*British Journal of Medicine & Medical Research*
*20(4): 1-9, 2017; Article no.BJMMR.31843*
*ISSN: 2231-0614, NLM ID: 101570965*

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# Comparison of Subciliary, Subtarsal and Transconjunctival Approaches for Management of Zygomaticoorbital Fractures

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***Authors' contributions***

*This work was carried out in collaboration between all authors. Author AM designed the study protocol, performed the surgeries, provided the clinical images and assisted in writing the initial draft. Author AH supervised the study, examined the patients and critically revised the draft. Author PS assisted in designing the study protocol, prepared the follow-up forms and wrote the initial draft. All authors read and approved the final manuscript.*

***Article Information***

DOI: 10.9734/BJMMR/2017/31843
Editor(s):
(1) Emad Tawfik Mahmoud Daif, Professor of Oral & Maxillofacial Surgery, Cairo University, Egypt.
Reviewers:
(1) Italo Giuffre, Catholic University of Roma, Italy.
(2) Ernesto Moretti, Universidad Abierta Interamericana, Rosario, Argentina.
Complete Peer review History: http://www.sciencedomain.org/review-history/18167

***Original Research Article***

***Received 27th January 2017***
***Accepted 5th March 2017***
***Published 11th March 2017***

## ABSTRACT

**Aims:** To compare access of the surgeon and bleeding during surgery, and ectropion and scar following the surgery in subciliary, subtarsal, and transconjunctival incisions for treatment of the zygomaticoorbital region.
**Study Design:** Descriptive cross-sectional
**Place and Duration of the Study:** This study was conducted in maxillofacial surgery ward in Alzahra and Kashani hospitals in Isfahan, Iran between March to December 2015.
**Patients and Methods:** 51 patients with unilateral zygomaticoorbital trauma were included in this study in three groups (17 in each). Subciliary, subtarsal, and transconjunctival incisions were

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performed and intraoperative access and bleeding, presence of ectropion in two-week follow-up, and visual analogue scale (VAS) score for scar by surgeon and patient in four-week follow-up were recorded. Data was statistically analyzed.

**Results:** The study sample consisted of 7 (13.71%) females and 44 (86.29%) males aging from 17 to 44 years (mean±SD=26.70±6.52). Although intraoperative bleeding and access during surgery were not significantly different between subciliary, subtarsal, and transconjunctival groups, ectropion was more common in subciliary group and VAS score for scar was higher in subciliary and subtarsal group for both surgeon and patient.

**Conclusion:** Transconjunctival incision without visible scar and ectropion and with intraoperative access and bleeding comparable to subciliary and subtarsal incisions seems to be an appropriate choice in most cases of zygomaticoorbital fractures.

*Keywords: Subciliary; subtarsal; transconjunctival; zygomaticoorbital fracture.*

## 1. INTRODUCTION

Zygomaticomaxillary complex and orbit are two important esthetic and functional facial structures. These anatomic regions are vulnerable to fracture due to prominence of the zygomaticomaxillary complex and delicacy of some orbital bones [1,2]. According to several studies zygomaticoorbital fractures are among the most common midfacial fractures [3-6]. Complications of these fractures include depression of the malar region [7,8], enophtalmos [7,9], injury to the globe and optic nerve and consequent blindness [10], sensory disturbance of the infraorbital nerve [11,12], trismus [7], injury to central nervous system [10], and even death [13]. Therefore, management of these fractures is of considerable importance.

Management of zygomaticoorbital fractures is performed based on degree of involvement and includes closed and open reduction [14]. However, closed reduction is less commonly used due to factors such as inability to judge the sufficiency of reduction [1,15]. Several incisions can be used for providing access to the underlying bones in open reduction technique.

Subciliary incision was first utilized by Converse in 1944 to provide access to the orbital region [16]. This incision is applied a few millimeters below the ciliary line and parallel to it and is performed from punctum in medial continuing to the lateral canthus [17]. There are three types of subciliary incision. The skin-only type, in which the skin is dissected from the orbicularis oculi muscle, is associated with higher risk of cutaneous necrosis, ecchymosis, and ectropion. In the skin-muscle type, the skin and orbicularis oculi muscle are elevated from the underlying tissue at the same level [17-19]. Finally in the third type which is known as stepped technique the skin flap is elevated for a few millimeters before dividing the muscle from the underlying tissue and thus this technique is considered to decrease scar inversion [20,21].

Subtarsal incision was suggested by Converse in 1960s [22]. This incision is a modified version of skin-muscle subciliary incision, in which the incision is made along the inferior border of the tarsal plate in the natural subtarsal crease. To prevent scar inversion, the orbicularis oculi muscle is divided in the direction of its fibers several millimeters below the skin. Then the incision is continued inferiorly at the level of the infraorbital rim in a preseptal plane [21].

Transconjunctival incision was first used in 1924 by Bourguet for inferior lid blepharoplasty [23]. Tessier and Converse in 1970s suggested this incision for management of facial trauma [24, 25]. In order to perform this incision, the inferior lid is everted and conjunctiva is sharply incised below the tarsus [26]. Afterwards, the incision is continued to the orbital rim in a preseptal or retroseptal approach [20]. To provide wide access to the zygoma and the inferior orbital rim, transconjunctival incision can be supplemented by lateral canthotomy [18].

Several studies have compared the complications and morbidity of these common incisions used for treatment of zygomaticoorbital fractures. A retrospective study and meta-analysis in 2009 revealed that hypertrophic scar occurs more frequently in subtarsal approach. Moreover, the findings of the study indicated the higher incidence of ectropion in subciliary and entropion in transconjunctival incisions [20]. Another study in 1998 aimed to compare subciliary and transconjunctival incisions reported that subciliary approach is related to higher risk of complications [27]. Moreover,

Waite et al. in their study suggested that transconjunctival approach for management of facial trauma is a favorable method with excellent esthetic outcome and without any scar, stating that these features do not apply to subciliary approach [28]. Similarly, the study of Appling et al. indicated that risk of transient ectropion and permanent scleral show is higher in subciliary incision compared to transconjunctival approach [29]. In 2010, Salgarelli et al. reported that inferior lid malposition is more common following transconjunctival incision with canthotomy than subciliary approach and transconjunctival approach without canthotomy [30]. Another study comparing subtarsal and subciliary incisions stated that incidence of scleral show and ectropion is less in subtarsal and scar formation and edema is less in subciliary incisions [21]. Also Subramanian et al. in [31] evaluated transconjunctival, subtarsal, subciliary, and infraorbital incisions for treatment of orbital fractures and concluded that although transconjunctival approach leads to excellent esthetic outcome, subtarsal and subciliary incisions provide the most favorable access during surgery. Finally in 2016 Strobel et al. [32] evaluated 45 patients for 30 months to compare long-term consequences of transconjunctival and subtarsal approaches for management of facial trauma. They reported that the two incisions are not significantly different with regard to long-term complications such as paresthesia or foreign body perception.

However, based on our knowledge, no previous study aimed to compare intraoperative access and bleeding and short-term outcomes of these three incisions for treatment of zygomaticoorbital trauma. Therefore, the aim of the present study is to compare access of the surgeon and bleeding during surgery, and ectropion and scar following the surgery in subciliary, subtarsal, and transconjunctival incisions for treatment of the zygomaticoorbital region.

## 2. PATIENTS AND METHODS

### 2.1 Patient Selection

This descriptive cross-sectional study was performed on 51 patients with zygomaticoorbital trauma attending maxillofacial surgery ward of Alzahra and Kashani Hospital in Isfahan, Iran in 2015. This research study was approved by Regional Bioethics Committee of Isfahan University of Medical Sciences (No. 395919). Thorough clinical and radiographic examination was performed to recognize eligible patients for the study. Once the condition of the patient was in a way that selection of one of the three common incisions was based on surgeon's choice the patients were informed regarding the study protocol and asked to sign the informed consent form according to Helsinki Declaration. Moreover, patients were able to leave the research study after operation. Inclusion criteria were unilateral zygomaticoorbital fracture, lack of systemic disease, patient age between 17 to 45 (as in older populations risk of scar formation and ectropion is increased due to decreased elasticity of the skin), lack of maxillofacial deformity, and not taking medication other than antibiotics and analgesics 4 days before surgery.

### 2.2 Surgical Procedures

All surgical procedures were performed by one surgeon under general anesthesia. One cartridge containing 1.8 mL of Lidocaine 2% and epinephrine 1:100,000 was injected through the incision line to control bleeding.

Subciliary incision was performed by incising the skin about 2 mm below the ciliary line. Then, the skin covering the orbicularis oculi muscle was elevated for 4-6 mm. Dissection was performed using orbital rim in the preseptal plane. Thereafter, the orbicularis oculi muscle was divided and the periosteum covering the orbital rim was exposed. The periosteum was then incised by scalpel and the underlying bone was exposed by using periosteal elevator (Fig. 1a). For closure of the incision, periosteum was sutured using absorbable material and skin was sutured by single nylon 6-0 sutures.

Subtarsal incision was performed similar to subciliary incision with the initial skin incision lower than subciliary incision and made in a natural subtarsal crease (Fig. 1b). Method of closure was also similar to the previous method.

For transconjunctival incision, the eyes were protected by eye shield and then lateral conthotomy was performed by fine tissue scissors. Dissection was made from the canthotomy incision in the lateral through subconjunctival plan to punctum in medial in a retroseptal approach. Then the conjunctiva was incised using tissue scissors and the periosteum was incised and removed to uncover the underlying bone (Fig. 1c). For closure of the incision the lateral canthus and conjunctiva were sutured by absorbable material.

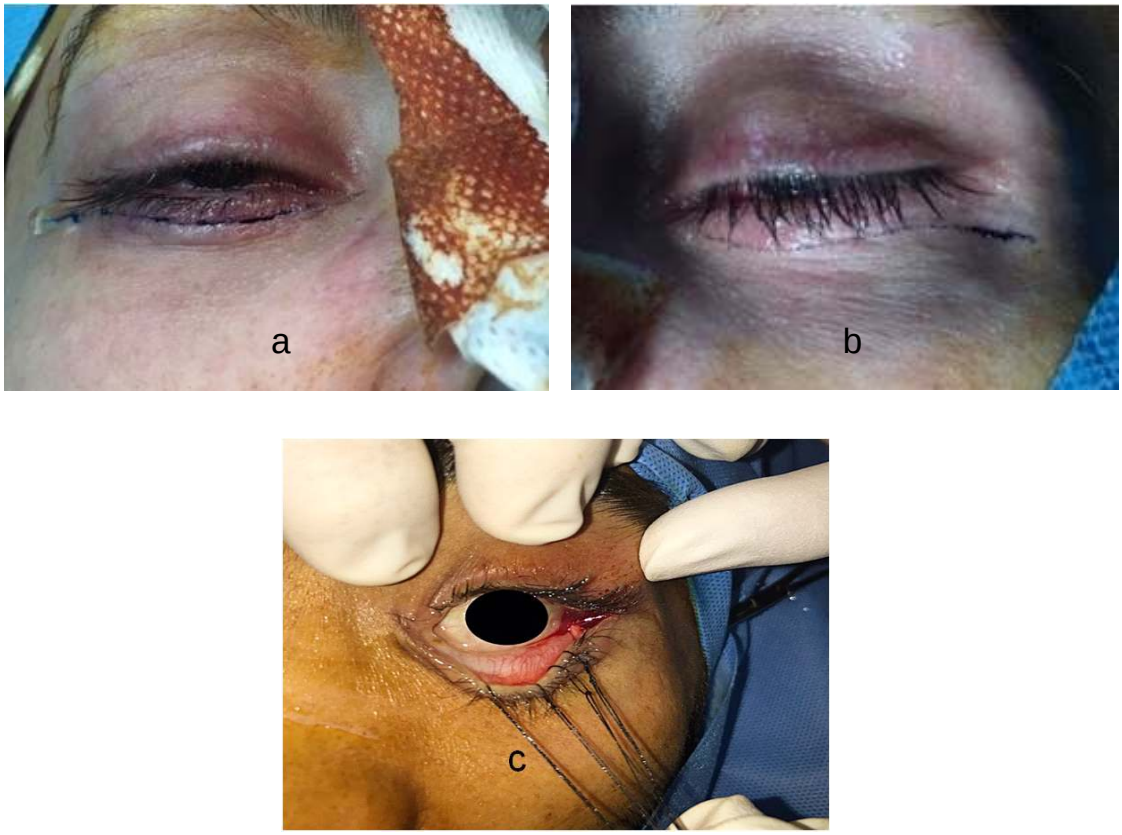


**Fig. 1. Incision line is depicted for a) subciliary, b) subtarsal, and c) transconjunctival incisions**

**Fig. 2. Clinical image of intraoperative access using subciliary approach for reconstruction of orbital rim by miniplate and medpor**

## 2.3 Data Collection

### 2.3.1 Before surgery

After the patients signed the informed consent form, standard photographs were taken from the patients with the midsagittal plane perpendicular to ground and patients looking straight to the lens. These photographs were used for further comparisons after surgery.

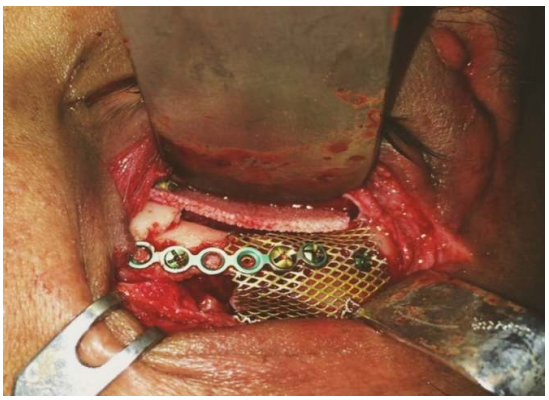

**Fig. 3. Clinical image of interaoperative access using subtarsal approach for reconstruction of zygomatic region and orbital floor using medpor and titanium mesh**

### 2.3.2 Immediately after surgery

Access during surgery was evaluated by the surgeon and recorded. Intraoperative bleeding

was evaluated by counting the number of gauzes used during the incision and also observation of the amount of blood in the suction container after performing incisions which was emptied before the procedure. Since only bleeding of the incisions was to be compared, evaluation of bleeding was ended whenever the orbital rim was exposed.

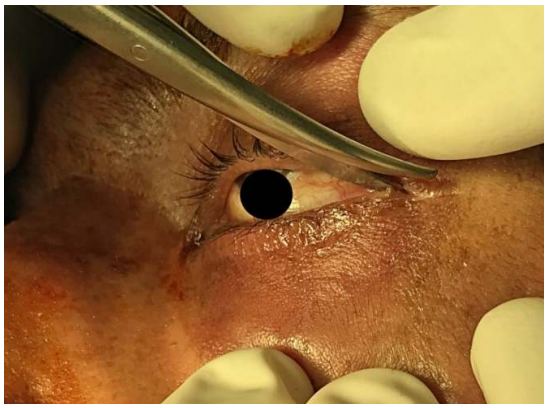

**Fig. 4. Clinical image of lateral canthotmy for initiation of transconjunctival approach**

#### 2.3.3 Two weeks after surgery

The standard photographs were repeated and presence or absence of ectropion was assessed by comparing the degree of palpebral fissure opening in pre-operative and 2-week-post-operative photographs.

#### 2.3.4 Four weeks after surgery

Scars were evaluated by 10-unit visual analogue scale (VAS). 0 was no scar and 10 was considered the worst scar possible. Surgeon and patient were asked to mark the scale blind to each other's marks.

### 2.4 Statistical Analysis

Data was analyzed by chi-square, Kruskal-Wallis, and Mann-Whitney test. Statistical Package for the Social Sciences (SPSS, version 22, IBM, NY, USA) was used for statistical analysis.

## 3. RESULTS

The study sample consisted of 51 patients (7 (13.71%) females and 44 (86.29%) males aging from 17 to 44 years (mean±SD=26.70±6.52).

Intraoperative bleeding was not significantly different among the three groups (*P*=0.775). Similarly no significant difference was observed among the groups in access during surgery (*P*=0.158).

In two-week follow-up it was revealed that ectropion was present only in 3 patients of the subciliary group (Fig. 2). None of the patients of the subtarsal and transconjunctival group had post-operative ectropion. The difference in presence of ectropion between subciliary group and the other two groups was statistically significant (*P*=0.041) (Table 1).

None of the patients of the transconjunctival group had scar. So the VAS score of scar for both surgeon and patient was 0 in this group. This shows a significant difference between transconjunctival group and other two groups in VAS score of scar by both surgeon and patient (*P*<0.001). However, mean VAS score of

**Fig. 5. Ectropion in one of the patients of the subciliary group. Note the malposition of the right inferior lid**

**Table 1. Comparison of intraoperative bleeding and access and ectropion in subciliary, subtarsal, and transconjunctival groups**

| | | Subciliary (17 patients) | Subtarsal (17 patients) | Transconjunctival (17 patients) | *P* value |
|---|---|---|---|---|---|
| **Intraoperative bleeding** | Inconsiderable | 8 (47.1%) | 10 (58.8%) | 7 (41.2%) | |
| | Moderate | 5 (29.4%) | 4 (23.5%) | 4 (23.5%) | 0.775 |
| | Considerable | 4 (23.5%) | 3 (17.6%) | 6 (35.3%) | |
| **Intraoperative access** | Moderate | 2 (11.8%) | 0 (0.0%) | 2 (11.8%) | |
| | Good | 15 (88.2%) | 13 (76.5%) | 11 (64.7%) | 0.158 |
| | Excellent | 0 (0.0%) | 4 (23.5%) | 4 (23.5%) | |
| **Ectropion** | Present | 3 (17.6%) | 0 (0.0%) | 0 (0.0%) | |
| | Absent | 14 (82.4%) | 0 (0.0%) | 0 (0.0%) | 0.41 |

**Table 2. Comparison of surgeon's and patient's VAS scores for scar in subciliary, subtarsal, and transconjunctival groups.**

| | Subciliary | Subtarsal | Transconjunctival | *P* value |
|---|---|---|---|---|
| Surgeon's VAS score (mean±SD) | 3.7±0.6 | 4.0±1.3 | 0.0±0.0 | <0.001 |
| Patient's VAS score (mean±SD) | 3.3±0.7 | 3.6±0.7 | 0.0±0.0 | <0.001 |

scar by surgeon or patient did not have any significant difference between subciliary and subtarsal groups (*P*=0.426 for VAS score of surgeon and *P*=0.141 for VAS score of patient) (Table 2).

## 4. DISCUSSION

The findings of the present study indicated that although intraoperative bleeding and access during surgery were not significantly different between subciliary, subtarsal, and transconjunctival groups, short-term outcomes of these incisions may be different as ectropion was more common in subciliary group and VAS score for scar was higher in subciliary and subtarsal group for both surgeon and patient.

Based on our results intraoperative bleeding was not statistically different between the groups. Nevertheless, considerable bleeding was encountered in 35%, 23%, and 17% of patients in transconjunctival, subciliary, and subtarsal groups, respectively. No previous study has compared intraoperative bleeding in these incisions. Moreover no difference was observed in the groups in access during surgery. However, Subarmanian et al. reported that subtarsal and subciliary approaches provide better access to the fractured zygomaticoorbital complex [31]. Factors such as surgeon's skill, extension of the fracture, and different rater opinions on what is a favorable access can be the reasons for possible inconsistencies in different studies.

Similar to the results of our study, De Riu et al. reported that visible scar was more frequently observed in subciliary group than transconjunctival group [19]. None of the 52 patients treated by subciliary incision in the study of Fleiner et al. presented unfavorable scar [33]. This can also be considered consistent with the results of the present study, as the mean VAS score for scar in subciliary group was 3.7 and 3.3 for surgeon and patient, respectively. However, presence of unfavorable scars following subtarsal incision was 8.3% and 1.4% in the studies of Baqain et al. [34] and Ridgway et al. [20], respectively. In most studies scars are examined and rated by the surgeon. However, in this study we asked both patient and surgeon to rate the scar on VAS. Differences in results of studies concerning subsequent scar of the three incisions can be attributed to this that who rates the scar and what is considered a favorable or unfavorable scar. Therefore, use of both surgeon and patient as raters and also VAS which helps to quantify the scar appearance can be considered in future studies.

Based on the findings of the present study ectropion was only observed in subciliary group (17%). Similarly, transient ectropion was observed in 12% of the patients in subciliary group and none of the patients in transconjunctival group in the study of Appling et al. [29]. Moreover, Rohrich et al. reported that subtarsal incision is followed by less occurrence of ectropion compared to subciliary incision [21]. Also, according to Wray et al. patients in subciliary group require further surgical management for ectropion more frequently when compared to transconjunctival incision group [17].

When selection of incision is being planned, one should consider preoperative esthetic, anatomic, and technical considerations of the patient. For instance, downward position and laxity of the inferior lid can result to inferior lid malposition and subsequent ectropion. Therefore, in addition to selection of appropriate incisions, preventive measures such as canthopexy, canthoplasty, orbicularis oculi muscle and zygomatic suspension, tarsal strip technique, and suture tarsorraphy should be considered [35]. Moreover, persistent periorbital edema which can be deteriorated following surgery, may contraindicate transconjunctival incision, as it can result in irreversible injury to the conjunctiva and shortening of the fornix [31]. Maxillofacial surgeons should select the best incision for patients with zygomaticoorbital fractures based on individual analysis. As the present study compared the short-term outcomes of the transconjunctival, subciliary, and subtarsal incisions, long-term comparisons of outcomes of the three incisions may be needed to help the clinician to choose the appropriate incision for treatment of fractures in zygomaticoorbital region in each patient.

## 5. CONCLUSION

Transconjunctival incision without visible scar and ectropion and with intraoperative access and bleeding comparable to subciliary and subtarsal incisions seems to be an appropriate choice in most cases of zygomaticoorbital fractures.

## CONSENT

All authors declare that 'written informed consent was obtained from all the patients (or other approved parties) for publication of this original research study and accompanying images.

## ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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