Sandwich osteotomy for vertical and transversal augmentation of the posterior mandible: a review

Sandwich osteotomy untuk augmentasi vertikal dan transversal pada posterior mandibula: sebuah tinjauan

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ABSTRAK

Penggunaan implan endoseous secara langsung berhubungan dengan topografi dan kualitas sisa tulang pasien. Beberapa teknik telah dicoba untuk memperluas penerapan melalui perubahan desain dan teknik bedah implan untuk augmentasi tulang. Artikel ini menjelaskan sandwich osteotomy yang dikombinasikan dengan autograft interposisi untuk augmentasi vertikal dan transversal pada mandibula posterior yang atrofik sebelum penempatan implan endoseous. Disimpulkan bahwa sandwich osteotomy segmental mandibula dapat direkomendasikan untuk memenuhi persyaratan dimensi augmentasi tulang preimplant pada mandibula posterior yang atrofik.

Kata kunci: sandwich osteotomy, atrofi mandibula posterior, interpositional autograft, implan endoseous

ABSTRACT

The use of endosseous implants is directly related to the topography and quality of the patient's residual bone. Several techniques have been tried to expand its application through implant design alterations and surgical techniques for bone augmentation. This article reviews the sandwich osteotomy combined with an interpositional autograft for vertical and transversal augmentation in the atrophic mandible prior to endosseous implant placement. In conclusion, segmental mandibular sandwich osteotomy can be recommended to fulfill the dimensional requirements of preimplant bone augmentation in atrophic posterior mandible.

Key words: sandwich osteotomy, posterior mandible atrophy, interpositional autograft, endosseous implant

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INTRODUCTION

The use of endosseous implants for successful restoration of patients with partial or total loss which has been well established is directly related to the topography and quality of the patient's residual bone. Several techniques have been tried to expand its use through implant design alterations and surgical techniques for bone augmentation process.¹ Vertical augmentation of the mandibular or maxillary alveolar ridge to increase bone volume for implant has shown variable and controversial outcomes in comparison with horizontal augmentation.²

In edentulous patients, vertical resorption can progress to reach the basal bone. Horizontally, the resorption may progress to the extent that, even when there is enough bone height, the lack of bone width may render implant placement impossible.¹ Posterior mandible may have thin alveolar bone after teeth lost, the facial cortical bone resorbs more than the lingual cortical, resulting in a 3 mm or less in width.³

Placement of dental implants is difficult in alveolar ridges with severe horizontal and vertical

bone resorption. To augment the severely atrophic ridge, grafting with bone blocks intraorally harvested has been recommended.⁴ Several techniques for bone augmentation, both vertically and horizontally, have been proposed. Different techniques have been used to achieve vertical augmentation, including onlay or inlay grafts, guided tissue regeneration, sinus floor grafting and transpositional or lateralization of the dental nerve.² An alternative surgical procedure is the osteotomes technique.¹

This article reviews the sandwich osteotomy combined with an interpositional autograft for vertical and transversal augmentation in the atrophic mandible prior to endosseous implant placement.

Endosseous implant

Dental implants are prosthetic devices of alloplastic material implanted into the oral tissues beneath the mucosal and/or periosteal layer, and on/ or within the bone, to provide retention and support for a fixed or a removable prosthesis. An endosteal or endosseous dental implant is a dental implant placed

Fig 1 A Posterior alveolar atrophy, B an alveolar osteotomy curves upward posteriorly and stays above the nerve, C a cortical graft is placed to ensure vertical height (Source: Miloro, M, Ghali GE, Larsen PE, Waite PD, editors. *Peterson's principal of oral and maxillofacial surgery*. 2nd ed. Toronto: BC Decker Inc; 2004. p. 230: 554-60).⁶

into the alveolar and/or basal bone of the mandible or maxilla and transecting onlay cortical plate.⁵

The endosseous dental implant is composed of an anchorage component, termed the endosseous dental implant body, which is ideally within the bone, and a retentive component, termed the endosseous dental implant abutment. Description forms such as cylinder, conical, screw, or blade may be used as adjectives to enhance the understanding geometry of endosseous dental implant.⁵

Interpositional bone graft

The interpositional bone graft is placed between a mobilized segmental osteotomy and the basal bone. A typical vertical gain is 4 or 5 mm in the maxilla but 5 to 10 mm in the mandible. The indication for the procedure is an alveolar defect where there is insufficient vertical height for placement of implants such as in the anterior maxilla or posterior mandible when a stable vertical augmentation is required, usually over a three- or four-tooth segment.⁶

Fig 1A shows a posterior mandible deficiency with 6 mm of bone available above the inferior alveolar nerve. An osteotomy was performed (Fig. 1B) through a vestibular incision to maintain both lingual and crestal blood supply. An interpositional cortical bone graft harvested from the ramus was placed at the osteotomy site, raising the alveolus about 7 mm (Fig. 1C). The raised segment rotated slightly lingually, but this was compensated for by using a bone plate to establish both the final vertical height and the crestal axis of the osteotomized segment.⁶

Procedures of sandwich osteotomy

Sandwich osteotomy is a surgical technique to repair the atrophic mandible, similar to the way it visors osteotomy, however, horizontal bone cutting, between the foramina mentalis is so limited that only the anterior portion of the cranial fragments are in the lift to the top.⁷

Bormann et al reported a sandwich osteotomy procedure which begins by making an elliptical

Fig. 2 Horizontal and vertical osteotomes carried out with a piezoelectric surgical device obtain the cranial bone fragment upfracture of the cranial bone fragment using a chisel (Source: Bormann KH, Suarez-Cunqueiro MM, von See C, Kokemuller H, Schumann P, Gellrich NC. Sandwich osteotomy for vertical and transversal augmentation of the posterior mandible. *Int Oral Maxillofac Surg* 2010; 39: 555).⁸

incision 10-12 mm from the ridge bone in the labiobuccal gingival of the edentulous area. A mucoperiosteal flap is raised without detaching the lingual and crestal mucoperiosteum to expose the labiobuccal cortical bone of the posterior atrophic mandible and mental nerve. Two vertical and one horizontal osteotomes are made with a piezoelectric device (Fig. 2a). The horizontal osteotomy is located at least 2 mm below the ridge bone and approximately 1.5-2 mm above the mandibular canal. The vertical mesial osteotomy is made 2 mm distal to the last tooth and the vertical osteotomy is made based on implant-graft treatment planning. The cranial fragment is not less 2 mm thick. Using a small chisel, the osteotomy was completed by breaking the lingual cortical and the coronal bone fragment is carefully mobilized by rotation and elevation (Fig. 2b). The lateral aspect of the cranial segment is elevated more than the lingual aspect, producing a transverse width increase in addition to the vertical augmentation effect (Fig. 3).⁸

A block autograft is placed as an interpositional graft between the mobilized cranial fragment and the basal bone, and particulated autograft is placed in the gaps around the interpositional graft. The block bone graft is harvested with a piezoelectric surgical device and the particulated autograft was harvested with the safescraper. At two surgical sites only particulated bone harvested with a safescraper from

the lateral oblique line is placed as an interpositional graft. The intraoral graft is taken from the lateral oblique. The cranial bone fragment is fixed two titanium miniplates and miniscrews. The grafts are covered with a porcine collagen resorbable membrane. The flap was sutured in two layers, inner layer submucosal mattress sutures and outer layer suturing mucosa.⁸

Fig. 3 Mobilisation of cranial bone fragment and the interpositional bone graft. The lateral aspect of the cranial bone fragment was elevated more than the lingual aspect. (Source: Bormann KH, Suarez-Cunqueiro MM, von See C, Kokemuller H, Schumann P, Gellrich NC. Sandwich osteotomy for vertical and transversal augmentation of the posterior mandible. *Int. Oral Maxillofac. Surg.* 2010; 39. p.556)⁸

DISCUSSION

The aim of preimplant surgery is the creation of an environment that is favorable to the function and long-term survival of endosseous dental implant. One essential requirement for successful implant is the presence of the sufficient bone in which the implant is placed.⁹

In case of atrophic mandible, the distance to the mandibular canal and the transverse decrease in bone is an anatomic limitation for prosthetic rehabilitation with endosseous implant. Several techniques have been used to solve this problem, such as block bone graft, alveolar distraction osteogenesis, titanium mesh and transposition of the alveolar nerve.⁸ Autologous materials, such as bone and cartilage, and allogenic materials, such as hydroxyapatite or bone substitutes, and their combinations, have been used for ridge augmentation. Autologous bone grafting is regarded as superior to the others in terms of postoperative and long-term outcomes.⁸

The reconstruction of deficient ridges with bone autografts alone has proved to be effective, although variable resorption of the transplanted bone graft has been reported.^{10,11} Depending on the quality of autograft (cortical versus particulate), resorption of

up to 50% of the graft volume was noted by Bruggekat. Mandibular symphysis or ramus is used as the donor site for the block grafts; bone from the tuberosity, lower portion of the nasal aperture, or any edentulous area is generally used for the particulate graft.¹¹

The interpositional bone graft, first described by Scettler in 1976, was initially performed for alveolar augmentation to improve denture retention. Many modifications followed, but dental implants were not considered. The interpositional graft is a relatively simple procedure that requires significantly less flap exposure than the one for block grafting. There is a risk for iatrogenic nerve injury, but interpositional grafts may have a greater potential for bone graft incorporation than block graft, as evidenced by animal study.¹²

The first reports about applying the sandwich technique in the mandible appeared in 1977. Since then, variations of this surgical technique have been described by several authors. According to Bormann et al the most difficult aspect of using the sandwich technique is the precision required to save the mandibular nerve in horizontal osteotomy. The major advantages of this technique is the possibility of increasing bone height and width with less morbidity than others technique. Another advantage, especially with respect to implants, is that vascularisation is maintained in bone ridge throughout augmentation intervention thus the interface at the implant shoulder in terms of hard-to-soft tissue to implant interface is kept as true to the original as possible.⁸

In order to preserve the blood supply, it is fundamental importance that the lingual pedicle of the soft tissue is not damaged. An experimental study confirmed that the lingual pedicle was able to maintain the viability of the coronal bone segment, allowing for rapid remodeling of the interpositional autogenous bone graft.⁸

Some studies claim that this technique should only be applied in patients with at least 6 mm of bone above the mandibular canal.⁸ Jensen considered maximum vertical movement to be about 5 mm in the anterior maxillary region and up to 8 mm in the posterior mandibular region.¹¹ According to Bormann et al, sandwich osteotomy technique in the posterior region of the mandible can reach nearly 8 mm. Another important consideration when using the sandwich osteotomy technique is that the cranial bone fragment must not be less than 5 mm thick.⁸

Bormann et al found a high rate sensory mental nerve disturbance after reconstruction (44% patients). This was probably due to flap retraction. None of the patients in clinical report experienced any potential

morbidity at the donor site.⁸ Jensen found transient paraesthesia in all patients, lasting up to 6 weeks, and all patients in the report recovered within this time.¹²

Although there are several bone augmentation techniques, osteotomy osteogenesis has more advantages. Alveolar distraction osteogenesis has the greatest potential of a 9.9 mm mean bone gain (range 4-15 mm). Sandwich osteotomy osteogenesis has the advantages of restoring vertical bone deficit together with transverse gain in dimension without undesired bone segment displacement, is less time-consuming and is less uncomfortable for the patient. Although nerve transposition maintains the vertical bone, it involves a high risk of permanent neuro sensory disturbance. It would seem that the choice of technique is based more on evidence of efficacy.⁸

Marchetti et al report that in all the treated sites with interpositional bone graft (sandwich technique)

it was possible to place implants. None of the 21 implants placed failed, and minimal bone resorption was present 14 to 16 months after the prosthetic loading. These findings suggest that interpositional bone grafting in the posterior mandible could be a viable alternative to other surgical techniques.¹³ Bourmann et al concluded that segmental mandibular sandwich osteotomy is recommended to meet the dimensional requirements of preimplant bone augmentation in atrophic posterior mandible.⁸ Choi et al also have concluded that this procedure of augmentation is safe.¹⁴

In conclusion, segmental mandibular sandwich osteotomy can be recommended to meet the dimensional requirements of preimplant bone augmentation in atrophic posterior mandible. Because this technique is safe and could be a viable alternative to other surgical techniques.

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