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Sandwich osteotomy for the reconstruction of deficient alveolar bone

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Abstract. Alveolar bone deficiency is a very common problem encountered by the practitioner when planning dental implants. The severity of the deficiency is variable. Many practitioners perform augmentation using the method they feel comfortable with and do not necessarily use the most appropriate method. This is a retrospective study on 21 patients between the ages of 25 and 63 years exhibiting moderate vertical alveolar bone deficiency and treated by the sandwich technique. Mean vertical bone gain was 7.5 mm. Sixty-one dental implants were inserted showing a survival rate of 96.7% with a median of 3.1 years follow-up. Main advantages of the method include minimal relapse, single operation and preservation of the native cortical bone in the occlusal surface. We believe the surgeon should maintain the capability of using different augmentation techniques and utilize them appropriately for different severities of deficiency. We wish to establish a paradigm for using different augmentation methods We recommend using the sandwich technique in the moderate deficient cases as described in this work, using alveolar distraction osteogenesis for the severe cases as described in our previous work, where lack of soft tissue for proper closure is a major limitation, and using guided bone regeneration for minor deficiencies.

Key words: sandwich osteotomy; smile osteotomy; augmentation; alveolar bone deficiency; dental implants.

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The introduction of dental implants resulted in a pursuit for achieving sufficient alveolar bone allowing for the placement of these implants either for a fixed prosthesis or partially implant-supported prosthesis. Many patients refuse to use a tissue-born prosthesis, especially in the mandible, due to lack of stability[1].

When the practitioner faces mild to moderate bone deficiency, some try to overcome the deficiency by means of minor bone augmentations or computerized guiding splints based on cone beam computed tomography (CBCT) to avoid damage to the inferior alveolar nerve (IAN) and cortical perforations.

Possible augmentation solutions for these cases include autogenous onlay bone grafting[2,3], guided bone regeneration (GBR)[4,5], alloplastic materials[4,6] and inferior alveolar nerve lateralization as a solution in the posterior mandible[7].

GBR and alloplastic materials are very limited in their potential for vertical augmentation and can be used for minor deficiencies[4,5]. Onlay bone graft is prone to resorption and is thus unpredictable[8]. IAN lateralization in the posterior mandible does not correct the unfavourable crown–root ratio and may result in damage to the nerve.

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When addressing severe cases of alveolar bone deficiency, we advocate using the alveolar distraction osteogenesis (ADO) technique as we previously described in several reports[9–13].

When moderate deficiency is encountered, onlay autogenous bone graft or sandwich technique can be utilized. In case of autogenous onlay bone graft, significant resorption occurs, mostly due to inadequate soft tissue coverage, lack of blood supply to the bone graft as opposed to the transported segment in inlay bone graft and forces applied directly on the graft[8,14].

The sandwich technique, which uses bone block graft positioned between osteotomized bony segments, was developed by Schettler in 1974[15].

The sandwich technique preserves the lingual/palatal and crestal periosteum and mucosa, allowing for better vascular supply to both the interpositional graft and the transported segment. The crestal cortical bone is transported and thus allows for less resorption and placement of endosseous implants in crestal rigid bone with superior primary stability[16].

In this report we present the results of the sandwich technique for treating moderate alveolar bone deficiencies and suggest a paradigm for treating moderate and severe alveolar bone deficiencies prior to dental implant placement.

Materials and methods

Sample

This is a retrospective study of patients suffering from severe alveolar bone loss and treated by the sandwich technique. All cases treated between the years 2007 and 2015 were retrieved. No cases were excluded. Data retrieved included: aetiology of bone deficiency, location of deficiency, bone achieved following interpositional bone graft, number of implants inserted, survival of implants, follow-up duration and complications.

Inclusion criteria: vertical alveolar bone loss of over 4 mm. Exclusion criteria: vertical alveolar defects of more than 8 mm.

Primary predictor variable was interpositional bone graft for alveolar bone augmentation prior to dental implant placement.

Primary outcome variable was implant failure, defined as removal of the implant, and was recorded as years of survival.

Interpositional bone graft was performed in 21 patients aged between 25 and 63 years with a mean age of 41 years. Fourteen patients were treated for deficiency in the mandible and seven patients were treated for deficiency in the maxilla.

Diagnosis

Preoperative clinical examination and radiographs, including a panoramic radiograph and CBCT revealed moderate alveolar atrophy; class IV–V according to the Cawood and Howell classification[17].

Aetiology: 11 patients presented with alveolar bone atrophy post-tooth extraction or dental implant removal, seven patients following trauma and three following enucleation of odontogenic cyst or benign tumors.

Fourteen patients received corticocancellous interpositional bone grafts harvested from the anterior iliac crest and seven patients received bone grafts harvested from the ramus. The size of the bone graft was calculated according to the deficiency in the recipient site. The voids between the bone graft and the recipient site were augmented using xenograft bone substitute (Bio-oss, Geistlisch, Switzerland).

Surgical procedure

Sandwich technique was performed as follows: a paracrestal subperiosteal flap was raised. Release of the flap is mandatory and included both lateral mucoperiosteal release incisions and incisions in the periosteum of the raised flap. The alveolar crest was exposed and a 5-mm-high segment 1–2 mm from each root, if it existed, on the lateral and medial borders was designed. The integrity and adherence of the attached mucosa to the occlusal surface of the transported segment was maintained. The segment was separated from the basal bone using a reciprocating saw (Fig. 1(A)). Meticulous technique is crucial to maintaining the palatal/lingual periosteum intact as this will constitute the sole source of blood supply to the elevated transport segment in the initial stages following surgery. The transported segment was raised according to the planned height and the harvested autogenous bone graft was placed between the bone segments (Fig. 1(B)). The transported segment and bone graft were fixed to the basal bone using miniplates (Synthes, Switzerland). The flap was advanced and closure was performed using nylon sutures.

Six months following the initial procedure, fixation plates were removed and endosseous implants (Zimmer Dental, Carlsbad, CA, USA) were inserted followed by prosthetic restoration. All implants were of a diameter of 3.75 mm. The length ranged between 10 and 13 mm.

This study followed the Declaration of Helsinki on medical protocol and ethics and the Institutional Ethical Review Board approved the study.

Results

All cases treated exhibited moderate alveolar bone deficiency which did not allow

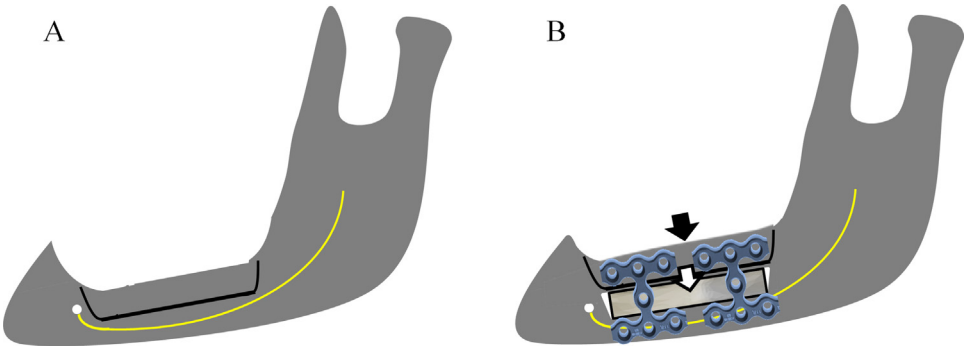

Fig. 1. The sandwich osteotomy technique. (A) A trapezoidal shaped osteotomy is performed, in case of the posterior mandible at least 2 mm above the inferior alveolar nerve. (B) The transport segment is vertically elevated and an interpositional autogenous corticocancellous bone graft is placed and both of them are fixed with miniplates to the basal bone. Black arrow indicates the elevated transport segment. White arrow indicates the interpositional bone graft.

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