Int J Clin Exp Med 2017;10(4):7199-7203
www.ijcem.com /ISSN:1940-5901/IJCEM0042635

Case Report

Three-point fixation of displaced tripod zygomaticomaxillary complex fracture: a modified surgical technique

Jiawen Si*, Rong Ren*, Minjiao Wang, Hongliang Li, Steve GF Shen, Jun Shi

*Department of Oral and Craniomaxillofacial Surgery, Ninth People's Hospital, College of Stomatology, School of Medicine, Shanghai Jiao Tong University, Shanghai 200011, China. *Equal contributors.*

Received June 30, 2016; Accepted December 1, 2016; Epub April 15, 2017; Published April 30, 2017

Abstract: Displaced tripod zygomaticomaxillary complex (ZMC) fractures are generally treated with open reduction and 3-point rigid internal fixation at the frontozygomatic suture, zygomaticomaxillary buttress, and inferior orbital rim. However, a clinical dilemma still exists in the postoperative morbidities such as ectropion of the lower eyelid and palpability of the Ti-plate at the inferior orbital rim area. In this study, we describe a modified3-point fixation method through the lateral eyebrow and gingival-buccal sulcus incisions in one displaced tripod ZMC fracture case. Open reduction and rigid internal fixation at frontozygomatic suture, zygomaticomaxillary buttress and sphenozygomatic suture was performed and good repositioning of the zygoma was achieved. No obvious complication was recorded during the 24-month follow-up. Although further investigation on this technique might be needed, this report illustrated the feasibility and treatment advantages of our modified method in selective displaced tripod ZMC fracture cases.

Keywords: Zygomaticomaxillary complex, bone fracture, sphenozygomatic suture, internal fixation, modification

Introduction

Due to the prominent position of the zygomatic region, the zygomaticomaxillary complex (ZMC) fracture is one of the most common facial fracture in the craniofacial area [1-3]. As the zygoma is closely connected to the frontal bone, sphenoid bone and maxilla, the ZMC fracture usually involves three-dimensional osseous disruption of the zygomaticomaxillary, zygomaticofrontal and zygomaticosphenoid processes [1, 2, 4]. For proper diagnosis and treatment, Zingg et al [3] developed a classification system based on the anatomical and clinical features of 1025 ZMC fractures: Type A involves isolated fracture of the zygoma; Type B involves a fracture where all three processes of zygoma are fractured (tripod fractures); Type C involves comminuted zygomaticfractures. In the retrospective studies of both Zingg et al and Hwang et al, tripod fractures formed about one-half of the ZMC fracture cases, while another half cases were simple or comminuted fractures [1, 3].

According to Zingg's classification, different treatment methods of tripod ZMC fracture were described in the literature. Some authors have proposed that 1-point fixation at the zygomaticomaxillary process could provide sufficient reduction and stability for ZMC fractures without comminution [5-7]. While others stated that proper management of tripod ZMC fracture can be achieved through at least a 2-pointfixation method with different approaches such as the lateral eyebrow incision, sub-ciliary incision and intraoral incision [3, 4, 8-12], or even a 4-point fixation approach with an additional preauricular incision [13]. Most commonly, displaced tripod ZMC fractures are treated with open reduction and 3-point fixation at the frontozygomatic suture (FZS), zygomaticomaxillary buttress (ZMB), and inferior orbital rim (IOR) through lateral eyebrow, gingivobuccal sulcus and sub-ciliary incisions, based on the more favorable results from 3-point fixation technique comparing to the 2-point fixation technique [8, 12]. However, a clinical dilemma still exists in the facts that postoperative complications such as implants palpation, ectropion, permanent scleral show, hypertrophic scar formation at the IOR area are often reported in the literature [2, 7, 14, 15].

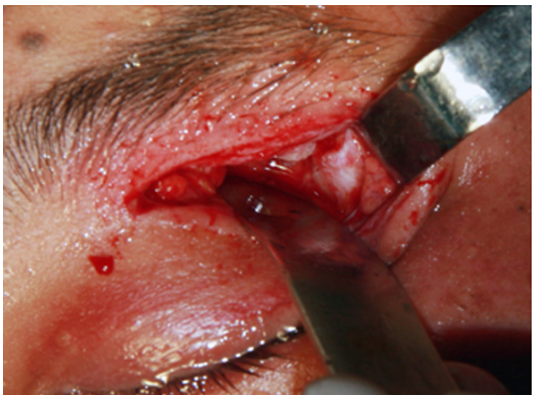

Figure 1. A 2-3 cm incision was made at the lateral brow to expose the fractures at frontozygomatic suture and sphenozygomatic suture. A gentle traction on the orbital globe with a narrow brain spatula was suggested to achieve a better exposure of the sphenozygomatic suture.

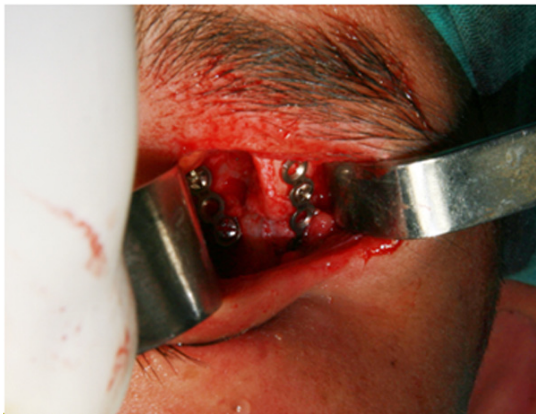

Figure 2. Internal fixation of fractures at frontozygomatic suture and sphenozygomatic suture was obtained by positioning 0.9 mm microplates with microscrews at the lateral orbital rim and at the sphenozygomatic junction respectively.

As the zygoma is closely connected to the frontal bone, sphenoid bone and maxilla through zygomaticomaxilllary, zygomaticofrontal and zygomaticosphenoid processes, the sphenozygomatic suture (SZS) can be taken as an important anatomical landmark for proper reduction and fixation of the ZMC fracture [1, 2, 4]. To avoid the sequela associated with incision and rigid fixation at IOR, we describe a modified 3-point fixation method through the lateral eyebrow and gingival-buccal sulcus incisions in one displaced tripod ZMC fracture case. Open reduction and rigid internal fixation at FZS, ZMB and SZS was performed. The details of this technique and the treatment outcome are reported in this study.

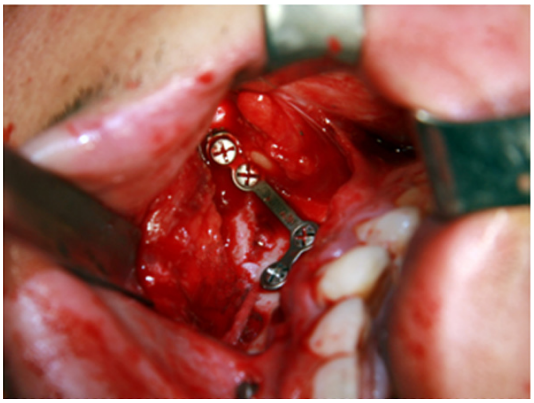

Figure 3. A horizontal gingivobuccal sulcus incision was performed from the left upper canine to the first molar. Internal fixation of fracture at zygomaticomaxillary buttress is performed with a 1.5 mm L-type miniplate and miniscrews.

Case report

A 30-year-old male was admitted to our department due to a car accident. Physical examination revealed no diplopia or malocclusion (Supplementary Figure 1, picture of pre-operation). Computed-tomography (CT) scan showed an inward and backward displacements of the left zygoma with no internal orbital wall or floor fracture. Since the patient revealed a stable physical state, open reduction and rigid internal fixation was performed under general anesthesia. Firstly, an approximately 2-3 cm incision was made at the lateral brow. After subperiosteal dissection was carried out to expose the FZS fracture, the medial periosteum on the lateral orbital wall was further elevated to expose the SZS fracture (**Figure 1**). A gentle traction on the orbital globe with a narrow brain spatula was suggested to achieve better exposure. Then, a horizontal gingivobuccal sulcus incision was performed from the upper canine to the first molar. The mucoperiosteal flap was elevated to expose the ZMB fractures. After open reduction was successfully achieved with manipulation, internal fixation of fractures at FZS and SZS was obtained by positioning 0.9 mm microplates with microscrews at the lateral orbital rim and at the sphenozygomatic junction respectively (**Figure 2**), while internalfixation of fracture at ZMB is performed with a1.5 mm miniplate and miniscrews placed intraorally (**Figure 3**). The preoperative and postoperative CT scan showed that all fractures were smoothly reduced (**Figure 4**). This patient's facial contour was well remained, while no obvi-

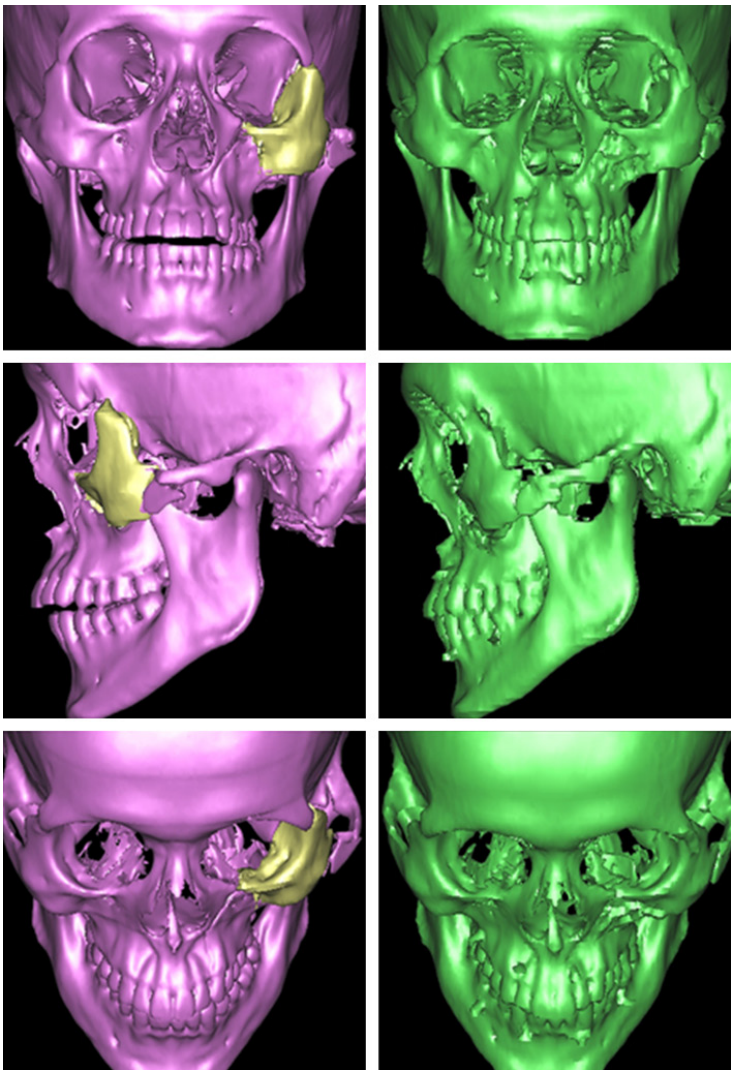

Figure 4. The preoperative and postoperative CT scan showed that all fractures were smoothly reduced (yellow: preoperative displaced zygoma; purple: the unaffected preoperative craniofacial bones; green: postoperative craniofacial bones).

Figure 5. The patient's facial contour and eye movement was well remained, while no obvious complication was recorded during the 24-month follow-up.

ouscomplicationwasrecordedduringthe24-month follow-up (**Figure 5**).

Discussion

Although no full consensus on treatment protocol of ZMC fracture has been achieved, most authors agreed with the need for open reduction and 3-point fixation at the ZMB, FZS and IOR to obtain an optimal reduction and stability for the tripod displaced ZMC fracture [1, 2, 4, 8]. According to Sergio's experience, the 3-point fixation approach was mandatory to properly reduce the tripod ZMC fracture with displacement bigger than 5 mm [8]. In 1990, Davidson et al [16] compared the stability of displaced ZMC fractures using different methods of internal fixation in human skulls. He found that the 3-point fixation approach provided the best stability comparing to 1-point fixation and 2-point fixation. More recently, Majeed et al [12] conducted a randomised prospective clinical trial of 100 patients to compare the surgical treatment results and complications of ZMC fracture using 2-point fixation versus 3-pointfixation. They found that postoperative complications such as decreased malarheight and vertical dystopia was more common in 2-point fixation group than in 3-point fixation group. However, as internal fixation at the IOR with a sub-ciliary incision or transconjunctival incision carries the risks such as intolerance of implants palpation, ectropion, permanent scleral show, hypertrophic scar formation, keratoconjunctivitis, epiphora, and other complications, mounting surgeons reported their modified technique trying to avoid internal fixation at the IOR and FZS area in treatment of ZMC fractures [7, 10, 12, 14, 17, 18].

Early in 1995, Mitchell et al [19] described an enhanced fixation method at the FZS in the treatment of displaced ZMC fractures, thus IOR fixation was not routinely performed. In 2009, Roberto et al [14] introduced a modified 3-point internal fixation technique that microplate and microscrews were positioned at the orbital floor approximately 5 mm posterior to the inferior orbital rim, so that they would not be palpable, however the sub-ciliary incision was still needed. More recently, De Souza et al [10] described the modification made to the intraoral approach to allow reduction and internal fixation at both IOR and ZMB through only one gingival-buccal sulcus. However the infraorbital nerve was dis-

sected to tunnelize the infraorbital rim, which may cause additional complication. In this report, we performed a modified 3-point internal fixation procedure at FZS, ZMB and SZS through a lateral brow incision and a gingivalbuccal sulcus incision. As the alignment of the zygoma and the greater wing of the sphenoid provide the intrinsic strength and intricate 3-dimensional feature of the zygoma, this technique allows direct visualization, reduction and fixation of the FZS, ZMB and SZS fractures [2, 4, 12]. The possibility of visualizing and directly manipulating improves anatomic reduction and fixation of the displaced tripod ZMC fracture, which minimizes the surgical trauma and optimizes the surgical time comparing to the traditional 3-point fixation approach. In addition, it is possible to check the intraoperative reduction of fracture at the IOR region by finger palpation. If any instability is noted, the IOR area can be exposed and plated for additional stability.

In our case, no immediate or delayed postoperative complications, such as infection, implant exclusion, inadequate reduction, etc. were observed up to 24-month. However, this selective approach for internal 3-point fixation should be only applied to displaced tripod ZMC fractures with no internal orbital wall or floor defects. Otherwise, a subciliary or transconjunctival incision would be needed for internal orbital reconstruction. Moreover, further investigations are still needed to illustrate the long-term feasibility and advantage of this technique.

Acknowledgements

This work was supported by the National Natural Science Foundation of China (No: 816-00827and 81570947) and the Foundation of Shanghai Jiao Tong University (No. YG2015-MS22).

Disclosure of conflict of interest

None.

Address correspondence to: Drs. Steve GF Shen and Jun Shi, Department of Oral and Craniomaxillofacial Surgery, Ninth People's Hospital, College of Stomatology, School of Medicine, Shanghai Jiao Tong University, No 639, Zhizaoju Road, Shanghai 200011, China. Tel: +86-21-23271207; E-mail: maxillofacsurg@163.com (SGFS); Dr.shijun.oms@gmail.com (JS)

References

[1] Hwang K and Kim DH. Analysis of zygomatic fractures. J Craniofac Surg 2011; 22: 1416-1421.

[2] Meslemani D and Kellman RM. Zygomaticomaxillary complex fractures. Arch Facial Plast Surg 2012; 14: 62-66.

[3] Zingg M, Laedrach K, Chen J, Chowdhury K, Vuillemin T, Sutter F and Raveh J. Classification and treatment of zygomatic fractures: a review of 1,025 cases. J Oral Maxillofac Surg 1992; 50: 778-790.

[4] Kelley P, Hopper R and Gruss J. Evaluation and treatment of zygomatic fractures. Plast Reconstr Surg 2007; 120: 5S-15S.

[5] Mohammadinezhad C. Evaluation of a single miniplate use in treatment of zygomatic bone fracture. J Craniofac Surg 2009; 20: 1398-1402.

[6] Kim JH, Lee JH, Hong SM and Park CH. The effectiveness of 1-point fixation for zygomaticomaxillary complex fractures. Arch Otolaryngol Head Neck Surg 2012; 138: 828-832.

[7] Hwang K. One-point fixation of tripod fractures of zygoma through a lateral brow incision. J Craniofac Surg 2010; 21: 1042-1044.

[8] Olate S, Lima SM Jr, Sawazaki R, Moreira RW and de Moraes M. Surgical approaches and fixation patterns in zygomatic complex fractures. J Craniofac Surg 2010; 21: 1213-1217.

[9] Singh V, Sharma B and Bhagol A. Evaluating the applicability of a biodegradable osteosynthesis plating system in the management of zygomatico-maxillary complex fractures. Otolaryngol Head Neck Surg 2011; 145: 924-929.

[10] de Souza Carvalho AC, Pereira CC, Queiroz TP and Magro-Filho O. Intraoral approach to zygomatic fracture: modified technique for infraorbital rim fixation. J Craniofac Surg 2012; 23: 537-538.

[11] Martinez AY and Bradrick JP. Y modification of the transconjunctival approach for management of zygomaticomaxillary complex fractures: a technical note. J Oral Maxillofac Surg 2012; 70: 97-101.

[12] Rana M, Warraich R, Tahir S, Iqbal A, von See C, Eckardt AM and Gellrich NC. Surgical treatment of zygomatic bone fracture using two points fixation versus three point fixation--a randomised prospective clinical trial. Trials 2012; 13: 36.

[13] Choi KY, Ryu DW, Yang JD, Chung HY and Cho BC. Feasibility of 4-point fixation using the preauricular approach in a zygomaticomaxillary complex fracture. J Craniofac Surg 2013; 24: 557-562.

[14] Becelli R, Quarato D, Matarazzo G, Renzi G and Dominici C. Esthetic positioning of rigid internal fixation in tripod zygomatic fractures. J Craniofac Surg 2009; 20: 724-725.

[15] Ellstrom CL and Evans GR. Evidence-based medicine: zygoma fractures. Plast Reconstr Surg 2013; 132: 1649-1657.

[16] Davidson J, Nickerson D and Nickerson B. Zygomatic fractures: comparison of methods of internal fixation. Plast Reconstr Surg 1990; 86: 25-32.

[17] Ellis E 3rd and Kittidumkerng W. Analysis of treatment for isolated zygomaticomaxillary complex fractures. J Oral Maxillofac Surg 1996; 54: 386-400; discussion 400-381.

[18] Kim ST, Go DH, Jung JH, Cha HE, Woo JH and Kang IG. Comparison of 1-point fixation with 2-point fixation in treating tripod fractures of the zygoma. J Oral Maxillofac Surg 2011; 69: 2848-2852.

[19] Mitchell DA, MacLeod SP and Bainton R. Multipoint fixation at the frontozygomatic suture with microplates: a technical note. Int J Oral Maxillofac Surg 1995; 24: 151-152.

Supplementary Figure 1. The picture of the patient before operation. Physical examination revealed a slight inward and backward displacements of the left zygoma with no diplopia or malocclusion.