

Applications of Computer-Assisted Navigation for the Minimally Invasive Reduction of Isolated Zygomatic Arch Fractures

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Purpose: Computer-assisted navigation has been widely used in oral and maxillofacial surgery. The purpose of this study was to describe the applications of computer-assisted navigation for the minimally invasive reduction of isolated zygomatic arch fractures.

Patients and Methods: All patients identified as having isolated zygomatic arch fractures presenting to the authors' department from April 2013 through November 2014 were included in this prospective study. Minimally invasive reductions of isolated zygomatic arch fractures were performed on these patients under the guidance of computer-assisted navigation. The reduction status was evaluated by postoperative computed tomography (CT) 1 week after the operation. Postoperative complications and facial contours were evaluated during follow-up. Functional recovery was evaluated by the difference between the preoperative maximum interincisal mouth opening and that at the final follow-up.

Results: Twenty-three patients were included in this case series. The operation proceeded well in all patients. Postoperatively, all patients displayed uneventful healing without postoperative complication. Postoperative CT showed exact reduction in all cases. Satisfactory facial contour and functional recovery were observed in all patients. The preoperative maximal mouth opening ranged from 8 to 25 mm, and the maximal mouth opening at the final follow-up ranged from 36 to 42 mm.

Conclusions: Computer-assisted navigation can be used not only for guiding zygomatic arch fracture reduction, but also for assessing reduction. Computer-assisted navigation is an effective and minimally invasive technique that can be applied in the reduction of isolated zygomatic arch fractures.

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J Oral Maxillofac Surg 73:1778-1789, 2015

Among facial fractures, zygomatic arch fractures occur rather frequently.^{1,2} Zygomatic arch fractures frequently result in an esthetically displeasing facial asymmetry and limitation of mouth opening as a result of impingement of the fractured segment on the temporal muscle. Treatment of zygomatic arch fractures can involve minimally invasive surgical

procedures for slightly dislocated fractures or surgery with more extensive access for large dislocations of bone segments.³

Open reduction and internal fixation can accurately realign the facial skeleton, but often with undesirable sequelae.⁴ Therefore, if the zygomatic arch fracture is not severe, the minimally invasive treatment of

Received from the State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) and the Key Laboratory of Oral Biomedicine, Ministry of Education, and the Department of Oral and Maxillofacial Surgery, School and Hospital of Stomatology, Wuhan University, Wuhan, China.

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This work was supported by the China Scholarship Council (201308420340).

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Received January 6 2015

Accepted March 9 2015

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0278-2391/15/002840

<http://dx.doi.org/10.1016/j.joms.2015.03.033>

reduction only (ie, without fixation) can be considered. For these zygomatic arch fractures, when the zygomatic arch is properly elevated and the periosteum has been left intact, the arch will commonly retain its reduction. These zygomatic arch fractures can be treated through closed reduction (by a hook inserted through the buccal skin) or open reduction (by transoral or temporal approaches). The challenge of this modality of treatment is to ensure that stable reduction has been achieved. Intraoperative confirmation of the proper reduction of the zygomatic arch is important; otherwise, the patient could bear the risk of having an inadequate or unstable reduction and a second operation. Current options for intraoperative assessment of the zygomatic arch reduction are comprised of transcutaneous palpation, radiologic visualization, and ultrasonography.

Computer-assisted navigation, initially developed for neurosurgical operations, allows visualization of an operative site and surgical instruments simultaneously and relates them to the patient's images.^{5,6} In theory, computer-assisted navigation is a powerful tool for evaluating fracture reduction; moreover, it

can be used to guide the reduction procedures. To the authors' knowledge, there are no previous studies of this technique used in the reduction of isolated zygomatic arch fractures, although its applications in maxillofacial fractures have been described previously.⁵⁻⁸ The purpose of this study was to describe the applications of computer-assisted navigation for the minimally invasive reduction of isolated zygomatic arch fractures and its effect.

Patients and Methods

To address the research purpose, the authors implemented a prospective study. All patients identified as having isolated zygomatic arch fractures presenting to the Department of Oral and Maxillofacial Surgery, School and Hospital of Stomatology at Wuhan University (Wuhan, China) from April 2013 through November 2014 were included in this study. To be included in the study sample, isolated zygomatic arch fractures must have occurred within 2 weeks, which means that all fractures were fresh. Patients

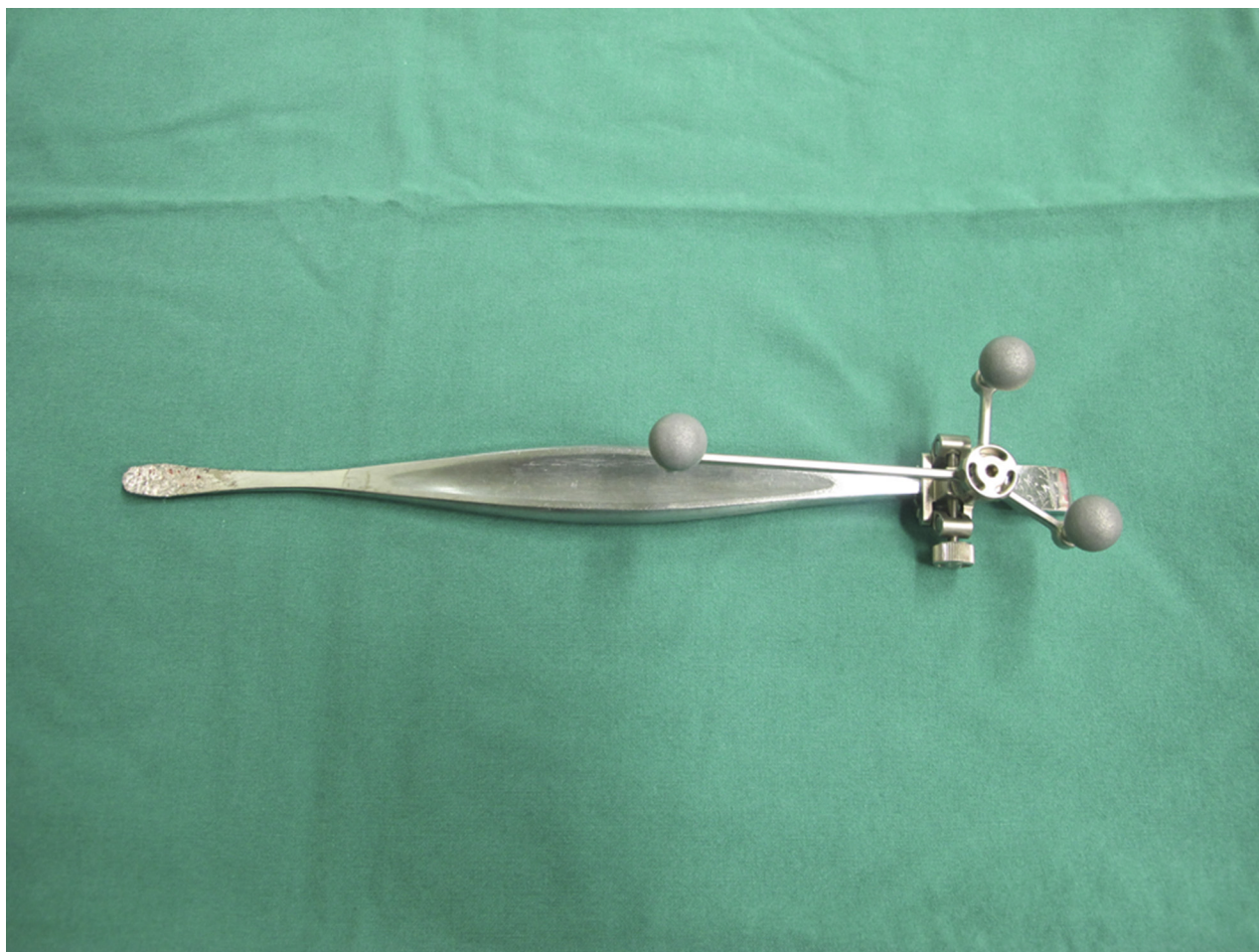


FIGURE 1. Registered periosteal elevator used to elevate the zygomatic arch fracture.

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