Infraorbital Rim and Orbital Floor Fractures; A Comparative Study between the Subciliary and the Preseptaltransconjunctival Approach

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ABSTRACT

The most commonly used approaches to the infraorbital rim and orbital floor are the subciliary and thtransconjuctival approach. In this study, we compared between both approaches in sixty patients. The subciliary approach in-spite of it rarely leaves a noticeable scar but has significant instant of temporary lower eye lid retraction that often results in permenanently severly inflamed and injured tissue. There is a current trend towards more central placement of incisions with respect to the globe, which provide nearly equal access and improved esthetics. Successful utilization of these approaches is dependent on surgeon's appreciation of the relationship between eyelid/periorbital anatomy, and lid'ocular function. That evolved the transconjuctival approach that decreases the risk of postoperative eye lid retraction, with lower incidence of ectropion in case of utilization of the transconjunctival approach versus the subciliary approach.

Key Words: *Orbital floor rim fracture, Subciliary, Preseptaltransconjunctival*

INTRODUCTION

The orbit is a pear-shaped cavity, with an apex directed posteriorly, medially and slightly upward. The lower wall of the cavity is described as the floor. It is also bound by the medial and lateral walls. The strong superior and inferior orbital margins, also mentioned as the orbital rim[(1)].

The orbital floor comprises the maxillary,zygomatic, and palatine bones. The floor terminates at the posterior edge of the maxillary sinus. It lies in close proximity to the inferior rectus muscle. The infrorbital groove, canal, and foramen are contiguous and tunnel through the maxilla, encasing the maxillary branch of the trigeminal nerve that exits the foramen as the infraorbital nerve providing innervation to the ipsilateral middle face. Infraorbital nerve dysfunction can occur with orbital floor fractures. It is accompanied by the infraorbital vessels. The medial wall comprises the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid bone, and the sphenoid body. The area damaged most easily by trauma is the thin lamina papyracea, which separates the orbit from the ethmoidal sinus. The zygomtic bone occupies an important and significant position of the floor and lateral wall of the orbit[(2)].

Blunt trauma to the orbital rim is a frequent cause of both orbital and surrounding bone fractures- the "blow-out fracture" of the orbit and the medial wall. Blow-out fractures can be classified into A) pure fractures involving orbital floor and medial wall with passage of soft tissue into the hole created by the fracture, causing enophthalmos and hypoglobus, and B) Impure fracture due to direct trauma to the infraorbital rim causing buckling of the orbital margin resulting in a low-out pttern of fracture with a concomitant rim fracture. [(3,4)].

Males are at a higher risk than females including orbital fractures and ocular injuries, and the incidence peaks in in a bimodal fashion, at 10-40 years and again at 70 years [(5)].

Evaluation of infraorbital rim and orbital floor fractures starts by adequate history taking. A history of stroking the eye by an object larger than the diameter of the orbital rim is commonly associated by "blow-out fracture". This type of fracture is thought to be from increased intraorbital pressure while causes the orbital bones to fracture at its weak point. Another theory is that compression of the inferior orbital rim causes direct buckling of the orbital floor[(6)].

The first step in assessing a patient after trauma especially of multisystem injury requires evaluation of airway, breathing, and circulatory status. Also, a full evaluation of the globe must be

performed. Assessment includes the facial contour, obvious abrasions and bruises, points of tenderness on gentle palpation. Any surgical emphysema, edema, or hemorrhage is noted. Particular points is assessed in the eye; periorbital edema and ecchymosis (that can be the only presentation in case of orbital floor feacture), bony "step-off" in case of infraorbital rim fracture,altered sensation below the ipsilateral eye,subconjunctival hemorrhage, epistaxis, visual acuity, visual fields, pupillary light reflex, color vision/saturation, limited eye movements and/or diplopia due to muscle entrapement, hypoglobus, enophthalmos, and proptosis [(7)].

Edema, diplopia, proptosis can disappear within 2 weeks after edema resolving. Optic nerve integrity is checked by asking the patient to confirm the presence of light over the closed eye lid.In case of muscle entrapment, occulocardiac reflex may occur; bradycardia, nausea, and syncope[(8)].

A plain X-ray – standard views are facial, occipitomental and submento-vertical views. Interpretation is difficult, but it is checked for orbital outline (droplet sign showing soft tissue prolapse in the maxillary sinus through the orbital floor). Thin cuts CT scanning is very useful to indicate more about distorted anatomy and is essential to plan for surgery [(9)].

Currently CT scanning is the gold standard in the imaging of the orbital fractures but MRI may be a useful alternative [(10)].

Patients should be advised to avoid blowing their nose for several weeks after the injury to prevent orbital emphysema and possible visual compromise. Nasal decongestant sprays can be used. Prophylactic antibiotics can be administrated to prevent orbital cellulitis, and steroids can be given to decrease orbital edema whether surgery will be done or not. Surgical timing and indicationis controversial and debatable. Timing of surgical intervention is best performed as close to 2 weeks from trauma date, to allow the swelling to subside and more accurate examination of the orbit to be performed. Additionally, the scarring usually has not advanced enough to prohibit adequate surgical correction. However, many surgeons go for earlier intervention [(11)].

Current guidelines for surgical indications include; A) diplopia due to limited muscle motility with CT radiological confirmation of orbital floor fracture and muscle entrapment, B) enophthalmos greater than 2 mm 14 days after trauma and cosmetically significant to the patient, that's why exophthalmometry is to be done at time of surgery and re-checked after 10-12 days, C) a fracture involving one half or more of the orbital floor, especially when associated by a medial wall defect that usually leads to functional and cosmetic deformity. In-spite of these guidelines, the clinicians must always take into account the clinical scenario and the patient's condition and wishes [(12)].

Surgical approach to the orbital rim and floor varies, and several approaches were described to expose the orbital floor and infraorbital rim. It can be accessed through several cutaneous approaches that leave-behind a scar, through a concealed transconjunctival approach to avoid the cutaneous scar,through transantral approach, orthrough endoscopic transmaxillary or transnasal route have been described, and recently these endoscopic approaches have the advantages of enhanced visualization and avoidance of adverse effects to the eye lid mentioned with other approaches [(13)].

The aim of surgical correction is exploration and release of the displaced or entrapped soft tissue. In addition to repair any bone defect with removal or repositioning of bony fragments allows for restoration of the partition between the orbit and maxillary sinus thereby restoring the orbital volume (several implants can be used to restore orbital anatomy). In this study, 2 approaches were used- the subciliary approach and the preseptaltransconjunctival approach and aiming to compare the advantage and disadvantages of each.

MATERIALS AND METHODS

The study was a prospective cohort study that included a total of 60 patients who had undergone surgical treatment for orbital floor and infraorbital rim fractures. The cases were performed in Cairo University Hospitals and several private hospitals. Inclusion criteria included patients with traumatic orbital floor and/or infraorbital rim fractures (whether isolated or associated with associated with other maxillofacial fractures) after 2 weeks of the onset of trauma with persistent diplopia, persistent enophthalmos more than 2 mm, fracture involving more than one half of the orbital floor,

and fractures with medial wall defect with functional or cosmetic deformity. The study was performed between May 2011 and December 2014. Exclusion criteria included patients below 12 years, and patient above 45 years, unstable patients or unfit patients. Enrolled patients were analyzed, history taken, physical examination performed, preoperative photography was done, imaging by plain X-ray and CT Scan was done, procedure was explained and informed consent was taken. Preoperative antibiotic was administrated. Intraoperative time was calculated. Postoperatively the antibiotic was continued, anti-inflammatory and pain killer was administrated, Follow up was done for 3-6 months after the surgery for evaluation of entropion, infection at surgical site, and cosmetic and functional results. Postoperative photography was taken. Out of the 60 patient, 30 patients underwent the transconjunctival approach with lateral canthotomy and the other 30 underwent the subciliaryapproach.

Preseptaltransconjunctival approach (photos 1,2,3,4, and 5)

Two traction sutures were placed on the lower lid through the tarsal plate, after the sclera shell was placed over the cornea. A third traction suture was placed in the inferior conjunctival foxnix and was used for counter-traction of the first two sutures and for adequate exposure.An incision was made from the punctum of the lacrimal canaliculus to the lateral orbital fissure. This incision was usually 3-4 ml below the lashes on the conjunctival surface below the tarsus. A direct plane of dissection was then created and followed over the orbital septum to the inferior orbital rim. It is important to avoid any inadvertent injury to the orbital septum anteriorly during this procedure; otherwise, the periorbital fat fat will herniate interfering with adequate visualization of the orbital floor. For lateral canthotomy, one tip of pointed scissors was placed inside the palpebral fissure, extending laterally to the depth of the underlying lateral orbital rim (approximately 7-10 mm). The scissors were used to cut horizontally through the lateral palpebral fissure. The structures cut in the horizontal plane were skin, orbicularis oculi muscle, orbital septum, lateral canthal tendon, and conjunctiva. The inferior attachments of the orbital septum should be separated from the inferior border of the infraorbital rim. As the orbital septum was completely freed, it was lifted upward and inward, thus retracting the orbital contents and giving an adequate view and good exposure of the defect.

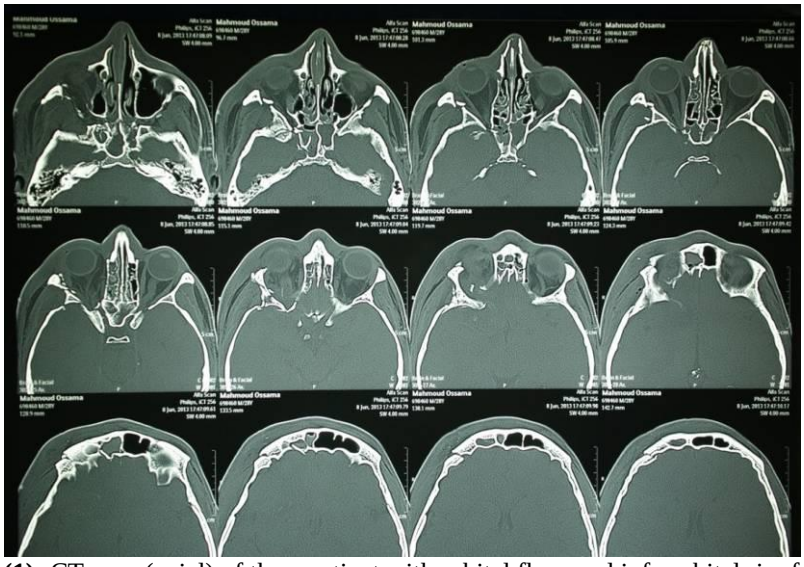

Photo (1): CT scan (axial) of the a patient with orbital floor and infraorbital rim fracture

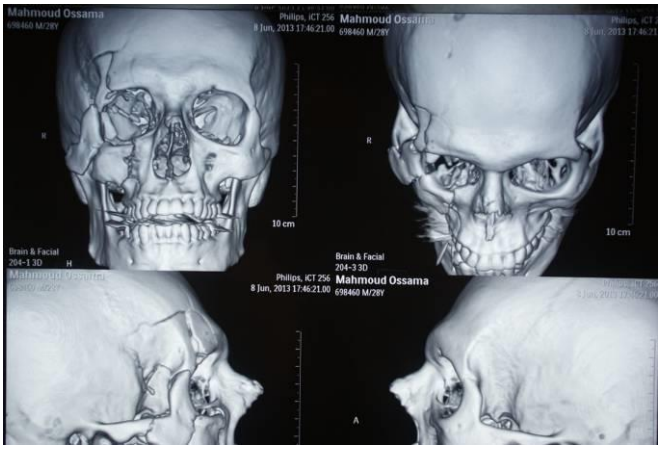

Photo (2): CT scan 3D for the same patient

Photo (3): Preseptaltransconjunctival approach

Photo (4): Postoperative photo for the same patient

Photo (5): Postoperative axial CT scan for the same patient

Subciliary approach procedure(photos 6,7,8, and 9)

A subciliary skin incision was made 2 mm below and parallel to the lid-margin, beginning near the punctum and extending 5-8 mm past the lateral canthus in a skin crease. The dissection was carried directly down to the tarsal plate, separating the preseptal orbicularis oculi fibers from it. Both this and subsequent portions of the dissection are easier if the appropriate surgical planes are first located laterally, with dissection then proceeding medially by simple blunt scissors dissection. Once the tarsal plate was cleared of orbicularis fibers, the orbital septum, held tense by upward traction on the previously placed lid-margin sutures, was likewise separated from the preseptal orbicularis by spreading the two layers with scissors. The dissection followed the orbital septum down to the inferior orbital rim. A 5-8 mm incision through the orbicularis fibers underlying the lateral extension of the skin incision permitted the skin-muscle flap to be retracted away from the fractured site easily, without danger of tearing the fragile lid-skin. Standard subperiosteal exposure of the fractured site was then performed.

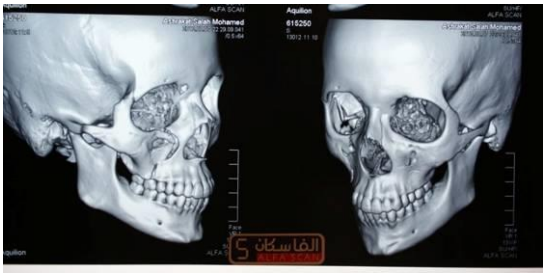

Photo (6) Preopertive CT scan 3D for a patient with orbital floor and infraorbital rim fracture

Photo (7): Intraoperative photo for the same patient – subciliary approach

Photo (8): Postoperative photo for the same patient

Photo (9): Postoperative CT scan 3D for the same patient

In the study, 30 patients underwent the preseptaltransconjunctival approach with lateral canthotomy; in 3 of these patients bio-resorbable plates and screws were used, in 24 patients titanium curved miniplate were used and in 3 patients reconstruction was done with mandibular graft. In the 30 patients with subciliary skin-muscle approach, titanium curved orbital miniplates were used. A frost stitch placed through the lower eye lid was suspended from the foreheaf with tape for 3 days postoperatively. Physiotherapy with digital palpebral massage was started immediately after removal of frost stitch.

In both procedures after fracture repair, a 5-0 absorbable suture re-approximated the orbicularis muscle and conjunctiva, and then the skin was sutured with 5-0 polypropylene suture. The lower lid was routinely suspended with a frost suture until early postoperative lid edema subsides within 3-4 days.

RESULTS

The sex distribution of patients include in the study showed the majority to be men (95%). The mean age of the patients was 28.4 years

(range: 12-45 years). The results were analyzed using the Fisher's exact test. The majority of patients were injured by motor vehicle accidents (*n*=19, 95%), while in the rest inter-personal violence. In general, statistically significant differences were found between the transconjunctival group and the subciliary group for the various parameters analyzed. Postoperative ectropion was found in nine patients with subciliary group while it was found only in three patient with transconjunctival group (*P* value <0.05); postoperative entropion was seen in nine patients of the transconjunctival group and none with the subciliary group (*P* value <0.05). There was no statistical difference between both groups with regard to infection of surgical site. Age, gender, and operative time required for the surgical procedures have no statistical significance associated with the complications in our study. The time required for the transconjunctival approach with lateral canthotomy was 21 minutes while from the subciliary approach it was 16 minutes. The difference was statistically significant (*P* value <0.05).

DISCUSSION

Several approaches to the orbital floor and infraorbital rim have been described; including the conventional cutaneous approach that may leave behind a disfiguring scar. An alternative to that, the transconjunctival approach was described to avoid such scar [(15)].

The first reports in the literature of open reduction of infraorbital rim and floor fractures through use of a subciliary incision was first described by Converse in 1944 and recognized the superior scar produced by the subciliary incision [(16)]. In the late 1960s "skin only" flap became popular but with incidence of permanent ectropion reported with "skin only" flap. In 1970s "skin-muscle" flap was widely used to facial fracture reduction. The first report in the literature of the transconjunctival approach was initially described by Bourguet in 1924 for cosmetic blepharoplasty to remove herniated fat pad. In 1973, access through the fornix was advocated avoiding visible scars by Tenzel, Tessier, and Conversefor the repair and exploration of the orbital floor fractures. Using transconjunctival incision for infraorbital rim and floor fractures allowed generous exposure of the entire lower orbital rim and zygoma with a lateral canthotomy. In our study, we compared thetransconjunctival with lateral canthotomy approach to subciliary approach [(17)].

A study comparing 45 subciliary skin--muscle flap incisions to 45 retroseptaltransconjunctival incisions undergoing orbital fracture repair was described by Wray *et al*. 1977 [(18)].

Four of the 45 eyelids treated by the subciliary approach required subsequent surgery to manage ectropion. There was only one case of ectropion in the transconjunctival group. One eyelid in the transconjunctival group was lacerated by traction; this prompted the authors to perform a lateral canthotomy in 25 of the 45 transconjunctival approaches. So in our study lateral canthotomy was added to the preseptaltransconjunctival incision. A retrospective study comparing 27 subciliary skin--muscle and 36 preseptaltransconjunctival approaches in patients undergoing orbital fracture repair was described by Appling *et al*. 1993 and found a 12% rate of transient ectropion and a 28% rate of permanent scleral show with the subciliary skin-muscle flap compared with no transient ectropion and a 3% rate of permanent scleral show with the transconjunctival approach [(19)].

In a 2001 study, ArnulfBaumannn and Rolf Ewers reported no complications in any patients with preseptaltransconjunctival approach. But after a primary subciliary incision, complications included one laceration of tarsal plate and one temporary entropion. The overall complication rate was 2% [(20)].

In our study in 30 subciliary skin—muscle flap, 30% rate (9 cases) of transient ectropion, no transient entropion (0% rate), no laceration of tarsal plate (0% rate), 3 button hole lacerations of lower eyelid (10% rate), no permanent ectropion, no permanent entropion, no infection of surgical site (0% rate) were found. In comparison, the transconjunctival group showed 10% rate (3 cases) of transient ectropion, 30% rate (9 cases) of transient entropion, 3 lacerations of tarsal plate (10% rate), no button hole laceration of lower eyelid, no permanent ectropion, no permanent entropion and no infection of surgical site. The operative time required from the start of skin incision to the exposure of fracture site were average of 21minutes for preseptaltransconjunctival incision with lateral

canthotomy and average of 16 minutes for subciliary skin—muscle flap incision.

It can be concluded that there is no consistent approach for orbital fractures has gained universal acceptance. And because of functional and aesthetic adversity (minimal lateral scar, patient acceptance, and less incidence of eye lid retraction and ectropion) many surgeons chose to treat infraorbital floor and rim fractures transcutaneously via an infraorbital approach [(21)]. But still, it can be mentioned that both the preseptaltransconjunctival approach with lateral canthotomy and the subciliary skin-muscle flap approach can be performed for open reduction and rigid fixation of infraorbital floor and rim fractures, and both have low morbidity, low risk of complications and gave satisfactory results.

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