Single-Point Fixation for Noncomminuted Zygomaticomaxillary Complex Fractures—A 20-Year Experience

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Purpose: Zygomaticomaxillary complex (ZMC) fractures occur often. However, no clinical consensus has been reached regarding the number of fixation points required when performing open reduction and internal fixation (ORIF). The objective of the present study was to explore the utility of single-point fixation in the management of noncomminuted ZMC fractures.

Patients and Methods: We analyzed the data from a retrospective case series of 211 patients treated during a 20-year period.

Results: The mean length of follow-up was 3.4 months. Of the 211 patients, 162 with noncomminuted ZMC fractures had been treated with single-point fixation of the zygomaticomaxillary buttress. During the follow-up period, 1 patient experienced tooth loss because of a root present in the fracture line, 7 experienced intraoral plate exposure, with 2 subsequently undergoing plate exchange, and 8 developed a wound infection. No patients required orthognathic surgery or cheek implants for malar asymmetry. No patient developed hypoglobus or enophthalmos, and none required revision ORIF of their ZMC fracture.

Conclusions: To the best of our knowledge, the present study represents the largest series in the literature reporting the surgical results and outcomes of patients with noncomminuted ZMC fractures treated with single-point fixation. In experienced hands, we believe this is a viable surgical option if appropriate surgical considerations are made.

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Zygomaticomaxillary complex (ZMC) fractures involve the malar eminence at 4 buttresses: the zygomaticomaxilllary (ZM), frontozygomatic (FZ), zygomaticosphenoid (ZS), and zygomaticotemporal.[1] These fractures result from assault (64.5%), traffic accidents (13.9%), falls (13.0%), industrial and work accidents (2.8%), and sporting activities (5.8%).[2-4] The incidence of these fractures has also varied because

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of different cultural and geographic factors.[3,4] The ZS suture on the lateral orbital wall has been shown to be the most reliable site to ascertain the adequacy of the reduction. In contrast, the FZ suture has been shown to be a poor indicator of the reduction.[2]

Although some fractures might be amenable to reduction without fixation, the optimal surgical management will usually require adequate reduction and fixation of the fracture fragments. The fixation methods used to manage ZMC fractures have included 1-, 2-, 3-, and 4-point fixation.[5-8] However, no consensus has been reached on the number, or location, of fixation points required to treat ZMC fractures. Dakir et al[9] reported data from a series of 30 patients treated with fixation of the ZM buttress, with acceptable outcomes. Hwang[10] used the lateral brow incision to access, reduce, and plate the FZ suture line as the sole fixation point for ZMC fractures. Kim et al[11] compared 1-point fixation along the ZM buttress in 14 patients and 2-point fixation at the ZM and FZ sutures in 16 patients with tripod fractures. They reported adequate reduction and alignment with single-point fixation.[11]

The objective of the present study was to further explore the utility of single-point fixation in the management of noncomminuted ZMC fractures. Because of the wide variability in the reported data regarding the number of fixation points required for adequate treatment of ZMC fractures, our hope was that our study would stimulate discussion regarding the appropriate treatment of ZMC fractures. To date and to the best of our knowledge, the present study is the largest to report the surgical results and outcomes of patients with noncomminuted ZMC fractures treated with single-point fixation. We have also discussed important surgical considerations.

Patients and Methods

The John Peter Smith institutional review board approved the present study. We performed a retrospective analysis of the data from patients who had undergone surgery for noncomminuted ZMC fractures from 1997 to 2016. The demographic data, surgical intervention, and complication rates were analyzed. The inclusion criteria were age older than 18 years, the presence of displaced noncomminuted ZMC fractures, surgical intervention for ZMC fractures using single-plate fixation, and a minimum follow-up period of 3 months. Patients not meeting these inclusion criteria were excluded.

A systematic approach to assess the quality of reduction was delineated as follows. After reduction of the ZM buttress, the orbital rim was palpated. A step-off greater than ~2 mm is an indication for orbital rim plating, because the cosmetic deformity will be more obvious with such a distance. This step-off was measured intraoperatively using a flexible measuring ruler. The FZ suture was then manually palpated without making any incisions. Displacement of the FZ suture was an indication for the need to plate this segment. After plating the segment, forced duction tests were performed. A finding concerning for herniation or entrapment with forced duction testing was considered an indication for orbital floor exploration and repair.

Regarding the surgical technique, the ZM buttress was approached via an intraoral vestibular approach. After exposure of the fracture line, the ZM buttress was reduced as delineated and plated, using single, 2.0-mm miniplate fixation.

Results

During the 20-year study period, 211 patients (167 men and 44 women; mean age, 43.9 years) met the inclusion criteria and had been treated for noncomminuted ZMC fractures. The mean operative time was 35.3 minutes. After fixation of the ZM buttress, 44 patients had a persistent step-off greater than 2 mm. These patients subsequently underwent 1.2-mm plate fixation at the inferior orbital rim. Five patients underwent rim and FZ suture plating in addition to plating of the lateral buttress. A total of 162 patients (76.8%) were successfully treated with single-point fixation. The mean length of follow-up was 3.4 months.

Of the 162 patients treated with single-point fixation, 132 were men and 30 were women. Their mean age was 45.2 years. Of the 162 patients, 1 experienced tooth loss because of a root in the fracture line, 7 developed intraoral plate exposure, 2 of whom subsequently underwent plate exchange. Also, 8 patients developed a wound infection. Of these 8 patients, 1 was treated with transoral incision and drainage and 7 with oral antibiotics. No patient required orthognathic surgery or cheek implants for malar asymmetry. Four patients underwent secondary lipotransfer for soft tissue contracture of the cheek, despite a well-positioned and healed bone. No patient developed hypoglobus or enophthalmos postoperatively. No patient required revision open reduction and internal fixation of their ZMC fracture (Table 1).

Discussion

No consensus has yet been reached regarding the indications, approaches, or techniques for the management of ZMC fractures. A recent survey of surgeons in the fields of otolaryngology, plastic and reconstructive surgery, and oral maxillofacial surgery demonstrated a wide ranging discrepancy regarding both the number of total fixation points used and the

Table 1. COMPLICATIONS AFTER SINGLE-POINT FIXATION OF ZYGOMATICOMAXILLARY COMPLEX FRACTURES

Complication	n (%)
Patients	162 (100)
Plate exposure	7 (4.3)
Wound infection	8 (4.9)
Soft tissue contracture	4 (2.5)
Hypoglobus	0 (0)
Enophthalmos	0 (0)
Revision surgery	0 (0)
Malar asymmetry	0 (0)

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surgical approaches implemented in the treatment of ZMC fractures.[12]

Our results have shown that single-point fixation of the ZM buttress is a viable option for the treatment of noncomminuted ZMC fractures. This technique, however, requires attention to important intraoperative details. After reduction and fixation of the ZM buttress, the FZ suture line must be palpated to establish the adequate alignment. The orbital rim must also be evaluated for proper alignment. A significant palpable step-off, which in our series we defined as a step-off greater than 2 mm, indicates a need to surgically address the orbital rim. It is important to perform forced duction testing to rule out entrapment of the inferior rectus muscle. If any concern exists for the presence of herniation or entrapment, the orbital floor should be explored and reconstructed, when indicated. However, in all other cases, single-plate fixation proved to be a sufficient reduction technique with minimal associated morbidity. Single-point fixation has important implications beyond those of fracture management. The decreased operative time used with this technique might be, not only more cost-effective, but will also result in decreased potential morbidity for patients with multiple medical comorbidities and an associated increased risk of anesthesia. Thus, single-point fixation could be of particular utility for patients for whom a decreased operative time would be of high priority. These patients should have an uncomplicated, mildly displaced, noncomminuted ZMC fracture pattern for which plating of the ZM buttress would result in appropriate reduction without any additional discernible step-off or deformity in other segments of the ZMC tetrapod. When extensive comminution is present, multiple approaches and fixation points will generally be needed to provide adequate reduction and rigid fixation of the fracture fragments. We believe that all displaced ZMC fractures will require at least single-point fixation owing to the traction placed on the fracture fragments by the masticatory muscles. All necessary fracture sites should be visualized to ensure an adequate reduction. The zygomatic arch, in most circumstances, will not require fixation, unless severe comminution or instability is present. In such cases, a coronal approach could be implemented, and fixation of the ZS suture can be considered for restoration of the orbital volume and reduction of the potential for oenophthalmos.[13]

Exposure of the ZM buttress via a transoral vestibular approach was implemented for our patients with adequate exposure of the associated fracture line. A study by Ellis and Kittidumkerng[14] evaluated the surgical approaches to the ZMC and documented that the vestibular approach was most commonly implemented, followed by a lower eyelid approach. The complications associated with the maxillary vestibular approach have been negligible, although the complication rate with the lower eyelid approach has been ~20%, including lid malposition and scleral show.[14-17] Further stabilization of the ZMC can be achieved with implementation of a lateral brow incision, which will provide a synergistic supportive role in stabilizing a mobile ZMC and facilitating fixation of the lateral buttress.[14] However, in our study population, with uncomplicated, mildly displaced, noncomminuted ZMC fracture patterns, further stabilization was not required and an isolated vestibular approach, therefore, was adequate for plating of the ZM buttress.

O'Hara et al[18] reported that rigid fixation of the ZM buttress is of paramount importance in addressing the biophysical forces within the ZMC complex. They reported this was attributable to the antagonistic forces secondary to the pull of the masseter muscle.[18] However, a state of balance between adequate stabilization and exposure of the facial skeleton is required, and no clear consensus has been reached regarding an optimal fixation technique. Our results have illustrated that single-point fixation of the ZM buttress will be sufficient in the stabilization of uncomplicated, mildly displaced, noncomminuted ZMC fractures. Increasing usage of intraoperative computed tomography, although not used routinely in this setting by the senior author, might further aid surgeons in determining the need for further reduction, thereby limiting unnecessary exposure at multiple sites.[19]

The limitations of the present study were that it was a single-surgeon experience, with the possible lack of external validity, and the possible introduction of bias favoring a specific operative technique. The retrospective nature of the present study and the limited interval of patient follow-up were also limitations that potentially affected its significance. Any conclusions from the present study should be made with these considerations in mind.

Prospective studies are needed to better compare the outcomes using different numbers of fixation points, techniques, and approaches. Furthermore, the development of patient-reported outcome measures for facial trauma is needed to facilitate improved metrics in the evaluation of surgical results and patient quality of life.

In conclusion, to the best of our knowledge, the present study is the largest series of patients with noncomminuted ZMC fractures treated with single-point fixation at the ZM buttress. In experienced hands, we believe this is a viable surgical option, if appropriate surgical considerations are made. More studies are needed to prospectively compare the surgical outcomes among the different fixation techniques.

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