Journal of Cranio-Maxillo-Facial Surgery 44 (2016) 868–875

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Bilamina cortical tenting grafting technique for three-dimensional reconstruction of severely atrophic alveolar ridges in anterior maxillae: A 6-year prospective study

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ARTICLE INFO

Article history:
Paper received 27 January 2016
Accepted 12 April 2016
Available online 29 April 2016

Keywords:
Autogenous bone block
Tenting technique
Alveolar ridge augmentation
Split block bone
Guided bone regeneration

ABSTRACT

Objective: To evaluate the efficacy and long-term outcome of the bilaminar cortical tenting grafting technique for reconstruction of vertical and horizontal alveolar ridge defects.
Material and methods: A bone block harvested from the lateral aspect of the mandibular ramus was bisected into two cortical laminae, which were then used to reconstruct the buccal and palatal walls of an alveolar ridge defect. The inter-laminar space was filled with particulate autogenous bone and the whole graft was covered with anorganic bone graft and collagen membrane. After 4–6 months, the width and height of the augmentation were recorded. The study sample consisted of 21 patients who were followed up for 6.09 ± 1.18-years.
Results: Vertical and horizontal bone gain was 5.70 ± 1.09 and 8.45 ± 0.87 mm, respectively, and respective resorption rates were 10.20% and 6.15%. One patient showed soft-tissue dehiscence, while all others healed without complication. After an average follow-up of 6-years, the block grafts were well integrated into the recipient sites and there was only a small reduction in the peri-implant bone level (0.77 ± 0.50 mm).
Conclusion: This technique was effective and reliable for three-dimensional reconstruction of severely atrophic alveolar ridges in anterior maxillae.

1. Introduction

In the anterior maxillary region, adequate bone volume at the future implant site is a prerequisite for ideal implant placement and a good esthetic outcome (Rieder et al., 2014). Following trauma to a tooth or its long-term absence, the alveolar bone becomes markedly reduced with respect to both height and width. Reconstruction of localized ridge deficiencies in the esthetic zone is a very challenging surgical procedure, especially in cases of extensive vertical and horizontal bone atrophy (Vierra et al., 2014). A variety of surgical techniques have been described to enhance the bone volume of deficient implant-recipient sites, such as distraction osteogenesis (Yamauchi et al., 2013), guided bone regeneration (GBR) (Dahlin et al., 2015) and onlay grafting (Fretwurst et al., 2015).

Distraction osteogenesis is technically demanding and often unacceptable for patients who cannot tolerate intraoral distraction devices (Kumar et al., 2014). Space is too limited for a single implant site. When the distracted bone block is small, it is easily absorbed causing exposure of the roots of adjacent teeth (Verlinden et al., 2015). In addition, distraction osteogenesis is generally limited to vertical bone augmentation, a problem when horizontal augmentation is also required (Verlinden et al., 2015). It has been reported that 25%–35% cases need an additional local bone graft after the bone distraction (Kontogiorgos et al., 2013). GBR is an alternative technique that can be used with a barrier membrane alone or in combination with bone grafts or bone substitutes (Dimitriou et al., 2012). In cases of a three-dimensional ridge defect, a nonabsorbable membrane with a supporting titanium frame is required (Funato et al., 2013). The possibility of grafting-material collapse or premature membrane exposure is greatly increased (Misch et al., 2015).

Autogenous bone, with its capacity to regenerate and form new bone through its osteoinductive, osteogenic and osteoconductive

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http://dx.doi.org/10.1016/j.jcms.2016.04.018
1010-5182/

properties, is still the gold standard for treatment of large lateral and vertical bone defects (Khoury and Hanser, 2015). Onlay bone block grafting was introduced as the most reliable method for treating narrow ridges (Misch, 1997). However, considerable graft resorption following vertical augmentation via this method calls its reliability into question. For example, Cordaro et al. recorded a 42% reduction in the vertical augmentation after a 6 month healing period (Cordaro et al., 2002). As an alternative to the single block onlay graft, a method using two thinner cortical blocks (laminae) was introduced. These can be fixed into the defect area to create the occlusal bone plate and the vestibular plate or the buccal and lingual walls (Khojasteh et al., 2012). However, few reports in the literature address use of this technique in the anterior maxillae.

In the esthetic zone, implants should be placed slightly palatally to achieve a satisfactory outcome, but this may be unachievable in cases of palatal bone defects. At present, there are no reliable surgical techniques to reconstruct palatal bone defects. In our study, GBR and a buccal periosteal flap were applied to prevent bone resorption after implementing the bilaminar cortical bone block method.

This 6-year prospective clinical study assessed bilaminar cortical tenting grafting technique (BCT) for three-dimensional reconstruction of severely atrophic alveolar ridges in the esthetic zone; evaluating the stability of the bone grafting and the long-term clinical outcome.

2. Material and methods

2.1. Patient selection

Over a 2-year period from 2007 to 2009, 21 patients (10 women and 11 men) ranging from 19 to 46-years old were consecutively recruited from those requiring rehabilitation of edentulous anterior maxillae in our school.

To be eligible for the present study, adult individuals had to have a completely healed edentulous site and clinical indication for horizontal and vertical bone augmentation as a result of the bone being too thin to host dental implants (Fig. 1).

The exclusion criteria were as follows: general contraindications for implant surgery; severe hemophilia; history of irradiation in the head and neck regions less than 1 year before the study; poor oral hygiene; uncontrolled diabetes; pregnancy or lactating status; psychiatric problems or unrealistic expectations; human immunodeficiency virus infection; smoking >10 cigarettes or cigar equivalents per day; chewing tobacco corresponding to >10 cigarette equivalents per day; acute infection in the area intended for implant placement; local inflammation, including untreated periodontitis; severe bruxism or clenching habits.

The study protocol was evaluated and approved by the institutional ethics committee prior to patient selection.

2.2. Clinical procedures

2.2.1. Preoperative procedure

Following selection, all patients were evaluated and treated for periodontal and dental health and received oral hygiene instructions until a clinically acceptable oral environment was achieved. Radiographic evaluations were performed to assess the dimensions of the alveolar process and the requirements for three-dimensional prosthodontically driven implant placement were identified.

2.2.2. Surgical procedure

All surgical procedures were performed by one experienced surgeon. All patients received prophylactic antibiotic therapy in the form of 2 g of amoxicillin (500 mg of clarithromycin in the case of penicillin allergy) 1 h before treatment.

Cortical bone block grafts were harvested from the lateral aspect of the mandibular ramus. The harvesting osteotomy was performed according to a standard protocol (Khoury and Hanser, 2015). The volume of bone to be obtained depended on the size and extent of the bone needed for grafting (Fig. 2). Bone chips were collected at the same time.

At the recipient site, a midcrestal incision was made, followed by intrasulcular buccal and palatal incisions at the adjacent teeth, including two buccal vertical releasing incisions. Full mucoperiosteal flaps were raised on the facial and palatal aspects to expose the alveolar ridge (Fig. 11a). The harvested cortical bone block was split along its long axis into two thin laminae with a diamond disk saw, and were then thinned to a thickness of 1 mm using a bone scraper (Fig. 3). A large contouring bur was used to trim the laminae

Fig. 1. Severe periodontitis case with horizontal and vertical bone defects in the esthetic zone (left central maxillary incisor).

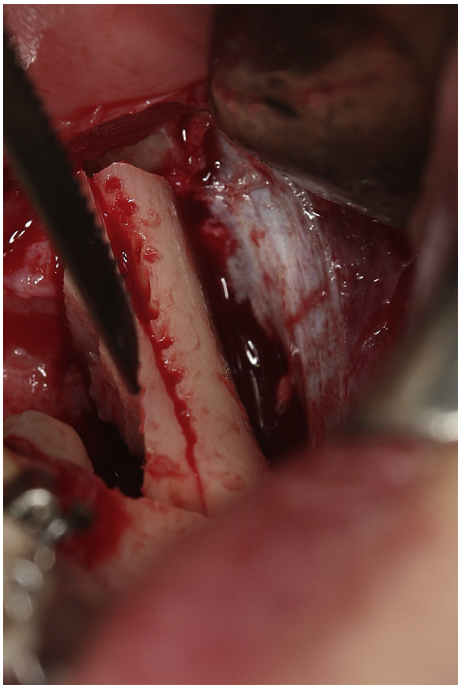

Fig. 2. A cortical bone block graft was harvested from the lateral aspect of the mandibular ramus.