Reconstruction of the Severely Resorbed Maxilla With a Combination of Sinus Augmentation, Onlay Bone Grafting, and Implants

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Purpose: A new method of reconstruction of the atrophic maxilla by combining a bilateral sinus floor elevation and cancellous bone graft with buccal and labial onlay graft using L-shaped corticocancellous blocks from the posterior iliac crest is presented.

Patients and Methods: Seventeen patients were treated with this procedure. One hundred one IMZ implants were placed in 14 patients, and 22 Bränemark implants were placed in three patients. Patients were observed for 6 months after prosthetic rehabilitation.

Results: All patients were fully rehabilitated with fixed bridges except one, who preferred an overdenture. Only two implants were lost at the time of the abutment connection. Some bone resorption was seen around six implants. The success rate with this procedure was 92.7% 6 months after prosthetic rehabilitation if implants with bone resorption were considered failures.

Conclusions: These preliminary results indicate that this surgical procedure is suitable for reconstruction of most atrophic maxillas.

In rehabilitation of the atrophic maxilla, the operative technique must be adapted to the kind of resorption that exists (Fig 1). The resorption pattern is not always the same; sometimes it is pronounced in the sagittal direction and sometimes in the vertical direction. If resorption has taken place mainly in the sagittal direction, a vertical splitting of the alveolar process and placement of an interpositional bone graft, in combination with bilateral sinus floor elevation, will resolve the problem. If the residual maxilla is flat mainly due to vertical resorption, a Le Fort I osteotomy with interpositional bone grafting will give excellent results. Implant placement can be done either simultaneously or delayed. By postponing the placement of implants, the mucoperiosteum has to be elevated a second time, introducing further bone resorption. Conversely, the implants can be placed more easily and ideally, and therefore more of these patients can be rehabilitated by fixed prosthesis rather than by overdentures. However, there is often a combination of vertical and horizontal resorption. In these cases, the thin residual alveolar ridge has to be removed when the Le Fort I osteotomy is used, because it is not suitable for implant placement. Conversely, vertical splitting of this thin alveolar ridge results in a broad ridge of insufficient height. A horseshoe onlay graft does not bring the maxilla forward and cannot adequately restore the maxillomandibular relationship in the sagittal direction. Rehabilitation with a fixed prosthesis is therefore difficult. A combination of onlay bone grafting with L-shaped...
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FIGURE 2. L-shaped bone grafts are fixed to the residual ridge with titanium screws. The voids are packed with cancellous bone graft mixed with hydroxyapatite.

blocks and sinus floor grafting has given excellent results in these atrophic maxillae.

Patients and Methods

Bone grafts are taken from the posterior iliac crest. The corticocancellous blocks contain a minimum of 10 mm of cortical bone on the upper border and 20 mm on the outer surface. Sufficient cancellous bone is also harvested for the grafting procedure.

Intraorally, an incision is made along the entire maxillary alveolar crest, with two relieving incisions buccally in the tuberosity region. After raising the mucoperiosteum, a standard sinus floor elevation procedure is done, and cancellous bone mixed with hydroxyapatite is packed into the area. Four to six L-shaped corticocancellous blocks are then fixed to the buccal and labial aspect of the alveolar ridge, each with one titanium screw (Fig 2). The voids between the blocks are filled with cancellous bone, sometimes mixed with hydroxyapatite. After incision of the periosteum at the depth of the mucoperiosteal flap, the mucosa is tightly closed with everted interrupted sutures (Vicryl 3/0). Four months later, six to eight implants are placed under local anesthesia. The titanium screws used for fixation of the grafts are removed at the same time. Sometimes these screws are removed via stab incisions under local anesthesia 1 month earlier.

Results

From March 1994 to May 1995, 17 patients (14 female and 3 male) were treated with this surgical procedure. The age of the patients ranged from 36 to 57 years, with a mean age of 51 years.

In one patient, elevation of the sinus mucosa was
impossible because of the extremely thin sinus lining. A titanium mesh was inserted bilaterally to hold the cancellous bone together on the sinus floor. The graft in the left sinus became infected, and the mesh had to be removed. As a result, some of the graft was lost. Nevertheless, eight implants were inserted 4 months after the reconstruction. In another patient, there was a partial loss of the bone graft in the right sinus because of chronic infection. Two patients had pain in the hip for a long period (several months). However, all patients were able to leave their bed 1 day postoperatively and walk.

Titanium-sprayed IMZ implants (Friatec Mannheim, Germany) were placed in 14 patients. In three patients, after reconstruction in our department, Branemark implants were placed elsewhere. In all patients except one, either six, seven, or eight implants were placed for support of a fixed prosthesis. One patient preferred an overdenture, and only four implants were placed.

One hundred one IMZ implants were placed in the 14 patients 4 months postoperatively: 75% had a length of 15 mm and a diameter of 4 mm (15/4). In 16%, implants 13 mm long and 4 mm in diameter were installed. In one patient the reconstruction was insufficient and only small, thin implants could be placed: one of 13/4, one of 11/4, two of 13/3.3, and two of 10/3.3.

Two implants were removed at the time of abutment connection, and one implant was removed 6 months after the prosthetic rehabilitation. Bone resorption was seen around six implants. Around two of them there was horizontal bone resorption of about 5 mm. Crater-like bone resorption was seen around another implant. This implant has been successfully treated with the guided bone regeneration technique. Around three other implants there was some bone resorption on the buccal aspect (3 to 6 mm). All of the other implants were fully surrounded by healthy bone.

The success rate of the implants was 97.5% 6 months after prosthetic rehabilitation. If the implants with bone resorption were considered a failure, the success rate dropped to 92.7%. The three nonintegrated implants and those with bone loss were all situated in bone grafts in the anterior region. As planned preoperatively, 16 patients are rehabilitated with fixed bridges and one with an overdenture (Figs 3, 4).

**Discussion**

With this technique, the success rate was 97.5% 6 months after prosthetic rehabilitation. If the implants with bone resorption are taken into account, then the failure rate was 92.7%. Sailer reported 100% success with the Le Fort I osteotomy and immediate implant placement in five consecutive patients. However, Isaksson et al, reporting on the same technique, removed 14 implants (21%) because of nonintegration. De Clercq et al, using the same technique in severely resorbed maxillae, reported 11.9% loss of implants but, in the group of patients in whom the insertion of implants was postponed 4 months after the Le Fort I procedure, the failure rate was only 7.4%. Adell et al reviewed the results of 23 consecutively treated patients with severely resorbed edentulous maxillae in whom implants were placed in horseshoe onlay grafts. A total of 124 implants were placed in the grafts; 8.1% of the implants were lost during the healing period before abutment connection.

The surgical technique combining onlay and inlay bone grafting offers a simple method for rehabilitation of the severely atrophic edentulous maxilla. A similar technique was described by Tidwell et al in 1992. They combined a bilateral sinus floor procedure with tunneling of the mucoperiosteum in the anterior region,
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packing the tunnel with cancellous bone mixed with hydroxyapatite. In this technique, the alveolar crest in the anterior region can be enlarged, but lengthening is difficult. They reported 6.4% failing implants in the floor of the sinus and 7.8% in the anterior onlay grafts.

L-shaped cortocancellous grafts provide an opportunity to widen and heighten the atrophic alveolar ridge up to 10 mm. It is not necessary to remove the residual alveolar crest. This technique, like the Le Fort I osteotomy, also provides the possibility of restoring the maxillomandibular relationship in both sagittal and vertical dimensions. Even in the premolar region, where the residual ridge is often too small for implant placement after sinus floor elevation, onlay grafting with L-shaped blocks can resolve the problem. This technique also can give excellent results in the combination syndrome (Kelly syndrome) when the resorption is severe in the labial region because of loading by the anterior mandibular teeth. The L-shaped graft has the advantage of providing a cortical layer on the buccal and occlusal aspect of the restored maxilla. This cortical layer withstands resorption better than cancellous bone.

There will always be some resorption when using bone grafts, so overgrafting is indicated. With the Le Fort I procedure, some bone resorption and thinning of the alveolar process is also noticed at the time of abutment connection. In our experience, resorption of the onlay grafts varies from one patient to another, and it occurs mainly on the buccal aspect of the graft. Loading of the graft by a removable denture is probably responsible for most of the resorption, but it is difficult to convince patients not to wear a denture during the healing period until abutment connection.

Because our cases were only observed for 6 months after the implants were loaded, longer follow-up is needed to evaluate the long-term stability of the bony augmentation.

References

reconstruction of severely atrophic (class VI) maxillae by immediate endosseous implants in conjunction with bone grafting and Le Fort I osteotomy. Int J Oral Maxillofac Surg 52:144, 1995