‘Y’ Modification of the Transconjunctival Approach for Management of Zygomatic Complex Fractures: A Prospective Analysis

K. Rajkumar¹ · P. Mukhopadhyay¹ · Ramen Sinha² · T. K. Bandyopadhyay³

Received: 7 December 2014 / Accepted: 5 March 2015 / Published online: 4 April 2015
© The Association of Oral and Maxillofacial Surgeons of India 2015

Abstract

Purpose The purpose of this study was to clinically and radiologically evaluate reduction and fixation of isolated zygomatic complex (ZMC) fractures treated by Y modification of the transconjunctival approach.

Patients and Methods A prospective evaluation of ten patients was undertaken for a period of 6 months using this modified approach from Jan 2012 to Jun 2013. Patients were examined preoperatively and post operatively at the end of 6 months for symmetry discrepancies involving A–P globe projection, lateral canthal level, malar projection and diplopia in direct and extreme gazes. Cosmetic outcomes were assessed by clinical assessment and examination of photographs. Quality of reduction and stability of fixation was assessed by examination of post-operative images.

Results All patients underwent a three point fixation of ZMC with reconstruction of the orbital floor using titanium mesh. Patients were post surgically followed up at regular intervals of 1, 3 and 6 months. Immediate complications noted were chemosis, lid edema and lower lid retraction. Late complications included minor scleral show in two cases. All patients experienced significant improvement with excellent esthetic appearance and function.

Conclusions Y modification of transconjunctival approach provides excellent surgical exposure for ZMC

fractures potentially avoiding the use of a second incision in the area of ZF suture. Although this technique provides good exposure and excellent esthetics, it requires more operating time and detailed knowledge of the anatomy of the lateral canthal region.

Keywords Zygomatic complex fractures · Transconjunctival approach · Preseptal approach

Introduction

Isolated zygomatic complex (ZMC) fractures are common facial injuries after maxillofacial trauma. They account for an estimated 15 % of all facial fractures [1]. Because of the intimate relationship of the zygoma with numerous other structures of the face, stable reduction of ZMC fractures is paramount to restoring pre injury function and esthetics. Because of the increase in orbital volume that can result from orbital floor disruption, internal orbital reconstruction has been a vital component of the treatment of isolated ZMC fractures. Many ZMC fractures are medially displaced, often rotating around the frontozygomatic suture. When the fracture is reduced by lateral rotation or displacement of the zygoma, the orbital floor defect could theoretically increase in size. Should this occur, soft tissue prolapsed into the maxillary sinus could occur and possibly lead to the development of enophthalmos. The postoperative position of the globe is affected by two main variables: restoration of the three dimensional position of the zygoma in space and the integrity of the orbital walls [2, 3]. Therefore when a ZMC fracture is addressed, it is necessary to restore the entire complex to its original position and then explore the orbital walls and graft bony defects to return the orbital contents to their original position [3, 4].

✉ K. Rajkumar
raj_78ia@yahoo.co.in

¹ TC 4/2071, Kavu Road, Kuravankonam, Trivandrum, Kerala 695003, India

² Sree Sai Dental College, Vikarabad, Hyderabad, India

³ Command Military Dental Center (Southern Command), pune 411040, India

Different approaches have been described to access the fractures of the ZMC and orbital floor: lateral eyebrow, upper blepharoplasty, coronal, subciliary, subtarsal, infraorbital, transconjunctival and transoral. All these approaches have their advantages, disadvantages and their indications according to location of the fracture, degree of displacement and surgeon's experience with a specific technique. The transconjunctival approach with canthotomy and cantholysis provides excellent exposure to the inferior orbital rim, the orbital floor and the lateral orbital wall. Advantages of the transconjunctival approach as opposed to the subciliary approach include lack of external scar and decreased risk of ectropion [5]. In the early 1970s Tenzel and Miller [6] described this approach for management of orbital floor fractures, but Tessier [7] and Converse et al. [8] popularized this technique a few years later for management of congenital malformations and orbital trauma.

The purpose of this article is to describe the 'Y' modification of the cutaneous portion of the transconjunctival approach with lateral canthotomy to gain exposure of the frontozygomatic area and the orbital floor through the same incision for simultaneous reduction and fixation of the Fracture ZMC.

Patients and Methods

A prospective evaluation of ten patients was undertaken using this modified approach. The study was undertaken from Jan 2012 to Jun 2013. The age of the patients ranged from 21 to 36 years. All the cases sustained injury due to road traffic accidents. All the patients had undergone a pre operative CT scan evaluation for determining the type and extent of fractures.

All patients fulfilled the following inclusion criteria:

1. Asymmetry in the malar region that affected the patient's appearance and ability to function.
2. Clinical and imaging diagnosis of zygomatic complex fractures without gross displacement and comminution of the zygomatic arch.
3. No previous surgical treatment.

Exclusion Criteria

1. Isolated zygomatic arch fractures or concomitant Midfacial, Panfacial or Nasoethmoid fractures.
2. Presence of Acute and chronic conjunctival diseases.

Patients were examined preoperatively and post operatively at the end of 6 months for discrepancies involving A–P globe projection, lateral canthal level, malar projection, and diplopia in direct and extreme gazes. A–P globe position was measured with a Hertell's Exophthalmometer.

Lateral canthal levels were measured bilaterally from a line connecting the supraorbital ridges. Malar projection was evaluated subjectively. Diplopia was assessed in the six cardinal positions of gaze. Preoperative features/findings of the fractured side were compared with the post operative findings at the end of 6 months.

Surgical Technique

After preparation and draping, 0.5 cc of Hypromellose Gel is used to protect the cornea. A Y-shaped mark is drawn on the lateral aspect of the lateral canthal angle following a skin crease (Fig. 1). One ml of 2 % Lignocaine with 1:80,000 epinephrine is infiltrated subcutaneously below the marked incision, at the frontozygomatic region and across the inferior orbital rim. 3-0 Vicryl sutures are passed in the medial, middle and lateral aspect of the lower eyelid through the tarsus. This will help with the lid retraction and act as a frost suture on completion of the case. After waiting for a few minutes for adequate action of the local anesthetic with epinephrine, an incision is made through skin and subcutaneous tissue until the orbicularis oculi muscle is identified (Fig. 2). Next, the incision is taken through the orbicularis oculi muscle and blunt dissection is performed under the muscle with a curved hemostat in a preseptal fashion following the infraorbital rim, ending just lateral to the lacrimal punctum. With 1 arm of the scissors placed inside the tunnel and the other arm on the outside of the conjunctiva, sectioning of the conjunctiva is performed with attention to stay 5 mm inferior to the lower tarsal plate. A traction suture using 3-0 vicryl is placed on the bulbar side of the conjunctiva to protect the cornea and expose the orbital septum (Fig. 3). Blunt dissection then proceeds in a preseptal fashion to reach the infraorbital rim.

Fig. 1 Y marking in the lateral canthal region

Fig. 2 Intra operative picture showing transconjunctival incision with Y extension in the lateral canthal region

Fig. 3 Preseptal dissection to reach the infraorbital margin

Sectioning of the orbital septum is done at the Arcus Marginalis and subperiosteal dissection done to expose the infraorbital rim and orbital floor. Subsequently canthotomy of the superficial limb of the lateral canthal ligament is performed and subperiosteal dissection is carried out to expose the fracture at the frontozygomatic region. The cutaneous Y will transform into a box when retracting its corners, increasing the working area and allowing access of the fronto zygomatic (FZ) suture, lateral orbital wall, body of the zygoma, infraorbital rim, and floor of the orbit with a single approach. A small upper vestibular incision is placed to expose the fracture at the zygomatic buttress.

Reduction and fixation of fractures in a regular fashion are accomplished (Figs. 4, 5). The superficial portion of the lateral canthal ligament is sutured back to the surrounding temporal aponeurosis using 3-0 vicryl. Closure of orbicularis oculi muscle covering the lateral orbit is done first, with resorbable sutures followed by suture of the orbital septum to the surrounding periosteum at the infra

Fig. 4 Fixation of the frontozygomatic region through the same incision

Fig. 5 Reconstruction of orbital floor using titanium mesh through the same incision

orbital rim using 4-0 vicryl. Next the conjunctiva is closed with inverted sutures using 6-0 vicryl. Next, the skin over the lateral canthus is sutured in the original Y shape with 6-0 prolene (Fig. 6). The eye is cleaned by copious rinses with saline solution and a frost suture is applied for a period of 2 weeks.

Results

Ten male patients with an age range from 21 to 36 years underwent open reduction and internal fixation of ZMC fractures by the Y approach combined with an intra oral maxillary vestibular approach. Seven patients had right sided fractures while three patients had left sided ZMC

Fig. 6 Closure of Y marking in the lateral canthal region sutured with 6-0 prolene

fractures. All patients underwent a three point fixation of ZMC with reconstruction of the orbital floor using titanium mesh. Three cases had associated mandibular fractures (3 parasymphysis and 1 condylar fracture). No cases had intra operative complications such as corneal abrasion, tearing (button holing) of eyelid or damage to the lacrimal system.

Patients were post surgically followed up at regular intervals of 1, 3 and 6 months. Immediate complications noticed was subconjunctival hemorrhage extending to the medial side, chemosis, lid edema and lower lid retraction. Late complications (Table 1) included minor scleral show in two cases. All patients experienced significant improvement with excellent esthetic appearance and function (Fig. 7).

The globe position in the A–P position was measured using a Hertell's Exophthalmometer. Six (60 %) patients had >2 mm of enophthalmos; four (40 %) patients had <2 mm of enophthalmos as compared with the non fractured side preoperatively. Postoperatively two patients had <2 mm of enophthalmos as compared with the non fractured side.

Lateral canthal levels were compared bilaterally. Two (20 %) patients had >2 mm of displacement of the canthus on the fractured side, and eight (80 %) patients had <2 mm of displacement on the fractured side. Postoperatively only four (40 %) patients had <2 mm of lateral canthal displacement compared with the non fractured side.

None of the patients exhibited diplopia in direct gaze or gross restriction of extra ocular movements' pre operatively or post operatively.

Malar projection was estimated by palpating and viewing both zygomas from the submentovetex view. Seven (70 %) patients appeared to have mild asymmetry in their malar prominence and another three (30 %) patients had moderate asymmetry preoperatively. Postoperatively at the end of 6 months, only four (40 %) patients mild asymmetry in their malar prominence, while six (60 %) patients had symmetric malar projection (Table 2).

Discussion

The most important principle in treating fractures, especially those of the face, is proper reduction. If the bone is not placed into the correct position, stabilization becomes superfluous. Many different treatment modalities have been advocated to repair ZMC fractures, each with variable success rate [9]. With the advent of rigid fixation, there has been a philosophy that stresses wide visualization and accurate reduction combined with 3-point fixation to precisely approximate the fractured segment [9]. Our rationale for using three-point visualization and fixation to treat ZMC fractures comes from basic fracture management theories. Studies by Karlan and Cassini [10], have shown that one- and two-point access approaches do not allow for adequate restoration of the three- dimensional pattern of ZMC fractures. Stabilization with the latter approaches often allows bony union to occur with skewed

Table 1 Patient data, procedures and associated complications

Number	Age (years)	Procedure	Complication
1	26	ORIF of ZMC	None
2	23	ORIF of ZMC and R parasymphysis	None
3	21	ORIF of ZMC	None
4	29	ORIF of ZMC and L parasymphysis Mandible	Minor scleral show
5	32	ORIF of ZMC	None
6	26	ORIF of ZMC	Minor scleral show
7	36	ORIF of ZMC	None
8	28	ORIF of ZMC and L parasymphysis Mandible and Condyle	None
9	22	ORIF of ZMC	None
10	24	ORIF of ZMC	None

Fig. 7 Preoperative, 1 month post operative and 6 months post operative result showing excellent aesthetic outcome

Table 2 Comparative evaluation of various parameters

Parameters	Pre operative	6 Months postoperative
<i>A–P globe position</i>		
>2 mm enophthalmos	06	Nil
<2 mm enophthalmos	04	02
<i>Canthal height</i>		
>2 mm asymmetry	02	Nil
<2 mm asymmetry	08	04
<i>Diplopia on examination</i>		
In direct gaze	Nil	Nil
In extreme gazes	Nil	Nil
<i>Malar projection</i>		
Symmetric	Nil	06
Mild asymmetry	07	04
Moderate asymmetry	03	Nil

anatomy and the sequelae of increased orbital volume, enophthalmos, inferior globe displacement, diplopia, and malar projection deficiency [4, 10–12]. These architectural changes can lead to functional and esthetic defects that are objectionable and very difficult to repair secondarily [3, 4]. We have observed in our study that all the ten cases of zygomatic complex fractures had some rotation around the frontozygomatic suture and in all the cases the rotation was medial, with the body of the zygoma displaced medially towards the maxillary sinus. Reducing these fractures by lateral rotation or displacement of the zygoma, the orbital floor defect could theoretically increase in size and possibly lead to the development of enophthalmos. These findings are consistent with the study of Ellis et al. [13]

who reviewed a retrospective series of sixty-five cases in whom, they found forty-one cases had medial rotation, with the body of the zygoma rotated toward the maxillary sinus.

However the disadvantages of three-point fixation include increased surgical time, additional surgical scars and additional hardware [13]. The purpose of this study was to overcome these disadvantages, albeit obtain three point visualization and fixation with minimal incisions so as to reduce the surgical time and scarring. In this study we have used a ‘Y’ modification of the transconjunctival approach with lateral canthotomy to gain exposure, reduction and fixation to the orbital floor and frontozygomatic area through the same incision.

The transconjunctival approach with canthotomy and cantholysis provides excellent exposure to the inferior orbital rim, the orbital floor and the lateral orbital wall. The mucous membrane approach hides the incision, allows for more forgiving closure of mucous membrane and provides a system of access for a diverse number of procedures that may at times require enlarging an incision over that originally planned. The use of transconjunctival incisions not only tends to provide better orbital and eyelid access, but also reduces the chances of scarring and complications [14].

There are two different routes for the transconjunctival approach: retroseptal and preseptal [15]. Many authors use retroseptal approach in blepharoplasty procedures and in treatment of orbital fractures, because of direct access to the orbital floor [16, 17]. However, reconstruction of the bony orbit has different goals than transconjunctival blepharoplasty. The advantage of the direct exposure of the

orbital fat in a lower-lid blepharoplasty [17] is a disadvantage in fracture repositioning. Other disadvantages of the retroseptal approach are: additional disturbances of the intraorbital connective framework and additional scar in the anterior part of the intraorbital fat system, which could influence the eye movements and can participate in the development of an enophthalmos [15]. We have used a preseptal technique in all our cases for accessing the orbital floor.

In our series of ten cases treated with the cutaneous Y modification of the transconjunctival approach at our institution, we were able to access the frontozygomatic suture without the need for a second incision. To accomplish this, canthotomy of the superficial portion of the LCT was performed. The Y will open itself into a box that can be moved to the frontozygomatic suture and the body of the zygoma after subperiosteal dissection along the lateral orbital margin. The resulting scar hides in a natural skin crease on the lateral canthal region, thus yielding a good cosmetic result (Fig. 8). A similar study has been carried out by Martinez et al. [18] with excellent results; however in their surgical technique they have detached the deep part of the LCT for greater exposure. This would entice accurate repositioning of LCT at the time of closure to prevent any lid malpositioning and canthal asymmetry. However we have not detached the deep part of LCT, though we did have difficulty in applying the superior screws in the four hole plate at the frontozygomatic region. This can be however be managed with adequate subperiosteal dissection and retraction.

Complications of this surgical approach are uncommon. In our series of ten patients, two patients had minor scleral show when assessed at the end of 6 months; however it did not represent a clinical problem for any of them (Table 1).

Fig. 8 Resulting scar hides in a natural skin crease on the lateral canthal region, yielding a good cosmetic result

Studies by Martinez et al. [18] and Novelli et al. [19] have reported a complication rate of about 10 %. Factors predisposing to eyelid retraction and ectropion after orbital fracture repair include hematoma, eyelid edema, adhesions of the orbital septum and scar contracture [20].

Many authors have proposed that the transconjunctival approach decreases the incidence of lower eyelid retraction [20–22]. In the study of Appling et al. [22], the incidence of permanent scleral show was 28 % after the subciliary approach and 3 % after transconjunctival approach. A meta-analysis published in 2009 compared subtarsal, subciliary and transconjunctival incisions and the incidence of lower eyelid malposition after trauma repair [23]. The authors found that the overall incidence of lower lid malposition was 5.1 % (ectropion, 4.7 %; entropion, 0.48 %). In their experience they recommend limiting the use of subciliary incisions and prefer the subtarsal approach for isolated ZMC fractures or a combination of ZMC and orbital floor fractures. They prefer the transconjunctival approach for isolated orbital floors in younger patients; however, if a ZMC fracture is to be addressed with this approach, they recommend the use of canthotomy and tarsorrhaphy suture. In this study the lateral canthotomy incision scar was bare minimum initially and it healed well in a few weeks without any objectionable scarring.

Overall, majority of ocular and facial asymmetries observed in this study regarding A–P globe position, canthal height, diplopia and malar projection, at worst were of minimal discrepancy (Table 2). The differences between fractured and non fractured sides were easily within acceptable limits.

In our study no permanent postoperative complications were noted in any of the cases such as cicatricial scarring, entropion, lid malposition and conjunctival granuloma. This finding was consistent with the observations of most authors.

Conclusion

The transconjunctival approach has been used classically for treatment of ZMC and orbital floor fractures. We believe that with the transconjunctival approach an excellent surgical exposure is accomplished, when combined with Y modification of lateral canthotomy. This could potentially avoid the use of a second incision in the area when plating the FZ suture. In our centre we have had good cosmetic results and few complications when using this approach. Although this technique has several advantages, including good exposure and excellent esthetics, it requires more operating time and detailed knowledge of the anatomy of the lateral canthal region when compared with other cutaneous approaches.

References

1. Kelley P, Crawford M, Higuera S, Hollier LH (2005) Two hundred ninety four consecutive facial fractures in an urban trauma center: lessons learned. *Plast Reconstr Surg* 116:42e–49e
2. Manson PN, Ruas EJ, Iliff NT (1987) Deep orbital reconstruction for correction of post-traumatic enophthalmos. *Clin Plast Surg* 14:113–121
3. Manson PN, Clifford CM, Su CT, Iliff NT, Morgan R (1986) Mechanisms of global support and posttraumatic enophthalmos: I. The anatomy of the ligament sling and its relation to intramuscular cone orbital fat. *Plast Reconstr Surg* 77:193–202
4. Jackson IT (1989) Classification and treatment of orbitozygomatic and orbitoethmoid fractures. *Clin Plast Surg* 16:77–91
5. Maturo S, Lopez MA (2008) Zygomatico-orbito-maxillary complex fractures. *Op Tech Otolaryngol* 19:86–89
6. Tenzel RR, Miller GR (1971) Orbital blow-out fracture repair, conjunctival approach. *Am J Ophthalmol* 71:1141–1142
7. Tessier P (1973) The conjunctival approach to the orbital floor and maxilla in congenital malformation and trauma. *J Maxillofac Surg* 1:3–8
8. Converse JM, Firmin F, Wood-Smith D et al (1973) The conjunctival approach in orbital fractures. *Plast Reconstr Surg* 52:656–657
9. Makowski GJ, Van Sickels JE (1995) Evaluation of results with three-point visualization of zygomaticomaxillary complex fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 80:624–628
10. Karlan MS, Cassisi NJ (1979) Fractures of the zygoma. *Arch Otolaryngol* 105:320–327
11. Zingg M, Chowdhury K, Ladrach K, Vuillemin T, Sutter F, Raveh J (1991) Treatment of 813 zygoma-lateral orbital complex fractures. *Arch Otolaryngol Head Neck Surg* 117:611–622
12. Manson PN, Crawley WA, Yaremchuk MJ, Rochman GM, Hoopes JE, French JH Jr (1985) Midface fractures: advantages of immediate extended open reduction and bone grafting. *Plast Reconstr Surg* 76:1–12
13. Ellis E III, Reddy L (2004) Status of the internal orbit after reduction of zygomaticomaxillary complex fractures. *J Oral Maxillofac Surg* 62:275–283
14. Wesley RE (1998) Transconjunctival approaches to the lower lid and orbit. *J Oral Maxillofac Surg* 56:166–169
15. Baumann A, Ewers R (2001) Use of the preseptal transconjunctival approach in orbit reconstruction surgery. *J Oral Maxillofac Surg* 59:287–291
16. Mangellos-Souza LC, De Freitas RR (1997) Transconjunctival approach to zygomatic and orbital floor fractures. *Int J Oral Maxillofac Surg* 26:31–34
17. Zarem HA, Resnick JJ (1991) Expanded applications for transconjunctival lower lid blepharoplasty. *Plast Reconstr Surg* 88:215–220
18. Martinez AY, Bradrick JP (2012) Y modification of the transconjunctival approach for management of zygomaticomaxillary complex fractures: a technical note. *J Oral Maxillofac Surg* 70:97–101
19. Novelli G, Ferrari L, Sozzi D, Mazzoleni F, Bozzetti A (2011) Transconjunctival approach in orbital traumatology: a review of 56 cases. *J Craniomaxillofac Surg* 39:266–270
20. Appling WD, Patrinely JR, Salzer TA (1993) Transconjunctival approach vs subciliary skin-muscle flap approach for orbital fracture repair. *Arch Otolaryngol Head Neck Surg* 119:1000–1007
21. Ilankovan V (1991) Transconjunctival approach to the infraorbital region: a cadaveric and clinical study. *Br J Oral Maxillofac Surg* 29:169–173
22. Waite PD, Carr DD (1991) The transconjunctival approach for treating orbital trauma. *J Oral Maxillofac Surg* 49:499–503
23. Ridgway EB, Chen C, Colakoglu S, Gautam S, Lee BT (2009) The incidence of lower eyelid malposition after facial fracture repair: a retrospective study and meta-analysis comparing sub-tarsal, subciliary, and transconjunctival incisions. *Plast Reconstr Surg* 124:1578–1586