Int. J. Oral Maxillofac. Surg. 2017; 46: 1045–1051
http://dx.doi.org/10.1016/j.ijom.2017.03.019, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Dental Implants

Maxilla reconstruction with autogenous bone block grafts: computed tomography evaluation and implant survival in a 5-year retrospective study

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Abstract. This retrospective study was performed to evaluate the bone thickness of the anterior maxillary region after reconstruction with autogenous bone blocks at 6 months and 5 years after surgery using computed tomography (CT) and to determine the implant survival rate. Eleven patients with a horizontal bone deficiency were treated with reconstructive procedures and implant placement. CT measurements were obtained before surgery (T0) and at 6 months (T1) and 5 years (T2) after surgery. The values were analysed statistically (analysis of variance and Tukey's test; $P < 0.05$). Implant survival was evaluated at follow-up. The mean width of the lower region of the ridge (± standard deviation, in millimetres) was 3.8 ± 1.6 at T0, 7.0 ± 1.6 at T1, and 6.5 ± 1.0 at T2; the mean width of the upper region of the ridge was 5.7 ± 2.3 at T0, 8.3 ± 2.2 at T1, and 7.3 ± 1.6 at T2. The mean total thickness of the ridge was 4.7 mm at T0, 7.6 mm at T1, and 6.9 mm at T2; the average increase in horizontal thickness was 2.9 mm at T1 and 2.2 mm at T2. A statistically significant difference was observed in the mean width of the lower portion at T1 and T2 compared to the width at T0. The implant survival rate was 94.1%. This technique demonstrated high predictability for implant survival, with a reduction in the graft bone during the follow-up period.

Key words: bone graft; dental implant; maxilla; tomography.

Accepted for publication 16 March 2017
Available online 12 April 2017

Introduction

Several reconstructive procedures for the maxilla have been proposed with the aim of increasing alveolar bone dimensions in both the vertical and horizontal directions. These include guided bone regeneration, bone block grafting, distraction osteogenesis, alveolar ridge expansion, and alveolar or maxillary osteotomy, as well

as different combinations of these techniques. In some cases, bone augmentation procedures are performed simultaneously with implant placement; however, in certain situations, the implant can only be placed after the bone graft has healed[1,2].

When the bone volume is insufficient for adequate implant placement (a minimum of 1 mm more than the selected diameter of the implant is required in all directions), bone reconstruction is necessary[1–10].

Autogenous bone is considered the gold standard among the different biomaterials for use in the restoration of bone thickness, as it is the only material to present osteoconductive, osteoinductive, and osteogenic properties[11]. It also presents immunogenic compatibility, has great vascularization potential, will not result in disease transmission, and has a physical and chemical structure identical to that of the host site. However, the use of autogenous bone is associated with some disadvantages, such as increased surgical morbidity, increased operative and treatment times, the potential risk of neurovascular injury, and a decrease in the volume of the graft[12–17].

The mandibular retromolar region is the best option for bone block harvesting, due to the volume of bone tissue, easy removal of the block, and lower morbidity in the postoperative period when compared to other intraoral areas, such as the chin[18]. The approximate bone volume is 4 ml and this bone is cortical with trabecular bone[19].

One of the disadvantages of a horizontal increase using an autogenous bone block graft is significant bone graft resorption[20]. Few studies have reported the increase in maxillary bone thickness after reconstruction surgery using autogenous bone blocks harvested from the retromolar region[10,16,20–22]. In addition, studies evaluating changes in bone block graft measurements using computed tomography (CT) after 5 years of follow-up and the association with implant survival are lacking in the literature. Therefore, the purpose of this study was to use CT to evaluate the bone thickness of the anterior maxillary region after reconstruction with autogenous bone block grafts harvested from the retromolar region after 6 months of healing and 5 years of follow-up and to determine implant survival.

Materials and methods

This retrospective study received ethical approval from the Research Ethics Committee of the University of the Sacred Heart (USC) in Bauru, São Paulo, Brazil. Eleven patients were recruited and their records analysed. These patients had undergone autogenous bone graft surgery for an atrophic maxilla (retromolar donor area) at the IMPPAR Dentistry Clinic in Paraná, Brazil. The surgeries and data collection were performed between 2008 and 2014. The following inclusion criteria were applied: (1) the patient presented a single missing tooth or partially edentulous space in the anterior maxilla with a residual average bone thickness of <5 mm as measured using CT; (2) the patient agreed to participate and provided a signed informed consent agreement. The following patients were excluded: (1) smokers; (2) patients with systemic diseases and patients taking drugs that could interfere with bone metabolism; (3) patients who did not complete prosthetic rehabilitation.

All autogenous bone grafts were performed by the same surgeon through the removal of the bone block from the retromolar region and fixation with titanium screws. All of the procedures were performed under local anaesthesia with infiltration of articaine hydrochloride 4% with epinephrine 1:200,000 (Nova DFL, Rio de Janeiro, Brazil). Access to the maxillary bone bed was gained through a mucoperiosteal incision in the crest and an oblique incision distal to the defective bone with preservation of the papilla. This was followed by elevation of the flap and decortication with a number 701 drill bit mounted in a straight line, with an approximate speed of 1200 rpm, under copious irrigation with 0.9% saline.

The incision for access to the mandible followed the direction of the oblique line and was made in the posterior–anterior direction, always supported on the bone tissue. The osteotomies were performed with a number 701 drill bit mounted in a straight line. The anteroposterior extent of the block corresponded to the size of the edentulous space in the maxilla to be treated, with the addition of a margin of 2 mm or 3 mm for safety. The depth of the cuts encompassed the cortical bone. After the osteotomies, the blocks were cleaved and removed with the help of straight chisels. Closure was performed with 5–0 nylon sutures (Johnson & Johnson, São José dos Campos, Brazil).

During the second surgical stage, 6 months after the grafting procedure, a mucoperiosteal flap was raised, the screw used to fix the bone graft was removed, and the implants were placed in accordance with the manufacturer's instructions. Titamax implants (Lot 800037070; Neodent, Curitiba, Brazil) with a Poros surface treatment (abrasive blasting followed by acid etching) and external hexagon connections were used. The implants were uncovered after 3 months, and a dental restoration crown with an adequate emergence profile was fabricated and placed to guide and shape the peri-implant tissue. The final impression of the implant was made approximately 3 months after placement of the provisional crown. Subsequently, an all-ceramic crown was fabricated on a customized titanium abutment (Neodent, Curitiba, Brazil) (Fig. 1).

Clinical and surgical data were evaluated and data sheets were prepared based on the patients' records. The following data were collected: sex, age, missing teeth, length and diameter of the implant, initial stability of the connection, number of implants, condition of the peri-implant tissue, implant loss, bone graft technique used, and prosthetic rehabilitation delivered.

The patients were assessed immediately after implant placement and at 6 months (A1), 1 year (A2), 2 years (A3), 3 years (A4), 4 years (A5), and 5 years (A6) thereafter (Fig. 2). The clinical condition of the prosthesis was evaluated during these examinations. Complications related to the prosthetic restoration were recorded, including prosthesis fracture (bar, acrylic, porcelain), prosthesis mobility (implant loss or abutment screw loosening), peri-implantitis, pain, and temporomandibular joint symptoms. For the analysis of implant survival, implants that were still present and were free of biological and/or technical complications were considered to have survived[23]. The implants were assessed after the clinical condition of the prosthesis had been evaluated.

CT scans were obtained before the reconstruction surgery (T0) and at 6 months (T1) and 5 years (T2) after the surgery. All CT images were obtained using a cone beam scanner (i-Cat; KaVo Dental, Joinville, Santa Catarina, Brazil) at the IMPPAR Dentistry Clinic; the scans were acquired in 0.2-mm thick sections with a 1-mm gap at settings of 120 kVp and 100 mA.

Intra-examiner error was evaluated prior to the start of this study in a separate retrospective study of five postoperative images of bone block grafts from random cases. The same radiologist repeated the measurements in all of the images three times in the pilot project. The graft measurements were obtained from the CT DICOM data using Somaris Sienet Magic View software (Siemens AG Medical Solutions, Erlangen, Bavaria, Germany), with a selection tool to identify the region of interest. The measurements were made by a single experienced radiologist.