Case Series

Intraoral Autogenous Block Onlay Bone Grafting for Extensive Reconstruction of Atrophic Maxillary Alveolar Ridges

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Background: *Endosseous implants require sufficient bone volume for complete bone coverage. Alveolar deficiency can prevent ideal implant placement. Local bone grafts are a convenient source of autogenous bone in alveolar reconstruction. The aim of this study was to describe a technique, and to evaluate the success of extensive bone reconstruction of atrophic maxillary alveolar ridges using only intraoral block bone grafts prior to dental implantation.*

Methods: *Files of 10 healthy patients with extensive bone reconstruction of the maxillary alveolar ridge using intraoral block bone graft operations were reviewed. Medical history, smoking status, bone origin (donor sites), number of bone blocks, and complications were recorded.*

Results: *Of the 10 extensive bone maxillary reconstructions, four were uneventful, two required additional bone augmentation at the time of dental implant placement, two had a minimal graft exposure, one had a minor adverse effect (temporary paresthesia), and one operation partially failed and required partial graft removal.*

Conclusion: *Intraoral bone block grafting is a predictable operation with a high success rate for long-span augmentation, up to complete jaw augmentation/extensive bone reconstruction of the maxillary alveolar ridge.* J Periodontol 2005;76:636-641.

KEY WORDS

Alveolar ridge augmentation; follow-up studies; grafts, bone.

Autologous bone grafting used with dental implants was originally described by Bränemark et al.[1] in 1975, and is now a well-accepted procedure in oral and maxillofacial rehabilitation.[2-5] Placement of an endosseous implant requires sufficient bone volume for complete bone coverage. Furthermore, the pattern of ridge resorption contributes to an unfavorable maxillomandibular relationship, requires angulations of the implants and/or angled abutments, and affects the proximity of adjacent facial concavities (maxillary sinus, nasal cavity) and vital structures (mandibular nerve).[6] Several possible origins for autogenic bone include the calvarium,[7] tibia,[8] and the iliac crest.[9-11] Although the iliac crest is most often used in major jaw reconstruction, it is not always recommended due to its morbidity, altered ambulation, and the need for hospitalization. There is also significant resorption associated with corticocancellous block grafts from endochondral donor sites.[11-13] These disadvantages, together with the fact that dental implants do not demand large amounts of bone, led to the growing use of intraoral block bone grafts from intraoral sources, especially from the mandibular symphysis[3,6,14-17] and ramus.[2,3]

In the repair of alveolar defects, bone grafts from the symphysis and ramus offer several benefits:[15-17] conventional surgical access and the proximity of donor and recipient sites reduce operative and anesthesia time, making it ideal for outpatient implant surgery; there is no cutaneous scar; and patients report minimal discomfort and less morbidity compared with extraoral locations.

The mandibular symphysis is one possible origin for intraoral block bone grafts described by Linkow[18] to be effective, and the mandibular ramus is another. This area provides good bone quality with fewer postoperative complications compared to the symphysis area.[3,11]

The purpose of this study was to describe a technique and to evaluate the success of extensive bone reconstruction of the maxillary alveolar ridge using an intraoral block bone graft prior to dental implantation.

MATERIALS AND METHODS

Files of 10 consecutive healthy patients (1 male, 9 females, ranging in age from 45 to 61 years, average

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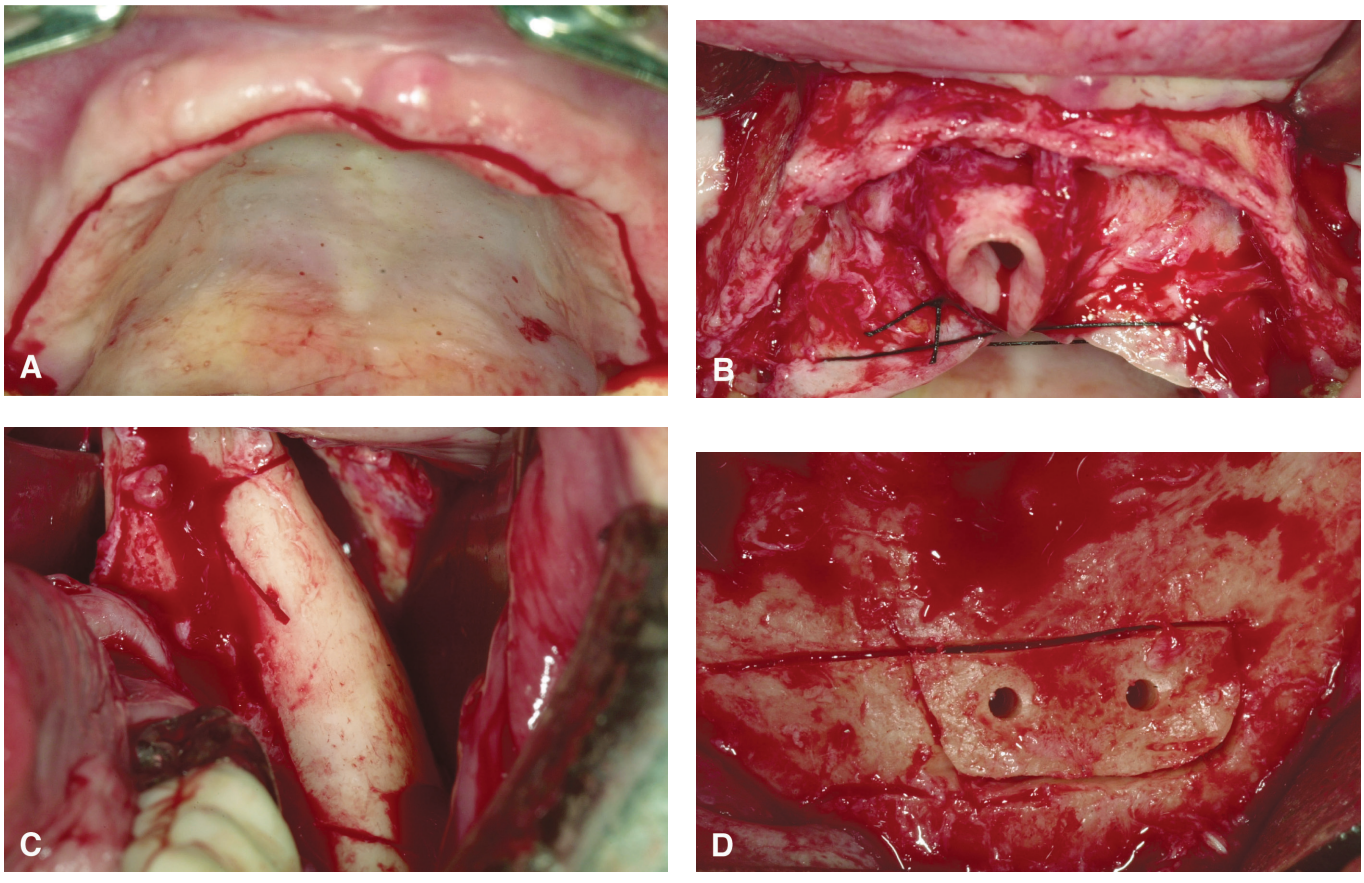

Figure 1.
A) *A midcrest incision was made along the entire maxillary ridge; two vertical releasing incisions were made at the maxillary tuberosity area.* ***B)*** *A mucoperiosteal flap was reflected toward the facial side while the palatal flap was held by 3-0 silk suture.* ***C)*** *Osteotomy of bone from the left mandibular ramus.* ***D)*** *Osteotomy of bone from mandibular symphysis. Notice the two drill holes made in advance for the two fixating screws.*

53 years) who reported extensive bone reconstruction of the maxillary alveolar ridge using intraoral block bone graft operations during the years 1999 to 2003 were reviewed. Medical history was recorded for each patient. Several different recipient sites were used for intraoral block bone grafts: mandibular symphysis (six grafts), mandibular ramus (five grafts), retromolar area (one graft), and maxillary tuberosity (one graft). A combined onlay bone grafting (OBG) and sinus lift elevation procedure was performed in eight operations (six bilateral and two unilateral), and two were combined with bilateral elevation of the floor of the nose.

One oral and maxillofacial surgeon (DSA) performed all grafting using the same operational protocol. A general anesthetic was used in nine operations. Oral examination and implantation protocols followed those described by Schwartz-Arad et al.[19] Preoperatively, panoramic and conventional or computerized tomography (CT) scans were evaluated for bone shape (mesio-distal width and vertical distance from the maxillary sinus and nasal cavity) and bone angulation. One hour before surgery, 1 g of amoxicillin and 8 mg of dexamethasone were administered. For the patients allergic to penicillin, 0.6 mg clindamycin was the drug of choice. Amoxicillin (1.5 g/day) or clindamycin (0.9 g/dat) was continued for 10 days post-surgery and 4 mg dexamethasone/day was administered for 2 additional days. Patients were instructed to rinse their mouth with chlorhexidine 0.5% for 2 minutes immediately preoperatively and to continue for 10 additional days, twice daily with chlorhexidine 0.2% post-operatively. OBG was performed 5 months prior to implant placement.

Recipient Site

To create the recipient site, a midcrest incision was made along the entire maxillary ridge and two vertical releasing incisions were made at the maxillary tuberosity area. A mucoperiosteal flap was reflected toward the facial side while the palatal flap was held by 3-0 silk suture (Figs. 1A and 1B). The recipient site was decorticated and recontoured using a round bone bur‡ for better adaptation of the graft and to improve

‡ Aesculap AG, Tuttlingen, Germany.

graft-to-recipient bone contact. The bone defect was evaluated to determine the size and shape of the block needed.

Donor Site

The donor site was created by harvesting a bone block from the mandibular ramus (modification of the technique described by Misch[20]) (Fig. 1C).

Access to the ramus area for bone harvest was gained through an extension of the commonly used envelope flap for third molar extraction. The incision started in the buccal vestibule, medial to the external oblique ridge, and extended anteriorly and laterally to the retromolar pad, continuing anteriorly into the buccal sulcus of the molars. A mucoperiosteal flap was reflected, exposing the lateral aspect of the ramus and the third molar area. To begin the ramus osteotomy, a reciprocating or oscillating saw was used to cut through the cortex along the anterior border of the ramus. An anterior vertical cut was made in the mandibular body, the length depending on the size of the graft needed, and a posterior vertical cut was made on the lateral aspect of the ramus. No inferior osteotomy was needed. The border cuts were deep, only until bleeding from the underlying cancellous bone was visible to prevent injury to the underlying neurovascular bundle. A thin chisel was gently tapped along the entire length of the external oblique osteotomy, taking care to avoid injury to the inferior alveolar nerve by not penetrating the cancellous bone beneath the cortical layer. Graft splitting from the ramus was then completed.

Harvesting Bone Block From Mandibular Symphysis (Fig. 1D)

An intrasulcular incision and two vertical releasing incisions were made between the premolar regions, reflecting the mucoperiosteal flap at the facial side. After exposing the symphysis and locating the mental foramina, a reciprocating saw was used to outline a rectangle, the size of the exposed defect. The superior aspect of the rectangle was at least 3 to 5 mm below the tooth apex, and the integrity of the lower border of the mandible was maintained. Osteotomes were used to free the block graft and harvest cancellous bone. Closure of the donor sites was completed after fixation of the bone graft and closure of the recipient site.

The graft was restored in sterile cold sodium chloride 0.9% solution;§ minimal time elapsed before placement in the recipient site. The block graft was then positioned over the recipient site with the endosteal side of the graft facing the cortical bone. The block was adapted to fit close to the site. To ensure immobility, the graft was fixed to the recipient site using titanium self-tap screws 1.6 mm in diameter‖ to be removed during implant placement. Any sharp angles in the block segment were eliminated, leaving a smooth outline without sharp edges that could perforate the overlying flap. Corticocancellous particles filled the gap between the graft and the recipient site to avoid interference of vascularization of the graft and creation of fibrous tissue ingrowth between the bed and graft. A resorbable membrane¶ was used to cover the bone particles taking care not to cover the block. The periosteum at the base of the facial flap was carefully incised to allow stretching of the mucosa and tension-free adaptation of the wound margins. The flap was sutured with a 3-0 non-rapid polyglactin# suture, which was removed 2 weeks later.

Provisional rehabilitation was made using a removable denture placed 4 weeks after bone grafting (relined with soft conditioner) or a fixed provisional rehabilitation supported by "hopeless" teeth and provisional dental implants.†† The provisional implants were placed into the maxillary bone, not in the grafted area. Teeth and provisional implants were extracted at the time of implantation or implant exposure. Data collected from the files included bone origin (donor sites), number of bone blocks, use of membrane, complications, and number of dental implants placed. Statistical analysis included descriptive statistics using a statistical software program.[21]

RESULTS

Of the 10 extensive bone maxillary reconstructions, four were uneventful, two required additional bone augmentation at the time of dental implant placement, two had a minimal graft exposure, one had a minor adverse effect (temporary paresthesia), and one operation partially failed and required partial graft removal.

No complications were found at the donor site except for minor swelling or hematoma.

Table 1 describes the extensive bone maxillary reconstruction, as well as the patients' medical and smoking status. There was no relation between complications or failure rates and bone source (donor site). There was no association between medical problems and complications.

Table 2 shows the number of dental implants placed in the maxilla after extensive bone maxillary reconstruction, complications, and the provisional rehabilitation that the patient received after reconstruction surgery.

DISCUSSION

The use of bone grafts for alveolar ridge augmentation is widely performed. Intraoral block bone graft surgery is a relatively new area in dental implants. The use of bone from the mandibular symphysis, retromolar area, mandibular ramus, and the maxillary tuberosity can

§ TEVA Medical Ltd, Ashdod, Israel.
‖ Osteomed Corporation Ltd, Addison, TX.
¶ BioGide, Geistlich Pharma AG, Wolhusen, Switzerland.
# Vicryl, Johnson & Johnson Int. Ethicon, St. Stevens Woluwe, Belgium.
†† MTI system, Dentatus, NY.

Table 1.

Medical and Smoking Status and Bone Maxillary Reconstructive Surgery

Patient	Gender	Age	Medical Status	Smoking	Anesthesia	Bone Origin	N Blocks	Sinus Lift	Nose Floor Elevation	Membrane
1	F	56	HT	+	General	Ramus (bilateral)	4	Bilateral	Bilateral	+
2	F	45	–	+	General	Symphysis + ramus (bilateral)	6	Unilateral	–	+
3	F	61	–	+	General	Symphysis	2	Bilateral	–	+
4	F	47	–	– (past smoker)	General	Symphysis	1	Bilateral	–	+
5	M	55	–	–	General	Symphysis	2	Unilateral	–	+
6	F	48	–	– (past smoker)	General	Symphysis	3	Bilateral	Bilateral	+
7	F	59	HT	–	General	Ramus (bilateral)	4	Bilateral	–	–
8	F	54	Factor II def.	+	General	Ramus (bilateral)	2	Bilateral	–	–
9	F	52	–	–	General	Ramus (unilateral)	3	–	–	+
10	F	53	–	–	Local	Symphysis + tuberosity	8	–	–	+

HT-hypertension.

Table 2.

Number of Dental Implants Placed After Extensive Maxillary Reconstruction; Complications; and Rehabilitation

Patient	Complications	Provisional Rehabilitation	N Dental Implants
1	–	Removable*	8
2	Additional bone augmentation required	Removable	9
3	–	Removable	6
4	Partial graft exposure and removal	Fixed†	10
5	Temporary paresthesia	Fixed†	10
6	Minimal graft exposure	Removable	8
7	–	Removable	10
8	–	Removable	10
9	Additional bone augmentation required	Fixed†	7
10	Minimal graft exposure	Removable	9

* Removable provisional rehabilitation placed 4 weeks after bone grafting.
† Fixed provisional rehabilitation supported on provisional dental implants.

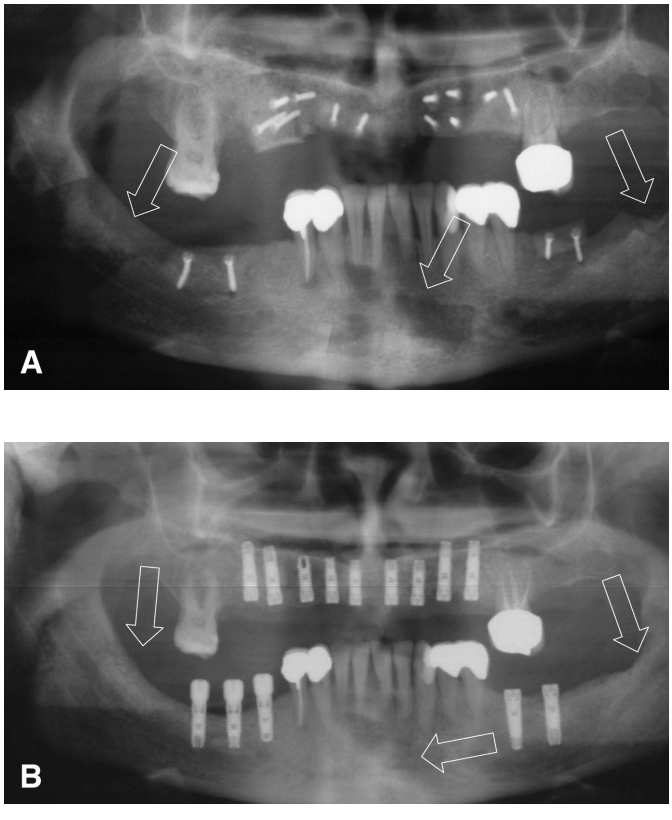

Figure 2.
A) *Postoperative panoramic view – maxillary edentulous ridge with extensive bone atrophy immediately after onlay bone graft. Bone was harvested from three donor sites (two rami and symphysis - arrows).*
B) *Five month post-operative panoramic view demonstrating the healing process of the three donor sites (arrows).*

serve as a good treatment alternative for alveolar ridge augmentation. The present study showed that an intraoral onlay bone block graft was a predictable operation with a high success rate for long-span augmentation, up to complete jaw augmentation or extensive bone reconstruction of the maxillary alveolar ridge. Figure 2 depicts panoramic views of a case where intraoral block bone grafts were used for long-span augmentation using three intraoral bone sources (two rami and the symphysis). This procedure offers the clinician additional bone for implant placement. Additional bone improves the crown-implant ratio by increasing the implant dimension and decreasing the crown dimension. The higher amount of good quality bone after augmentation allows the clinician to place a wider and longer implant in a better trajectory. The alveolar ridge should have adequate width to allow bone on both facial and lingual implant surfaces for circumferential osseointegration. A wider ridge may be desirable to place a wide implant when depth is not available. Furthermore, experimental evidence has shown that grafts from membranous bone show less

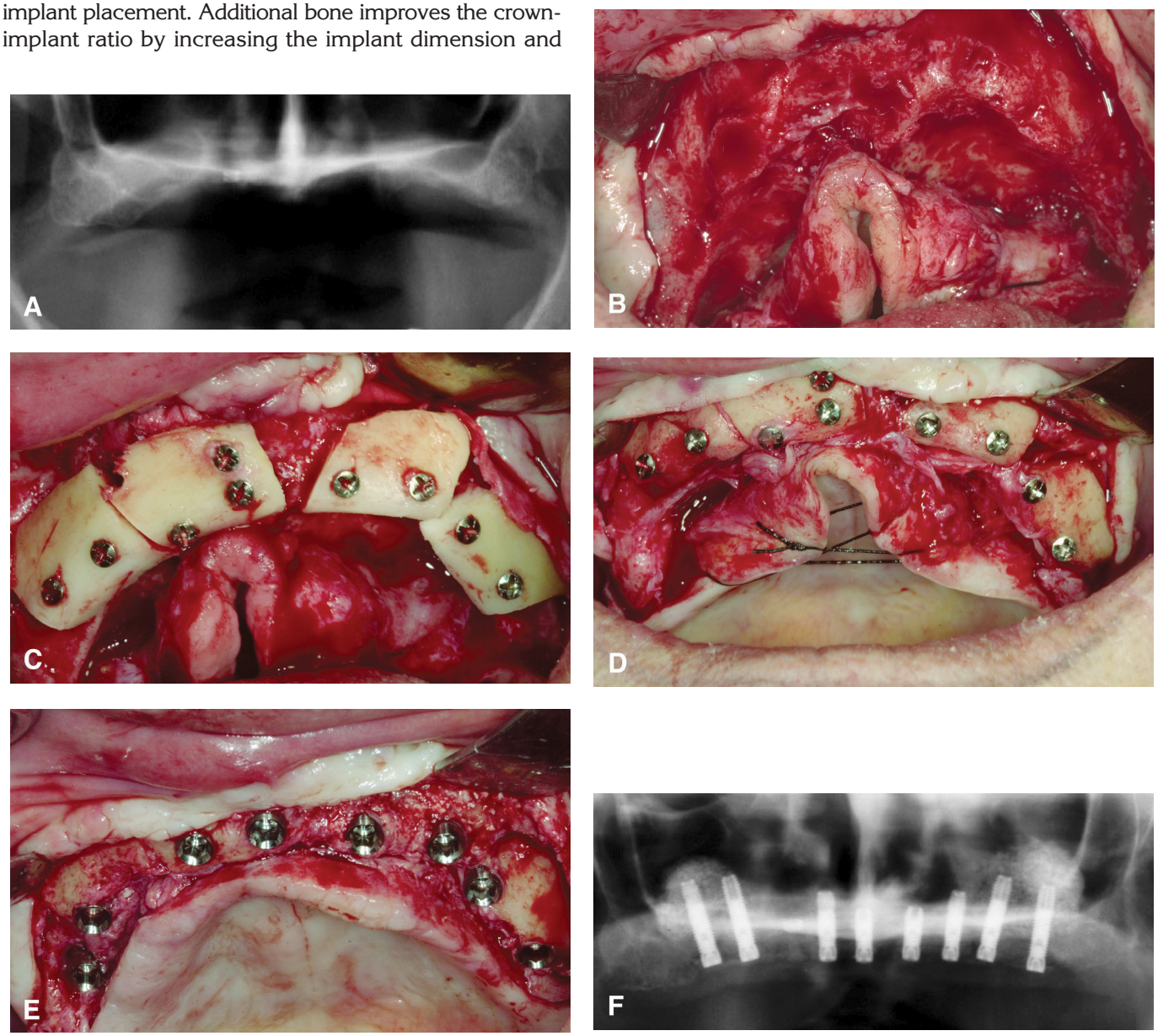

Figure 3.
A) *Pre-operative panoramic view: maxillary edentulous ridge with extensive bone atrophy.* ***B)*** *Labial view: atrophied maxillary edentulous ridge.* ***C)*** *Labial view of the same patient during OBG. Four bone blocks were used to reconstruct the atrophied maxilla. Donor sites were the mandibular right and left rami. Bone blocks were fixed to the alveolar ridge using 1.6 self-tap titanium screws. At least two screws were used for each block to prevent rotational movement.* ***D)*** *Labial view of the same patient, 5 months after OBG, with almost complete bone resorption.* ***E)*** *Labial view, 6 months after implant placement, showing improved ridge dimensions compared to the pre-operative situation (2B).* ***F)*** *Postoperative panoramic view demonstrating eight dental implants that will support the fixed prosthesis.*

resorption than endochondreal bone due to early revascularization, better potential for incorporation in the maxillofacial region because of a biochemical similarity in the protocollagen, and greater inductive capacity because of a higher concentration of bone morphogenetic proteins and growth factors.[2,3,14] Recently, it was shown that cortical bone grafts maintain their volumes significantly better than cancellous bone grafts.[22] Less resorption of the graft harvested from the intraoral origin makes this bone more favorable for implant placement. Implant placement shortly after graft incorporation has a stimulating effect on the bone, preserving the augmented bone volume and preventing further loss.

The dense structure of the cortical portion of the graft offers improved implant stability and stress transmission upon implant loading.[4,11]

Misch[20] recommends that only short spans be augmented using intraoral block bone grafts. In the present study, the extensive length of the recipient site did not influence the outcome of the operation. Figure 3 demonstrates a case where an intraoral block bone graft was used for long-span augmentation using three intraoral bone sources (two rami and the symphysis).

The intraoral block bone graft procedure can be combined with other surgical procedures, such as sinus lift elevation or nasal floor elevation.

CONCLUSIONS

An intraoral bone graft from the mandibular symphysis, retromolar area, mandibular ramus, and the maxillary tuberosity can serve as a good, predictable treatment modality for long-span augmentation, up to complete jaw augmentation/extensive bone reconstruction of maxillary alveolar ridges. OBG has a low complication and failure rate.

REFERENCES

1. Bränemark PI, Lindstrom J, Hallen O, Breine U, Jeppson PH, Ohman A. Reconstruction of the defective mandible. *Scand J Plast Reconstr Surg* 1975;9:116-128.
2. Misch CM. Ridge augmentation using mandibular ramus bone grafts for the placement of dental implants: Presentation of a technique. *Pract Periodontics Aesthet Dent* 1996;8:127-135.
3. Misch CM. Comparison of intraoral donor sites for onlay grafting prior to implant placement. *Int J Oral Maxillofac Implants* 1997;12:767-776.
4. Rissolo AR, Bennett J. Bone grafting and its essential role in implant dentistry. *Dent Clin North Am* 1998;42:91-116.
5. Lynch SE, Genco RJ, Marx R. *Tissue Engineering: Applications in Maxillofacial Surgery and Periodontics*, 1st ed. Chicago: Quintessence Publishing; 1999:83-98.
6. 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 Implants* 1992;7:360-366.
7. Harsha BC, Turvey TA, Powers SK. Use of autogenous cranial bone grafts in maxillofacial surgery: A preliminary report. *J Oral Maxillofac Surg* 1986;44:11-15.
8. Breine U, Bränemark PI. Reconstruction of the alveolar jaw bone. *Scand J Plast Reconstr Surg* 1980;14:23-48.
9. Keller EE, van Roekel NB, Desjardins RP, Tolman DE. Prosthetic surgical reconstruction of the severely resorbed maxilla with iliac bone grafting and tissue-integrated prostheses. *Int J Oral Maxillofac Implants* 1987;2:155-165.
10. Listrom RD, Symington JM. Osseointegrated dental implants in conjunction with bone grafts. *Int J Oral Maxillofac Surg* 1988;17:116-118.
11. Schwartz-Arad D, Dori S. Intraoral autogenous onlay block bone grafting for implant dentistry (in Hebrew). *Refuat Hapeh Vehashinayim* 2002;19:35-39.
12. Smith JD, Abramson M. Membranous vs. endochondral bone autografts. *Arch Otolaryngol* 1974;99:203-205.
13. Zins JE, Whitaker LA. Membranous vs. endochondral bone autografts: Implications for craniofacial reconstruction. *Plast Reconstr Surg* 1983;72:778-785.
14. Misch CM, Misch CE. The repair of localized severe ridge defects for implant placement using mandibular bone grafts. *Implant Dent* 1995;4:261-267.
15. 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.
16. Montazem A, Valauri DV, St-Hilaire H, Buchbinder D. The mandibular symphysis as a donor site in maxillofacial bone grafting: A quantitative anatomic study. *J Oral Maxillofac Surg* 2000;58:1368-1371.
17. Proussaerfs P, Lozada J, Kleinman A, Rohrer MD. The use of ramus autogenous block grafts for vertical alveolar ridge augmentation and implant placement: A pilot study. *Int J Oral Maxillofac Implants* 2002;17:238-348.
18. Linkow LI. Bone transplants using the symphysis, the iliac crest and synthetic bone materials. *J Oral Implantol* 1983;11:211-247.
19. Schwartz-Arad D, Gulayev N, Chaushu G. Immediate versus non-immediate implantation for full arch fixed reconstruction following extraction of all residual teeth: A retrospective study. *J Periodontol* 2000;71:923-928.
20. Misch CM. The harvest of ramus bone in conjunction with third molar removal for onlay grafting before placement of dental implants. *J Oral Maxillofac Surg* 1999;57:1376-1379.
21. Dixon WJ, ed. *BMDP Statistical Software*. San Francisco: University of California Press; 1993.
22. Ozaki W, Buchman SR. Volume maintenance of onlay bone grafts in the cranio-facial skeleton: Micro-architecture versus embryologic origin. *Plast Reconstr Surg* 1998;102:291-297.

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