Available online at www.sciencedirect.com
SciVerse ScienceDirect
British Journal of Oral and Maxillofacial Surgery xxx (2014) xxx–xxx
BRITISH Journal of Oral and Maxillofacial Surgery
www.bjoms.com

New perspectives in the treatment of severe mandibular atrophy: "double sandwich" osteotomy

Albino Triaca [a,1], Daniel Brusco [a,1], Paolo Asperio [b,2], Raquel Guijarro-Martínez [c,*]

[a] *Zentrum für Kiefer- und Gesichtschirurgie, Klinik Pyramide am See, Bellerivestrasse 34, CH-8034 Zürich*
[b] *Resident, Department of Oral and Maxillofacial Surgery, Cardinal Massaia Hospital, Corso Dante, 202, ITA-14100 Asti*
[c] *Fellow, Zentrum für Kiefer- und Gesichtschirurgie, Klinik Pyramide am See, Bellerivestrasse 34, CH-8034 Zürich*

Accepted 17 April 2014

Keywords: Mandible; Atrophy; Bone grafting; Bone resorption; Reconstruction.

The gold standard for treatment of advanced mandibular atrophy continues to be autologous bone grafting. [1,2] Since its description in the 1970s, the sandwich technique has been found to be reliable for the reconstruction of atrophic mandibles (Cawood and Howell types IV-V). [1,3–5] Its main advantages are the potential for three-dimensional reconstruction, minimal morbidity, and stable long-term outcomes. [1,3–5] However, beyond certain cranialisation of the cut fragment of bone, the vertical vector becomes mixed and the reconstructed alveolar ridge may be morphologically inadequate for the placement of implants.

Operative technique

A full-thickness incision is made buccally 1 mm below the mucogingival line. Soft tissues are tunnelled cranially in a subperiosteal plane. Moderate lateral extension of the subperiosteal dissection facilitates eventual mobilisation of the cut bone. However, the crestal periosteum must be preserved to ensure adequate vascularisation of the future cranial segment.

A horizontal osteotomy of the edentulous mandibular bone is then made with a thin bur or piezoelectric saw. The osteotomy is finished by 2 (mesial and distal) slightly divergent vertical osteotomies (Fig. 1). The bone fragment, which remains anchored to the lingual and crestal periosteums, is raised cranially with a Gillies hook so that it "faces" the operator (Fig. 2). At this point, a second horizontal osteotomy is made to divide the freshly cut surface into 2 fragments: the first (the former buccal aspect), which remains attached to the crestal periosteum, becomes the roof of the defect, and the second (lingual aspect), which remains attached to the

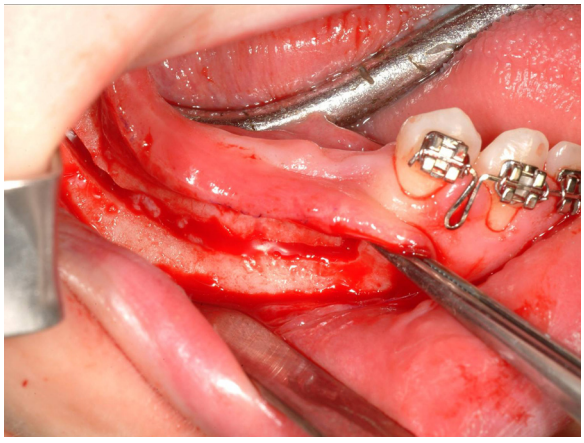

Fig. 1. Horizontal osteotomy finished by 2 vertical osteotomies. Note that the crestal periosteum remains attached to the cranial segment.

* Corresponding author. Tel.: +41-44-388 14 88; fax: +41-44-388 14 99.
E-mail addresses: a.triaca@pyramide.ch (A. Triaca), d.brusco@pyramide.ch (D. Brusco), asperio@asl.at.it (P. Asperio), guijarro.raq@gmail.com (R. Guijarro-Martínez).
[1] Tel.: +41-44-388 14 88, fax: +41-44-388 14 99.
[2] Tel.: +39-0141-489352, fax: +39-0141-485438.

http://dx.doi.org/10.1016/j.bjoms.2014.04.013

Please cite this article in press as: Triaca A, et al. New perspectives in the treatment of severe mandibular atrophy: "double sandwich" osteotomy. *Br J Oral Maxillofac Surg* (2014), http://dx.doi.org/10.1016/j.bjoms.2014.04.013

Fig. 2. A Gillies hook is used to raise the fragment of bone to expose its undersurface and stabilise it. The fragment is then divided into 2 segments by a longitudinal osteotomy.

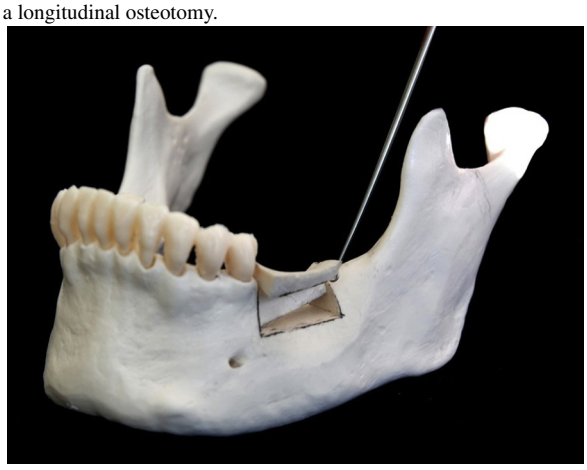

Fig. 3. The longitudinal osteotomy creates 2 fragments: 1) The former buccal aspect, which remains attached to the crestal periosteum, and 2) The lingual aspect, which remains attached to the lingual periosteum. The resulting three-dimensional defect can now be filled with autologous or heterologous bone, or both.

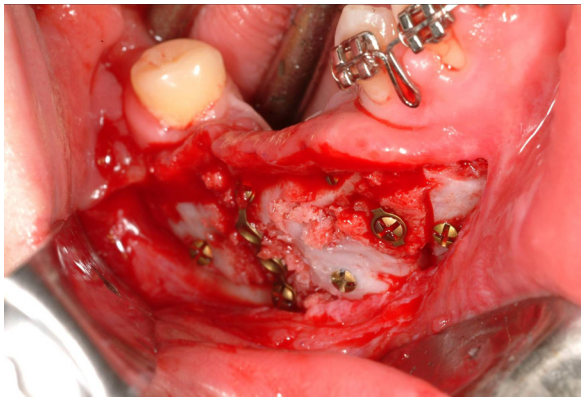

Fig. 4. Stabilisation of the whole construction with osteosynthesis material.

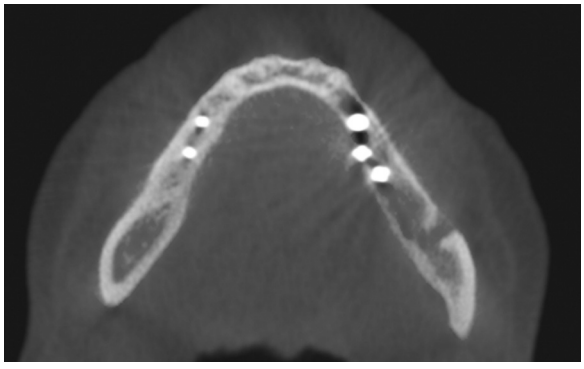

Fig. 5. Two-year follow-up computed tomographic scan of a patient in whom the left hemimandible was rehabilitated with a fixed, implant-supported prosthesis after a "double sandwich" osteotomy of the premolar and molar regions, and a lateralisation of the mandibular nerve. Note the harmonious contour of the buccal cortex in the axial view.

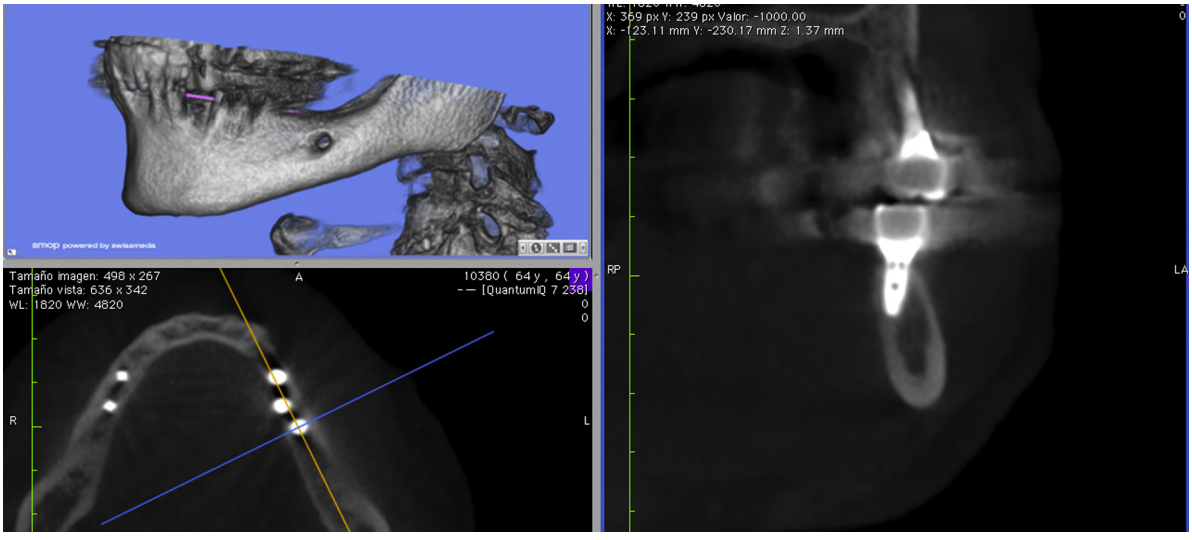

Fig. 6. Three-dimensional reconstruction: axial and coronal views of the same patient as in Fig. 5. The three-dimensional reconstruction shows the distal emergence of the mandibular nerve after a nerve lateralisation procedure. The coronal cut shows that the cervical bone has an adequate width. This transverse dimension corresponds with the initial buccal height of the cut bony segment.

Please cite this article in press as: Triaca A, et al. New perspectives in the treatment of severe mandibular atrophy: "double sandwich" osteotomy. *Br J Oral Maxillofac Surg* (2014), http://dx.doi.org/10.1016/j.bjoms.2014.04.013

lingual periosteum, becomes the lingual wall of the defect (Fig. 3).

The ensuing structure is a three-dimensional scaffold that can be filled with heterologous bony substitutes alone or in combination with autologous bone, depending on the degree of atrophy of the jaw. In our practice, autologous bone grafts of intraoral (mandibular ramus) or extraoral (iliac crest) origin are routinely used. The vertical dimension is stabilised by the cortical component of the bony blocks. The initial buccal height of the cut segment, now the roof of the three-dimensional framework, becomes the width of the new ridge. The underlying space is filled with a mixture of medullary bone and demineralised bovine bony particles (Bio-Oss® and/or Bio-Oss Collagen®, Geistlich Pharma AG, Wolhusen, Switzerland). The reconstruction is stabilised with osteosynthesis material and finally covered with a resorbable collagen membrane (Bio-Gide®, Geistlich Pharma AG, Wolhusen, Switzerland) (Fig. 4). After release of the buccal periosteum, the wound is closed in 2 layers.

Figs. 5 and 6 show a computed tomographic scan taken at the 2-year follow-up of a patient in whom the "double sandwich" osteotomy was used to augment the left hemimandible. A fixed prosthesis supported by 3 implants was designed.

The "double sandwich" osteotomy creates a vascularised 3-wall defect that permits vertical and transverse bony regeneration. Compared with the classic sandwich technique, it generates a firm vertical augmentation vector, and the new transverse width of the alveolar ridge is firmly maintained by the initial buccal height of the cut segment. Predictable bony regeneration and stable long-term results are guaranteed by the undisrupted vascularisation of the lingual and crestal periosteums.

References

1. 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 J Oral Maxillofac Surg* 2010;**39**:554–60.
2. Hernandez-Alfaro F, Sancho-Puchades M, Guijarro-Martinez R. Total reconstruction of the atrophic maxilla with intraoral bone grafts and biomaterials: a prospective clinical study with cone beam computed tomography validation. *Int J Oral Maxillofac Implants* 2013;**28**:241–51.
3. Schettler D, Holtermann W. Clinical and experimental results of a sandwich-technique for mandibular alveolar ridge augmentation. *J Maxillofac Surg* 1977;**5**:199–202.
4. Jensen OT. Alveolar segmental "sandwich" osteotomies for posterior edentulous mandibular sites for dental implants. *J Oral Maxillofac Surg* 2006;**64**:471–5.
5. Egbert M, Stoelinga PJ, Blijdorp PA, de Koomen HA. The "three-piece" osteotomy and interpositional bone graft for augmentation of the atrophic mandible. *J Oral Maxillofac Surg* 1986;**44**:680–7.

Please cite this article in press as: Triaca A, et al. New perspectives in the treatment of severe mandibular atrophy: "double sandwich" osteotomy. *Br J Oral Maxillofac Surg* (2014), http://dx.doi.org/10.1016/j.bjoms.2014.04.013