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Delayed open reduction and single screw internal fixation as a treatment option in cases of failed non-surgical treatment of bilateral condylar head fractures with fragmentation

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ABSTRACT

Purpose: To share our experience in the open reduction and single screw internal fixation of delayed bilateral condylar head fractures with fragmentation and evaluate its feasibility and outcomes.
Patients and methods: The study involved 6 males and 1 female. All patients had multiple injuries at different body sites and failed non-surgical treatment of bilateral condylar head fractures. The mean period between the injury and the operation was 5.7 (4–8) weeks. According to the preoperative computer-aided design, and the clinical manifestations, the fracture fragments were reduced and fixed with a single screw. A helical CT scan was requested postoperatively to check the reduction of the fragments and the location of the screws. Mean follow-up duration was 9.7 (8–14) months.
Result: The malocclusion was corrected after operation. The intraoperative passive mouth opening was 3.93 ± 0.19 cm. The mouth opening was 3.43 ± 0.35 cm in 3 months follow-up, and more than 3 transverse fingers at the last follow up. No one had a progressive limitation of the mouth opening in 8–14 months of follow up.
Conclusions: The strategy of open reduction and single screw internal fixation of bilateral condylar head fracture with fragmentation of mandible is feasible and effective. It is a treatment option in the rare delayed cases of failed non-surgical treatment.

1. Introduction

Condylar fractures are the most controversial fractures regarding diagnosis and management (Bos et al., 1999; Assael, 2003; Brandt and Haug, 2003; Villarreal et al., 2004). With the development of images and digital surgery, more and more surgeons use the technique of open reduction and rigid fixation to treat the condylar neck and subcondylar fractures (Assael, 2003; Brandt and Haug, 2003). Although the open treatment of condylar head fractures has been approved by more surgeons with the superiority of the open treatment in the height reduction of the ramus, the temporomandibular joint ankylosis (TMJ), soft tissues, and the function of TMJ yield have compared better with closed treatment recently (Kermer et al., 1998; Hlawitschka and Eckelt, 2002; Hlawitschka et al., 2005; Landes and Lipphardt, 2006; Pilling et al., 2006; Loukota, 2007; Landes et al., 2008; Vesnaver, 2008; Kolk and Neff, 2015; Shiju et al., 2015). Most surgeons choose closed treatment of the fragmental condylar head fractures because it is too difficult to reduce and fix the fragments. However, in some severe complications like the shortening of the ramus' height and malocclusion, even the ankylosis would be caused by inappropriate closed treatment. The golden opportunity for open treatment also was lost.

In 2013, a patient who had undergone management of the mandibular symphyseal fracture and intermaxillary fixation in another general hospital complained of an occlusal disturbance and limitation of mouth opening with 6 weeks delayed bilateral condylar head fractures with fragmentation and came to our department for further treatment. The diagnosis had been ensured from the helical computed tomography (CT). According to the 3-D model on computer, the stump of the condyle was appressed on the lateral part of the fossa resulting from the incomplete reduction of the TMJ lateral dislocation. At the beginning, we planned to

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remove the fracture fragments and reduce the stump to the fossa and reposition the articular disc to isolate the stump from contact with the fossa. Then the CT scan and the computer 3-D model showed that a big part of the fracture segments was attached with the lateral pterygoid muscle (LPM), and it could be repositioned and fixed with screws according to the computer simulation by Mimics 15.0 software (Materialize, Leuven, Belgium). During the operation, the surgeons found that the callus formation among the multiple fragments of the condylar fracture parts had fused together, and it was steady enough to support an internal fixation; we then tried to reduce the segment and fix it on the top of the stump with one screw. Per the preoperative computer simulation, the fracture segment was fixed with one bicortical screw. The outcomes were dramatically good at 6 months follow up. The other 6 patients with similar conditions were treated by this method. This article shares our experience of this method and evaluates its feasibility and outcomes.

2. Patients and methods

In the period between 2013 and 2014, 7 patients visited our clinic for further treatment of delayed bilateral condylar head fractures with fragmentation. The study involved 6 males and 1 female, and the age at the time of injury ranged from 21 to 42 years. Diagnoses were made from clinical manifestations and CT scan. The most frequent causes of injury were road traffic accidents followed by accidental falls. All patients had multiple injuries on different sites of the body, such as limb fractures, chest trauma, abdominal injuries, and so on. The mean (range) time between the injury and the operation was 5.7 (4–8) weeks. The mean follow-up duration was 9.7 (8–14) months. The personal and clinical data of the patients are shown in Tables 1 and 2. The classification of the fracture was done according to He's classification (He et al., 2009) and is presented in Table 2 also according to the actual AOCMF classification system (Neff et al., 2014). All patients had intermaxillary fixation in another general hospital. Although open reduction and internal fixation had been done to manage the mandibular symphyseal fracture in 3 of 7 cases, occlusal disturbance and limitation of mouth opening had been involved in all cases because of the insufficient reduction and fixation (Figs. 1 and 2).

2.1. Preoperative simulation

The digital imaging and communications in medical (DICOM) files from CT were imported into the Mimics 15.0 software. Images were segmented by radiodensity and calculated into three-dimensional shapes by surface rendering on the software platform to make sure that the segment with the attachment of LPM could be located and repositioned (Figs. 3–6). Based on the data of the preoperative simulation, the length and the angle of the screw were measured and the surgical plan of fracture segments reduction and fixation was made by the senior surgeons.

2.2. Operation

All patients were operated on under general anesthesia. The fixation of the symphyseal fracture must be removed first. Because of the insufficient reduction of fracture and unstable fixation, the callus was removed by elevators in this study. A classic preauricular incision was used to approach the fracture. To avoid damage to the facial nerve, the superficial temporal fascia was cut along the anterior border of the superficial temporal artery, and the branches of the facial nerve at the parotid plexus were dissected without invading the neural membrane. After the capsule of the TMJ had been exposed, a T-shape incision was made. Further dissection exposed the lateral side of the condylar stump and neck. We expended the fracture segments with an elevator gently. According to the preoperative computer simulation, the elevator always slides into the callus between the fracture segments and the ramus along the medial surface under the sigmoid notch. When the elevator was twisted to dissect the fracture segments from the medial surface of the ramus, more attention should be paid to the bleeding from the callus gap. Frequently, gelfoam and/or Surgel could stop the bleeding easily. The ramus was distracted inferiorly to widen the joint space by a nasal septum round chisel pushing on the sigmoid notch, and the fractured fragment was reduced by a modified periosteal elevator cooperatively. The contracture of LPM as compared to early repositioning maneuvers is not so obvious under the sufficient muscle relaxants used in the operation. If surgeons are worried about the stripping of the LMP in some contact cases, the following method can be used. When the dislocation fragment is repositioned, restrain the fragment instead of pulling it back at the time the sigmoid notch is pushed down. Then relax the down force of the sigmoid notch and reposition the fragment and the stump slowly. Repeat the push and relax circle a few times, then the contract should be looser than before and the fragment can be repositioned easily. The fragment was maintained in the fixed position with two elevators while the hole was drilled at the preselected point and the bicortical screw (AO 2.0 system locked bicortical screw) was inserted. During the operation, the determined fragment and the small fragments adhered with it would be repositioned, but free parts would be removed then. Usually, the screw was chosen preoperatively depending on the surgical simulation to reduce the operating time, and it was then tightened gently. After it had been verified that the fracture was fixed with a bicortical screw, and the articular disc was correctly positioned and fixed on the stump (Figs. 7 and 8), then the free fracture fragments were removed and the capsule was carefully sutured in position and the wound closed in layers. Other simultaneous mandibular

Table 1
The personal and clinical data of the patients.

Case No.	Age	Sex	Cause	Period after injury (weeks)	Duration of follow up (months)		Preoperative mouth opening (cm)	Postoperative passive mouth opening (cm)	Postoperative mouth opening (cm) 3 months	Mouth opening at the last follow up (transverse fingers)	Length of the screw (L/R)
					Clinically	Telephone interview					
1	42	M	Traffic accident	6	6	8	0.8	4.0	4.0	3–4	16/16 mm
2	28	M	Traffic accident	8	3	9	0.5	4.0	3.5	3–4	16/16 mm
3	24	M	Traffic accident	4	3	7	1.0	4.0	3.5	3–4	14/14 mm
4	35	M	Traffic accident	4	3	5	0.8	3.5	3	3	16/16 mm
5	21	M	Fall	6	3	5	1.0	4.0	3.5	3–4	16/16 mm
6	33	M	Fall	4	3	5	1.0	4.0	3.5	3–4	16/18 mm
7	37	F	Traffic accident	8	4	4	0.8	4.0	3	3–4	16/14 mm