

# Fixation at the Inferior Orbital Rim in Medially Rotated Zygomatic Complex Fractures

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**Background:** Zygomatic complex fractures are quadri-pod fractures because of the involvement of the zygomaticotemporal, zygomaticomaxillary, zygomaticofrontal, and zygomaticosphenoid junctions. The need to address one or more fixation points of these four articulations mainly depends on the degree of displacement. In this article, the authors present a series of medially rotated zygomatic complex fractures to demonstrate that one-point fixation at the inferior orbital rim (IOR) is sufficient in most cases.

**Methods:** This is a retrospective study of all medially rotated zygomatic complex fractures treated by the authors over the last 4 years.

**Results:** The patients were six men with a mean age of 41 years. All patients sustained medially rotated zygomatic complex fractures. Three patients had symptomatic orbital floor defects. One patient had concurrent displaced superior orbital rim fracture. Surgery was done using the transconjunctival approach. A titanium mesh was used to fix the IOR. For orbital floor reconstruction, the same titanium mesh was extended into the floor to cover the defect. The patient with concurrent superior orbital rim fracture required a second point of fixation at the lateral orbital rim.

**Conclusions:** Single-point of fixation at the IOR is sufficient in most medially rotated zygomatic complex fractures as long as there is minimal displacement at other fracture points. Some of these patients may have symptomatic orbital floor defects. Simultaneous fixation of the IOR and orbital floor reconstruction may be done via a transconjunctival approach. (*Plast Reconstr Surg Glob Open* 2021;9:e3739; doi: [10.1097/GOX.0000000000003739](https://doi.org/10.1097/GOX.0000000000003739); Published online 5 August 2021.)

## INTRODUCTION

Zygomatic complex fractures are quadri-pod fractures because of the involvement of zygomaticotemporal, zygomaticomaxillary, zygomaticofrontal, and zygomaticosphenoid junctions. In the current article, fracture sites will be quoted as the four potential sites of fixation as follows: the zygomaticomaxillary buttress (ZMB), the lateral orbital rim (LOR), the zygomatic arch (ZA), and the inferior orbital rim (IOR). The need to address one or more fixation points of these four articulations mainly depends on the degree of displacement: one-point fixation is usually done at the ZMB; two-point fixation is usually done at the ZMB + LOR; three-point fixation is usually done at the ZMB +

LOR + IOR; only severely displaced fractures require four-point fixation.<sup>1,2</sup>

In this article, the author presents a series of medially rotated zygomatic complex fractures to demonstrate that one-point fixation at the IOR is sufficient in most cases. The transconjunctival approach not only provides access for fracture reduction, but also simplifies the procedure with minimal skin scarring and no risk of loss of facial soft tissue suspension associated with the multi-point fixation approach. Furthermore, the approach allows simultaneous orbital floor reconstruction if indicated.

## PATIENTS AND METHODS

This is a retrospective study of all medially rotated zygomatic complex fractures treated by the author over the last 4 years. Demographic data, cause of injury, associated injuries, the presence of symptomatic orbital floor fractures, radiological findings, the number of fixation points, and outcome were documented.

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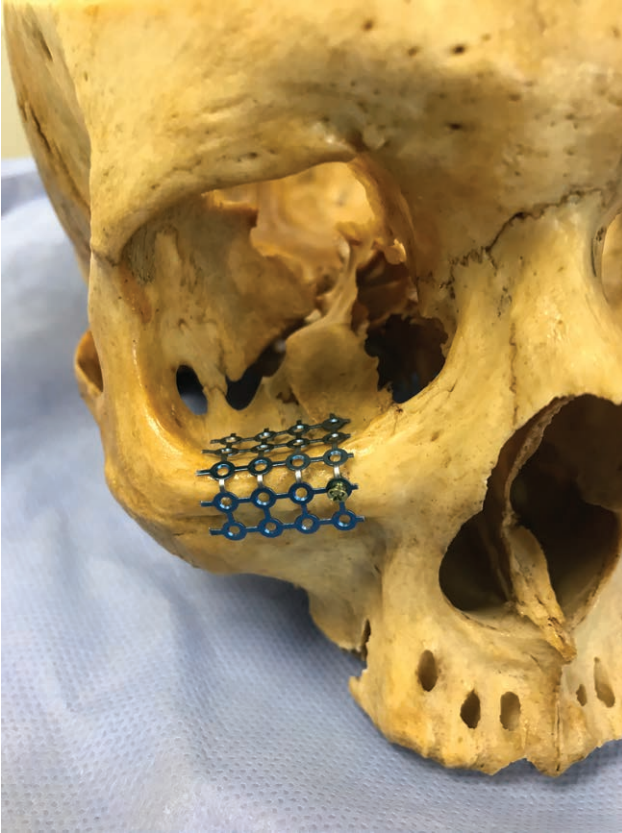
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**Fig. 1.** Demonstration of the titanium mesh used in the study.

## RESULTS

### Demographic Data and Preoperative Findings

Six men were included in the study. The mean age was 41 years (range: 29–48 years). The mechanism of the injury was road traffic accident ( $n = 2$ ), a direct hit by a heavy object ( $n = 2$ ), or falling from height ( $n = 2$ ). All patients sustained medially rotated zygomatic complex fractures. Three patients had symptomatic orbital floor defects. Associated injuries included mild head injury ( $n = 1$ ), rib fracture ( $n = 1$ ), contralateral maxillary sinus fracture ( $n = 1$ ), and ipsilateral displaced superior orbital rim/depressed skull fractures ( $n = 1$ ). All patients had paresthesia along the inferior orbital nerve distribution. Two of the three patients with symptomatic orbital floor defects had diplopia in the up-gaze only. The third patient had an orbital floor defect and concurrent and ipsilateral displaced superior orbital rim leading to diplopia in all gaze positions. All patients were assessed radiologically by CT scans. All fractured zygomatic complexes were rotated medially and inferiorly toward the maxillary sinus. The degree of displacement was most significant at the IOR. Surgery was done within seven days in all patients. The radiological findings were confirmed by the intraoperative findings. Intraoperatively, all patients were found to have orbital floor fractures along the direction of the IOR fracture. The three patients with diplopia had orbital floor defects with entrapment of intraorbital tissue in the maxillary sinus. The remaining three patients had no



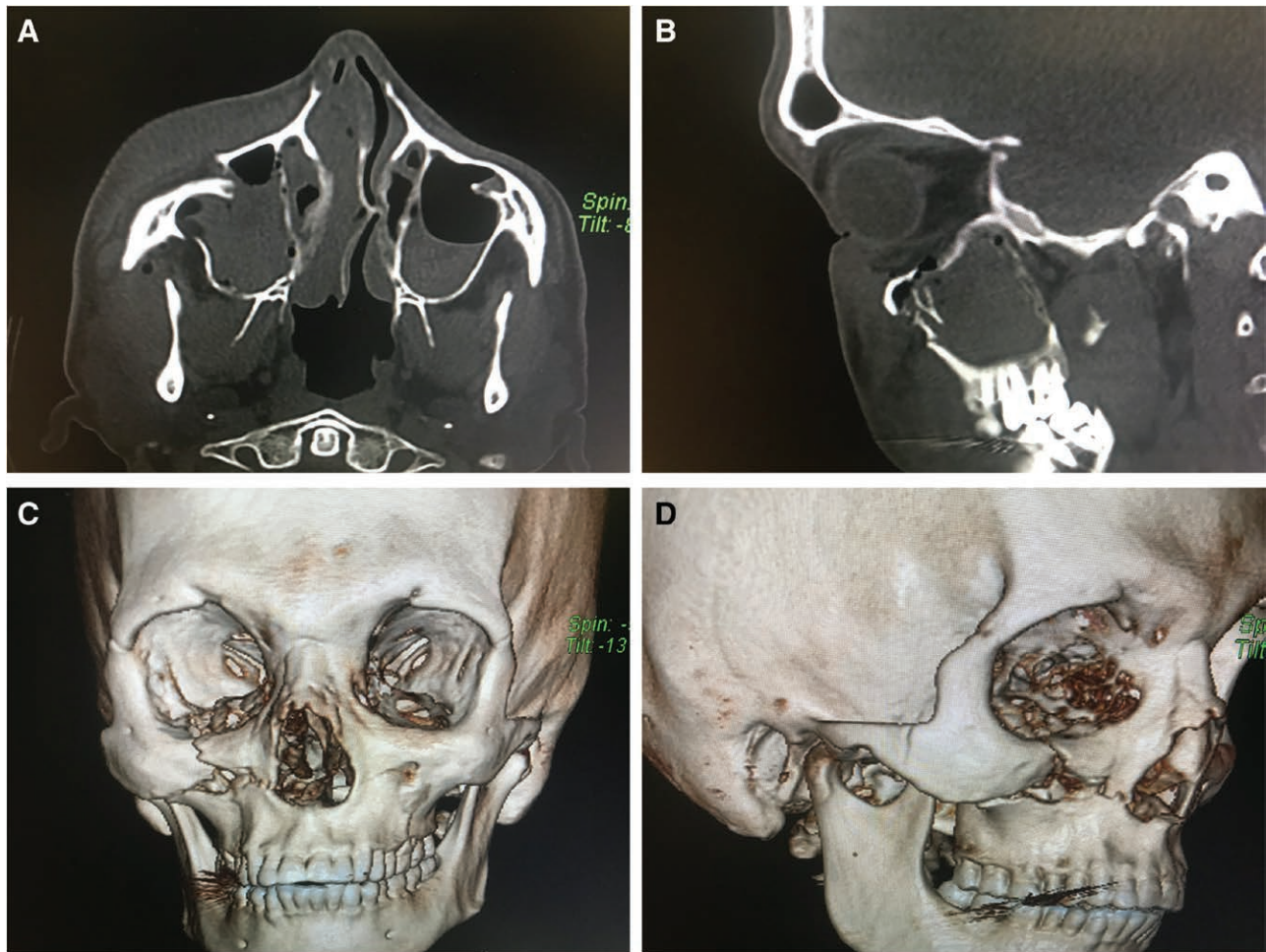
**Fig. 2.** An example of a medially rotated zygomatic complex fracture fixed at the IOR (one-point fixation). Preoperative appearance.

significant floor defects; and these defects in the orbital floor were more apparent after fracture reduction and were confined to the most anterior part of the floor, in continuity with the IOR fracture (Figs. 2–6). The inferior orbital nerve was found to be compressed by the displaced fracture in all patients. The site of the nerve compression was either at the orbital floor or at the infraorbital foramen because of the inferior displacement of the fracture.

### Surgical Technique

The procedure was done under general anesthesia and oral endotracheal intubation. A transconjunctival approach with lateral canthotomy was done in all cases. The anterior part of the orbital floor was exposed subperiosteally in all patients. The prolapsed orbital tissue was released in the three patients with symptomatic orbital floor defects. Reduction of the medio-inferiorly rotated zygomatic complex was then done. Reduction was done slowly in the opposite direction of the rotation (ie, superio-lateral direction) using blunt hooks and a Kocher. The Kocher was applied on the lateral fracture fragment at the IOR, and the hooks were used to help the reduction at the ZMB. Accurate reduction was ensured by the alignment of the two bony fragments at the IOR as well as the alignment of the orbital floor segments. A titanium mesh with 1.5-mm screws was used to fix the IOR. In the three patients who required orbital floor reconstruction, the same titanium mesh was extended far into the orbit to reach and cover the defect (Fig. 1). In the





**Fig. 3.** A, Preoperative CT scan showing the medio-inferior displacement into the maxillary sinus; B, Preoperative CT scan showing the orbital floor defect at the site of intraocular air collection related to the inferior rectus muscle. C, Preoperative 3D CT scan (frontal view) showing the medio-inferior rotation. The most significant displacement is at the IOR. However, there is also displacement at the zygomaticotemporal region and slight torsion at the frontozygomatic suture. D, Preoperative 3D CT scan (oblique view) showing minimal displacement at the LOR and the ZA.

remaining three patients (with no preoperative diplopia), the titanium mesh was extended only to the most anterior part of the floor to cover the small anterior orbital floor defect. Forced duction test was performed intraoperatively to ensure adequate orbital floor reconstruction. Palpation of the zygomatic arch and the lateral orbital rim was also done to ensure that there is no significant displacement or the presence of palpable step. Single-point fixation at the IOR was sufficient in five of the six patients, and a demonstrative example is shown in [Figures 2–6](#). The sixth patient had a concurrent displaced superior orbital rim fracture that required a second point of fixation at the LOR ([Fig. 7](#)).

#### Postoperative Care, Complications, and Results

Since there was only one-point fixation, patients were instructed not to lie prone or on the side of the fracture postoperatively. No postoperative complications were seen. At final follow-up (3–6 months postoperatively), there was complete resolution of the diplopia and complete resolution of the sensory symptoms related to the

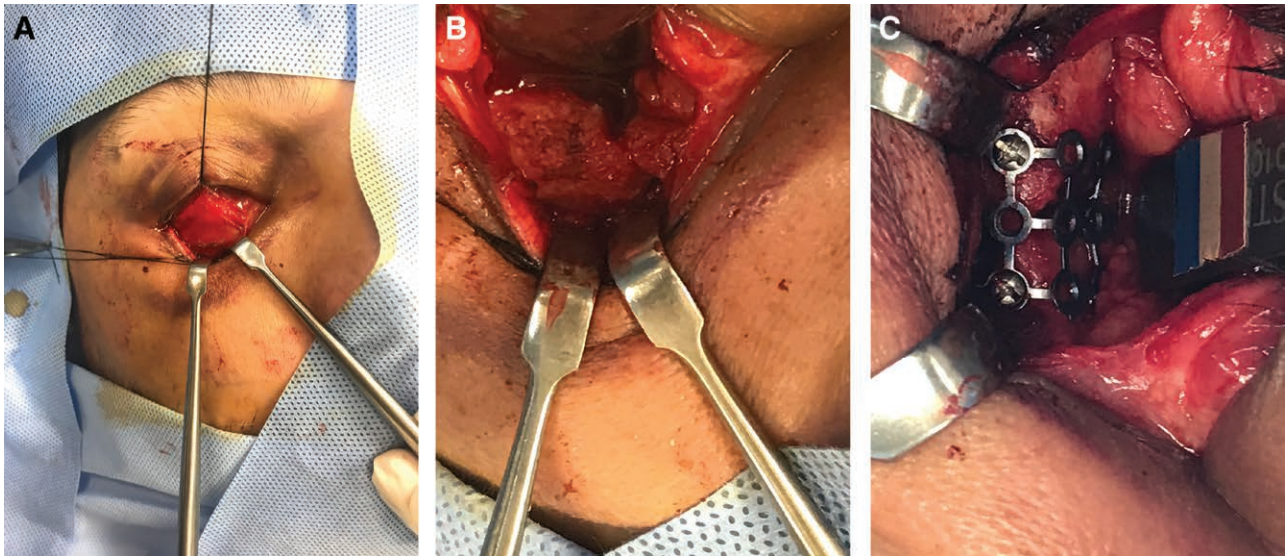
inferior orbital nerve. Cheek prominence was rated clinically as normal by comparing it with the contralateral side. All patients were satisfied with the outcome.

### DISCUSSION

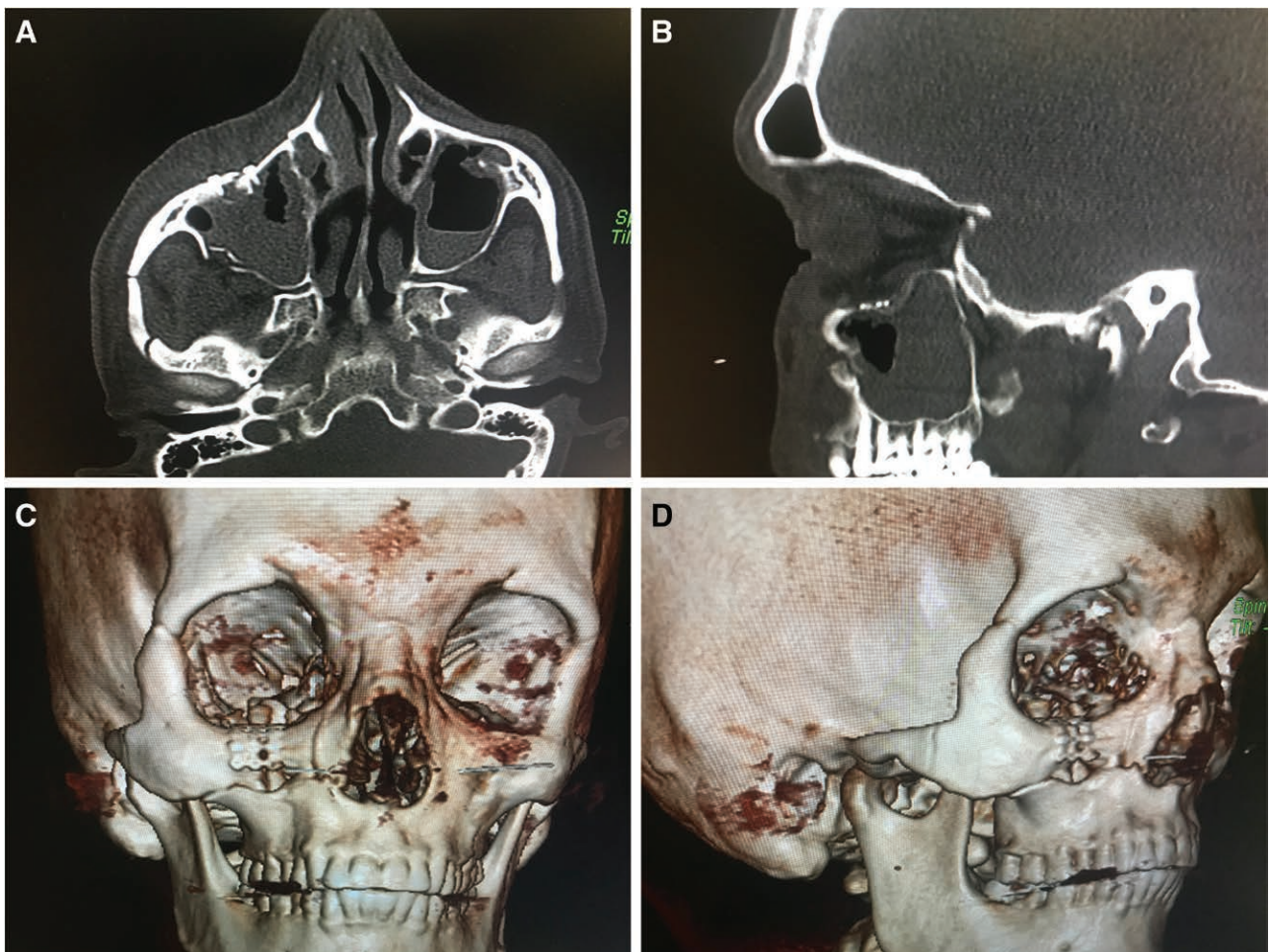
Zygomatic fractures may be classified into six groups,<sup>3</sup> as shown in [Table 1](#). Our series is unique and included only medially rotated fractures. The first observation from our study is the presence of concurrent inferior displacement of the zygomatic complex into the maxillary sinus. Hence, they are in medio-inferior rotation. Another observation is the presence of paresthesia along the distribution of the inferior orbital nerve in all patients. The nerve was seen intraoperatively to be compressed but not transected, explaining the full recovery seen in all patients. All patients had significant displacement at the IOR and also orbital floor fractures along the IOR fracture.

Generally, adequate reduction of a quadri-pod fracture could only be ensured by reduction of at least two different planes. In our series, this was obtained by reducing





**Fig. 4.** A, The transconjunctival approach. B, Exposure of the IOR and orbital floor. Before fracture reduction, only a small anterior floor defect is apparent. This defect will be larger after reduction as will be seen in the next figure. C, The titanium mesh in place. Note the large anterior orbital floor defect (under the mesh) and hence the mesh extends into the orbital floor.



**Fig. 5.** A, Postoperative CT scan showing the reduced fracture (compare with Fig. 3A). Note that a fragmented zygomatic arch has become apparent after reduction. Although there is no displacement of the arch, it is potentially unstable. Hence, postoperative care included avoiding pressure on the fracture site. B, Postoperative CT scan showing the reconstruction of the orbital floor (compare with Fig. 3B). C, Postoperative 3D CT scan (frontal view) showing the reduced fracture (compare with Fig. 3C). The reduction at the frontozygomatic suture and at the buttress is not perfect but acceptable. D, Postoperative 3D CT scan (oblique view) showing a good alignment at the LOR and the ZA (compare with Fig. 3D).





**Fig. 6.** Postoperative clinical view at 2 months after surgery showing the restoration of the cheek prominence.

the plane of the IOR/maxillary sinus plane and the plane along the orbital floor. Hence, it is mandatory to do subperiosteal dissection of the orbital floor in all cases, even in the absence of diplopia.

The principles of zygomatic complex fractures and their management are well described in the literature.<sup>4</sup> There are three principles relevant to our article. Firstly, medial and inward displacement of the zygomatic complex may happen without fracture of the zygomatic arch or body. However, medial and inferior rotation of the complex (which is the case in our series) is not possible without another fracture line in the body or the temporal process of the zygomatic bone. Hence, the general recommendation is two-point fixation for rotated zygomatic complex fractures.<sup>1,2,4</sup> Secondly, the infraorbital rim is a thin bone and may not give sufficient strength or support. Hence, the literature recommends to put plates in the maxillary buttress and frontozygomatic suture, which are more stable. In addition, plates placed in the infraorbital margin are easily palpable and create discomfort in cold climates because the skin overlying this region is very thin. Thirdly, exposure of the IOR will always carry the risk of postoperative ectropion. In our series, single-point fixation at the IOR was done via a transconjunctival approach, and our justification for that, knowing the above three principles, will be discussed. Patient selection for single-point fixation is essential. Our approach is suitable only for patients in whom the main displacement is at the IOR.

**Table 1. Classification and Zygomatic Fractures<sup>3</sup>**

Group	Description
I	Un-displaced/minimally displaced fractures
II	Isolated zygomatic arch fracture
III	Displaced but unrotated zygomatic complex fractures
IV	Medially rotated fractures
V	Laterally rotated fractures
VI	Severely displaced/complex comminuted fractures

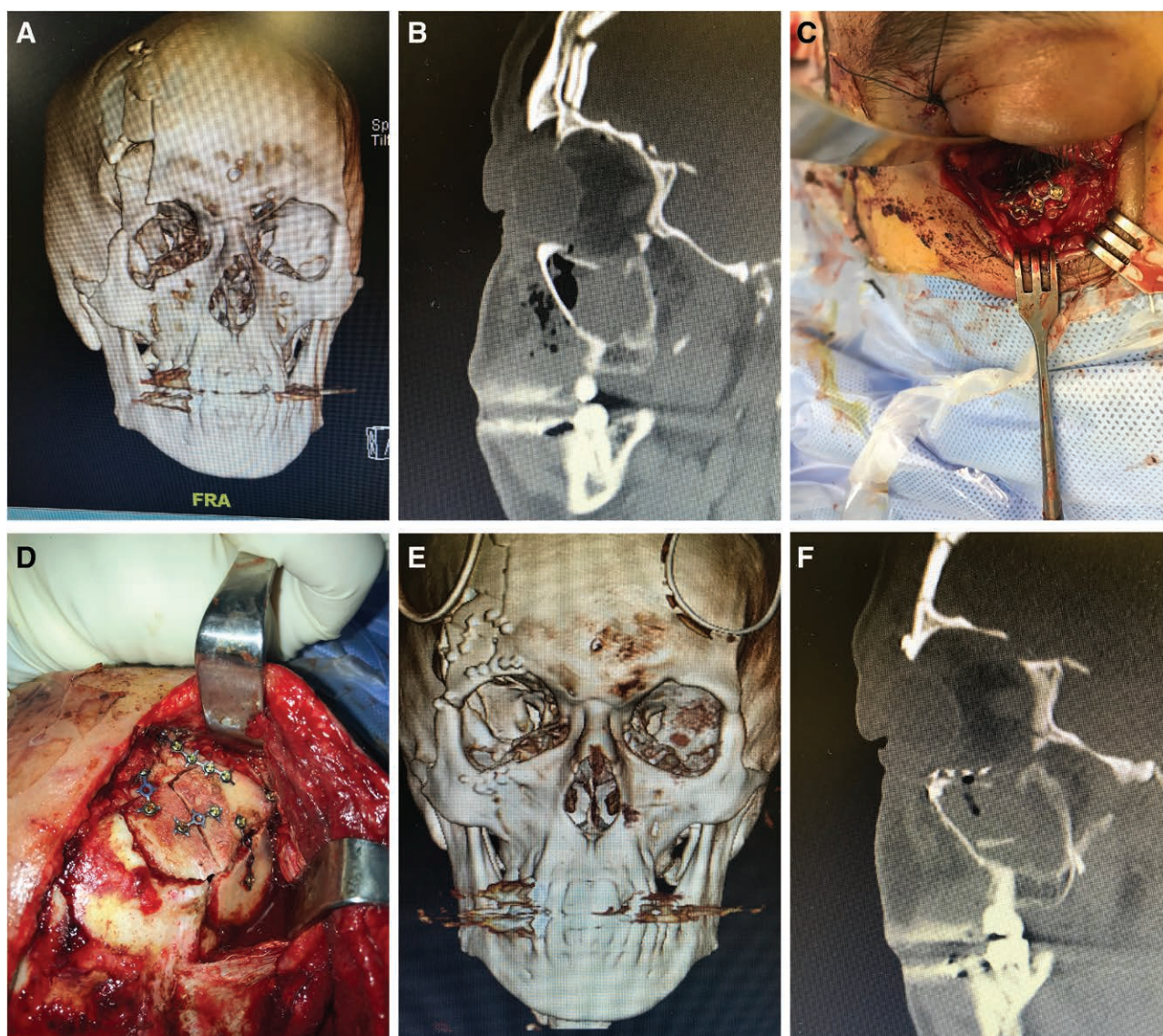
If there is significant displacement at another fracture site, a second point of fixation is mandatory, and this was demonstrated in our series in the patient with concurrent displaced superior orbital rim fracture. We are aware that single-point fixation is not as stable as two-point fixation and hence, postoperative care in our series included avoiding pressure on the fracture site.

We believe that single-point fixation has several advantages such as reducing operative time, less skin scarring, and eliminating the risk of postoperative soft tissue prolapse associated with the multi-point fixation approach. Our choice of the site of fixation at the IOR fits our patient population not only because the main displacement was at the IOR, but also because of the concurrent orbital floor defects. Reduction and fixation of the IOR and orbital floor reconstruction was done simultaneously using a titanium mesh. However, minor residual displacements are likely to persist at other fracture sites (and this is demonstrated in our postoperative figures).

However, all fractures healed well with no apparent cheek bone asymmetry on final follow-up, and all patients were satisfied with the results. The titanium mesh is relatively thin (compared with plates), and hence, it is much less palpable. The senior author (MMA) has used this mesh at the IOR for many years during his practice in Saudi Arabia, and none required removal of the mesh because of discomfort in the cold climate. However, it should be noted that our winter climate is not very cold. With major displacement at the IOR, it is unlikely that the orbital floor is not involved even in patients with no preoperative diplopia. Once the IOR is reduced, the orbital floor defect becomes more apparent. We found that the floor defect in such cases only involved the most anterior part of the orbital floor (in continuity with the IOR fracture line) and hence, we always extended the titanium mesh into the anterior part of the floor, as shown in [Figures 2–6](#). Finally, our exposure via the transconjunctival approach minimizes skin scarring and carries a lower risk of lower eyelid ectropion compared with other skin incisions at the lid margin or at the infra-orbital rim.

We reviewed previously reported large series of zygomatic complex fractures to investigate the frequency and indications of using a single-point fixation. One large series was the multi-center European zygomatic fracture research project.<sup>5</sup> There were 1406 patients in the series. One-point fixation was done in 264 cases (17%). Of these 264 cases, 98 (37%) had fixation at the IOR only. However, the majority of these had isolated IOR fractures. The authors stated that the choice of the number and site of fixation points depended mainly on the degree of displacement and the preference of the surgeon. They





**Fig. 7.** The only case that required two-point fixation (at the IOR and the LOR). A, Preoperative 3D CT scan showing the medio-inferiorly rotated zygomatic complex with concurrent superior orbital rim and depressed skull fractures. B, Preoperative CT scan showing a large orbital floor defect. C, Fixation of the IOR and reconstruction of the orbital floor using a titanium mesh. D, Reduction and fixation of the superior orbital rim and skull fractures. E, Postoperative 3D CT scan (compare with Fig. 7A). F, Postoperative CT scan showing reconstruction of the orbital floor using the titanium mesh (compare with Fig. 7B).

also stated that the stability of the fracture may often be assessed intraoperatively following the placement of the first plate, and accordingly, a second plate may be avoided. In our series, we assessed the stability intraoperatively. Another large series was reported by Zingg.<sup>6</sup> There were 423 cases of quadri-pod zygomatic complex fractures. The authors first obtained closed reduction with a J-shaped hook elevator inserted through an intraoral incision or a stab incision below the zygomatic arch. Once reduction was obtained, the majority were treated with single-point fixation using a miniplate at the frontozygomatic junction. No further details were given by the authors. In our series, we also used hooks for fracture reduction.

The best material to be used in the reconstruction of the orbital floor defect is still controversial.<sup>7,8</sup> In our series,

we used the titanium mesh to simultaneously fix the IOR and reconstruct the orbital floor. The technique has several advantages, including omitting donor site morbidity, being radio opaque, and having no risk of postoperative resorption. However, it is rarely associated with a specific complication known as the orbital adherence syndrome.<sup>9</sup> Excessive fibrosis around the titanium results in restrictive diplopia, and removal of the mesh is usually curative.

In conclusion, single-point of fixation at the IOR is sufficient in most medially rotated zygomatic complex fractures as long as there is minimal displacement at the ZA and LOR. Some of these patients may have symptomatic orbital floor defects. Simultaneous fixation of the IOM and orbital floor reconstruction may be done via a trans-conjunctival approach.



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#### PATIENT CONSENT

*The patient provided written consent for the use of his image.*

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