridge augmentation indications and problems. J Prosthet Dent 1985;54:374–383.
8. Goldberg VM, Stevenson S. Natural history of autografts and allografts. Clin Orthop Relat Res 1987;225:7–16.
9. Oklund S, Prolo DJ, Gutierrez RV, King SE. Quantitative comparison of healing in cranial fresh autografts, frozen autografts and allografts in canine skull defects. Clin Orthop 1986;205:269–291.

10. Peetz M. Characterization of xenogeneic bone material. In: Boyne PJ (ed). Osseous Reconstruction of the Maxilla and the Mandible. Chicago: Quintessence, 1997.
11. Gaggl A, Shultes G, Karcher H. Vertical alveolar ridge distraction with prosthetic treatable distractors: A clinical investigation. Int J Oral Maxillofac Implants 2000;15:701–710.
12. Oda T, Sawaki Y, Ueda M. Experimental alveolar ridge augmentation by distraction osteogenesis using a simple device that permits secondary implant placement. Int J Oral Maxillofac Implants 2000;15:95–102.
13. McCarthy C, Patel RR, Wragg PF, Brook IM. Dental implants and onlay bone grafts in the anterior maxilla: Analysis and clinical outcome. Int J Oral Maxillofac Implants 2003; 18: 238–241.
14. Kaufman E, Wang PD. Localized vertical maxillary ridge augmentation using symphyseal bone cores: A technique and case report. Int J Oral Maxillofac Implants 2003;18:293–298.
15. Raghoebar GM, Batenburg RH, Vissenk A, Reintsema H. Augmentation of localized defects of the anterior maxillary ridge with autogenous bone before insertion of implants. J Oral Maxillofac Surg 1996;54:1180–1185.
16. Widmark G, Andersson B, Ivanoff CJ. Mandibular bone graft in the anterior maxilla for single-tooth implants. Presentation of a surgical method. Int J Oral Maxillofac Surg 1997;26:106–109.
17. Khoury F, Happe A. The palatal subepithelial connective tissue flap method for soft tissue management to cover maxillary defects: A clinical report. Int J Oral Maxillofac Implants 2000;15:415–418.
18. Schropp L, Kostopoulos L, Wenzel A. Bone healing following immediate versus delayed placement of titanium implants into extraction sockets: A prospective clinical study. Int J Oral Maxillofac Implants 2003;18: 189–199.
19. Dahlin C, Anderson L, Lindhe A. Bone augmentation at fenestrated implants by an osteopromotive membrane technique. A controlled clinical study. Clin Oral Implants Res 1991;2:159–165.
20. Becker W, Dahlin C, Becker BE. The use of e-PTFE barrier membranes for bone promotion around titanium implants placed into extraction sockets: A prospective multicenter study. Int J Oral Maxillofac Implants 1994;9:31–40.
21. Simion M, Trisi P, Piattelli A. Vertical ridge augmentation around implants using a membrane technique associated with osseointegrated implants. Int J Periodontics Restorative Dent 1994;14:496–511.
22. Tinti C, Parma-Benfenati S. Treatment of peri-implant defects with the vertical ridge augmentation procedure: A patient report. Int J Oral Maxillofac Implants 2001;16:572–577.
23. Simion M, Misitano U, Gionso L. Treatment of dehiscences and fenestrations around dental implants using resorbable and non-resorbable membranes associated with bone autografts: A comparative clinical study. Int J Oral Maxillofac Implants 1997;12:159–167.
24. Piattelli M, Scarano A, Piattelli A. Vertical ridge augmentation using a resorbable membrane: A case report. Periodontol 1996;67:158–161.
25. Donovan MG, Dickerson NC, Henson LJ, Gustafson RB. Maxillary and mandibular reconstruction using calvarial bone grafts and Brånemark implants: A preliminary report. J Oral Maxillofac Surg 1994;52:588–594.
26. Friedlaender GE. Current concepts review. Bone grafts: The basic science rationale for clinical applications. J Bone Joint Surg 1987;69:786–790.
27. Gungormus M, Yavuz MS. The ascending ramus of the mandible as a donor site in maxillofacial bone grafting. J Oral Maxillofac Surg 2002;60:1316–1318.
28. Moenning JE, Graham LL. Elimination of mandibular labial undercut with autogenous bone graft from a maxillary tuberosity. J Prosthet Dent 1986;56:211–214.
29. Nkenke E, Schulze-Mosgau S, Radespiel-Troger M. Morbidity of harvesting of chin grafts: A prospective study. Clin Oral Implants Res 2001;12:495–502.
30. Schliephake H, Dard M, Planck H, et al. Alveolar ridge repair using resorbable membranes and autogenous bone particles with simultaneous placement of implants: An experimental pilot study in dogs. Int J Oral Maxillofac Implants 2000;15:364–373.
31. Novaes AB Jr, Novaes AB. Soft tissue management for primary closure in guided bone regeneration: Surgical technique and case report. Int J Oral Maxillofac Implants 1997;12:84–87.
32. Rosenquist B. A comparison of various methods of soft tissue management following the immediate placement of implants into extraction sockets. Int J Oral Maxillofac Implants 1997,12:43–51.
33. Rehrmann A. Eine Methode zur Schliessung von kieferhohlenperforationen. Dtsch Zahnärtz Wschr 1936;39:1136–1141.
34. Reikie DF. Restoring gingival harmony around single tooth implants. J Prosthet Dent 1995;74:47–50.