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Clinical Paper
Dental implants

A prospective study on the morbidity resulting from calvarial bone harvesting for intraoral reconstruction

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Abstract. Calvarial bone grafts are used for reconstruction of the maxilla or mandible to enable implant placement. The aim of this study was to assess the morbidity resulting from the use of calvarial bone grafts to reconstruct the maxilla and mandible. Thirty-six consecutive patients were included in this prospective study (14 men and 22 women; mean age 59 ± 8.2 years). Perioperative and postoperative complications related to harvesting of the calvarial bone were scored, as well as the occurrence of intraoral complications (average follow-up 25 ± 12 months). Perioperative exposure of the dura occurred in four patients and the graft broke during harvesting in five patients. With a change in the technique, these complications no longer occurred. Postoperative pain levels at the calvarial donor site were low (visual analogue scale (VAS) 1.9 ± 2.0 on day 1) and of short duration (5.2 ± 4.7 days to becoming pain-free). In all cases sufficient bone could be harvested to enable the placement of implants. The exposure of the dura and the intraoral complications were of no clinical consequence. Therefore, calvarial bone grafts appear to be promising for use in pre-implant intraoral reconstructions.

Keywords: Calvarial; Bone graft; Morbidity; Maxilla; Reconstruction; Pre-prosthetic surgery.

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Introduction

In edentulous patients, resorption of the maxilla and mandible can result in problems wearing a denture due to a lack of supporting bone. The placement of dental implants is advocated to increase the retention of dentures.[1] However, in the case of severe resorption, there is insufficient bone volume to place the dental implants. In The Netherlands, the anterior iliac crest is the most commonly used donor site for reconstruction of the maxilla or mandible to obtain more bone volume.[2] A drawback of the use of anterior iliac crest bone grafts is donor site morbidity.[2] This morbidity includes gait disturbances, pain, and hyposensitivity of the lateral aspect of the thigh due to neuropraxis of the lateral femoral nerve.[3,4]

An alternative to the anterior iliac crest donor site is the calvarium.[5] Calvarial bone grafts have been used for the reconstruction of the orbital walls, nasal bones, cranial defects, and defects of the maxilla and mandible.[6] They have also been used for maxillary reconstructions to enable the placement of dental implants.[7,8] It is assumed that calvarial bone grafting is accompanied by less donor site morbidity than iliac crest grafting,[9,10] but investigations have primarily been retrospective in nature.[5,6] Therefore, the purpose of this study was to prospectively assess the donor site morbidity of calvarial bone harvesting in a group of 36 consecutive patients in

whom a calvarial bone graft was used to reconstruct the maxilla or mandible as a pre-implant placement procedure.

Materials and methods

This prospective observational study was performed with the approval of the ethics committees of the study hospitals (Scheper Hospital and Refaja Hospital).

Patients

From April 2010 to December 2013, 36 consecutive patients were included in the study. This convenience sample was chosen to serve as a baseline for power calculations for future studies.

Inclusion criteria were the following: (1) patient referral to the department of oral and maxillofacial surgery by a dentist or prosthetic specialist because of problems wearing a denture (pain, mobility, loss of retention, chewing problems) due to severe resorption of the edentulous maxilla or mandible. (2) A computed tomography (CT) scan demonstrating an insufficient amount of remaining bone in the maxilla and/or mandible for the placement dental implants (less than 4 mm bone height in the maxillary sinus area; less than 4 mm bone width in the anterior maxillary area; less than 10 mm bone height in the mandible), and in addition a CT scan of the calvarium with frontal reconstructions demonstrating sufficient thickness of the temporal bone (>5 mm) in the area between the tuberculum articulare and the end of the mastoid bone. (3) Written informed consent.

Patients taking bisphosphonates, chemotherapeutic, and/or immunosuppressive drugs were excluded.

Calvarial bone harvesting technique

The operative procedure for harvesting of the calvarial bone is described in detail in a previous publication by Schortinghuis et al.[11] In brief, the outline of the tabula externa graft was marked with a burr until the diploë was encountered. Next, using a bone scraper,[12] a trough was made outside the graft. For the first 10 patients in this study, the calvarial graft was removed in one piece by undermining the corners with an oscillating saw.[13] Using a curved chisel, the graft was then loosened in one piece from the tabula interna. In the subsequent patients, parallel saw-cuts were made in situ so that the graft could be removed piece by piece thus preventing graft breakage. Autopolymerizing bone cement was used to reconstruct the defect (Palacos; Heraeus Medical GmbH, Haarlem, The Netherlands).

Augmentation of the maxilla

After exposure of the maxillary bone, a sinus lift procedure was performed on both sides and the 'scraped' calvarial bone was placed under the maxillary sinus membrane. The cortical calvarial bone graft was sawn into different pieces that were fixed onto the remaining alveolar process using 1.5-mm osteosynthesis screws. A lag-screw technique was used: by drilling a wider hole in the graft, the screw head exerts a compression force onto the graft when tightening it to the alveolar process. After fixation, special care was taken to round off sharp bone edges, since calvarial bone is hard and can have sharp edges that may penetrate the overlying mucosa. The remaining cancellous bone was used to fill the gaps. Collagen membranes were used to cover the augmented sites. Primary wound closure was accomplished using resorbable sutures (Vicryl Rapide 3–0; Johnson & Johnson, Amersfoort, The Netherlands).

Augmentation of the mandible

After exposure of the mandibular bone, calvarial bone blocks were fixed on the alveolar process to augment the anterior part of the mandible. Cancellous bone was used to fill the gaps. After placement of a collagen membrane, the wound was closed in layers.

Postoperative care

Patients were given a broad-spectrum antibiotic (amoxicillin/clavulanic acid) and non-steroidal anti-inflammatory drugs (ibuprofen) for 1 week. Patients were instructed to maintain a soft diet and were not allowed to wear their maxillary denture for 2 weeks. After 4 months, six dental implants were placed in the augmented maxilla. Two dental implants were placed in the augmented mandible. All patients were enrolled in a dental hygiene protocol consisting of patient instructions, regular professional cleaning of the peri-implant area when needed, and regular follow-up with a dental hygienist for the prevention of peri-implantitis.

Morbidity assessments

During the grafting procedure of the calvarial bone, the following items were recorded: exposure of the dura (yes/no), dural tear (yes/no), accidental fall of bone (yes/no), fracture of the graft during removal (yes/no), and the duration of the harvesting procedure (min). The number of days of hospitalization was also recorded.

Postoperative pain was scored on a 10-cm visual analogue scale (VAS), ranging from 'no pain' (0) to 'the worst pain imaginable' (10). Pain at the donor site and at the receptor site was scored once a day for 30 days. The scores were kept in a logbook.

The following data were recorded by the surgeon at postoperative weeks 1, 2, 6, 12, 16, and 32, and at 12, 18, 24, and 30 months after surgery: donor site (calvarial) aspect of the scar (dehiscence yes/no, erythema yes/no, swelling yes/no, pain yes/no), hair loss (yes/no), localized pain (yes/no), and contour deficit (yes/no). When a contour deficit was present, it was determined whether or not this was bothersome to the patient (yes/no). With regard to the receptor site (maxilla/mandible), the presence of dehiscence (yes/no), fistula (yes/no), erythema (yes/no), loss of implants (yes/no), gingivitis (yes/no) were also recorded at the same time-points by the maxillofacial surgeon. Peri-implant bone loss was assessed using postoperative orthopantomographic radiographs obtained at 6 weeks, 12 weeks, 12 months, and 24 months. The amount of peri-implant bone loss was calculated considering the peri-implant bone level on the postoperative radiograph taken the day after surgery as the baseline. A bone attachment loss of >2 mm was considered as bone loss. Sensory disturbances of the mandible were also recorded.

During the placement of implants, or placement of healing abutments in the case of immediate implantation, the loss of bone or presence of signs of bone resorption (yes/no) was recorded.

Results

A total of 36 consecutive patients gave informed consent to participate in the study and underwent surgery. Fourteen were male and 22 female, and their mean age was 59 ± 8.2 years. The mean follow-up was 25 ± 12 months. For 31 patients, only an augmentation procedure was performed (maxilla $n = 26$, mandible $n = 4$, maxilla and mandible $n = 1$); implants were inserted 4 months later (Straumann standard dental implants; Institut Straumann AG, Basel, Switzerland). The remaining five patients underwent augmentation of the maxilla with the simultaneous placement of dental implants (Biomet T3 implants; Biomet 3i, Palm Beach Gardens, FL, USA). In the anterior region of the maxilla, the implants were inserted in the buccal plated alveolar process at tooth locations 12, 14, 22, and 24. In the sinus region, the implants were placed in the simultaneously augmented sinus floor at locations 16 and 26. At 4