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ORIGINAL ARTICLE

# Management of Post-traumatic Zygomatic Orbital Deformity

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## ABSTRACT

Secondary deformities of orbitozygomatic region present a formidable challenge to surgeon in terms of restoration of form and function. Often times the reasons sited in literature for these deformities are inadequate management or misdiagnosis at the time of initial presentation. However all the patients in our series presented late to us on account of difficult terrain and poor means of transport, at the time of initial presentation only. These patients were provided primary first aid at hospitals near the site of injury and were subsequently referred to our only tertiary care center of maxillofacial surgery often weeks after initial trauma. The average time of presentation ranged from four weeks to sixteen weeks in these patients by which time the fractures had already malunited. We carried out refracturing at malunited fracture sites in fractures four to six weeks old and osteotomy techniques in patients presenting later than six weeks after trauma. In this paper we present our experience of twenty three patients presenting over a period of seven years from 2005 to 2012. All the patients were evaluated clinically and radiographically and subsequently underwent ORIF with titanium bone plates and screws after refracture or osteotomy of the zygomatic orbital deformity. Follow up ranging from seven years to twelve months indicated stable surgical results with good functional and surgical outcome.


**Keywords:** Post-traumatic, Zygomatic fractures, Orbital Fractures, Surgery.

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## INTRODUCTION

Modern techniques of fracture management allow easy access to the whole craniofacial skeleton, accurate fracture reduction, internal fixation with mini and microplating systems and primary bone grafting where necessary to replace missing bone. The goal of primary treatment is to restore normal anatomy and therefore normal form and function of the craniofacial complex. However, patients may present with post-traumatic deformity for a variety of reasons. They may fail to present in the acute phase or injuries may go undiagnosed if specialist expertise is not available. Other serious injury or medical conditions may preclude or compromise immediate treatment of facial injuries and the results of primary treatment may be unsatisfactory if the extent of the injury is underestimated or in the more severe comminuted panfacial fractures.[1]

Orbitozygomatic trauma presenting 3 to 4 weeks after the initial injury is defined as post-traumatic zygomatic orbital deformity. Inadequate or absence of initial treatment results in a characteristic deformity: decreased anteroposterior projection of the zygomatic body, associated with increased facial width due to collapse and outward bowing of zygomatic arch.[2-4] Increased volume of the bony orbit results in enophthalmos. Due to remodeling process, most of the landmarks for proper positioning are lost.[5] Secondary management of orbitozygomatic trauma has been sited frequently in the literature as a consequence of either inappropriate treatment at the time of primary repair or missing the diagnosis at time of primary reporting. However in our hilly state with difficult terrain and poor means of transport, patients often report late to our only tertiary care center of maxillofacial surgery in the entire state of Himachal Pradesh, at the time of first presentation. It is quite common to see these patients 3 to 4 weeks after the episode of trauma, where the primary first aid has been provided to them at a hospital near the site of injury and subsequently these patients were referred to our center for definitive management of orbitozygomatic trauma.

The reconstruction of the zygomatic area displays little morbidity and results in marked improvement of the facial appearance, but it is difficult to achieve perfect results, especially in non-post-traumatic cases. The results in all groups are better when using osteotomy technique. It is therefore advocated in preference to the onlay technique even in cases in which the zygoma is evidentially hypoplastic.[6] The concepts of managing secondary deformities of orbitozygomatic region are entirely different from the management of fresh trauma. All these cases involve refracturing the malunited bones by osteotomy techniques and performing open reduction and internal fixation with bone plates. The reconstruction of the internal orbit is also carried out if

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required. Autogenous bone grafting and alloplastic grafts for concealing the deformity have also been mentioned in the literature but the results are not very accurate or stable. The main indications for management of these deformities can be cosmetic or functional. Cosmetic indications include enophthalmos, hypo-ophthalmos, antimongoloid slant and orbital dystopia. The functional indications could be binocular diplopia, restricted mouth opening and infraorbital nerve paresthesia.

Usually, the pattern of post-traumatic skeletal deformity is quite complex, with gross dislocation of large fragments being responsible for significant deformation while smaller fragments cause contour irregularities and distorted soft tissue landmarks. Resorption (with interposed soft tissues) is another cause of bone defects. Bony correction must support the thickened and scarred soft tissue in such a way as to create a normal external appearance. In most areas this is achieved by reducing the malpositioned skeletal elements into their normal position, with rigid fixation preventing secondary dislocation.[7]

In the current paper we outline our experience in the management of malunited orbitozygomatic trauma by performing osteotomies and repositioning zygomatic orbital complex to restore the position of the orbit and its contents. We fixed all osteotomy sites by open reduction and internal fixation using titanium bone plates and screws.

## PATIENTS AND METHODS

We performed retrospective analysis of last 8 years from 2005 to 2013 of all the patients who presented with malunited orbitozygomatic trauma at our center. Twenty three patients were found in the inclusion criteria which included presentation of zygomatic orbital deformity after 4 weeks of episode of trauma. Data was collected on demographics, the time of initial injury, the time of presentation at our institution, the method of treatment along with type and location of fixation employed. The comparative evaluation was done using preoperative and postoperative CT scans (Figs 1 and 2). A thorough postoperative follow-up ranging from 7 years to 1 year was done using recall visits. The patients were analyzed postoperatively for stability of results and complications if any.

## RESULTS

As is expected in post-traumatic deformities most of the patients in our series were males and third decade of life was the most common age of presentation in our series (Figs 3 and 4).

The most common operation involved wide surgical exposure followed by refracturing the malunited sites followed by fixation using mini bone plates. Seven out of twenty three patients underwent zygomatic osteotomy due to presentation of the patients later than 6 weeks where malunited fracture sites were not clearly discernible. One patient underwent inferior orbital marginotomy for correction of infraorbital nerve paresthesia which the patient was finding troublesome. Three of our patients presented postoperatively with persistent enophthalmos after having undergone refracturing of malunited fracture sites possibly because of undercorrection in superior repositioning of fractured bone. All these three patients subsequently underwent zygomatic osteotomies and a satisfactory correction of enophthalmos was achieved (Fig. 5).

Six patients underwent four point fixation at the level of FZ suture region, infraorbital rim, zygomatic arch and zygomaticomaxillary buttress region. The four point fixation was necessitated in these patients due the need for internal orbital reconstruction. Eight patients underwent three point fixation at FZ suture region, zygomatic arch and zygomaticomaxillary buttress region. Eight patients underwent two point fixation at frontozygomatic suture area and zygomaticomaxillary buttress region. One patient underwent fixation

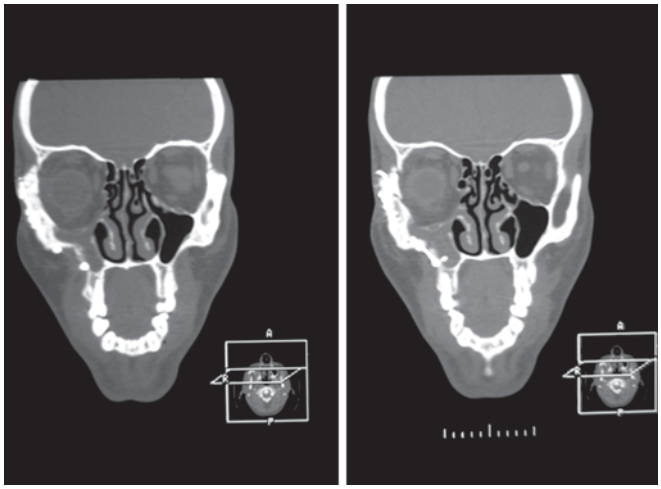

**Fig. 1:** Preoperative CT scan

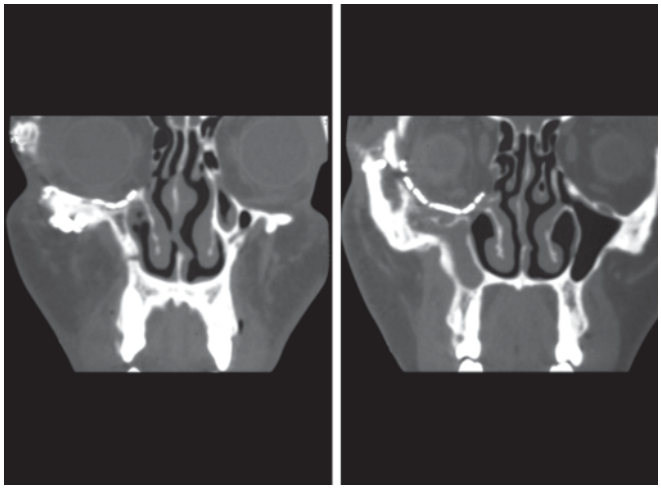

**Fig. 2:** Postoperative CT scan after zygomatic osteotomy

at infraorbital margin only for inferior orbital marginotomy (Fig. 6).

The average length of hospital stay ranged from 1 to 3 weeks with majority of the patients being discharged on the tenth postoperative day (Fig. 7).

## DISCUSSION

Secondary deformities of orbitozygomatic region are complex in nature leading to serious cosmetic and functional problems in patients. The secondary deformity of the orbit housing the eye can have disturbing psychologic and social implications for the patients due to hypo-ophthalmos, orbital dystopia and enophthalmos which are cosmetically disturbing sequelae of malunited orbitozygomatic deformities. The functional consequences of binocular diplopia and restricted mouth opening due to impingement on coronoid process are also debilitative conditions requiring treatment. Operative correction of established traumatic deformities with permanent physical disfigurement can pose a formidable challenge to the surgeon.

Surgeons have struggled with the treatment of established post-traumatic deformities for many years. With more widespread adoption of craniofacial techniques, traditional approaches, such as repeated onlay bone grafts and alloplastic implants have been relegated to secondary roles. Restoration of normal anatomic position of displaced facial bones by appropriate segmental and/or Le Fort-type osteotomies has become standard of treatment for severe post-traumatic facial deformities. Once the underlying osseous support structure has been properly realigned, soft-tissue and ocular adnexal abnormalities are addressed.[1]

The general line of treatment consists of an integral repositioning of the displaced facial mass as a monobloc, if possible. Some compromises have to be accepted with slightly displaced fragment (malar bone) or with already united fragments which one wishes to use as platforms for overlay bone grafts although bone grafts do not play the main role, but are of secondary use in filling orbital gaps, maxillomandibular remodeling, restoration of the nasal bridge, etc.[8] If the zygomatic complex is part of the midface osteotomy, it is not possible to independently reposition the zygoma from the midface resulting in compromised esthetics. This can be overcome by independently osteotomizing the zygomatic complexes. The approach to the zygomatic area can be a

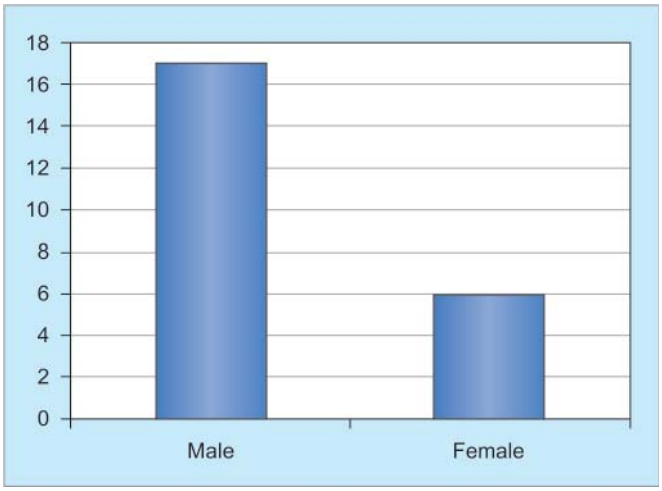


**Fig. 3:** Sex distribution

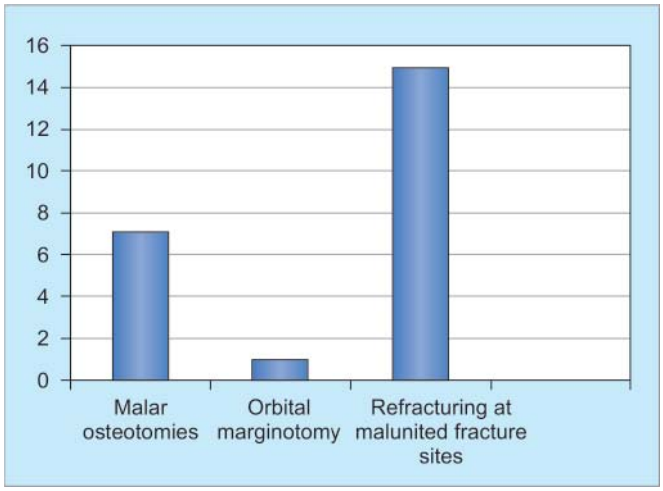


**Fig. 5:** Type of operation

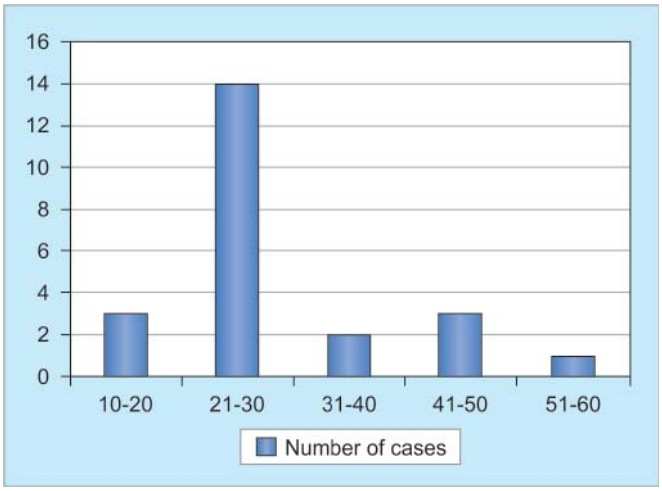


**Fig. 4:** Age distribution

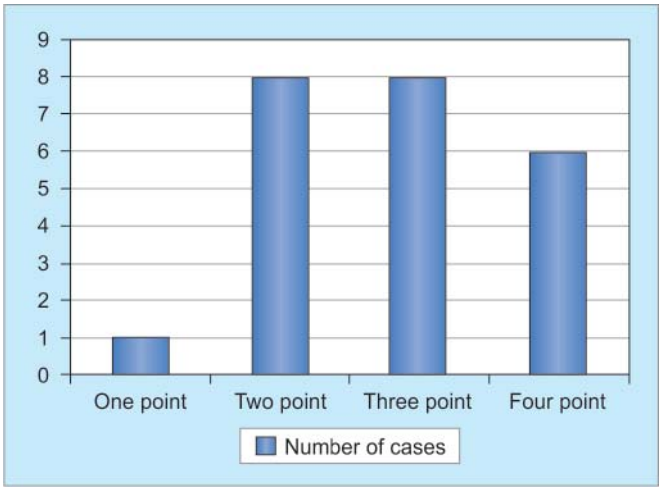


**Fig. 6:** Number of point fixations

problem because the external facial approach will result in scarring that may be unesthetic, whereas intraoral approach provides limited access.[9]

Refracturing the bones by osteotomy techniques in the orbitozygomatic region are complex procedures requiring surgical expertise and sound clinical experience. The correct 3D repositioning of the osteotomized fragments and carrying out internal fixation with bone plates is associated with a steep learning curve. However, when carefully, rightly and meticulously performed the results are very gratifying (Figs 8 and 9).

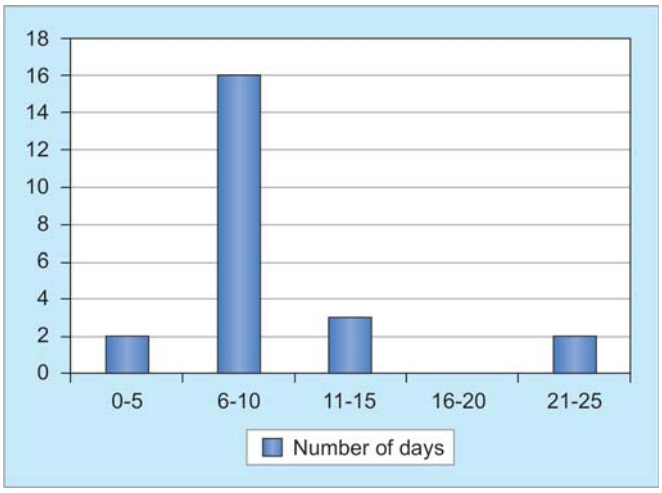


**Fig. 7:** Average of hospital stay

**Fig. 8:** Zygomatic orbital deformity

**Fig. 9:** Postoperatively after zygomatic osteotomy

The key to successful treatment of post-traumatic facial deformities is establishment of a correct diagnosis and formulation of a well-organized treatment plan. Whenever possible, total reconstruction should be carried out. When staging is required, planning must be precise in order to disguise the previous deformities. The vertical, horizontal and sagittal dimensions of the craniofacial skeleton should be re-established first.[1]

Zygomatic osteotomy is the workhorse for managing secondary deformities of orbitozygomatic region (Fig. 10). It requires extensive surgical exposure of the deformity by periorbital, coronal and intraoral approaches. We routinely perform this osteotomy by subtarsal, hemicoronal and intraoral vestibular incisions. The entire zygomatic complex along with lateral and inferior orbital walls and the orbital roof and virtually entire medial wall of orbit can be exposed through these approaches. Followed by exposure the osteotomy is started in frontozygomatic region. The first osteotomy cut is generally placed in the frontozygomatic suture region from where the line of osteotomy is tracked along lateral orbital wall along the sphenozygomatic suture traversing to the floor of the orbit near the anterior boundary of inferior orbital fissure. After osteotomising the lateral wall, the zygomatic arch is divided obliquely in an anteroposterior direction too maintain maximum contact of bone in narrow and slender arch region for osteosynthesis. Another line of osteotomy is started at the infraorbital rim which traverses posterolaterally inside the orbit to join the lateral osteotomy cut at the anterior boundary of inferior orbital fissure. Osteotomy is then carried through the infraorbital rim to the anterolateral surface of maxilla continuing in a

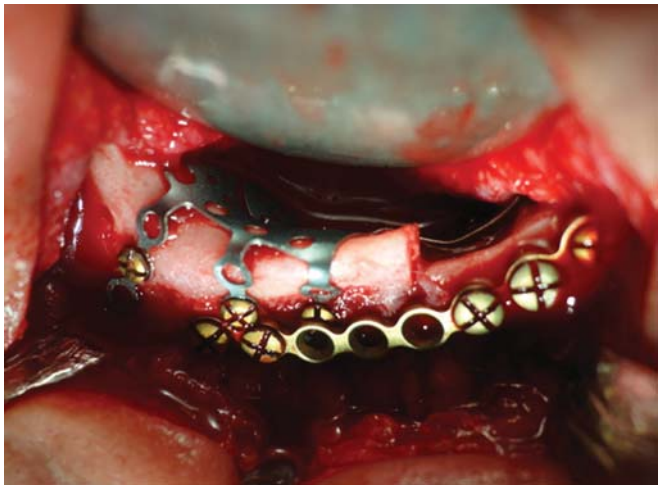

**Fig. 10:** Zygomatic osteotomy with internal orbital reconstruction

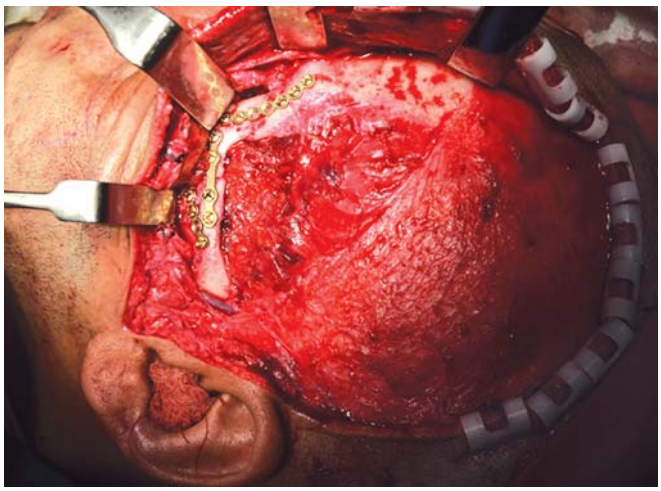

**Fig. 11:** Coronal approach exposing the entire zygoma

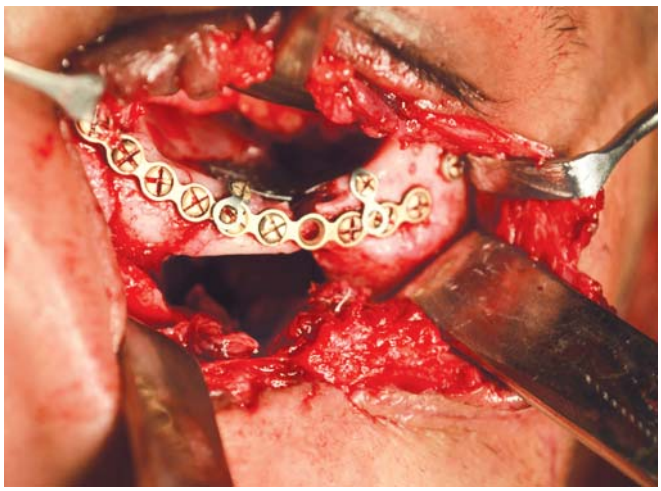

**Fig. 12:** Orbital floor reconstruction with titanium mesh

posteroinferior direction to the zygomaticomaxillary buttress region from where it moves superiorly to join the lateral orbital osteotomy. Once the osteotomy is completed, the zygoma starts to move freely.

Care is taken to not to strip the facial mimetic muscles extensively on the anterolateral aspect to prevent subsequent soft tissue sag postoperatively.

Incorrect primary reconstruction of the facial skeleton is the underlying problem of virtually every post-traumatic deformity. Subsequent healing of the inadequately supported soft tissues leads to shrinkage, thickening and malposition of landmarks. This resultant soft tissue deformity has implications for the technique and outcome of every secondary correction: (a) the malpositioned soft tissue envelope of the faceneeds to be completely mobilized and rearranged in its correct position, (b) the rigidity of the soft tissue mask requires exaggeration of skeletal correction in certain areas in order to obtain adequate external contouring, (c) the soft tissue deformity limits the functional as well as esthetic result which can be achieved.[7]

After determining the 3D position clinically the zygoma is repositioned after a triangular chunk of bone is removed from the frontozygomatic region to enable superior repositioning of the zygoma. Internal fixation is carried out with titanium mini bone plates and screws in the frontozygomatic region and zygomatic arch region (Fig. 11). Another mini bone plate of slightly thicker profile is fixed in the zygomaticomaxillary buttress region. Internal orbital reconstruction with autogenous calvarial bone or alloplastic materials like titanium, porous polyethylene can be done in grossly communited or missing orbital floor.

Split thickness calvarial bone graft technique involves removal of the outer table while leaving the inner table in situ. A relatively simple procedure, it leaves a cosmetically acceptable donor site.[10] The major disadvantage of the calvarial bone grafts include the difficulty in bending calvarial bone, the relative lack of cancellous bone, and the risk of dural exposure.[11] We have used the outer table of calvarial bone graft from parietal region for delayed reconstruction of the orbital floor with satisfactory outcomes in three cases. Titanium orbital mesh in our armamentarium is a very reliable tool for internal orbital reconstruction as it is highly biocompatible, thin and pliable with external limbs for stabilization on the anterolateral zygomaticomaxillary surface (Fig. 12).

Orbital roof fracture is a complex injury and is best treated by a multispecialty team using the methods learned from the treatment of congenital orbital dystopia.[12] Indications for delayed exploration and repair of an orbital roof fracture relate to persistent orbital and intracranial complications. These would include the presence of a persistent CSF fistula, persistent extraocular muscle imbalance, orbital volume disturbance and cosmetic considerations. Importance of a combined approach involving maxillofacial surgeons, neurosurgeons and ophthalmologists is emphasised.[13] Craniofacial techniques have radically improved the possibilities for correction of post-traumatic orbital and facial deformities. However, the soft tissue deformity still limits the functional and esthetic improvement which can be achieved. The results are never as good as the primary repair.[7] Nevertheless after osteotomy 10% of the results were unsatisfactory. However, since the evaluation of symmetry is very difficult intraoperatively without a method for objective measurement, we have to take into account that postoperatively small deviation from the ideal position are observed.[6,14] Navigational surgery helps obviate this handicap but it is still far too expensive to be utilized routinely.

We found in our series the osteotomy techniques to be reliable and satisfactory tools in restoring form and function in post-traumatic zygomatic orbital deformity, though it requires a definite learning curve for planning and executing treatment.

## CONCLUSION

Osteotomy techniques of the zygomatic orbital region are versatile, reliable and efficient method of managing zygomatico-orbital deformities. The osteotomies can be fixed by semi-rigid fixation using titanium bone plates and screws. Our study showed long-term stability of surgical results with follow-up ranging from two to seven years. However, we do recommend considerable experience and surgical expertise before embarking on these procedures as they can be technically challenging.

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