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A 9–14 year follow-up of onlay bone grafting in the atrophic maxilla

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Abstract. Treatment of the atrophic edentulous maxilla is challenging especially when bone graft procedures are necessary. In this study an onlay bone graft, a saddle or veneer, with or without maxillary sinus floor inlay graft, harvested from the anterior iliac crest, in combination with implants was used in the reconstruction of patients with extreme atrophy in their maxillae. The aim was to investigate treatment outcome, and the impact of gender and smoking, in 44 patients in a prospective, long-term, follow-up study concerning implant survival rate and marginal bone loss adjacent to the surfaces of the implant.

Mean follow-up time was 11 years. Of 334 inserted Brånemark implants, with machined surface, 27 failed. Estimated implant survival rate was 90%. Marginal bone loss was 1.8 mm 1 year after implant surgery; 2.3 mm after 5 years; and 2.4 mm after 10 years. There was a significant difference between genders in implant survival. Marginal bone loss differed significantly between smokers and non-smokers up to the 5-year examination and between genders after the 4-year examination. The onlay bone graft, with or without a maxillary inlay graft, results in high implant survival rate, good oral function and stabilised marginal bone. All patients are still wearing their original fixed bridges.

Keywords: bone grafting; autogenous bone; iliac crest; maxilla; implants; marginal bone level.

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In the atrophic edentulous maxilla, grafting procedures in combination with endosteal implants are necessary[1,5,6,13,16,17,24,35]. The final physiological resorption differs between patients, so different reconstructive techniques should be used, for example, in the thin alveolar process a saddle or veneer onlay graft can be chosen[20], while if there are reversed intermaxillary relations or an increased vertical distance between the maxilla and mandible, an interpositional bone graft and Le Fort I osteotomy is an alternative[25].

One requirement for successful treatment with endosteal implants is a sufficient amount of jaw bone. In patients with advanced resorption of the maxilla this bone is not available, therefore augmenting procedures to reconstruct the alveolar crest to increase the vertical and horizontal dimensions are necessary.

The aim of reconstruction with bone grafts and implants is to restore facial morphology. The condition of the alveolar crest determines the choice of surgical technique to optimize function and appearance for the patient. The anterior iliac crest is a common donor site, especially when both cortical and cancellous bone are required. The medial table has a thin cortical plate compared with the superior or lateral borders of the iliac

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crest. The area of the lateral iliac crest, where the medial gluteus muscle inserts, known as the tubercle, contains cortical bone with a high density and thickness. This area is preferable when large amounts of cortical bone are needed. The disadvantage of harvesting bone from the superior or lateral border of the iliac crests is that interference with the insertion of the gluteus muscles may cause gait disturbance[10].

The aims of this study were to evaluate the implant survival rate and marginal bone level after long-term follow-up and to study the impact of smoking and gender on these aspects.

Material and methods

This study comprised 44 consecutive edentate patients with maxillary atrophy, 15 men and 29 women. The patients were referred to the Department of Oral and Maxillofacial Surgery, Umeå University Hospital, for reconstruction of the maxillary alveolar ridge with bone grafts and implants. The mean age of the patients was 58 years (range 45–68 years). This group of patients was followed annually with a mean follow-up time of 11 years (range 9–14 years) after the implant surgery. The patients in this study suffered from severe maxillary atrophy verified by clinical and tomographic examination. Most patients had sufficient bone height, but not sufficient width in the maxilla for implant treatment; class IV according to Cawood and Howell[8]. Some patients also had inadequate vertical height, more often seen in the anterior maxilla; class V according to Cawood and Howell[8].

Of the 44 patients, 24 underwent reconstruction in the anterior and posterior maxilla with an onlay bone graft; a veneer graft in the posterior maxilla and a veneer or saddle graft in the anterior maxilla. The remaining 20 patients had reconstruction with an onlay bone graft in the anterior maxilla and an inlay bone graft in the maxillary sinus floor bilaterally. Vertical augmentation of the nasal floor was performed with an onlay bone graft in 40 of the 44 patients.

The 29 female patients received 223 implants and the 15 men received 111 implants. Twenty-seven patients were non-smokers and 5 patients had previously smoked but had stopped smoking before surgery; 12 patients were active smokers. In the smoking group of 12 patients 89 implants were inserted and in the non-smoking group of 32 patients received 245 implants.

The patients had been edentate for a long time: 32 patients for more than 25 years (25–48 years), 4 patients for 10–25 years, and 7 patients for up to 10 years. Edentate duration was not reported for one patient. Of 44 patients, 22 were dentate or supported with an implant-supported fixed bridge in the mandible and 21 patients had an anterior dentition with or without removable prostheses. Only one patient in the study was edentate.

Reconstructive surgery

Surgery was performed under general anaesthesia with oral endotracheal intubation. A local anaesthetic with a vasoconstrictor was used for haemostasis. Bensylpenicillin, 3 g, were administered at the start of the operation. The iliac crest was chosen as the donor site. A corticocancellous block was harvested from the superolateral border of the iliac crest. The bone grafts were stored in blood-soaked gauze. The wound was closed in layers; the closure of the first layer, the fascia lata, was carefully readapted to avoid marrow bone bleeding into surrounding soft tissue. An activated vacuum drainage was positioned between the fascia lata and the muscles and kept in place until bleeding stopped, usually on the second postoperative day. The skin was closed with continuous intracutaneous sutures using resorbable material.

Intraorally, a mucoperiosteal flap, labially directed through a midcrestal incision, was raised to expose the lateral wall of the sinus, nasal aperture and the anterior maxillary alveolar crest. The surgical bone-grafting procedure, preparation of the sinuses, and elevation of the sinus and nasal mucosa have been described previously[20]. The bone grafts were placed in the sinuses as well as on the anterior nasal floor and as veneer or saddle grafts on the alveolar ridge. The cortiococancellous bone blocks were adjusted and placed on the alveolar process and rigidly fixed with titanium screws (2 mm diameter). Each bone block was rigidly fixed with 2–3 screws engaging the total residual alveolar process. In order to avoid tension on the mucoperiosteal flap, a periosteal horizontal incision was made to increase the length of the flap. The mucoperiosteal flap was then closed with single sutures. All patients were mobilised early, no later than the day following the operation and discharged from hospital on the second or third day after surgery. The patients were not allowed to wear removable dentures during the first 4–6 postoperative weeks.

Implant surgery

Six months after bone graft surgery, the implant surgery was performed, following the routines of the Brånemark system[7], under local anaesthesia and conscious sedation. The bone graft fixation screws were removed at implant surgery. A surgical guide was used to optimise the position of the implants. Thirty-two patients received 8 implants, seven patients 7 implants, two patients 6 implants, two patients 4 implants, and one patient 9 implants. A total of 334 Brånemark machined surface implants were inserted. The implants were supplied with cover screws and left for healing for 6 months before abutment connection.

Prosthetic treatment

After the grafting procedure the patients did not use their dentures for 4–6 weeks. Thereafter the patients were supplied with a new removable dentures. During the healing period, after the grafting surgery, the patients were recalled for individual check ups and, if needed, the dentures were relined with a soft-tissue relining material. After implant surgery, the dentures were again relined. Abutments were attached after a 6-month healing period in most cases. Multi-unit abutments were used but in some patients angled abutments (17°) had to be used. In all patients for whom a metal–ceramic bridge was planned, a temporary bridge in acrylic was first fabricated. The temporary bridge was used for 4–8 weeks. The temporary bridge was fabricated with short cantilevers or without cantilevers and with flat cusps to allow gentle occlusion. The permanent metal–ceramic bridge was formed according to the procedures described in the manual. If the bridges were fabricated in gold–acrylic or titanium–acrylic no temporary bridge was made; this procedure was used for most cases.

In patients who lost implants, a decision was made whether to install supplementary implants. Depending on which implant had been lost, the position of the remaining implants, the dentition in the opposing jaw and individual factors such as loading, functional habits and cantilever length played an important roll in determining if supplementary implants should be inserted. If so, a temporary bridge was fabricated reinforced with Kevlar® threads, and ordinary gold cylinders were used in the acrylic material. The temporary bridge was then used for the additional healing period for approximately 6 months.