Systematic Review

Comparison of Transconjunctival versus Subtarsal Approach in Orbital Reconstruction with Respect to Post-Operative Complications and Aesthetic Outcome - A Systematic Review

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Abstract

Background: Limited evidence exists regarding the optimal surgical approach for orbital floor reconstruction, resulting in uncertainty regarding the choice of approach with the best aesthetic outcomes and lowest post-operative complications. **Objectives:** This systematic review aimed to compare the transconjunctival and subtarsal approaches (STA) in orbital reconstruction in terms of post-operative complications and aesthetic outcomes. **Data Sources:** The systematic review was conducted following PRISMA guidelines. PubMed, Google Scholar and Cochrane databases were searched from January 1, 2000 and December 31, 2021. **Study Eligibility Criteria:** Eligible studies included clinical studies comparing the transconjunctival and STA approaches in orbital reconstruction. The outcome variables assessed were aesthetic scar, hyperaesthesia, entropion, ectropion, enophthalmos, epiphora and other complications. A total of 346 articles were initially identified, and after evaluation using Mendeley software, 292 articles were reviewed. Finally, five articles that met the inclusion criteria were included in this systematic review. **Study Appraisal and Results:** The transconjunctival approach demonstrated superior aesthetic outcomes compared to the STA approach. However, the STA approach had a lower incidence of post-operative complications, including hyperaesthesia, entropion, ectropion, enophthalmos and epiphora. **Limitations:** The main limitation of this systematic review is the limited availability of literature directly comparing these two approaches, which precluded the inclusion of randomised controlled trials. Furthermore, the search strategy was restricted to specific databases, namely PubMed/Medline, Google Scholar and the Cochrane Collaboration Library.

Keywords: Aesthetic scar, orbital reconstruction, post-operative complications, subtarsal approach, transconjunctival approach

Introduction

The orbit is particularly susceptible to fractures because of its exposed position and its thin bones. Tessier and Converse in the 1970s said that external impact to this area may cause blowout or zygomatico-maxillary fractures, which may be both accompanied by orbital floor defects.[1] The orbital floor and periorbital rim can be reached through the following incisions: transconjunctival approach (TCA), transcutaneous, transnasal or a transoral approach. However, approaches widely used for the management of orbital trauma, pathology and cosmesis are the transcutaneous and transconjunctival incisions. Howard and Osguthorpe in 1997 mentioned that there are three basic transcutaneous approaches (incisions) through the external skin of the lower eyelid. They are sub-ciliary (SCA), subtarsal (STA) and infraorbital (IOA) approaches.[2] Baqain ZH *et al*. mentioned that selection of the appropriate surgical approach is guided by the following goals: proper intraoperative visibility, minimal post-operative scarring and good aesthetic outcomes, all of these approaches usually provide sufficient access to and visualisation of the operative field; however, they differ in terms of simplicity, the time needed to gain access and aesthetic outcomes. Furthermore, they differ in the design and accessibility provided by each incision.[3]

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Transconjunctival approach

Transconjunctival incision was first used in 1924 by Bourguet for inferior lid blepharoplasty.[4] Tessier and Converse in 1970s implicated this incision for the management of facial trauma.[1] The TCA, also called the inferior fornix approach, can be performed either preseptally or retroseptally based on the relationship of the orbital septum to the path of dissection. Converse *et al*., advised that for the incision, the lower eyelid is everted with a Desmarres retractor and a Jaeger Lid retractor is used to push the globe backward, with the tip of the retractor firmly seated posterior to the IOA rim and conjunctiva is sharply incised below the tarsus.[5]

Subtarsal approach

In 1981, Converse *et al*. proposed that STA incision is made in a natural skin crease at or below the level of the tarsus, approximately half the distance between the lash margin and orbital rim. It extends laterally and inferiorly, using the natural skin creases of the lower eyelid.[5] This incision is a modified version of skin-muscle SCA incision, in which the incision is made along the inferior border of the tarsal plate in the natural STA crease.[6,7] Ellis added that to prevent scar inversion, by suggesting the orbicularis oculi muscle is divided in the direction of its fibres several millimetres below the skin.[8] Then, the incision is continued inferiorly at the level of the IOA rim in a preseptal plane.

The objective of this systematic review is to compare transconjunctival versus STA approach in orbital reconstruction in terms of aesthetic scar and post-operative complications such as oedema, intraoperative bleeding, ectropion, entropion and hyperaesthesia.

Materials and Methods

This systematic review was reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and the protocol was registered in the International Prospective Register of Systematic Reviews database under the number CRD42021267504. The following eligibility criteria were applied according to the PICO framework for the selection of the studies: (1) Population (P): Patients requiring orbital reconstruction post fracture. (2) Intervention (I): Patients undergoing TCA for orbital reconstruction post trauma. (3) Comparison (C): Patients undergoing STA approach for orbital reconstruction post trauma. (4) Outcome (O): Post-operative complications and aesthetic outcome. Inclusion criteria: Interventional studies, retrospective studies, cohort studies and case series studies will be included. Articles comparing transconjunctival and STA approach for orbital reconstruction will be included. Articles evaluating aesthetic scar and post-operative complications include ectropion, oedema, epiphora, diplopia, intraoperative bleeding, etc., Articles with minimum follow-up of one month; articles in English language or other language where English translation is possible and Articles published in the English language and between 1st January 2000 and 31st December 2021. Review articles, conference abstracts, editorials or letters, *in vitro* studies and animal studies were excluded from the systematic review.

Search strategy searches were performed in the PubMed/Medline, Google Scholar, Cochrane Collaboration Library databases and a full electronic search strategy of PubMed is listed in Table 1. In addition, the reference lists of eligible articles were hand searched. Duplicates were found and removed. The titles and abstracts of studies were retrieved using the search strategy and then selected independently by two authors. The complete content of the extracted studies was independently assessed for eligibility by the same two authors. Any situations that resulted in disagreement were resolved through a consensus meeting with a third reviewer. The following data were extracted: First author; time of publication; country of origin; study design; age, sex and number of patients, parameters and result with its conclusion [Table 2].

The study was conducted at the Department of Oral and Maxillofacial Surgery, Maharashtra University of Health Sciences, India, between March 2021 and September 2021.

Results

The database search showed five articles on PubMed, 0 articles on Cochrane database and 341 articles on Google Scholar. In the first step of the screening process Mendley desktop software (version 1803, acquired by Elsevier in 2013) was used for removal of duplicate articles. After removing duplicates, 292 articles were finally evaluated according to the framework of the PRISMA-statement. In the second step of screening process, 285 articles were excluded because they were determined to be irrelevant based on titles and abstracts. In the third step of screening process, further articles were excluded because they did not meet the inclusion criteria. Hence, the selection process resulted in five full-text articles. A detailed summary of data selection has been put forth in the PRISMA 2009 flow diagram [Flowchart 1].

Risk of bias within the study

The risk of bias was assessed using risk of bias (RoB) 2: A revised, validated version of Methodological Index for Non-Randomised Studies (MINORS) criteria for clinical trial. Review authors judgement regarding each criterion in the MINORS tool. Graph 1: Risk of bias assessment for the studies evaluated using MINORS tool. High risk: score equal to or <12. Low risk: score >12 and ≤16.

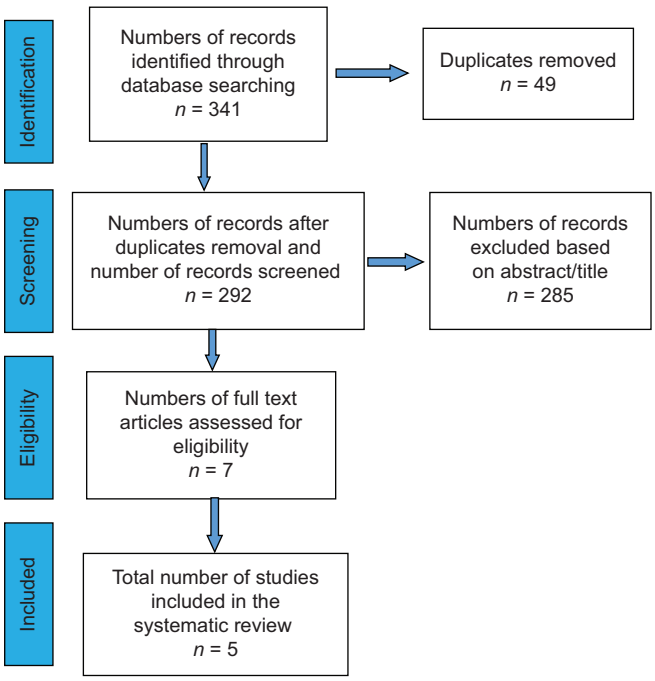
One study Subramanian *et al*.[9] showed high risk of bias with the score 11 out of 16 and remaining four studies, Strobel *et al*.,[10] Haghighat *et al*.,[11] Mohamed *et al*.[4] and Oztel *et al*.[12] showed low risk of bias with 13, 13, 13 and 15 scores, respectively.

Discussion

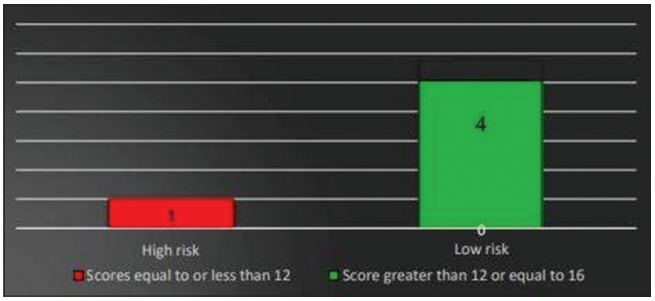
The key to skeletal surgery is having adequate exposure. To achieve the bony surgery, the most direct route through the soft tissues to the bone is often taken, especially in

Table 1: Pubmed search strategy

Serial number	Search criteria	Number of articles
Number 14	Search: (((((((PATIENTS UNDERGOING ORBITAL RECONSTRUCTION) OR (ORBITAL RIM FRACTURES)) OR (ORBITAL FLOOR FRACTURES)) OR (ZYGOMATICOMAXILLARY COMPLEX FRACTURE)) OR (ZYGOMATICO ORBITAL FRACTURE)) AND (TRANSCONJUNCTIVAL APPROACH)) AND (SUBTARSAL APPROACH)) AND (((POST OPERATIVE COMPLICATIONS) OR (ESTHETIC SCAR)) OR ("AETHESTIC"[All Fields] AND ("cicatrix"[MeSH Terms] OR "cicatrix"[All Fields] OR "scar"[All Fields]))))	5
Number 13	Search: ((POST OPERATIVE COMPLICATIONS) OR (ESTHETIC SCAR)) OR ("AETHESTIC"[All Fields] AND ("cicatrix"[MeSH Terms] OR "cicatrix"[All Fields] OR "scar"[All Fields]))	130,532
Number 12	Search: AETHESTIC SCAR	0
Number 10	Search: ESTHETIC SCAR	4358
Number 9	Search: POST OPERATIVE COMPLICATIONS	126,412
Number 8	Search: SUBTARSAL APPROACH	27
Number 7	Search: TRANSCONJUNCTIVAL APPROACH	597
Number 6	Search: ((((PATIENTS UNDERGOING ORBITAL RECONSTRUCTION) OR (ORBITAL RIM FRACTURES)) OR (ORBITAL FLOOR FRACTURES)) OR (ZYGOMATICOMAXILLARY COMPLEX FRACTURE)) OR (ZYGOMATICO ORBITAL FRACTURE)	2356
Number 5	Search: ZYGOMATICO ORBITAL FRACTURE	91
Number 4	Search: ZYGOMATICOMAXILLARY COMPLEX FRACTURE	293
Number 3	Search: ORBITAL FLOOR FRACTURES	1764
Number 2	Search: ORBITAL RIM FRACTURES	396
Number 1	Search: PATIENTS UNDERGOING ORBITAL RECONSTRUCTION	140



Flowchart 1: PRISMA flowchart



Graph 1: Risk of bias assessment for MINORS

orthopaedic surgery. When working on the face, another significant consideration is cosmesis. Incisions to expose the facial skeleton are usually made in inconspicuous or hidden areas. Often this may be at the expense of ease of exposure of the bones. This is certainly the case with surgical approaches to the IOA rim and orbital floor. Rohrich *et al*.[13] stated that the most direct approach would involve making an incision at the IOA rim. However, this method is seldom used due to the visibility of the resulting scar. Alternatively, incisions placed below the eyelashes (SCA) or behind the eyelid (transconjunctival) are utilised to conceal any visible scars. However, the drawback of these incisions is that they provide less direct access to the bones. As a result, dissection of the soft tissues becomes necessary, often in various surgical planes, in order to expose the bone. This type of dissection can sometimes result in functional and aesthetic complications like ectropion, entropion, scleral show and palpebral asymmetries. Lower eyelid complications such as canthal malposition, lacrimal system avulsion, conjunctival granulomas, inclusion cysts, prolonged chemosis, eyelid laceration and flattening of the orbital lower eyelid fat have also been noted during orbital reconstruction.[14,15] Ectropion is challenging due to its aesthetic and functional impact on patients. To prevent ectropion, additional canthopexy or the transconjunctival surgical approach are reasonable options in selected cases.[16] Performing surgical procedures on the orbital rim and floor presents specific challenges due to its location in one of the most visually prominent aesthetic regions of the face. The orbital area is known for having the thinnest skin on the face, which means that

Table 2: Data collection

Author	Year	Country	Title	Study design	Age group	Sample size	Study population	Intervention	Comparison
Subramanian *et al*.[9]	2009	India	Comparison of various approaches for exposure of infraorbital rim fractures of zygoma	Prospective study	-	40	Zygomatic complex fractures with or without other fractures of the facial skeleton	Group I - 10 TCA with lateral canthotomy	Group II - SCA (single eyelid incision) 10; Group III - STA incision 10; Group IV - IOA incision 10
Strobel *et al*.[10]	2016	Germany	Subtarsal versus transconjunctival approach-aesthetic and functional long-term experience	Prospective study	Mean age: Group 1 - 41.3 years; Group 2 - 45.7 years	45	Mid face fracture involving orbital floor	Group 1 - STA 30 patients	Group 2: TCA 15 patients
Haghighat *et al*.[11]	2017	Iran	Comparison of subciliary, subtarsal and transconjunctival approaches for the management of zygomaticoorbital fractures	Descriptive cross sectional	17-45 years	51	Patients with unilateral zygomaticoorbital trauma	G1 - SCA; G2 - STA	G3 - TCA
Mohamed *et al*.[4]	2020	Egypt	Anthropometric changes in the morphology of the lower eyelid after using three different approaches in patients with orbital fractures	Prospective randomised controlled clinical study	17-60 years	45	Orbital floor and IOA rim fractures	G1 - subciliary - 15 G2 - STA - 15	G3 - retroseptal TCA -15
Oztel *et al*.[12]	2021	Australia	Subtarsal versus transconjunctival approach: Long-term follow-up of aesthetic outcomes and complications	Prospective study	-	67	Unilateral orbital floor reconstruction due to trauma	Group 1 - STA tarsal - 44	Group 2 - TCA - 23

Author	Follow-up period (months)	Outcome measurements	Aesthetic scar	Complications	Concluding remarks
Subramanian *et al*.[9]	6	Aesthetic scar scale: Mean grade on the scale of 1–3 (1 point for invisible scar, 2 points for barely visible scar and 3 points for visible scar) complications	Group I - 1.00 Group III - 1.9	Group 1 - ectropion-1 patient (10%) Group 3-0 complication	TCA approach provides an excellent aesthetic result. However, the STA incisions provide a more rapid, direct approach to the orbital floor and IOA rim with minimal morbidity and an aesthetically acceptable scar
Strobel *et al*.[10]	6–30	Aesthetic scar scale: MVSS complication-hypaesthesia and other complications	MVSS: G1-23.3% (1.7 on 10)	Transient post-surgical hypaesthesia: G1-5 (33.3%); G2-8 (53.3%) Other complication: G1-4 (26.6%); G2-7 (46.6%)	These two approaches should not be regarded as competing but rather should be applied in a case specific manner STA approach is a safe and aesthetically favourable method
Haghighat *et al*.[11]	1	Aesthetic scar scale: VAS score complication-intra operative bleeding ectropion	VAS score surgeon's VAS score (mean ± SD) G2-4.0 ± 1.3 G3-0.0 ± 0.0 Patient's VAS score (mean ± SD) G2-3.6 ± 0.7 G3-0.0 ± 0.0	Intraoperative bleeding Inconsiderable: G2-10 (58.8%); G3-7 (41.2%) Moderate: G2-4 (23.5%); G3-4 (23.5%) Considerable: G2-3 (17.6%); G3-6 (35.3) Ectropion present: G2-0; G3-0 Absent: G2-0; G3-0	TCA incision without visible scar and ectropion and with intraoperative access and bleeding comparable to SCA and STA incisions seems to be an appropriate choice in most cases of zygomaticoorbital fractures

Contd...

Table 2: Contd...

Author	Follow-up period (months)	Outcome measurements	Aesthetic scar	Complications	Concluding remarks
Mohamed *et al*.[4]	6	Aesthetic scar scale: Complication-ectropion entropion	Score 0: G2-7; G3-15 Score 1: G2-4; G3-0 Score 2: G2-1; G3-0 Score 3: G2-1; G3-0 Score 4: G2-2; G3-0	Ectropion (%): G2-6.7; G3-6.7 Entropion (%): G2-0; G3-20	STA approach is minimally invasive incision that provides an adequate and direct approach to orbital floor and IOA rim fractures, with a favourable periorbital architecture and the lowest incidence of LLCs. Therefore, the STA technique should be preferred over SCA and TCA approaches
Oztel *et al*.[12]	12–39	Aesthetic scar scale: MSS complication - V2 paraesthesia, reoperation enophthalmos, epiphora, diplopia, ectropion, entropion post-operative infection	MSS Scale Surgeon *n*=26.3% scar with STA. Non-medically trained people - 10.6% with STA	V2 paraesthesia: G1-6 (13.6%); G2-6 (26%) Reoperation: G1-3 (6.8%); G2-4 (17.3%) Enophthalmos: G1-2 (4.5%); G2-2 (8.7%) Epiphora: G1-3 (6.8%); G2-2 (8.7%) Diplopia: G1-6 (13.6%); G2-6 (26%) Ectropion: G1-0; G2-0 Entropion: G1-0; G2-0 Post-operative infection: G1-0; G2-0	TCA approach is a useful technique that offers a surgical approach with no scarring, over the long-term, only a small proportion of STA scars are visible to the average person. Surgeons should consider both approaches and their clinical advantages when treating patients with traumatic orbital injuries

VAS: Visual Analogue Scale, STA: Subtarsal approach, SD: Standard deviation, LLCs: Lower lid complications, IOA : Infraorbital approach, MVSS: Modified Vancouver Scar Scale, MSS: Manchester Scar Scale, TCA: Transconjunctival approach, SCA: Sub-ciliary approach

even minor complications can have a noticeable impact on both aesthetics and functionality. According to Al-Moraissi *et al*., the traditional approach to accessing the orbit involves three transcutaneous incisions. The TCA, on the other hand, specifically aims to avoid making any incisions in the skin around this area. However, it is important to note that the TCA also carries its own set of complications.[17] Surgical approaches should ideally be straightforward, provide direct and optimal access to the target area, minimise time requirements and prioritise minimising complications. In his study, Al-Moraissi *et al*. discuss the ongoing debate surrounding the optimal surgical approach for managing orbital and periorbital lesions or fractures, aiming to minimise complications specifically in the lower lid region. The study objective is to systematically compare and analyse the aesthetic scarring and post-operative complications between the STA and TCA. By doing so, the researchers seek to establish scientific evidence that can help determine the surgical approach with the lowest occurrence of scarring and post-operative complications.[17-19] According to Ridgway *et al*., the occurrence of clinical complications and the risk of scar formation following surgical intervention for orbital floor and IOA rim explorations using either a transcutaneous or TCA are subjects of debate in the existing literature.[20]

This systematic review examines five studies conducted between 1st January 2000 and 31st December 2021 that compare the STA and TCAs for orbital reconstruction. The comparison focuses on evaluating the aesthetic scar and post-operative complications including intraoperative bleeding, ectropion, entropion, hyperaesthesia, epiphora, enophthalmos, diplopia and post-operative infection. Subramanian *et al*. found that both approaches provided adequate exposure of the fracture site, but the TCA required the longest time (22 min) for exposure. Complications such as ectropion were observed in the transconjunctival group, while the STA group had fewer complications. Aesthetic scar assessment used a scale from 1 to 3, with 1 indicating an invisible scar, 2 for barely visible, and 3 for visible. The mean grade for the transconjunctival group was 1, while the STA group scored 1.9. The authors concluded that the TCA yields better aesthetic results, but the STA incisions offer a faster, more direct approach to the orbital floor and IOA rim with minimal morbidity and an aesthetically acceptable scar.[9] In 2016, Strobel *et al*. conducted a study comparing the STA and TCAs in 45 patients who underwent orbital reconstruction. Out of these, 30 patients were treated with the STA approach and 15 with the TCA. The complication rates were comparable between the two approaches, with no significant differences ($P = 0.29$). Among the patients treated with the STA approach, discrete scar formation was observed in seven out of 30 cases. The Modified Vancouver Scar Scale showed that 93.3% of cases had scars rated as unremarkable hyper-or hypotrophy, with a mean score of 1.7 out of 10 possible points. There were no statistically significant differences in conspicuous scars and asymmetries between the two approaches in both non-expert and expert groups ($P > 0.05$). The authors concluded that the

STA approach is a safe and aesthetically favourable method for orbital reconstruction.[10] Haghighat *et al*. conducted a study on 51 patients divided into three groups, comparing the subcilliary, STA, and TCAs. They found no significant differences in intraoperative bleeding and surgical access between the STA and transconjunctival groups. However, the Visual Analogue Scale score for scar was higher in the STA group, as reported by both the surgeon and the patient. The authors concluded that the transconjunctival incision, which does not result in visible scars or ectropion and provides comparable intraoperative access and bleeding to SCA and STA incisions, is an appropriate choice for most cases of zygomaticoorbital fractures.[11] In conclusion, the study by Mohamed *et al*. compared three different approaches for orbital fractures and assessed anthropometric changes in the lower eyelid. All approaches provided sufficient exposure, with the STA approach offering rapid access and satisfactory aesthetic outcomes. Significant differences were observed in the eye fissure index (EFI) and lower iris coverage (LIC) measurements. The SCA approach showed the highest increase in EFI measurements and decreased LIC measurements the most compared to the other approaches. The authors recommended the minimally invasive STA approach as it provides a direct and effective method for orbital floor and IOA rim fractures, resulting in favourable periorbital architecture and the lowest incidence of lower lid complications.[4] In conclusion, Oztel *et al*. found that the STA approach in orbital reconstruction resulted in a high percentage of patients (61% to 76.5%) with no visible scar formation according to multiple evaluation scales. Surgeons were better at identifying STA scars compared to nonmedically trained individuals. Most scars were mild and had minimal impact on patients' quality of life. The majority of patients (93.3%) expressed satisfaction with the scar appearance. The authors recommended the TCA as it provides a scarless surgical technique, with only a small proportion of STA approach scars being visible to the average person in the long term.[12]

Limited literature directly comparing the STA and TCAs prompted the review of additional articles discussing these individual approaches. Hartwig *et al*. concluded in their study that the TCA is a safe method for orbital fracture. They also noted that post-operative diplopia is typically not noticeable to the patient and does not align with abnormal ophthalmic findings.[21] Saluja *et al*. conducted a study on the TCA and its modifications for treating orbito-zygomatic complex fractures. They observed that this approach provided efficient surgical access, good exposure and resulted in non-visible scars. The authors concluded that the TCA is superior to other techniques, despite the longer procedure time, due to its numerous advantages.[22] In their 2020 study, Bronstein *et al*. compared the SCA and TCAs for orbital repair in terms of post-operative complications. The authors concluded that both approaches were equally safe.[23]

In their 2021 study, Trevisiol *et al*. compared the SCA and TCAs in terms of the incidence of lower eyelid post-operative complications in orbital floor fractures, including ectropion, entropion and scleral show. The authors concluded that there were no significant differences in outcomes between the two approaches. They emphasised the importance of tailoring the choice of technique to the patient's characteristics and the surgeon's experience.[24]

In a study conducted by Roochi and Abbasi *et al*. in 2021, no significant difference was found in the incidence of common complications, including ectropion and entropion, between the transconjunctival and SCA approaches.[25] Similarly, in a 2022 study by Bhatti *et al*., comparing the incidence of complications of ectropion and entropion in the transconjunctival and SCA approaches for treating zygomaticomaxillary complex (ZMC) fractures, no discernible variance was observed between the two techniques.[26]

In their 2022 study, Yassin *et al*. implemented the Y-modification of the TCA for treating ZMC fractures. The study revealed favourable outcomes with regard to surgical time and minimal post-operative complications.[27]

In a 2019 retrospective analysis by Mahajan *et al*., the STA incision was found to be a favourable approach for IOA rim fractures and orbital floor exploration, with positive outcomes regarding ectropion, scleral show and scar formation.[28]

When treating traumatic orbital injuries, surgeons should consider the advantages of both approaches. The selection of the incision should take into account the patient's pre-operative aesthetic, anatomic and technical considerations. For example, if the patient has a downward position and laxity of the inferior lid, it may lead to inferior lid malposition and subsequent ectropion. In addition to choosing the appropriate incision, Fonseca RJ recommended considering preventive measures such as canthopexy, canthoplasty, orbicularis oculi muscle and zygomatic suspension, tarsal strip technique and suture tarsorrhaphy.[18]

This systematic review has some limitations, including the lack of randomised controlled trials comparing the two approaches and the limited search strategy that focused on PubMed/Medline, Google Scholar and Cochrane Collaboration Library databases. Owing to the limitations of this study, we suggest that the results be elucidate with wariness.

Conclusions

The TCA is more aesthetically favourable compared to the STA approach. However, the STA approach has a lower incidence of post-operative complications such as hyperaesthesia, entropion, ectropion, enophthalmos and epiphora. It is less technically demanding and minimally invasive, allowing for a direct approach to orbital floor and IOA rim fractures while maintaining favourable periorbital architecture. Therefore, maxillofacial surgeons should consider pre-operative aesthetics, anatomy and technical factors when selecting the best incision for patients with zygomaticoorbital fractures.

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Conflicts of interest

There are no conflicts of interest.

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