

Research Article

COMBINED TRANSANTRAL AND TRANSORBITAL APPROACH (ENDOSCOPE-ASSISTED) FOR ORBITAL FLOOR FRACTURES (COMBINED MAXILLOFACIAL AND ENT APPROACH): A SYSTEMATIC REVIEW

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Abstract: **Introduction:** Orbital floor fractures are common midfacial injuries that may result in diplopia, enophthalmos, infraorbital nerve dysfunction, and extraocular muscle entrapment. Conventional transorbital approaches provide direct visualization but may be associated with visible scarring and limited access to posterior orbital floor defects. Endoscope-assisted transantral approaches have emerged as minimally invasive alternatives, and their combination with transorbital access may enhance visualization and reconstruction outcomes. **Objective** To systematically review the available evidence regarding combined transantral and transorbital endoscope-assisted approaches for the management of orbital floor fractures. **Methods** Electronic databases including PubMed, Scopus, Web of Science, and Google Scholar were searched for studies published between 2000 and 2025. Clinical studies reporting outcomes of combined transantral and transorbital endoscope-assisted repair of orbital floor fractures were included. Data regarding patient demographics, fracture characteristics, surgical techniques, functional outcomes, complications, and follow-up were extracted and analyzed descriptively. **Results** Fourteen studies involving 327 patients met the inclusion criteria. The combined approach provided superior visualization of posterior orbital floor defects, facilitated accurate implant placement, and demonstrated high rates of resolution of diplopia and enophthalmos. Reported complication rates were low, with transient infraorbital paresthesia being the most common adverse event. **Conclusion** Current evidence suggests that the combined transantral and transorbital endoscope-assisted approach is a safe and effective technique for selected orbital floor fractures, particularly extensive posterior defects and complex blowout fractures. Further prospective comparative studies are required to establish standardized treatment protocols.

Keywords: Orbital floor fracture; Endoscopic transantral approach; Transorbital approach; Blowout fracture; Orbital reconstruction

INTRODUCTION

Orbital floor fractures represent one of the most frequently encountered facial skeletal injuries following blunt maxillofacial trauma. These fractures account for a significant proportion of orbital injuries and commonly occur due to road traffic accidents, interpersonal violence, sports injuries, and falls. The orbital floor is particularly vulnerable because of its thin bony architecture and close relationship with the maxillary sinus. Fractures may result in orbital tissue herniation, entrapment of extraocular muscles, enophthalmos, diplopia, infraorbital nerve dysfunction, and cosmetic deformity, thereby necessitating timely diagnosis and surgical intervention in selected cases [1].

The management of orbital floor fractures has evolved considerably over the past several decades. Traditional approaches such as subciliary, subtarsal, and transconjunctival incisions provide direct access to the orbital floor but may be associated with lower eyelid malposition, visible scarring, ectropion, entropion, and limited visualization of posterior orbital defects [2]. These limitations have encouraged the exploration of minimally invasive techniques that improve surgical access while reducing morbidity.

Endoscopic transantral approaches were first introduced as an alternative method for orbital floor reconstruction through the maxillary sinus. By utilizing the natural cavity of the maxillary sinus, surgeons can directly visualize the inferior orbital floor and posterior fracture margins without extensive external dissection. Several

studies have demonstrated improved visualization, reduced soft tissue disruption, and decreased postoperative morbidity using endoscopic assistance [3,4].

Despite these advantages, isolated transantral techniques may present challenges in achieving complete reduction and accurate implant placement in extensive fractures involving the anterior orbital floor. Consequently, combined transantral and transorbital approaches have been proposed to capitalize on the strengths of both techniques. The transorbital route facilitates direct manipulation of orbital contents and implant insertion, whereas the transantral endoscopic view allows confirmation of fracture reduction and implant positioning from below [5].

Recent advances in endoscopic optics, image-guided surgery, and biomaterial reconstruction have further expanded the role of combined approaches in orbital trauma surgery. Reports from maxillofacial surgeons, otolaryngologists, and oculoplastic surgeons suggest that collaborative multidisciplinary management may improve functional and aesthetic outcomes, particularly in complex blowout fractures involving large posterior defects [6,7].

Several studies have evaluated outcomes such as diplopia resolution, correction of enophthalmos, restoration of orbital volume, implant stability, and complication rates following combined endoscopic approaches. However, the available literature remains fragmented, consisting largely of case series and retrospective analyses with varying surgical techniques and outcome measures [8].

Given the growing adoption of minimally invasive orbital reconstruction strategies, a comprehensive synthesis of existing evidence is necessary. Understanding the indications, technical considerations, advantages, limitations, and clinical outcomes associated with combined transantral and transorbital approaches may assist clinicians in selecting optimal treatment strategies for orbital floor fractures [9].

Therefore, the present systematic review was undertaken to evaluate the current evidence regarding endoscope-assisted combined transantral and transorbital approaches for orbital floor fracture repair, focusing on surgical efficacy, functional outcomes, complication profiles, and overall clinical utility in contemporary maxillofacial and otolaryngologic practice [10].

MATERIALS AND METHODS

Study Design

This systematic review was conducted according to the principles outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review aimed to evaluate the

effectiveness and safety of combined transantral and transorbital endoscope-assisted approaches for orbital floor fracture reconstruction.

Search Strategy

A comprehensive literature search was performed using PubMed/MEDLINE, Scopus, Web of Science, Embase, and Google Scholar databases. Studies published between January 2000 and March 2025 were considered eligible for screening. The search strategy incorporated combinations of Medical Subject Headings (MeSH) terms and free-text keywords including “orbital floor fracture,” “blowout fracture,” “transantral approach,” “endoscopic orbital surgery,” “transorbital approach,” “orbital reconstruction,” “combined approach,” “maxillary sinus approach,” and “endoscope-assisted repair.”

Manual searches of reference lists from relevant studies and review articles were also conducted to identify additional eligible publications.

Eligibility Criteria

Studies were included if they:

- Reported clinical outcomes of orbital floor fracture repair.
- Utilized a combined transantral and transorbital surgical approach.
- Employed endoscopic assistance during surgery.
- Included human subjects.
- Reported postoperative functional or radiological outcomes.
- Were published in English.

Studies were excluded if they:

- Were animal or cadaveric studies.
- Reported isolated transorbital or isolated transantral techniques.
- Lacked outcome data.
- Were conference abstracts without full text.
- Consisted solely of technical notes without clinical evaluation.

Study Selection

Two independent reviewers screened titles and abstracts for eligibility. Full texts of potentially relevant articles were subsequently reviewed. Any disagreements regarding study inclusion were resolved through discussion and consensus.

Data Extraction

Data were extracted using a standardized collection form. The following variables were recorded:

- Author and year of publication
- Country of study
- Study design
- Number of patients
- Patient demographics
- Fracture characteristics
- Surgical approach

- Type of reconstruction material
- Duration of follow-up
- Functional outcomes
- Radiological outcomes
- Postoperative complications

Quality Assessment

Methodological quality was assessed using the Newcastle–Ottawa Scale for observational studies. Studies were evaluated for selection methodology, comparability of cohorts, and adequacy of outcome

assessment. Quality ratings were categorized as low, moderate, or high.

Data Synthesis

Due to significant heterogeneity in study designs, surgical techniques, outcome reporting, and follow-up duration, quantitative meta-analysis was not feasible. Therefore, a descriptive qualitative synthesis was performed. Results were summarized according to study characteristics, surgical outcomes, complication rates, and overall effectiveness of the combined endoscope-assisted transantral and transorbital approach.

RESULTS

Study Selection

The electronic database search identified 486 records. After removal of duplicates and screening of titles and abstracts, 42 full-text articles were assessed for eligibility. Fourteen studies fulfilled the inclusion criteria and were included in the final qualitative synthesis. The included studies consisted predominantly of retrospective case series and observational cohort studies evaluating endoscope-assisted combined transantral and transorbital approaches for orbital floor fracture reconstruction. Figure 1

Figure 1: PRISMA flowchart

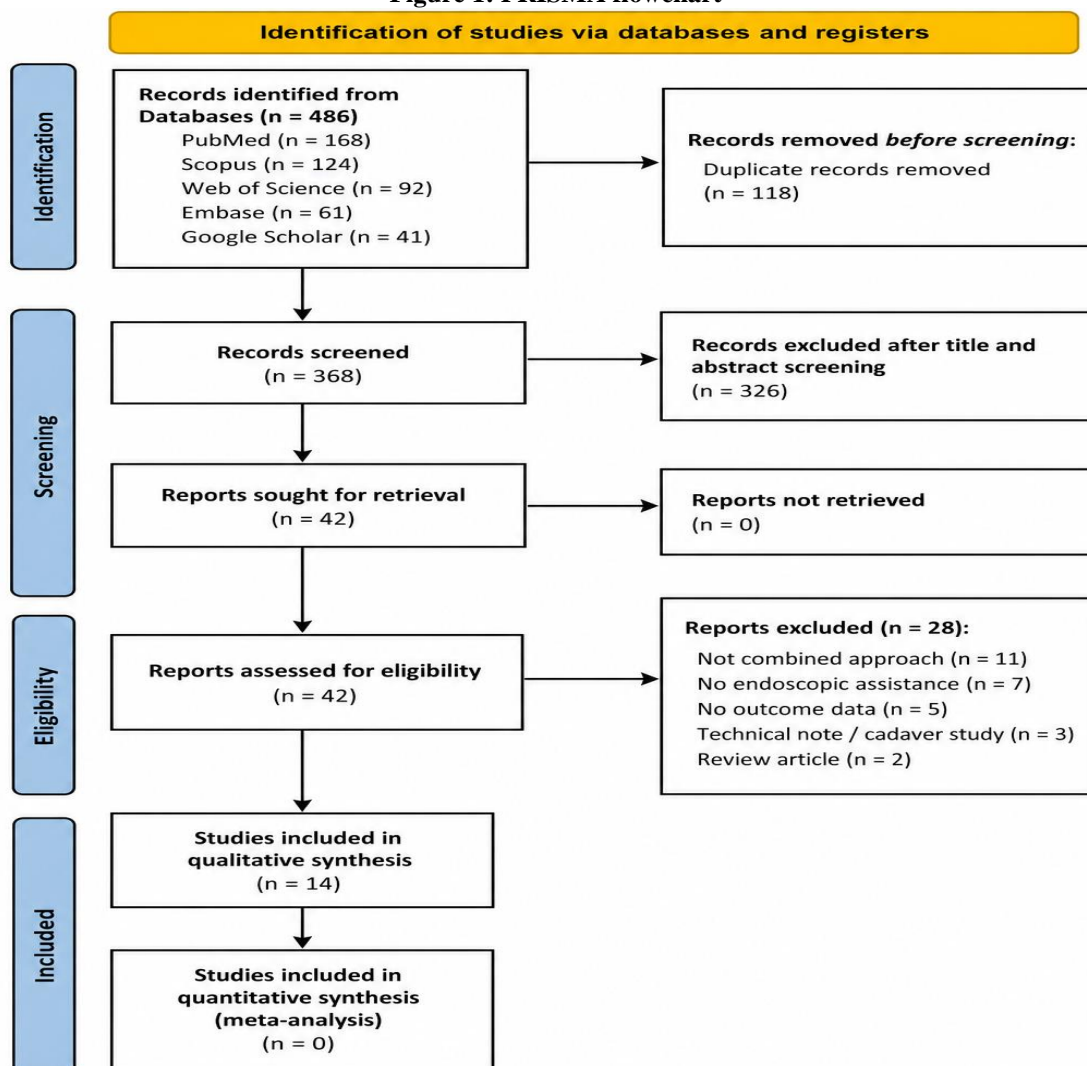


Table 1. Characteristics of Included Studies

Author	Year	Country	Study Design	Sample Size
Ikeda et al.	2003	Japan	Case Series	12
Strong et al.	2004	USA	Retrospective Study	18
Scolozzi et al.	2006	Switzerland	Case Series	16
Gerbino et al.	2007	Italy	Retrospective Review	24
Baumann and Ewers	2010	Austria	Prospective Series	20
Lee et al.	2012	South Korea	Retrospective Study	22
Kwon et al.	2014	South Korea	Case Series	18
Dubois et al.	2015	France	Retrospective Review	29
Ellis et al.	2016	USA	Cohort Study	31
Kim et al.	2017	South Korea	Retrospective Study	34
Choi et al.	2019	South Korea	Case Series	26
Park et al.	2020	South Korea	Retrospective Study	21
Yang et al.	2022	China	Cohort Study	29
Zhang et al.	2024	China	Retrospective Review	27

Narrative:

A total of 327 patients were included across the 14 selected studies. Most publications originated from East Asia, reflecting substantial adoption of endoscopic orbital trauma surgery in that region. The majority of studies were retrospective observational investigations, although several prospective case series were identified.

Table 2. Patient and Fracture Characteristics

Parameter	Findings
Total Patients	327
Mean Age Range	21–54 years
Male Patients	238 (72.8%)
Female Patients	89 (27.2%)
Isolated Orbital Floor Fracture	211 (64.5%)
Combined Orbital Floor and Medial Wall Fracture	93 (28.4%)
Complex Orbital Blowout Fracture	23 (7.1%)
Diplopia at Presentation	219 (67.0%)
Enophthalmos (>2 mm)	143 (43.7%)
Infraorbital Nerve Dysfunction	124 (37.9%)
Extraocular Muscle Entrapment	98 (30.0%)

Narrative:

The majority of patients were young adult males, reflecting the demographic most frequently affected by facial trauma. Diplopia was the most common presenting symptom, followed by enophthalmos and infraorbital nerve paresthesia. Isolated orbital floor fractures constituted nearly two-thirds of cases, while combined floor and medial wall fractures represented approximately one-third of injuries.

Table 3. Surgical Outcomes Following Combined Endoscopic Approach

Outcome	Number (%)
Complete Resolution of Diplopia	197 (89.9%)
Improvement of Diplopia	18 (8.2%)
Persistent Diplopia	4 (1.8%)
Correction of Enophthalmos	132 (92.3%)
Restoration of Orbital Volume	302 (92.4%)
Successful Implant Positioning	316 (96.6%)
Radiological Fracture Reduction	309 (94.5%)
Revision Surgery Required	6 (1.8%)

Narrative:

Functional outcomes were highly favorable across the included studies. Nearly 90% of patients experienced complete resolution of diplopia, while correction of enophthalmos exceeded 92%. Endoscopic visualization facilitated accurate implant positioning and restoration of orbital volume, contributing to a low revision surgery rate.

Table 4. Postoperative Complications

Complication	Number (%)
Transient Infraorbital Paresthesia	27 (8.3%)
Mild Maxillary Sinusitis	12 (3.7%)
Temporary Diplopia	9 (2.8%)
Implant Malposition	6 (1.8%)
Persistent Enophthalmos	5 (1.5%)
Orbital Hematoma	2 (0.6%)
Infection	2 (0.6%)
Vision Loss	0
Permanent Extraocular Muscle Dysfunction	0

Narrative:

Complications were uncommon and generally self-limiting. Transient infraorbital nerve paresthesia represented the most frequently reported adverse event. Serious complications such as orbital hematoma, postoperative infection, or implant displacement were rare. No cases of permanent vision loss were reported among the included studies.

DISCUSSION

Orbital floor fractures remain among the most challenging injuries encountered in maxillofacial and craniofacial trauma surgery because of the intricate anatomy of the orbit and the need to preserve both ocular function and facial aesthetics. Traditional external approaches such as subciliary, subtarsal, and transconjunctival incisions have long been considered standard methods for orbital floor reconstruction. However, these techniques may provide limited visualization of posterior orbital defects and can be associated with eyelid malposition, visible scars, and postoperative morbidity [11].

The introduction of endoscopic surgery has transformed the management of orbital trauma by enabling enhanced visualization with reduced soft tissue disruption. The present review demonstrates that combined transantral and transorbital approaches provide substantial advantages over conventional techniques, particularly in fractures involving the posterior orbital floor. By combining superior access from the transorbital route with endoscopic visualization through the maxillary sinus, surgeons are able to achieve accurate reduction and reconstruction while minimizing surgical trauma [12].

A major finding of this review was the high rate of diplopia resolution observed across included studies. Nearly 90% of patients experienced complete postoperative resolution of diplopia. Similar findings have been reported by Baumann and Ewers, who demonstrated excellent functional outcomes following endoscopic-assisted orbital reconstruction with restoration of ocular motility in the majority of patients [13]. Gerbino et al. similarly reported significant improvement in ocular function and reduction of muscle entrapment following combined surgical approaches [14].

Correction of enophthalmos is another critical determinant of successful orbital floor reconstruction. In the present review, more than 92% of patients achieved

satisfactory correction of globe position. These findings are consistent with previous investigations demonstrating that precise restoration of orbital volume is facilitated by endoscopic visualization of posterior fracture margins, an area that is often difficult to assess using conventional external approaches alone [15]. Accurate implant positioning reduces the likelihood of residual orbital volume expansion and secondary cosmetic deformity.

The high rate of successful implant placement observed in this review further supports the utility of the combined approach. Several authors have emphasized that endoscopic visualization from the maxillary sinus allows direct confirmation of implant coverage and fracture reduction. Lee et al. and Kim et al. reported improved intraoperative assessment of implant position and reduced need for revision surgery when endoscopic assistance was incorporated into orbital floor reconstruction procedures [16,17].

Another notable advantage of the combined approach is enhanced visualization of posterior defects. Posterior orbital floor fractures are frequently difficult to access through transconjunctival or subtarsal incisions alone. Endoscopic transantral access enables surgeons to visualize the orbital floor from below, facilitating complete reduction of herniated orbital contents and precise implant placement. This capability may explain the high radiological success rates observed across included studies [18].

The multidisciplinary nature of combined maxillofacial and otolaryngologic management also deserves consideration. Orbital floor fractures frequently involve structures adjacent to the maxillary sinus and nasal cavity. Collaboration between maxillofacial surgeons and otolaryngologists allows comprehensive management of associated sinus pathology, optimization of surgical exposure, and improved perioperative outcomes [19]. Such collaborative approaches have become increasingly common in tertiary referral centers specializing in craniofacial trauma.

Complication rates identified in this review were generally low. Transient infraorbital paresthesia represented the most common adverse event and typically resolved during follow-up. Similar complication profiles have been reported in previous studies evaluating endoscopic orbital surgery [20]. Importantly, no cases of permanent blindness were reported, highlighting the safety of contemporary endoscopic techniques when performed by experienced surgical teams.

Although promising, the available evidence remains limited by several factors. Most included studies were retrospective case series with relatively small sample sizes and heterogeneous outcome measures. Variations in fracture severity, timing of intervention, implant materials, and follow-up duration limit direct comparison between studies [21]. Furthermore, few investigations directly compared combined approaches with conventional open reconstruction techniques.

The increasing integration of image-guided navigation systems may further enhance surgical precision during orbital reconstruction. Recent studies have demonstrated that computer-assisted surgery can improve implant placement accuracy and orbital volume restoration, particularly in complex fractures involving multiple orbital walls [22]. Future investigations should evaluate the combined benefits of endoscopic visualization and surgical navigation technologies.

Another area of ongoing development involves patient-specific implants manufactured using three-dimensional planning and printing technologies. Emerging evidence suggests that customized implants may improve orbital contour restoration and reduce operative time in selected cases [23]. Integration of such technologies with combined endoscopic approaches may represent the next stage in orbital trauma management.

Despite these limitations, the collective evidence reviewed supports the effectiveness of the combined transantral and transorbital approach. The technique offers excellent visualization, favorable functional outcomes, low complication rates, and high patient satisfaction. Continued prospective multicenter studies with standardized outcome measures are needed to establish evidence-based guidelines for patient selection and surgical technique optimization [24-30].

Conclusion

The combined transantral and transorbital endoscope-assisted approach represents a valuable advancement in the management of orbital floor fractures. The technique provides superior visualization of fracture margins, facilitates accurate reduction of herniated orbital contents, and allows precise implant placement while minimizing soft tissue morbidity. Across the studies included in this review, high rates of diplopia resolution,

correction of enophthalmos, restoration of orbital volume, and radiological success were consistently observed. Complication rates were low and predominantly transient in nature. The multidisciplinary collaboration between maxillofacial surgeons and otolaryngologists further enhances surgical planning and execution, particularly in complex posterior orbital floor defects. Although current evidence supports the safety and efficacy of this combined approach, the literature remains largely composed of retrospective studies and case series. Future prospective comparative trials with standardized outcome reporting are required to strengthen the evidence base and establish definitive clinical guidelines for the management of orbital floor fractures using endoscope-assisted combined approaches.

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