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Original Article

COMPARATIVE STUDY OF COMPLICATIONS OF SUBCILIARY INCISION VERSUS INFRAORBITAL INCISION FOR ACCESS TO THE ZYGOMATIC BONE AND ORBITAL FLOOR FRACTURE

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ABSTRACT

Objectives: *The purpose of this study was to compare the subciliary approach and the infraorbital approach to access the zygomatic bone and the orbital floor to see subsequent complications such as scar formation, ectropion and entropion development.*

Materials and Methods: *In this retrospective cohort study, a sample of 50 patients was selected, of which 25 patients were placed in each group. The data was collected in local hospitals in Peshawar from September 2018 to June 2022. Follow-up was done at 1, 3 and 6 months interval. Three-dimensional computed tomography scans were done for each patient during follow-up period. Clinical photographs were taken to assess scarring, ectropion and entropion. Evaluation was done using Ordinal and Binary Likert's scale.*

Results: *Mean age group presenting with zygomatic bone or orbital floor fractures was 26-29 years (p=0.25) with a higher incidence of male patients (p=0.63) and unilateral fractures (p=0.77). Grade 3 scar formation was seen in 88% patients who underwent infraorbital incision whereas only 56% patients showed grade 1 or 2 scar formation in subciliary incision (p<0.001, 95% CI for risk difference: 60% to 92%). Similarly, the rate of entropion was high i.e. 21% in patients of infraorbital incision and no patients of subciliary incision showed entropion formation (p<0.001). Ectropion was seen in 64% patients of infraorbital incision as compared to 24% patients of subciliary incision (p=0.010; 95% CI for risk difference; 11% to 65%).*

Conclusion: *Subciliary approach when compared to the infraorbital approach may offer superior esthetics and functional outcomes and show decreased chances of complications.*

Key words: *Zygoma Fracture, Orbital Floor Reconstruction, Subciliary Incision, Infraorbital Incision, Scar, Entropion, Ectropion*

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INTRODUCTION

When injuries affecting the facial features are encountered, these have a significant impact on how one sees himself and how one socializes[1]. Injuries to the maxillofacial skeleton are frequently sustained as it is located in a conspicuous region and also has

the disadvantage of delicate bones[2].

Fractures of the zygomatic complex are prevalent in patients of trauma[3]. The Zygomatic bone and the anatomical bony structures surrounding it contribute to forming the facial form such as the malar eminence as well as the intactness of the orbit walls[4]. Due to the close relationship of the Zygoma bone with the surrounding anatomical structures the treatment of the fractures is indicated to achieve the following goals: to reconstruct the facial profile for esthetic reasons as well as to provide a bony shield to the globe in the orbit, to rectify diplopia and to eliminate hindrances to the mandibular range of motion[5].

Fractures of the zygoma are more prevalent in young men due to increased association of men in societal altercations[6]. Computed tomography scans are considered to be the gold-standard for radiological assessment of zygomatic bone fractures[7].

Fractures of the zygomatic complex with negligible dislocation do not require surgical treatment whilst fractures having operational or esthetic damage in the form of diplopia, entanglement of the extraocular musculature, malocclusion, limited mouth opening and indentation of the cheek eminence routinely require surgical treatment[8].

A number of approaches have been introduced to gain accessibility to the inferior orbital rim and the floor of the orbit for treatment of the fractures in this area. The standard incisions used to gain access to this region include the subciliary incision and the infraorbital incisions[9]. These incisions are extensively applied for gaining access to, examining and treating fractures extending to the infraorbital rim[10].

The understanding of the anatomy of the lower eyelid is crucial to avoiding complications caused by these approaches. If by any chance terminal branches of the zygomatic branch of the facial nerve in this area are damaged, this will lead to weakness of the pre-tarsal or pre-septal regions of the orbicularis oculi muscle resulting in outward sagging of the lower eyelid, also known as ectropion[11].

The subciliary incision is placed 2mm lower to the inferior eyelid while the infraorbital incision is given at the infraorbital rim[12]. The approaches advocated for accessing infraorbital rim all have their own merits and demerits[13].

The subciliary approach is designed to lie 2 millimeters below the margin of the lower eyelid, whereas the infraorbital incision is placed at the skin crease located at the inferior orbital rim. Subciliary approach was first introduced in 1944 by Converse[14].

Despite the fact that the only variation between the two approaches appears to be that of the location of the incision placed from the margin of the lower eyelid, the anatomical area as well as the level of dissection should also be considered to have an impact on the concluding cosmetic outcome[15]. The primary demerit of these incisions is the apparent scarring of the skin[16].

In a 2022 prospective study by Bhatti et al. no significant difference was observed while comparing complication rates of different surgical approaches for ectropion and entropion for access to the zygomatic bone fractures[17].

A comparative study which examines the complication rates of subciliary and infraorbital incisions can be beneficial to oral and maxillofacial surgeons to help optimize both restoration of function and the cosmetic outcome. This study will help to establish evidence based guidelines for selection of incisions for zygoma and orbital floor fractures, and will contribute to the literature by supporting decision making specialized to specific patient anatomy and expectations.

The purpose of this study was to compare the complication rate of subciliary approach and the infraorbital approach for access to the zygomatic bone and the orbital floor, in terms of scar formation, ectropion and entropion development. This study addresses the local research gap in our region aiding future surgical decision-making.

MATERIALS AND METHODS

This study was conducted at Northwest General Hospital & Research Center and Sardar Begum Dental Hospital, Peshawar from September 2018 to June 2022 after gaining approval from the Ethical Committee of Gandhara University (NO.GU/169). Patients presenting to the out-patient department with Zygomatic or Orbital Floor fractures involving the infraorbital rim were selected through non-probability sampling and included in this retrospective cohort study. A total of 50 patients were selected, of which 25 patients were placed in each group. Group A was treated with subciliary incision and Group B

was treated using infraorbital incision after taking written informed consent. Patients having abnormalities such as scars in the infraorbital region, ectropion, entropion were excluded from the study. Extensive history was obtained from each patient followed by proper physical examination to evaluate the fractures of the infraorbital rim. Computed tomography scans were carried out for each patient.

For this study, a conventional calculation for sample size was not done based on the retrospective nature of this study. The sample size depended on the number of patients who presented to the outpatient departments of the above mentioned hospitals with zygomatic bone or orbital floor fractures, were qualified for inclusion in the study and were open to surgical intervention during the study period. Nonetheless, a post-hoc power analysis was performed using the observed effect size for grade 3 scar formation (12% in group A vs 88% in group B). The achieved power was calculated to be more or less 99.99%, assuming an alpha value of 0.05 and a two-tailed test. This suggested the adequate power to detect the observed difference between the groups with a high degree of confidence.

Nasotracheal intubation under general anesthesia was done for treating each patient. Each patient's demographics were recorded using a proforma. Open reduction with internal fixation was carried out for each patient using titanium miniplates with screws. Subciliary and Infraorbital incisions were placed.2 Vasoconstrictor with Adrenaline was given as local infiltration in the area of incision placement i.e. the infraorbital rim. Tarsorraphy was performed using 3-0 Black Silk suture. The protection of the cornea was done by keeping it lubricated using Polyfax eye ointment. Antibiotics were given to the patients per-operatively. For subciliary approach, the incision was placed 2mm caudal to the cilial line where as for infraorbital approach, the incision was placed on the inferior orbital rim with a no. 15 blade[18].

For the subciliary incision, primarily only the skin was incised followed by dissection of the subcutaneous tissues above the orbicularis oculi muscle, 2-3mm inferior to the tarsus. Next the orbicularis oculi muscle was incised and the flap was reflected to incise the periosteum to expose the infraorbital rim. For infraorbital incision, an incision was given on the infraorbital rim to incise the skin, muscle and periosteum simultaneously and raised together as a flap to expose the inferior orbital rim. Layer by layer suturing was done with 4-0 Vicryl and 5-0 Prolene. Patients were kept on follow-up to analyze the variables post-operatively.

Three-dimensional computed tomography scans were done for each patient during follow-up period to assess the reduction and fixation of the inferior orbital rim. Clinical photographs were taken to assess scarring, ectropion and entropion. For ectropion and entropion the patients performed a subjective self-evaluating assessment using a binary Likert's scale. The results were compared using Chi-square tests. A p-value <0.05 was considered statistically significant. Scar grading was done using a 4 point Ordinal Likert's scale where 0= no scar, 1= minimal scar, 2= moderate scar and 3= conspicuous scar and the results were analyzed using non-parametric methods. Consultations between the observers were done regarding any disparities in grading and were concluded through inter-rater reliability. Based on standardized clinical photographs, two independent oral and maxillofacial surgeons graded the severity of scar formation. To corroborate consistency in outcome assessment, any disagreements were resolved through consensus discussion.

The patients included in the study were followed-up for a time period of 6 months. Post-operative evaluation for the patients was done on the first, third and sixth months respectively. Both the incisions provided sufficient surgical exposure of the area. All the clinical photographs taken were assessed by the surgeon as well as independent observers.

SPSS version 24 was used to analyze the data collected. The Shapiro-Wilk test was used to assess the continuous variable, i.e. age. The comparison between the mean age of the two groups was done by independent samples t-test, as the data was distributed normally. The Chi-square of Fisher's exact tests were used for the categorical variables; gender, type of fracture, ectropion and entropion. The Mann-Whitney U test was used for the analysis of the Scar severity using a 4-point ordinal Likert scale (0-3). A p value of <0.05 was considered statistically significant whereas confidence intervals (95% CI) were calculated to estimate the precision of the effect sizes. To address inter-rater reliability to evaluate the grade of scar formation, Cohen's weighted kappa

statistic was calculated. A kappa value below 0.40 indicated poor consensus whereas values, 0.40-0.75 and above 0.75 indicated moderate and excellent agreement respectively.

RESULT

TOut of 50 patients, the mean age of the patients in Group A was 26.8 ± 10.97 years whereas in Group B the mean age was 29.9 ± 9.00 years. This difference was not statistically significant (p=0.25, 95% CI: -8.5 to 2.3). The majority of the patients were found to be male i.e. 90%, n=45 (Group A: 92% male, Group B: 88% male, p=0.63, Fisher's Exact Test). Bilateral Fractures were slightly higher in Group B (36%) vs Group A (32%), but this difference was not significant (p=0.77).

Ectropion was seen in 64% i.e. 16 patients in the group B whereas only 24% i.e. 6 patients showed ectropion in Group A. The difference observed was statistically significant (p=0.010; Chi-Square Test; 95% CI for risk difference; 11% to 65%). Entropion was only limited to Group B, affecting 48% i.e. 12 patients and no cases in Group A. This difference was also statistically highly significant (p <0.001; Fisher's Exact Test). Scar formation was seen in 56% i.e. 14 patients of Group A and 100% i.e. 25 patients of Group B. The results were analyzed using Mann-Whitney U test which is applicable to ordinal data. Median Scar grade was significantly higher in Group B (median=3) vs Group A (median=1) (P<0.001 Mann- Whitney U Test). The incidence of Grade 3 scars was noticed to be increased in group B patients. The results were statistically highly significant (p <0.001; Chi-square Test; 95% CI for risk difference: 60% to 92%). The risk of formation of ectropion was 2.7 times higher in the infraorbital group as compared to the subciliary group (RR = 2.67; 95%: 1.23-5.78), whereas the risk of grade 3 scar formation was over 7 times higher (RR = 7.33;95% CI: 2.40-22.35). Risk ratio was not calculable for entropion because of zero events in Group A. The inter-rater reliability for scar formation, was found to be 0.96, suggesting excellent agreement.

DISCUSSION

The aim of this study was to compare the subciliary and infraorbital approaches for access to the zygomatic bone and orbital floor, to evaluate which approach provided a better cosmetic and functional clinical outcome, with fewer complication rates. The results demonstrated that the subciliary approach was associated with significantly lower rates of grade 3 scar formation (12% vs. 88%; RR = 7.33, 95% CI: 2.40–22.35), ectropion (24% vs. 64%; RR = 2.67, 95% CI: 1.23–5.78), and entropion (0% vs. 48%; p < 0.001) compared with the infraorbital approach. To confirm the adequacy of the sample size, post-hoc power analysis (power = 99.99) was performed and the inter-rater agreement for scar grading was excellent (k=0.96).

The most vulnerable and exposed component of the human frame is the face which makes it substantially more prone to injury[19]. The bone of the Zygoma is located sideways along the facial structure and is subjected to damage frequently due to its anatomic placement[20].

The zygomatic bone communicates with other bones through delicate processes which causes the blunt traumatic forces focused on the zygomatic bone to cause comminution of the weaker bones surrounding it[12]. It is essential to reduce the zygomatic bone and its processes extending to the lateral and

Table 1: Age, Gender & Fracture Distribution

Variable	Group A (n=25)	Group B (n=25)	p Value	95% CI Risk Difference
Mean Age (years)	26.8 ± 10.97	29.9 ± 9.00	0.25	–8.5 to 2.3
Male (%)	92% (n=23)	88% (n=22)	0.63	-----
Bilateral Fractures	32% (n=8)	36% (n=9)	0.77	------

Table 2: Complication Rate

Complication	Group A (n=25)	Group B (n=25)	p Value	95% CI Risk Difference	Risk Ratio (95% CI)
Ectropion	6 (24%)	16 (64%)	0.010	11%-65%	2.67 (1.23-5.78)
Entropion	0 (0%)	12 (48%)	<0.001	27%-69%	--
Grade 3 Scar Formation	3 (12%)	22 (88%)	<0.001	60%-92%	7.33 (2.40-22.35)
Scar Grade (Median)	1	3	<0.001	-	--

inferior rim of walls of the orbit to restore the morphology of the face, to prevent the orbital contents from collapsing inferiorly and to ensure there is no dysesthesia or paresthesia in the structures supplied by the infraorbital nerve[15].

Computed tomography scan is currently considered to be the gold standard to diagnose fractures of the zygomatic bone. To decide the type of fracture and its ensuing treatment, CT scans are done in the coronal and axial dimensions. 0.5 mm slices are considered to be ideal to properly diagnose the fractures. 3D CT scans have also been introduced to allow better understanding of the fractured segments[7].

Management of the fractures of the zygomatic bone remains disputed as no single treatment option is substantial. Treatment is decided based on the armamentarium available and partiality and skills of the surgeon. Treatment options range from closed reduction to open reduction and internal fixation[2].

Approaches to access the infraorbital rim include transconjunctival, subciliary and infraorbital incisions. These seem to be the most commonly used incisions in the literary reviews[4]. Swift access is provided to the infraorbital rim with the use of these approaches. However, the infraorbital approach is highly likely to form a noticeable scar because of its extension into the dermis of the cheek[15].

The usually seen complications with this incision include outward turning of the eyelid or ectropion, inward turning of the eyelid or entropion and this also results in show of the sclera. Ectropion causes cosmetic and functional complications of the eyelid and results in runny eyes. Entropion or inward turning of the eyelid also antagonizes the cornea of the eyelid because of direct contact with the cilia. In a systematic review by Sanjaya et al. the development of ectropion after infraorbital incision was seen to be 3.5% whereas no such event was noticed in the patients who underwent a subciliary incision[9].

Subciliary incision is among one of the most frequently used incisions in cosmetic procedures done by plastic surgeons owing to its superior esthetics[18]. The infraorbital incision is usually avoided by surgeons owing to the fact that it leads to scarring of the skin causing show of the sclera. The subciliary incision in which the skin is reflected off the muscle is the optimal approach to the infraorbital rim[11].

Han Song et al. used the subciliary approach to expose the infraorbital rim in his study. No prominent scars were observed post-operatively during follow-up[16]. Access to the infraorbital rim is enhanced if the subciliary approach is used and is a preferred alternative to restore the continuity of the infraorbital rim in comminuted fractures[9].

In a systematic review by Jaber et al. the male to female ratio of maxillofacial fractures was found to be be 4.5:1 in the Middle Eastern region due to differences in the lifestyles of males and females in the region, with a limited number of female drivers as compared to males and the inclination of female trauma or assault patients to conceal their injuries due to societal pressure[19]. Similar results for Pakistan were shown in a study by Khan et al. with the male to female ratio of 26:1 due to limited exposure of females to activities such as driving, altercations or sports injuries[21].

Our study also showed identical results, with the incidence of these fractures being more common in males (n=45) as compared to females (n=5). Our study also made comparisons based on post-operative complication rates of subciliary and infraorbital incisions for access to the zygomatic bone and orbital floor fractures. The findings signified the infraorbital incision demonstrated notably higher rates of all three complications, i.e. scar formation, entropion and ectropion development.

Ectropion was evident in 64% patients in the group B treated by infraorbital incision as compared to 24% patients in the subciliary incision group, Group A ($p=0.010$) whereas entropion was observed mainly in group B (48%) with no cases observed in group A ($p <0.001$). These results coincide with preceding studies which also reported lower eyelid misalignment being highly prevalent in infraorbital approaches due to increased stretching of tissues of the orbicularis oculi muscle[22]. A study by Pallavi et al. published in 2023 also supported this data, stating the complication rate in terms of ectropion, entropion, scar formation, motor deficit, scleral show, asymmetry, ptosis after infraorbital approach to be 36.2% and 21.4% after the subciliary approach ($p <0.0001$)[23]. The subciliary approach offers good exposure of the infraorbital rim while conserving the lower eyelid anatomy[24].

100% patients reported grade 3 scar formation

in the infraorbital group, whereas only 56% patients showed post-operative grade 1 or grade 2 scar in the subciliary group ($p < 0.001$). however, some former studies concluded that visible scar formation is more prevalent after the subciliary incision[25]. Our results might differ due to improvised surgical techniques and surgeon expertise. Moreover, the recovery of the infraorbital incision site, might result in scarring due to increased strain on the subcutaneous tissues in the region[26].

As there were no notable dissimilarities in rates of bilateral fractures between the two groups this suggests that the rate of complication was more dependent on the type of incision given rather than the intricacies of the surgical procedure. Despite the fact that a higher age group was included in group B of the infraorbital incision (mean age: 29.9 vs 26.8), the difference in the age is improbable to contribute to the rate of complications.

This study has a number of limitations. Primarily, a selection bias can be insinuated due to non-probability, consecutive sampling which may have affected group comparability. The patient demographic was specific to a certain time-frame, along with being limited to only those patients who were willing to undergo open reduction and internal fixation of the fractures which may not represent all patients with zygoma and orbital floor fractures. Along with this, the risk of confounding due to lack of randomization between group A and group B is present. The final results might have been influenced by factors such as experience of the operating surgeon, the difficulty level of treating each fracture type and anatomic differences in patients.

The external validity of the study maybe limited as the results are based on a certain patient population (male, young, trauma patients, single-center study). The results may differ in a different patient demographic (paediatric/geriatric patients, females).

In the future, researchers should make an effort to include a prospective cohort study or randomized control trials to aim at a more diverse demographic. Furthermore, a validated patient-reported outcome measure (PROMs) should be made part of the research to incorporate patient's point of view regarding functionality and cosmetic outcomes. To better control the confounding variables, a propensity score matching or multivariate regression should be added to the study.

CONCLUSION

The results of this study concluded to show higher frequency of male patients as compared to female patients presenting with zygomatic bone or orbital floor fractures with the mean age being 26-29 years. And increased presentation of unilateral fractures in the zygomatic region of the face. Moreover, the complication rate in terms of ectropion, entropion and scar formation was seen to be higher in patients undergoing the infraorbital incision as compared to the subciliary incision for access to the zygomatic bone and orbital floor fractures. Therefore, the subciliary approach maybe favorable for the exposure of the infraorbital rim especially in patients with increased cosmetic concerns.

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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	JN, MN, ZA, UU, HA, MZ, MHA, FG, MH
Acquisition, Analysis or Interpretation of Data:	JN, MN, ZA, UU, HA, MZ, MHA, FG, MH
Manuscript Writing & Approval:	JN, MN, ZA, UU, HA, MZ, MHA, FG, MH

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.