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Horizontal alveolar ridge augmentation using autologous press fit bone cylinders and micro-lag-screw fixation: Technical note and initial experience

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ABSTRACT

Introduction: The use of autologous block bone grafts for horizontal alveolar ridge augmentation in dental implantology is a common surgical procedure. Typically, bone grafts are individually moulded.
Objective: The aim of this paper is to introduce an innovative procedure in lateral bone augmentation, where the recipient side is adjusted to the graft, not vice versa as in common procedures. Our initial clinical experience of twenty-five consecutive cases is presented.
Materials and methods: Adjusted trephine drills were used to harvest partly cylindrical grafts from the retromolar region of the mandible. After preparing the recipient site with accurately fitting grinding drills, the bone grafts were transplanted.
Results: The horizontally compromised alveolar ridges were successfully augmented and treated with dental implants. No major complication occurred during transplantation, the healing period, and subsequent implant therapy in our experimental setting with 25 patients and 38 augmentation procedures. One out of twenty-five patients presented with temporary dysaesthesia of the inferior alveolar nerve.
Conclusion: The new method presented is an effective treatment option for horizontal alveolar ridge augmentation prior to single implant installation. Further studies should evaluate the donor site morbidity and long-term outcome on a larger population.

1. Introduction

Following the implant treatment concept of backward planning it is crucial to install implants in a correct prosthetic position. Any anatomical deficits should be augmented prior to insertion of implants to promote osseointegration – the predominant parameter for the assessment of implant success (Papaspyridakos et al., 2012). Various procedures may be used to treat horizontal bone defects of the alveolar ridge in the upper and lower jaw. Lateral placement of granular materials covered with membranes or alternatively an onlay graft, either autologous bone or bone substitute blocks, are two major alternatives (Cawood et al., 2007; Cuesta Gil et al., 2010; Draenert et al., 2011; Esposito et al., 2009; Sisti et al., 2012). Risk factors such as smoking and diabetes complicate onlay bone grafting (Levin et al., 2004). Typical donor sites are the mandible, calvarial bone, iliac crest, and proximal tibia. The use of autologous block bone grafts for horizontal alveolar ridge augmentation in dental implantology is a well established surgical procedure (Chiapasco et al., 2009). Commonly, the bone blocks are harvested using different types of chisels combined with drills or piezo-surgery instruments. The harvested grafts have to be individually moulded to allow a congruent fitting to the recipient site. The efficiency and success of this procedure is directly dependent on the experience and skills of the surgeon.

In 1895 and 1908, healing requirements for bone grafts were described by the German anatomists Barth and Axhausen (Axhausen, 1908; Barth, 1895). They pointed out that the level of vitality of a bone graft is correlated with trophic findings at the recipient side, congruency between the graft and the residual bone, immobilisation, and soft tissue coverage. Various authors have confirmed these basic recommendations in recent decades (Claes et al., 1998; Jagodzinski and Krettek, 2007; Marsell and Einhorn, 2011).

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The aim of this paper is to introduce a systematic and standardised procedure for harvesting and transferring partly cylindrical shaped autologous bone grafts for targeted horizontal alveolar ridge augmentation using adjusted instruments. Our initial clinical experience in twenty-five consecutive cases are analysed and presented.

2. Material and methods

The step-by-step surgical protocol is demonstrated and supported by illustrations. Generally, several donor sites are available for harvesting bone grafts for our surgical technique, namely the chin and the retromolar region of the lower jaw. To demonstrate the clinical application of the method, an initial series starting from April 2010 until February 2013 of twenty-five consecutive clinical cases with a total of 38 horizontal alveolar ridge defects is analysed. The following inclusion criteria were applied to the study subjects: severe atrophy of the partly edentulous anterior maxilla or mandible, and intention to treat with osteoplasty prior to insertion of dental implants. Exclusion criteria comprised extended bone defects of the alveolar ridge, haemorrhagic diathesis or medication with bisphosphonates, infectious diseases such as hepatitis, malignancy and radiotherapy. All patients included were treated with standardised partly cylindrical bone grafts from the retromolar region using the Osseo Transfer System (BEGO Implant Systems, Bremen, Germany).

2.1. Pre-surgical evaluation

Prior to surgical treatment, a clinical examination of the patient including a radiographic evaluation using reference bodies at the donor site (dental and panoramic X-rays) and a cast analysis was performed (Fig. 1A+B).

2.2. Surgical principles

Ablative grinding drills with defined outer diameters of 5.5 mm, 6.5 mm, and 7.5 mm transform the existing individual horizontal bony defect into a standardised recipient site (Fig. 2A+B). The ground bone was discarded. Adjusted trephine drills with corresponding inner diameters of 5.5 mm, 6.5 mm, and 7.5 mm which are laser scaled every 5 mm in length were used to harvest standardised partly cylindrical bone grafts at the donor site (Fig. 3A+B). The recipient site with the respective horizontal defect was evaluated intraoperatively using the laser scaled grinding drills as reference. After harvesting, a gliding hole is burred into the centre or apical third of the bone graft. After positioning the graft at the recipient site, it was fixed and immobilised with one micro-lag-screw (Fig. 4A+B).

2.3. Surgical steps

After induction of local anaesthesia at the defect site and the retromolar region using Ultracain DS (Hoechst Marion Roussel Deutschland GmbH, Frankfurt, Germany), a surgical preparation to display the operative sites was performed. To estimate the defect size in terms of diameter and length, the laser scaled ablative grinding burrs (Diameters: 5.5 mm, 6.5 mm, and 7.5 mm) were used to obtain measurements (Fig. 3A). The individual defects were then standardised using the appropriate grinding burrs. The ground bone from at the recipient site was discarded. Using the corresponding trephine drills, all partly cylindrical bone grafts were harvested from the retromolar region. The grafts were transferred to the recipient site after creating gliding holes into the centre or apical third of the standardised onlay grafts. After positioning, each graft was fixed with a single micro-lag-screw. The donor sites were treated similarly to osteotomy sites of wisdom teeth. Wound closures at recipient sites were tension-free due to a periosteal incision.

Approximately 3 months after bone grafting, the lag-screw was removed under local anaesthesia and a dental implant was inserted into the reconstructed alveolar ridge (Fig. 5A+B).

3. Results

In all 38 augmentations of the initial clinical series ($n = 25$; 16 female, 9 male), reconstruction of the alveolar ridge with the integration of a congruent fitting graft was achieved (Table 1). The average age of the patients was 39.9 (SD $\pm$ 18.3) years. Twenty per cent of the evaluated patients were smokers ($n = 5$ out of 25; all male). The most common indications for the treatment were trauma or caries related tooth loss ($n = 22$ out of 25). Three out of twenty-five patients were suffering from congenital hypodontia. In 17 augmentation procedures the donor site was the right mandibular retromolar region, 19 bone grafts were harvested from the left and one bone harvesting was performed bilaterally. The 7.5 mm diameter trepan burr was used in 20 out of 38 augmentations. A 6.5 mm diameter bone graft was obtained in 13 procedures, while the 5.5 mm diameter graft was used in 4 cases.

After an average healing period of 120.32 days (SD $\pm$ 24.73 days) the horizontal dimension was still sufficient and an anatomically correct implant insertion was performed. Subsequent functional and aesthetic rehabilitation after osseointegration of the implant into the augmented area was realised using implant-supported crowns (Fig. 5C). The average time of follow-up after bone grafting was 506.6 days (SD $\pm$ 235.59 days). No signs of local infection at the harvesting or recipient sites were observed during healing. One patient presented with temporary dysaesthesia of the inferior alveolar nerve (female, nonsmoker).

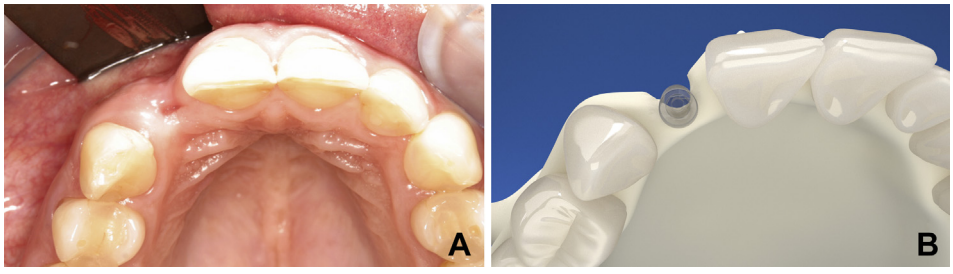

Fig. 1. A: Initial clinical situation depicting a missing single tooth and a local horizontal atrophy of the upper jaw. B: Schematic defect situation with simulated implant (translucent) in an optimal position visualizing the missing vestibular bone.