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Management of ZMO Fracture Using Transcutaneous Approaches Versus Retro septal Transconjunctival Approach

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Objective: ZMO fracture indicated for ORIF can be accessed using many approaches, comparison andevaluation of methods was mandatory to reveal the most convenient approach with special attentionto surgical scar appearance and patient's esthetics.
Design: Prospective study of the ZMO trauma patients.
Participants: Twenty-one patients were operated. Distributed in three groups seven patients in each.Groups represented the three approaches, transconjunctival, subtarsal and subciliary. Additionalhealthy un-operated patients were examined as control.
Methods: Patients suffering from ZMO fracture were randomly distributed and operated using thethree mentioned approaches. Patients were evaluated post operatively regarding to esthetic outcome,patient satisfaction, pain, incidence of poor wound healing and the quality of fixation.
Results: Modified Vancouver Scar Scale (MVSS) results showed lower values for Transconjunctivalapproach (4 ±1.225) followed by Subtarsal approach (6 ±2.83) and highest value for Subciliaryapproach (7.2 ±1.095). With statistically significant difference between Subciliary andTransconjunctival but there is no statistically significant difference between Subtarsal and the othertwo groups.
Conclusions: The transconjunctival approach was associated with lower rates of complications,patient complaints and pain.
Keywords: ZMO,ORIF,midface trauma

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Introduction:

Orbital floor and mid facial fractures are a common result of periorbital trauma.(1) Traumatic incidents are increasing throughout the world, therefore maxillofacial surgeons must be updated with different ways and approaches to treat the facial fractures.

There are two major approaches to the orbit, the transcutaneous with three variations, subciliary approach where the incision is 2mm below the cilia line and having two sub variations, skin flap (non-stepped) and skin muscle flap (stepped). The subtarsal approach where the incision is around 6-7mm below the cilia line, inferior to the tarsal plate/on the first skin crease. When John Converse published the method in 1944, it soon became widely recognized and clinically applied in orbital surgery.(2) Finally the infraorbital approach where the incision is on the cheek and not on the lower eyelid, about 10mm below the cilia line, which is mainly frowned upon because it has the most visible scar. As for the second major approach it is the transconjunctival where there are mainly two variations, preseptal transconjunctival approach which is more demanding and requires meticulous manipulation and surgical skills. The second variation is retroseptal transconjunctival approach, which is easier and slightly faster.(3)

This approach was first described by Bourquet(4) for lower eyelid fat removal. Tessier(5) later popularized this approach, in 1973 for exposure of the orbital floor and maxilla, for treatment of facial and orbital fractures.

Wilson et al.(6) compared between the two approaches, he mentioned that neither the transconjunctival nor the transcutaneous approaches are immune from complications. But he stated that, oral and maxillofacial surgeons are more likely to be able to manage complications from the subtarsal approach, such as ectropion, scleral-show, and/or hypertrophic scar formation better than they might manage complications from the transconjunctival approach, such as entropion, ectropion, sclera-show, lid malposition, and conjunctival granulomas. He finally states that for average surgeons who treat orbital injuries infrequently, they are better off using the subtarsal approach, as its easier, faster, safer and more predictable.

Strobel et al.(7) also compared between both approaches, but he also mentioned that he investigated the postoperative scar formation via modified Vancouver Scar Scale. His results were in favor of the subtarsal approach, as he says because “it’s both safe and esthetically favorable method”.

This study attempts to discuss Orbito-zygomatic Fractures and compare between the retroseptal transconjunctival approach and the subtarsal transcutaneous approach, as well as provide an appraisal of the surgical approaches.

The aim of this study was to compare the clinical outcome of surgical approaches to the orbit. Namely, the Transcutaneous, Retro-septal and Transconjunctival approach.

MATERIALS & METHODS

A total sample size of 21 calculated using G-power 3.1 program with alpha error 0.5 and beta power 0.8. The patients with zygomatic-maxillary-orbital fractures were recruited from clinics of the department of Oral & Maxillofacial Surgery - Ain Shams University and Craniomaxillofacial Surgery Department–Al Bank Al Ahly Hospital. Thorough clinical and radiographic examination was performed to recognize eligible patients for the study. Once the condition of the patient was met, 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.

Patients were divided randomly into 3 groups:

First group includes 7 patients that underwent retroseptal transconjunctival approach.

Second group includes 7 patients that underwent subtarsal transcutaneous approach.

Third group includes 7 patients that underwent subciliary transcutaneous approach.

Patients included were suffering traumatic injuries in the maxillofacial region involving the orbital floor and indicated for surgical repair and ORIF. All cases were unilateral ZMO fractures. Large defects, signs of muscle entrapment, pre-operative diplopia, and enophthalmos were indications for surgery. Patients included in this study were healthy, free from any systematic disorders and fit for surgical intervention.

Detailed history was taken and examination of the orbital, oral and para-oral structures were carried out including eye movement assessment, diplopia and pupil retraction. Radiographic examination was carried from images acquired from Computed Tomography (CT).

Surgeries were carried out according to the AO guidelines.

Post-Operative assessment:

Pateints were examined periodically at 1 week, 6 weeks, 3 months and 6 months post-operatively. The following parameters were used for assessment.

- Modified Vancouver Scar Scale (mVSS) (5)

The scale is a numerical assessment of four skin characteristics where 0 represents the person's normal skin. These characteristics include height (range, 0 – 4), pliability (range, 0 – 4), vascularity (range, 0 –3), and pigmentation (range, 0 –3). The investigator assigns each evaluation site a numerical value for each of these characteristics based on how much it differs from their normal skin. (Table 1)

- Epiphora, asymmetry, wound dehiscence and infection incidence were also subject to evaluation.
- Pain was assessed using a visual analogue scale recorded by the patient on each post-operative visit.
- Facial esthetics in comparison with the un-operated side using a visual analogue scale (VAS) given to each patient and one of his family members in form of questionnaire asking for facial esthetics, visual abnormalities, paresthesia, and degree of healing and patient gives his opinion in form of score ranging from 0 to 10.
- Sensory deficit (paresthesia or anesthesia of the lower eyelid or cheek) evaluated.

Table 1 Modified Vancouver Scar Scale

Score	Pigmentation	Vascularity	Pliability	Height
0	Normal	Normal	Normal	Normal
1	Hypo-pigmented	Pink	Flexible with minimal resistance	0 to 1 mm
2	Mixed pigmentation	Red	Yielding –giving way to pressure	1 to 2 mm
3	Hyper-pigmented	Purple	Resistant to manual pressure	2 to 4 mm
4	–	–	Rope like tissue band	More than 4 mm
5	–	–	Contracture of scare producing permanent deformity	–

CT scan immediate and 6 months post-operative was done to assess the

orbital volume after ORIF (Open Reduction Internal Fixation) and compare it with the contralateral unaffected side.

Results

The current study included 21 patients, 7 in each group. Which were group 1 the transconjunctival incision, group 2 the subtarsal incision while group 3 the subciliary. The mean age of patients was 30 years old. (Figs 1-3) .

Figure 1 A photograph showing preoperative (left) and 6 months (right) postoperative views of a transconjunctival incision patient. Group 1 case 1

Figure 2 A photograph showing preoperative (left) and 6 months (right) postoperative views of a subtarsal incision patient. Group 2 case 1.

Figure 3 A photograph showing 1 week (left) and 6 months (right) postoperative views of a subciliary incision patient. Group 3 case 7

Immediate post-operative examination and assessment:

Healing pattern

Transconjunctival group: None of the patients treated by transconjunctival approach developed post-operative ectropion or scarring, except 1 case where a lateral canthotomy had to be done.

Subtarsal group: All patients healed normally, sutures were removed in planned time. One patient healed with a huge scar secondary to post traumatic laceration. One patient developed lower lid ectropion.

Subciliary group: All patients healed normally, sutures were removed in planned time. No signs of infection were observed and no patient suffered from wound dehiscence in any group. Pain and edema were within normal limits.

Paresthesia or abnormal sensation

One patient had paresthesia initially from the trauma in the subtarsal group.

Two patients in the subciliary group had paresthesia but regained normal function.

Visual disturbance

One patient subjected to transconjunctival approach complained from post-operative limitation in field of view and another in the subciliary group complained from diplopia.

Radiographic assessment using CT scan was done post-operatively. Reduction and fixation were satisfactory in the CT scans. There were no signs of any soft tissue herniation into the maxillary sinus, nor cloudiness. No osteolysis found around the screws. (Figs 4-6)

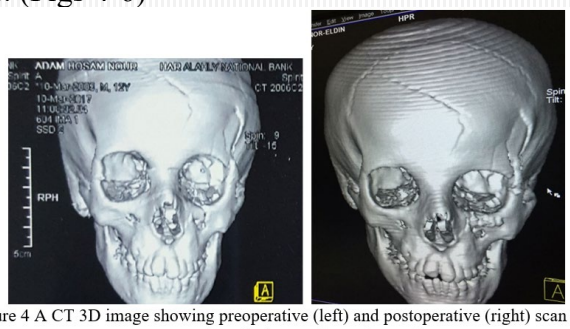

Figure 4 A CT 3D image showing preoperative (left) and postoperative (right) scan for a transconjunctival case. Group 1 case 1.

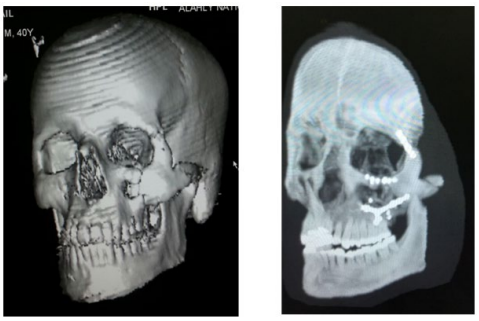

Figure5 A CT 3D image showing preoperative (left) and postoperative (right) scan for a subtarsal case. Group 2 Case 1.

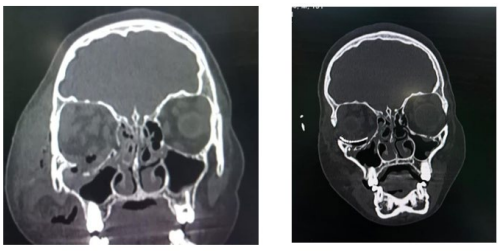

Figure 6 A CT coronal cut showing preoperative (left) and postoperative (right) scans for a subciliary case. Group 3 case 7.

A PowerPoint presentation was prepared from all photo shoots, with the order of cases randomized using Excel. A monitor was used to display the PowerPoint presentation of blinded cases to 2 experts (oral and maxillofacial surgeons) who were asked to evaluate all cases for conspicuous asymmetries and periorbital scars, and then filling out the mVSS form for each patient.

Statistical analysis:

Primary outcome:

Primary outcome is measured using Modified Vancouver Scar Scale (MVSS). The results showed lower value for Transconjunctival (4 ±1.225) followed by Subtarsal (6 ±2.83) and highest value Subciliary (7.2 ±1.095). With statistically significant difference between Subciliary and Transconjunctival but there is no statistically significant difference between Subtarsal and the other two groups. (Fig 7)

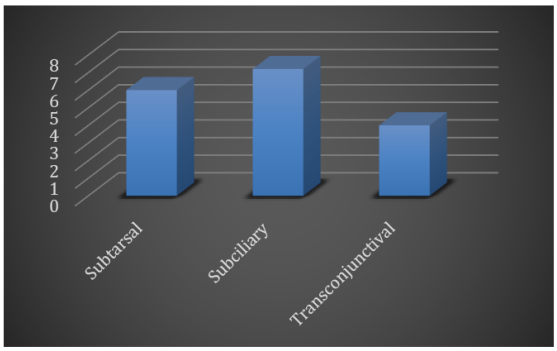

Figure 7 Chart showing primary outcome results

Secondary outcome:

Secondary outcome are pliability, height, vascularity, pigmentation and pain.

All the secondary outcomes showed no statistically significant difference between all the three tested groups except for pain which the results showed lower value for Transconjunctival (1.667 ±0.577) followed by Subtarsal (2.75 ±1.708) and highest value Subciliary (4.4 ±1.14). With statistically significant difference between Subciliary and Transconjunctival but there is no statistically significant difference between Subtarsal and the other two groups. (Fig 8) (Table 2)

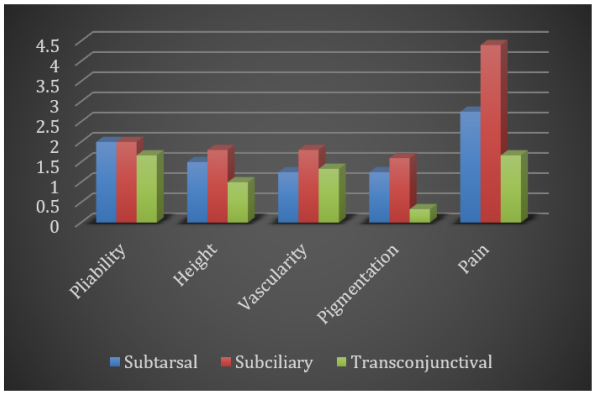

Figure 8 chart showing secondary outcome results

Table 2 Outcomes means ±SD and P-Values

	Subtarsal	Subciliary	Transconjunctival	P-Value
Pliability	2 ±0.816 [a]	2 ±0.707 [a]	1.667 ±0.577 [a]	0.791
Height	1.5 ±1.291 [a]	1.8 ±0.447 [a]	1 ±0 [a]	0.429
Vascularity	1.25 ±1.258 [a]	1.8 ±0.447 [a]	1.333 ±1.528 [a]	0.717
Pigmentation	1.25 ±0.957 [a]	1.6 ±0.548 [a]	0.333 ±0.577 [a]	0.102
Pain	2.75 ±1.708 [a,b]	4.4 ±1.14 [a]	1.667 ±0.577 [b]	0.041
MVSS	6 ±2.83 [a,b]	7.2 ±1.095 [a]	4 ±1.225 [b]	0.046

Means that do not share same letter in the same raw are significantly different.

Discussion

The current study set out to compare esthetic results of orbital floor fracture repair associated to the transconjunctival vs subtarsal vs subciliary approach to access the orbital floor in the effort to investigate which produces better esthetic and functional results at the end of the follow up period.

When reviewing the literature on infra-orbital rim approaches many were found on different transcutaneous approaches (8–10), few have compared a transconjunctival approach with a transcutaneous approach. Different authors have adopted the transconjunctival approach with success for different lower orbit procedures. Therefore, in this study a comparison of the pos-operative result between Subciliary, Subtarsal and transconjunctival approaches was conducted.

One of the concerns of a transconjunctival approach is the limitation of

the exposure due to the anatomical short coming of the lower conjunctival fornix. Sometimes surgeons retract aggressively to overcome this shortcoming, but in doing so a common complication occurs like eyelid laceration. However, to avoid this complication, a lateral canthotomy can be added to the transconjunctival incision, which allows great exposure. Some studies did not see the benefit of a lateral canthotomy (11,12). While others agreed to its necessity (2,13–16). But this is not the concern in this study.
The current study found differences in the aesthetic and functional outcome of orbital floor surgery using a transconjunctival incision versus subciliary/subtarsal incision.

The subciliary approach has the highest incidence of lower eyelid scaring and ectropion than the subtarsal and even more so than the transconjunctival approach. Although some of these complications might resolve given enough time, with this in mind it would seem that the transconjunctival approach is a preferred option.

Several articles compared between the transcutaneous approaches and the transconjunctival incision and favored the latter, mainly due to lower incidence of ectropion(17,18).

Choosing the appropriate approach could be subjective to each surgeon depending on different variables, as the sole purpose for the inferior orbital surgical approaches is establishing normal function and mainly esthetics, the approach selected should enable the surgeon to visualize the entire area of interest. According to Wilson S and Ellis E(6) the transcutaneous incision provides the surgeon with the latitude to extend the exposure as laterally as is necessary without infringement on the lateral canthal ligament. The approach selected must be based on the surgeon's ability to perform the procedure which dictates him being skilled in the selected approach, and know how to deal with any complications that might occur. The current study is on agreement with the findings of Wilson and Ellis when they finally state that for the average oral and maxillofacial surgeon who treats orbital injuries infrequently, the subtarsal approach will prove to be a better choice when access to the infraorbital rim and/or orbital floor is needed, it is simple, predictable, effective and safe.
Strobel L et al.(7) also compared between the transconjunctival and subtarsal approach using the mVSS, and his results were statistically insignificant, which were similar results to this study. He then concluded that the subtarsal approach is a safe and esthetically favorable method. The current study found that the aesthetic result of the transconjunctival incision was superior to that of the subtarsal.
Westfall CT et al.(19) conducted an eight year study of the transconjunctival approach, and although his study was based on monitoring the complications that arose, he said that most complications such as scleral show, ectropion or lacerations were due to aggressive retraction or inexperienced surgeon. In this study there was one case that developed scleral show from laceration because of aggressive retraction, which demonstrates the finding by that study.

Mohamed FL et al.(8) compared between the same three approaches in this study, his analysis also revealed that there were no significant differences between the three approaches except for measurements of the eye fissure index (EFI) and lower iris coverage (LIC). The EFI and LIC were worse with the subciliary approach and best with the transconjunctival approach. His conclusion based on his results was that the subtarsal approach is a minimally invasive incision that provides adequate and direct approach to the orbital floor and infraorbital rim fractures. Again, both Mohamed FL et al and this study results are similar to some extent.
Baqain et al.(20) evaluated the long term esthetic and function outcomes of using the subtarsal technique for orbital trauma patient. More than one aspect was evaluated, but most important was scar formation and esthetic appearance, which as previous studies, the subtarsal approach was proven to be a safe and simple procedure to perform for treating orbital floor fractures, and results in a good surgical outcome functionally and esthetically, which is agreeable if the operative time was an issue or the surgeon is not skilled enough to perform a transconjunctival approach.

Lane et al.(1) reported on the surgical outcomes of the transconjunctival approach in patients undergoing orbital fracture repair without periosteal or conjunctival closure. They stated that this technique is associated with a low incidence of post-operative complications, and that it is applicable in the repair of both isolated floor fractures and complex orbital fractures.

Appling et al.(21) conducted his research comparing the transconjunctival vs the subciliary approach, again despite the difference in study population the results were fairly similar to this study. His results were based on two groups of 59 patients, where patients that were managed by transconjunctival approach reported a 3% rate of permanent scleral show versus 28% in patients undergoing orbital exploration through a conventional transcutaneous approach, stating that the former provides excellent exposure with less risk of postoperative eyelid retraction and ectropion.

Uemura et al.(22) mentioned that the retroseptal transconjunctival approach was probably the best especially with Asian population, because of their orbital anatomy. All operative procedures were done by transconjunctival approach alone without lateral canthotomy or any other additional approach. The orbital floor fracture repair was successful with all cases, with average time of the whole operation 49mins, but the operation time is subjective to each surgeon and his skills.

Trevisiol L(23) and Al Moraissi E et al.(24) outlined in their literatures a higher incidence of ectropion in the patients who underwent the transcutaneous approach with respect to their transconjunctival counterpart, these results are partially in agreement with this study. But there is a difference between our results which is related to the relatively limited size of the study population. Further large-scale studies are thus warranted.

Convers JM et al.(2) advocates the transconjunctival approach for the repair of orbital fracture, mentioning the advantage being having a direct approach to an exposure as satisfactory as that achieved by a transcutaneous approach, without the inconvenience of a slightly visible scar.

Watanabe H et al.(3) conducted a study that lasted more than 20 years concerning the transconjunctival approach. None of his cases developed ectropion or entropion, he goes on and states that it is vitally important that the surgeon masters the transconjunctival approach well before he has good results. These results are nearly the same as the current study.

Kumar S et al.(4) had a series of eight patients that underwent fracture repair of the ZMO via a transconjunctival approach, the results were similar to the previously discussed by the other authors, as well as his study. He goes on to say that excellent exposure was achieved for reduction and rigid fixation of the fractured fragment. No post operative complications occurred. Therefore, he recommends the transconjunctival approach for its superior esthetic results and direct simultaneous access to the orbital floor and orbital rim.

There are several advantages offered by the transconjunctival approach over the use of transcutaneous incisions in developing an approach to the orbit. The main purpose and advantage are esthetically the lack of an external incision, and possibly a lesser occurrence of vertical shortening of the eyelid. The only caveat with the transconjunctival approach is the surgeon has to be experienced enough to get good results, once the surgeon is familiar with the technique, it is probably no more difficult than other approaches. In addition, given a proper case selection, the complication rate is lower than transcutaneous approach.

This study was performed to evaluate mainly the esthetic outcome and complications of the transcutaneous versus transconjunctival approach in the repair of orbital floor fractures reconstructed by plates and titanium mesh. The study was conducted on 21 patients with orbital floor fractures indicated for repair and the mean age of the patients was 30.

The included patients were randomly divided in three equal groups (7 patients in each group). Group 1 transconjunctival approach, group 2 subtarsal approach, group 3 subciliary

were performed to expose, reduce and reconstruct the orbital floor and walls with titanium mesh and plates.
Clinical assessment included modified Vancouver scar scale, epiphora, asymmetry, pain, wound dehiscence and sensory deficit.

The study results indicates that the transconjunctival approach is associated with lower rates of complications and pain in comparison with the subciliary and the subtarsal approaches. There is statistical significance between the transconjunctival and subciliary, but there is no statistically significant difference between the subtarsal and the other two approaches. Therefore, this study advocates the use of transconjunctival incision for orbital fractur, although you can't go wrong with any one of them.

Conclusion:

Choice of surgical procedure for VPD
The study results indicates that the transconjunctival approach is associated with lower rates of complications and pain in comparison with the subciliary and the subtarsal approaches. There is statistical significance between the transconjunctival and subciliary, but there is no statistically significant difference between the subtarsal and the other two approaches. Therefore, this study advocates the use of transconjunctival incision for orbital fractur, although you can't go wrong with any one of them.

Ethics approval and consent to participate

Ethics approval was obtained from Faculty of Dentistry Ain Shams University Research Ethics Committee (FDASU-REC), code number (FDASU-RecIM011716).

Competing interests

The authors declare that no competing interests exists.

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