

CLINICAL TECHNIQUES AND TECHNOLOGY

Correction of a mandibular asymmetry after fibula reconstruction using a custom-made polyetheretherketone (PEEK) onlay after implant supported occlusal rehabilitation

Correzione di asimmetria mandibolare a seguito di ricostruzione con fibula mediante protesi customizzata in polietheretherketone (PEEK) dopo riabilitazione protesica impianto supportata

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SUMMARY

This study describes an unusual case of mandibular asymmetry after fibula free flap reconstruction in a young man following major facial trauma that was corrected using a custom-made polyetheretherketone prosthesis. There is little information in the literature on the use of alloplasts to correct mandibular asymmetry as interest in 'aesthetic re-modelling' has traditionally focused on nasal, zygomatic and chin regions. This report demonstrates that this technique can be used successfully to address selected cases of mandibular asymmetry.

KEY WORDS: Virtual surgery • Mandibular reconstruction • Fibular free flap • Oromandibular reconstruction • Mandibular asymmetry

SUMMARY

Questo studio descrive un caso insolito di asimmetria mandibolare dopo ricostruzione con lembo libero di fibula in un giovane paziente a causa di un grave trauma facciale corretto mediante l'utilizzo di protesi custom-made in polyetheretherketone. C'è poco riportato in letteratura sull'utilizzo di protesi alloplastiche per correggere asimmetrie mandibolari; l'interesse per il rimodellamento estetico si è concentrato sulle regioni nasale, zigomatica e del mento. Questo caso dimostra che questa tecnica può essere utilizzata con successo per affrontare alcuni casi di asimmetria mandibolare.

PAROLE CHIAVE: Chirurgia virtuale • Ricostruzione mandibolare • Lembo libero di fibula • Ricostruzione oro-mandibolare • Asimmetria mandibolare

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Introduction

The complexity of the three-dimensional anatomy of the oro-maxillo-facial region creates a genuine challenge for surgical reconstruction and correction of deformities. Advances in CAD-CAM technology have created an increasing number of applications for virtual surgical planning in oro-maxillo-facial surgery, such as stereolithographic models, preoperative planning¹, fabrication of cutting guides and manufacture of custom implants². The use of patient-specific implants (PSIs) should be considered as a viable option for the treatment of facial asymmetry. This report describes the surgical planning and technique, and aesthetic and functional outcomes of a custom-made pre-

fabricated PEEK PSI (Synthes GmbH, Oberdorf, Switzerland) using CAD-CAM for the correction of mandibular asymmetry after fibula free flap reconstruction.

Case report

A 27-year-old man was referred to our department for correction of facial asymmetry as a result of major trauma with loss of the hemi-mandible, which had been reconstructed with a fibula free flap 3 years earlier in another department (Fig. 1A-C). After implant positioning in the fibula and provisional dental restoration to stabilise the maxillo-mandibular relationship, 64-slice high resolution computed tomography (CT) scan of

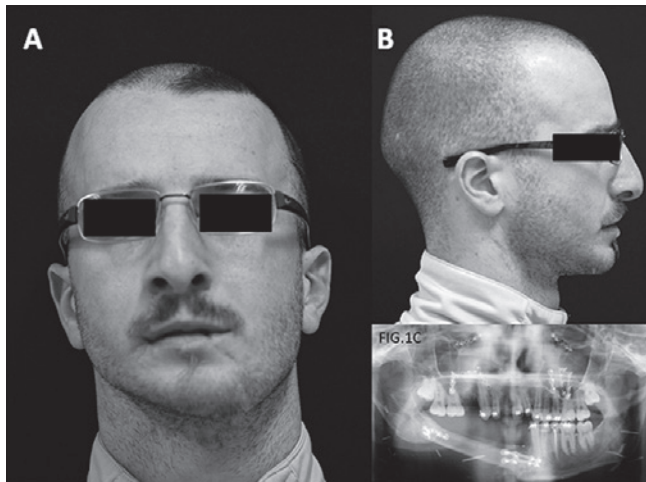


Fig. 1. Aesthetic outcome after fibula free flap reconstruction: frontal view (A), lateral view (B) and orthopantomography (C).

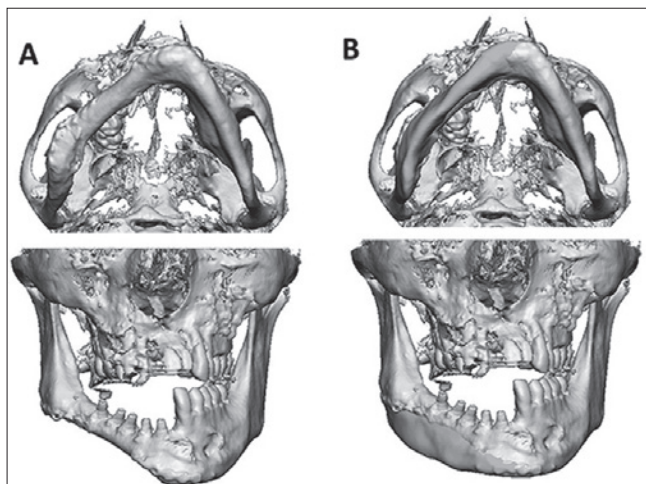


Fig. 2. 3D reconstruction of the craniofacial skeleton: actual inferior view and frontal view (A) virtual inferior view and frontal view after positioning of the custom-made prosthesis (B).

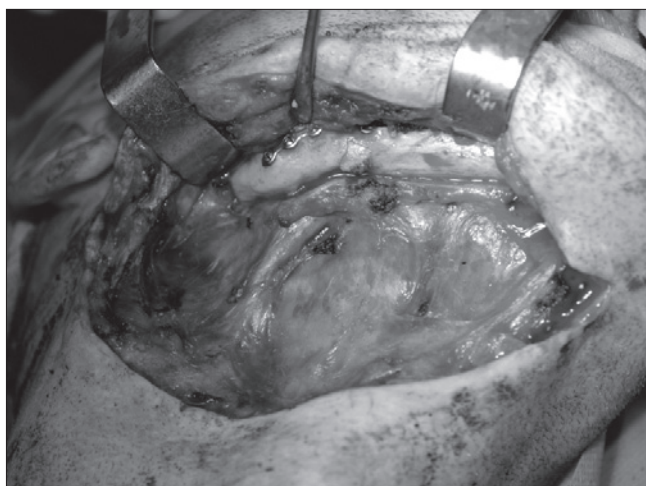


Fig. 3. Surgical technique: access to the mandible and identification of the vascular pedicle.



Fig. 4. Fixation of the custom-made prosthesis to the mandible.

the craniofacial skeleton was performed. 3D rendering based on the DICOM data was performed using CMF software 6.1 (Materialise, Leuven, Belgium), which produced a three-dimensional virtual model of the mandible. Using the mirroring technique, a patient-specific implant (PSI) was produced virtually to obtain optimal mandibular bone symmetry. 3D computer images of the defect (Fig. 2A), the implant and the implant fitted into the defect (Fig. 2B) were sent electronically for final approval by surgeons before manufacturing of the final custom-made prefabricated PEEK PSI (PEEK OptimalT onlay; Synthes). Under general anaesthesia, an extended submandibular approach was performed. After identification of the fibular vascular pedicle, the fascia was incised and the bone was exposed paying particular attention to try to eliminate any interference from soft tissues (Fig. 3). The final PSI fit on the bone was excellent and it was fixed with two 1.5 diameter screws, 15 mm in length (Fig. 4). The post-operative period was uneventful and the patient was discharged on the second day with antibiotic therapy (amoxicillin-clavulanic acid 1 g, three times a day for 8 days), and the cutaneous sutures were removed after 7 days. After 8 months of follow-up, there were no clinical or radiological complications (Fig. 5A, B).

Discussion

Today, mandibular reconstruction with a fibula free flap is considered to be the workhorse in head and neck surgery; however, vascular complications, infections, plate exposure, plate fracture, or vascular pedicle ossification can occur³. The introduction of computer-assisted mandibular reconstruction (CAMR) with the pivotal role of virtual surgical planning has increased the accuracy of pre-operative planning, leading to greater surgical precision, reduction in surgical time and an improved aesthetic result⁴. However, due to high costs, at present the most popular method used to restore correct mandibular segment po-

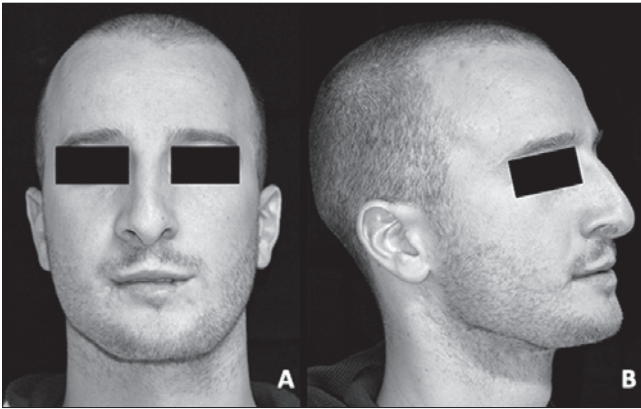


Fig. 5. Aesthetic outcome: frontal (A) and lateral view (B).

sitioning is the technique of pre-plating. In the literature, we can find many techniques described for pre-plating^{5,6} and mandibular non-tooth bearing segment repositioning⁷. Despite the accuracy of the pre-operative planning and surgical execution, mandibular reconstruction can sometimes result in a facial deformity or asymmetry. Treatment of mandibular asymmetries in patients who have undergone mandibular reconstruction, can pose a significant clinical problem. We have described a case of facial asymmetry secondary to mandibular lower profile and angle deficiency in a young man that was reconstructed with a fibula osteofascial flap after a major trauma corrected by the manufacture and placement of a PSI. Although alternative methods were potentially available to correct this deformity, patient factors including occlusion, dental/skeletal relationship and chin position limited our options. Furthermore, construction of the custom-made onlay involved the development of a computer-generated 3D virtual model and computer-aided design and computer-aided manufacture (CAD-CAM) of the onlay. There is little information in the literature on the use of alloplasts to correct mandibular asymmetry^{8,9}, as traditionally interest in 'aesthetic re-modelling' has focused on nasal, zygomatic and chin regions¹⁰⁻¹². Correction of mandibular asymmetry after reconstruction as well as oral rehabilitation with osseointegrated implants should be considered an integral part of the reconstructive process. In our opinion, in selected cases, the bone flap position for implant rehabilitation is more important than an excellent aesthetic outcome which then needs to be corrected at a later time using a PSI, as described herein. Bone height and position correction for successful implant rehabilitation is more difficult to achieve than aesthetic refinements, especially in irradiated patients who have undergone mandibular reconstruction for oral malignancies. Nowadays, virtual surgery allows fibular segments to be placed in the correct position for possible dental rehabilitation. Planning for implantation begins before surgery, and the positioning of final fibular segments

should also be programmed as a function of a possible dental rehabilitation with osseointegrated implants, which are often an integral part of mandibular reconstruction. In the authors' experience, it is very important to perform, when possible, the most precise reconstruction for both aesthetic and future functional outcomes. Occlusal stability is a key point that must be achieved before aesthetic evaluation and a corrective program; fibula free flap implant supported rehabilitation is considered to be the best choice. Considering the concept of 'two arches' in mandibular reconstruction as described by Chen et al.¹³, on many occasions and for many reasons, this concept translates into a compromise choice where necessary additional secondary corrections can then be made, as in the case described. In this case, we used a custom-made PEEK Optima-LT onlay (Synthes). PEEK is a semi-crystalline thermoplastic with excellent mechanical and chemical resistance properties that are retained at high temperatures. It is considered to be an advanced biomaterial used in medical implants engineered for strength, stability and biocompatibility. This material is radiolucent (minimal MRI artefact) with bone-like stiffness and strength, and is very light weight compared to other implants. Moreover, it is autoclavable and withstands repeated sterilisation. After 8 months of follow-up, there were no clinical or radiological problems.

In conclusion, the aesthetic result and perfect bone-prosthesis contact demonstrate how computer aided design and computer aided manufacture are becoming increasingly important in surgery, especially in the oro-maxillo-facial region.

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