Journal of Cranio-Maxillo-Facial Surgery 43 (2015) 611–615

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Long-term peri-implant bone level changes of non-vascularized fibula bone grafted edentulous patients

Fabian Duttenhoefer [a, *], Claudia Nack [b], Christian Doll [b], Jan-Dirk Raguse [b], Berthold Hell [c], Andres Stricker [a], Katja Nelson [a], Susanne Nahles [b]

[a] Department of Oral and Maxillofacial Surgery, University Hospital Freiburg, Freiburg, Germany
[b] Department of Oral and Maxillofacial Surgery/Clinical Navigation, Campus Virchow-Clinic, Charité University Hospital, Berlin, Germany
[c] Department of Oral and Maxillofacial Surgery, Ev. Jung-Stilling-Hospital, Siegen, Germany

ARTICLE INFO

Article history:
Paper received 15 September 2014
Accepted 27 February 2015
Available online 9 March 2015

Keywords:
Atrophied jaw
Avascular fibular graft
Onlay graft
Ridge augmentation

ABSTRACT

Long-term results of reconstructions and prosthetic rehabilitation of patients presenting severely atrophied edentulous ridges remains a challenge for clinicians. Among the various available augmentation materials there is evidence that avascular fibula bone grafts possess a reliable resistance against resorption and may thus provide a valuable source to reduce the loss of vertical bone height after reconstruction of the severely atrophied mandible and maxilla.

The purpose of the present study was to assess long-term crestal bone level stability in avascular fibula bone grafts. 8 edentulous female patients (average age 70.6 years) with Class-VI-atrophy and less than 5 mm residual bone volume received onlay-grafting with avascular fibula bone grafts and were monitored with a mean observation time of 133.7 months (121–186). A total of 39 implants were placed in the maxilla and mandible. Three patients received immediate and five patients delayed implant placement 3 months after grafting. All patients were provided with bar-retained dentures. Postoperative evaluation included clinical implant success (Buser) and radiographic examinations (orthopantomogram) to quantify crestal bone resorption. Grafting was successfully performed in all patients with no regrafting necessary. All implants but one, lost 2 years after abutment connection, remained successfully integrated and fulfilled the Buser criteria, rendering to a success rate of 97 %. Mean bone resorption after 10 years was mesial 1.4 mm and distal 1.4 mm at each implant-site. Maximum bone resorption occurred between postoperative and first year, thereafter no significant resorption was measured in re-examinations up to 15 years. Avascular fibula grafts are a reliable bone graft for augmentation procedures in atrophied edentulous ridges. Dental implants that integrated in the autogenous fibular bone grafts showed a stable crestal peri-implant bone level up to 15 years after implant placement.

1. Introduction

Regeneration of physiologic oral function is crucial for adequate nutrition, aesthetic recovery and improvement in quality of live (Yu et al., 2011). Still, prosthetic rehabilitation of patients presenting severely atrophied edentulous ridges is a major clinical challenge. Advanced atrophy with less than 5 mm residual bone impairs conventional implant insertion and constitutes a paramount indication for the use of bone grafts prior implantation (Keller, 1995). To date, numerous techniques regarding the surgical approach in combination with different grafting procedures have been identified (Buser et al., 2002; Schliephake et al., 1999b). Nonvascularised autogenous bone grafts, predominantly from the iliac crest, are a well-proven and documented procedure in the augmentation of the severely atrophied alveolar ridge (Lundgren et al., 1999; Reinert et al., 2003). However, the loss of vertical bone height due to resorption of the graft has been postulated to be a challenge after implantation (Balshi et al., 2003; Bell et al., 2002). Current literature showed that microvascular fibula free flaps for mandibular reconstruction comprises a resistant,

* Corresponding author. Universitätsklinik für Zahn-, Mund- und Kieferheilkunde, Abteilung Klinik und Poliklinik für Mund-, Kiefer- und Gesichtschirurgie, Hugstetter Str. 55, D-79106 Freiburg, Germany. Tel.: +49 761 270 49330; fax: +49 761 270 4800.
E-mail address: fabian.duttenhoefer@uniklinik-freiburg.de (F. Duttenhoefer).

http://dx.doi.org/10.1016/j.jcms.2015.02.020
1010-5182/

denturebearing surface and allows successful implant osseointegration (Chang et al., 2014; Yu et al., 2011). Interestingly, there are no long-term data available whether the treatment with avascular fibula grafts involves similar adequate properties. In a preceding investigation we assessed the clinical potential of nonvascularised bone from the fibula and could show reduced resorption rates and complete dental rehabilitation with osseointegrated implants with an observation period of up to 6 years (Keller, 1995; Nelson et al., 2006). The aim of this retrospective study was to assess long-term crestal bone level changes in avascular fibula bone grafts up to 15 years after augmentation.

2. Materials and methods

2.1. Patients and implants

The clinical and radiologic follow-up of 5 edentulous, female patients enrolled in a preceding study by Nelson et al. were re-assessed regarding the peri-implant bone height after augmentation of the severely atrophied mandible and maxilla with avascular fibula bone grafts. The study protocol and surgical procedures are described in detail in the publication of Nelson et al., 2006 (Buser et al., 2002; Nelson et al., 2006; Schliephake et al., 1999b). Clinical criteria included the implant success (Buser et al., 2002), graft success and radiological crestal bone resorption. Within the present study three further patients were included in the evaluation, so the data of eight patients were analysed. All patients within this study were treated in the same department (Dept. of CMF-Surgery, Charité CVK, Berlin). The patients presented a Class VI atrophy according to the Cawood classification with severely atrophic jaws with less than 5 mm residual bone volume (Cawood and Howell, 1988; Lundgren et al., 1999; Reinert et al., 2003). The average age of the patients was 70.6 years (range 61–76) and the mean observation period was 133.7 months (121–186 months).

2.2. Operative procedure

In brief, throughout the study a team of three operators, two harvesting the fibula graft, one performing augmentation and implantation procedures, accomplished all surgeries and applied the same technique in each patient. Two patients received implants in the same approach, all others received the implants after a healing period of 3 months. After removal of the lateral compartment muscles, around 8 cm above the lateral fibular malleolus, the demanded bone graft was proximally and distally partially osteotomized and harvested. A suction drain was inserted prior to wound closure and the donor calf was firmly wrapped with an elastic below-the-knee bandage. At the first postoperative day patients progressed at their own rate without formal physical therapy.

A midcrestal approach with incision along the maxilla or mandibular alveolar crest and vertical relief incisions were performed to expose the recipient site. In case of the mandibular approach, the inferior alveolar nerve was repositioned to the lateral edge of the mandible. To fit recipient site dimensions the harvested cortico-cancellous bone required slight trimming in shape and size. Bone splinters and filings were caught in a bone filter (KFT2; Schlumbohm OHG, Germany). The grafts were fixed in place with one or two titanium screws (Modus 1.5; Medartis, Germany) and covered with resorbable membranes (BioGide; Geistlich Biomaterials, Wolhusen, Switzerland). Gaps between the augmented blocks were filled with the bone splinters and filings.

A total of 39 implants were inserted thereof 18 Rootline Camlog (CAMLOG Biotechnologies AG, Wimsheim, Germany), 12 Steri-Oss (Nobel Biocare AB, Sweden) and 8 ITI implants (Straumann AG, Switzerland). In five patients four implants per patient (n = 20) were placed in the lower jaw. In one patient two implants (n = 2) were inserted in the lower jaw. Two patients received implants in the mandible as well as in the maxilla, thereof one patient received four implants in the lower and upper jaw (n = 8) and the other patient four implants in the mandible and five implants in the maxilla (n = 9). The lengths of the implants were 9–15 mm. After a healing period of three months all patients were provided with a bar-retained denture. Implant success was evaluated using the criteria by Buser et al., 2002.

One histologic specimen (Azur II and Pararosanilin staining) was obtained from one patient after 10 years with a trephine bur during the auxiliary placement of a mandibular implant.

2.3. Radiographic parameters

To quantify resorptive periimplant changes panoramic radiographs (Oralix 9200 pan oral imaging system Gendex Dental Systems, Chicago, IL, or Orthophos XG 5/Ceph, Germany) were taken in all patients at regular intervals after implant placement (t0), after 12 months (t1), after 6 years (t2) and after 10 years (t3). In three of the patients measurements were additionally taken after an observation period of 15 years. A single investigator, detached from patient treatment, was assigned to perform quantifications. The panoramic radiographs made by Oralix 9200 additionally had to be digitalized. The quantitative evaluation of the crestal bone loss was analysed using the method described by Gómez-Roman et al. (1995) (Balshi et al., 2003; Bell et al., 2002; Gómez-Roman et al.,1995) At the Camlog and Steri Oss implants a specific reference point at the level of the implant–abutment interface was used, at the ITI implants the smooth-rough border of the implants was taken. At the mesial and distal site of each implant using magnifying glasses (Surgical telescopes 3.5×, Designs for Vision Inc., Ronkonkoma, NY, USA) the measurements of the vertical change of marginal bone were performed at all described time points t0, t1, t2 and t3, three times at the mesial (m) and distal (d) site of the implant with the digital gauge (Holex, Hoffmann, Nürnberg, Germany). The values were adjusted by using the equation regarding the original length of the implant to eliminate distortions of the radiograph.

The interpretation of the mesial and distal aspect was performed separately and the mean values for all mesial sites and distal were determined as follows:

m0/d0 = postoperatively value of mesial/distal bone contact from the reference point.

m1/d1 = value of mesial/distal bone contact from the reference point after 12 months.

m2/d2 = value of mesial/distal bone contact from the reference point after 6 years.

m3/d3 = value of mesial/distal bone contact from the reference point after 10 years.

Bone level changes were analysed by subtracting the values of bone loss from the initial postoperative value.

2.4. Statistical analysis

The intraclass correlation coefficient (ICC) was used to determine the intra-observer reliability (SPSS, SPSS Inc., Chicago, IL, USA).

Descriptive analysis was performed with all data available. The mesial and distal sites were analysed separately. The analyses were performed using SPSS 13 (SPSS Inc, USA) and SAS 9.1 (SAS Institute Inc., Cary, NC, USA).