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Computer-assisted planning of distraction osteogenesis for lower face reconstruction in gunshot traumas



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ABSTRACT

Purpose: Reconstruction of gunshot wounds of the lower face remains a challenge for the maxillofacial surgeon. We present our experience with the use of virtual surgery using Computer-Assisted Design (CAD)/Computer-Assisted Manufacturing (CAM) techniques to create a custom-made distraction device and prefabricated cutting guides (for both fibula and jaw osteotomies) and for device positioning.

Materials and methods: We describe two cases of lower face reconstruction after gunshot wounds by osteogenic distraction osteogenesis (DO) and computer-assisted surgery (SurgiCase CMF 5.0[®] software, Materialise). Surgical osteotomies and placement of the custom-made distraction device were performed intraoperatively based on prefabricated guides.

Results: This fully digital preoperative planning improves the precision of osteotomies sites and distraction vectors. It largely reduces the operative time, with a greater operative safety.

Conclusions: Reconstruction by DO allows the bone and soft tissues to be simultaneously regenerated. However, the control of three-dimensional reconstruction of the lower face with distraction is difficult in facial gunshot patients because of the difficulties in locating anatomical landmarks. Surgical osteotomies are pre-planned and rapidly performed using a cutting guide. Precise placement of the distraction device is achieved without the need for subjective assessment of the sole surgeon. In our experience, the surgery has resulted in outcomes similar to those predicted by the computer-assisted planning.

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1. Introduction

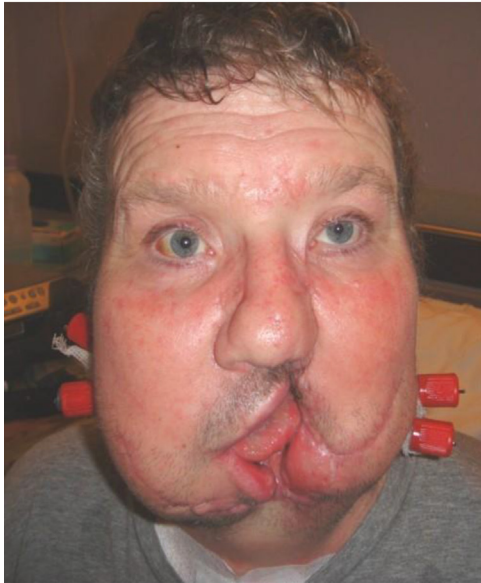
Lower face defects resulting from gunshot wounds often cause severe functional and cosmetic deformities. Distraction osteogenesis (DO) is already a well-established technique to treat those facial wounds, because this type of injury requires the reconstruction of bone and soft tissues (Labbé et al., 2005). As well as in bone elongation, it results in the simultaneous formation of new skin, muscles, and subcutaneous tissues. The objectives of this reconstruction are both functional and aesthetic: to restore facial

contours, to provide labial function and also to provide masticatory function through dental rehabilitation. The principal interest of the DO is the simultaneous creation of the facial soft tissues. Therefore, there is no need to harvest muscles or composite flaps (free or pedicled). DO also recreates the alveolar ridge with its attached gum, suitable for dental reconstruction by osseointegrated implants. Thus, the problems of inflammation around dental implants are largely overcome (Taupin et al., 2012). DO is also interesting from an economic point of view due to the smaller cost for DO in comparison with free flaps (Wojcik et al., 2011). The total duration of treatment is longer than with microsurgery techniques, although the duration of hospitalization is shorter.

Previously, we have reported our experience of DO using a customized external device (DEOS) with an endless screw. This bidirectional device was successfully used for reconstruction of the lower and midface regions (Labbé et al., 2009). However, the three-

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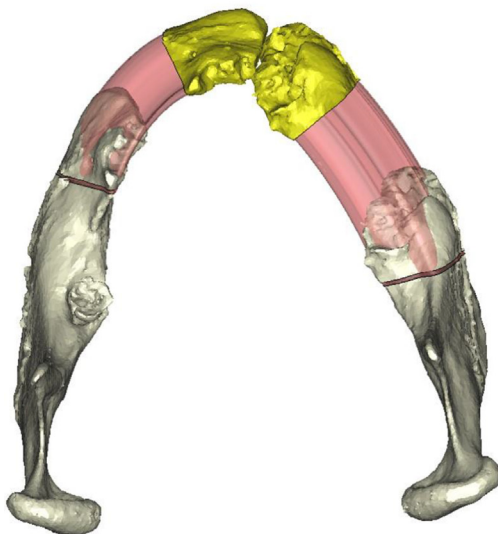
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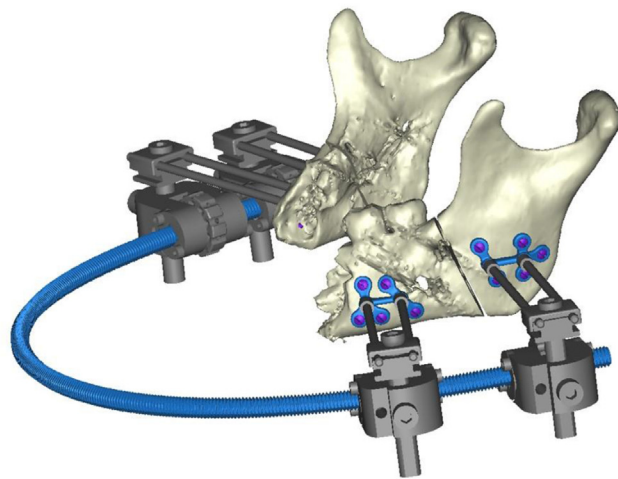
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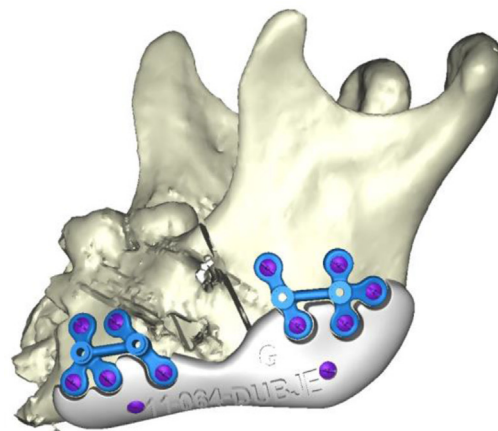
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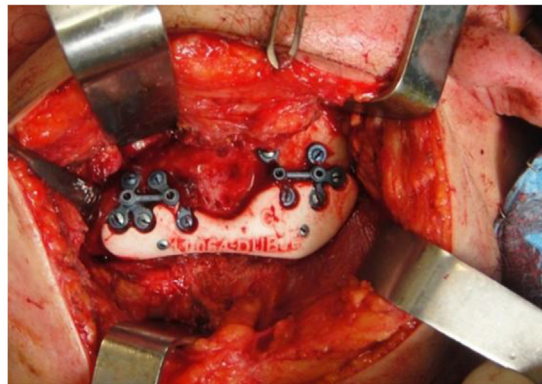
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