Preseptal Transconjunctival Approach for Orbital Floor Fracture Reconstruction: Surgical Anatomy, Technical Considerations, and Clinical Outcomes

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Abstract

Background: Orbital floor fractures represent a common subset of midfacial trauma and frequently result from blunt force mechanisms such as interpersonal violence, sports injuries, and motor vehicle accidents. These fractures may lead to functional and aesthetic complications including diplopia, enophthalmos, infraorbital nerve hypoesthesia, and restriction of extraocular muscle movement. Surgical reconstruction is often required when significant orbital floor disruption leads to orbital volume changes or entrapment of orbital contents. Over the past several decades, multiple surgical approaches have been developed to access the orbital floor, including subciliary, subtarsal, and transconjunctival techniques. Among these, the **preseptal transconjunctival approach** has gained widespread acceptance due to its ability to provide excellent surgical exposure while minimizing visible scarring and reducing the risk of lower eyelid malposition.

The aim of this review is to provide a comprehensive overview of the **preseptal transconjunctival approach for orbital floor fracture reconstruction**, with emphasis on surgical anatomy, operative technique, indications, advantages, limitations, and clinical outcomes reported in the literature. Particular attention is given to the anatomical considerations of the lower eyelid and orbital septum that enable safe dissection within the preseptal plane, thereby facilitating access to the orbital rim and floor while preserving eyelid support structures. In addition, this review evaluates the role of the preseptal transconjunctival approach in comparison with alternative surgical approaches, highlighting its reduced rates of complications such as ectropion, scleral show, and visible scarring.

Furthermore, the article discusses technical modifications, including lateral canthotomy and transcaruncular extensions, which can improve surgical exposure in complex fractures involving the medial orbital wall or extensive orbital floor defects. Clinical outcomes reported in contemporary studies demonstrate that the preseptal transconjunctival technique offers reliable access, favorable aesthetic results, and low complication rates when performed with appropriate anatomical understanding and meticulous surgical technique.

In conclusion, the preseptal transconjunctival approach represents a safe, effective, and cosmetically advantageous method for orbital floor fracture reconstruction. A thorough understanding of lower eyelid anatomy and careful adherence to surgical principles are essential for optimizing patient outcomes and minimizing complications. Continued refinement of surgical techniques and implant materials will likely further enhance the role of this approach in modern orbital reconstructive surgery.

Keywords: *Orbital floor fracture, Transconjunctival approach, Orbital fracture reconstruction*

Introduction

Orbital floor fractures are among the most frequently encountered injuries in midfacial trauma and represent a significant clinical challenge for reconstructive surgeons. These fractures commonly occur as a result of blunt facial trauma, including interpersonal violence, sports-related injuries, and motor vehicle accidents. The orbital floor is particularly susceptible to fracture due to its relatively thin bony structure, which separates the orbital cavity from the maxillary sinus. Disruption of this structure can lead to herniation of orbital contents into the maxillary sinus, resulting in functional complications such as diplopia, restriction of extraocular muscle movement, infraorbital nerve paresthesia, and enophthalmos. Accurate diagnosis and appropriate surgical management are therefore essential to restore both orbital function and facial aesthetics. [1]

The surgical reconstruction of orbital floor fractures has evolved considerably over the past several decades. Early approaches to the orbital floor were primarily performed through external skin incisions such as the subciliary or subtarsal approaches, which provided adequate exposure but were frequently associated with visible scarring and postoperative eyelid complications. These complications included ectropion, scleral show, and lower eyelid retraction, which may significantly affect both functional and aesthetic outcomes. As a result, surgeons have sought alternative approaches that allow sufficient access to the orbital floor while minimizing disruption of lower eyelid support structures. [2]

The transconjunctival approach has emerged as one of the most widely accepted techniques for accessing the orbital floor because it avoids external cutaneous incisions and therefore eliminates visible scarring. Within this technique, two principal dissection planes have been described: the **preseptal** and **retroseptal** approaches. The preseptal transconjunctival approach involves dissection anterior to the orbital septum, allowing controlled exposure of the infraorbital rim and orbital floor while maintaining the integrity of the orbital septum and supporting structures of the lower eyelid. This approach provides excellent surgical visualization and is associated with a lower incidence of postoperative eyelid malposition compared with traditional external approaches. [3]

A comprehensive understanding of the surgical anatomy of the lower eyelid is fundamental for safe and effective use of the preseptal transconjunctival approach. Key anatomical structures—including the tarsal plate, orbital septum, capsulopalpebral fascia, and inferior oblique muscle—play important roles in maintaining eyelid stability and ocular function. Careful dissection within the appropriate anatomical planes allows surgeons to reach the orbital floor while minimizing trauma to these critical structures. Consequently, mastery of the anatomical relationships of the lower eyelid and orbit is essential for preventing complications and achieving optimal reconstructive outcomes. [1,3]

Despite the growing popularity of the preseptal transconjunctival approach, variations in surgical technique, indications, and reported outcomes remain present in the literature. Additionally, differences in surgeon preference and training often influence the choice of surgical access for orbital floor reconstruction. Therefore, a comprehensive synthesis of the available evidence is necessary to clarify the advantages, limitations, and clinical outcomes associated with this approach. The aim of this review is to provide an in-depth evaluation of the **preseptal transconjunctival approach for orbital floor fracture reconstruction**, focusing on surgical anatomy, operative technique, indications, complications, and reported clinical outcomes in contemporary reconstructive practice. [2,3]

Surgical Anatomy of the Orbital Floor and Lower Eyelid

A comprehensive understanding of the anatomical structures of the **orbital floor and lower eyelid** is essential for the safe and effective performance of the preseptal transconjunctival approach. The orbital floor forms the inferior boundary of the orbit and is primarily composed of the maxillary bone, with smaller contributions from the zygomatic and palatine bones. This thin bony plate separates the orbital cavity from the maxillary sinus and is particularly vulnerable to fracture following blunt trauma due to its delicate structure. Disruption of the orbital floor may result in herniation of orbital contents into the maxillary sinus, which can lead to functional disturbances such as diplopia and enophthalmos due to increased orbital volume and displacement of the globe. [7]

The infraorbital groove and canal represent critical anatomical landmarks along the orbital floor. The **infraorbital nerve**, a branch of the maxillary division of the trigeminal nerve (V2), passes through the infraorbital canal and emerges at the infraorbital foramen to provide sensory innervation to the lower eyelid, upper lip, lateral nose, and cheek. During orbital floor reconstruction, this neurovascular bundle must be carefully preserved to avoid postoperative sensory deficits such as infraorbital hypoesthesia or paresthesia. Identification of the infraorbital canal also assists surgeons in determining the boundaries of the fracture and helps guide safe placement of orbital implants during reconstruction. [8]

The lower eyelid consists of multiple anatomical layers that contribute to eyelid stability and ocular protection. From superficial to deep, these layers include the skin, orbicularis oculi muscle, orbital septum, capsulopalpebral fascia, tarsal plate, and conjunctiva. The **orbital septum** is a fibrous membrane extending from the orbital rim to the tarsal plate and functions as a barrier separating orbital fat from the eyelid structures. In the preseptal transconjunctival approach, surgical dissection is performed anterior to the orbital septum, allowing controlled access to the infraorbital rim while maintaining the structural integrity of the eyelid support system. This preservation contributes to the reduced incidence of postoperative eyelid malposition associated with this approach. [9]

The capsulopalpebral fascia is another essential component of lower eyelid anatomy and serves as the functional equivalent of the levator aponeurosis of the upper eyelid. It is responsible for downward movement of the lower eyelid during inferior gaze and plays a key role in eyelid stability. Damage to this structure during surgical dissection may lead to complications such as lower eyelid retraction or ectropion. Additionally, the inferior oblique muscle originates near the anterior medial orbital floor and courses laterally beneath the inferior rectus muscle, making it susceptible to injury if surgical dissection extends too deeply or posteriorly. Careful identification of these structures is therefore critical during orbital floor exposure. [7,9]

Another important anatomical feature relevant to orbital floor surgery is the periosteum lining the orbital rim and floor. Incision of the periosteum at the infraorbital rim allows entry into the **subperiosteal plane**, which provides a safe surgical corridor for elevation of the orbital contents and exposure of the fractured orbital floor. Maintaining dissection within this plane protects the orbital fat and extraocular muscles while allowing adequate visualization for fracture reduction and implant placement. A thorough understanding of these anatomical relationships is therefore fundamental to the safe execution of the preseptal transconjunctival approach and contributes significantly to minimizing intraoperative and postoperative complications. [7–9]

Epidemiology and Mechanisms of Orbital Floor Fractures

Orbital floor fractures represent a significant proportion of midfacial injuries encountered in trauma practice and are commonly referred to as **"blowout fractures."** These injuries typically occur when blunt force is transmitted to the orbital region, resulting in increased intraorbital pressure that leads to fracture of the thin orbital floor. Epidemiological studies have demonstrated that orbital fractures frequently occur in young adult males and are commonly associated with interpersonal violence, road traffic accidents, sports injuries, and falls. The relatively thin structure of the orbital floor, particularly in its posterior medial portion, makes it especially susceptible to fracture when exposed to sudden compressive forces. Understanding the epidemiological distribution of these injuries is essential for clinicians involved in trauma management and reconstructive surgery. [10]

Two principal mechanisms have historically been proposed to explain the pathophysiology of orbital floor fractures: the **hydraulic theory** and the **buckling theory**. The hydraulic theory suggests that blunt trauma to the globe transmits a sudden increase in intraorbital pressure, which is then distributed to the orbital walls, leading to fracture of the weakest portion of the orbit—typically the orbital floor. In contrast, the buckling theory proposes that force applied to the infraorbital rim is transmitted posteriorly along the orbital floor, resulting in a bending or buckling effect that causes the bone to fracture. Contemporary biomechanical studies suggest that both mechanisms may contribute simultaneously, depending on the direction and magnitude of the traumatic force. [11]

Clinically, orbital floor fractures may present with a variety of functional and aesthetic manifestations. Patients frequently report symptoms such as diplopia, restricted ocular movement, infraorbital nerve numbness, and periorbital swelling. Herniation of orbital fat or entrapment of the inferior rectus muscle may lead to limited upward gaze and persistent diplopia. Additionally, disruption of the orbital floor can result in enlargement of the orbital cavity, which may produce **enophthalmos** or posterior displacement of the globe. These clinical findings are important indicators for surgical intervention, particularly when functional impairment or significant orbital volume changes are present. [12]

Radiologic evaluation plays a critical role in confirming the diagnosis and determining the extent of orbital floor fractures. **Computed tomography (CT)** is considered the imaging modality of choice because it provides detailed visualization of the bony orbital walls, orbital contents, and associated facial fractures. CT imaging allows clinicians to assess the size of the defect, the presence of muscle entrapment, and the degree of orbital tissue herniation into the maxillary sinus. Accurate radiological assessment is essential for preoperative planning and selection of the most appropriate surgical approach for orbital floor reconstruction. [10–12]

A clear understanding of the epidemiology and mechanisms underlying orbital floor fractures is fundamental for guiding treatment strategies. Recognition of the biomechanical forces responsible for these injuries helps surgeons anticipate fracture patterns and potential complications. This knowledge also provides a foundation for selecting optimal surgical techniques, such as the preseptal transconjunctival approach, which allows effective exposure of the orbital floor while minimizing complications related to lower eyelid disruption. [10–12]

Indications for Surgical Reconstruction of Orbital Floor Fractures

The management of orbital floor fractures depends on the severity of the injury, associated clinical symptoms, and the degree of orbital structural disruption. While many minor orbital floor fractures may be managed conservatively, surgical reconstruction becomes necessary when functional impairment or significant anatomical deformity is present. The primary goals of surgical treatment are to restore orbital volume, release entrapped orbital tissues, and prevent long-term complications such as persistent diplopia or enophthalmos. Determining appropriate indications for surgery is therefore critical in achieving optimal functional and aesthetic outcomes in patients with orbital trauma. [13]

One of the most widely accepted indications for surgical repair is **persistent diplopia associated with extraocular muscle entrapment**. Entrapment most commonly involves the inferior rectus muscle or adjacent orbital soft tissues, leading to restricted ocular motility and symptomatic double vision, particularly during upward gaze. This condition may be confirmed clinically through ocular motility testing and radiologically using computed tomography imaging. Early surgical intervention is generally recommended when muscle entrapment is identified, as prolonged incarceration may lead to muscle ischemia and fibrosis, potentially resulting in permanent motility dysfunction. [14]

Another important indication for surgical reconstruction is the presence of **significant enophthalmos or large orbital floor defects**. Enophthalmos occurs when increased orbital volume or herniation of orbital contents into the maxillary sinus leads to posterior displacement of the globe. Defects involving more than approximately **50% of the orbital floor or measuring greater than 2 cm²** are commonly associated with progressive enophthalmos and therefore frequently warrant surgical repair. Early reconstruction in such cases helps restore orbital volume and prevents delayed aesthetic deformities that may be difficult to correct secondarily. [15]

Infraorbital nerve dysfunction is another clinical feature frequently associated with orbital floor fractures. Patients may experience numbness or paresthesia affecting the lower eyelid, cheek, upper lip, and lateral nose due to compression or injury of the infraorbital nerve within the infraorbital canal. Although sensory disturbances may resolve spontaneously in some cases, persistent or progressive symptoms combined with radiographic evidence of significant fracture displacement may support the decision for surgical intervention. Additionally, large fractures associated with extensive orbital tissue herniation into the maxillary sinus may contribute to orbital volume expansion and functional impairment, further strengthening the indication for operative management. [13–15]

In clinical practice, the decision to proceed with surgery often involves a combination of radiological findings and clinical symptoms rather than reliance on a single criterion. Surgeons must carefully evaluate ocular motility, degree of enophthalmos, defect size, and patient-specific factors when determining the optimal management strategy. Once surgical repair is indicated, selection of an appropriate surgical approach becomes essential for achieving adequate exposure of the orbital floor while minimizing complications related to the lower eyelid. Among the available approaches, the transconjunctival technique—particularly the preseptal approach—has gained increasing popularity because it provides excellent access to the orbital floor with minimal risk of visible scarring or postoperative eyelid malposition. [13–15]

Historical Evolution of Surgical Approaches to the Orbital Floor

The surgical management of orbital floor fractures has evolved considerably over the past several decades as surgeons have sought techniques that provide adequate exposure while minimizing complications. Early surgical approaches to the orbital floor primarily relied on **external cutaneous incisions**, particularly the subciliary approach, which involves an incision just inferior to the lower eyelid eyelashes. This technique provided excellent visualization of the infraorbital rim and orbital floor and was widely adopted in early orbital fracture reconstruction. However, despite its effectiveness in providing surgical access, the subciliary approach was frequently associated with complications such as visible scarring, lower eyelid retraction, and ectropion, prompting surgeons to explore alternative surgical routes that could reduce these undesirable outcomes. [16]

Another commonly utilized external approach was the **subtarsal incision**, which is placed within a natural skin crease of the lower eyelid. The subtarsal approach offered improved scar concealment compared with the subciliary incision and allowed direct access to the infraorbital rim and orbital floor. Nevertheless, the technique still involved a cutaneous incision and therefore carried a risk of visible scarring and postoperative eyelid malposition. Although subtarsal incisions remain useful in certain clinical situations, particularly in complex midfacial trauma, many surgeons have sought methods that avoid skin incisions entirely to improve aesthetic outcomes. [17]

The introduction of the **transconjunctival approach** represented a significant advancement in orbital fracture surgery. This technique utilizes an incision through the conjunctiva of the lower eyelid, thereby avoiding external scars while providing direct access to the infraorbital rim and orbital floor. Initially described in oculoplastic surgery and later adopted in craniofacial and maxillofacial surgery, the transconjunctival approach rapidly gained popularity due to its favorable cosmetic results and reduced incidence of lower eyelid complications. Studies comparing transconjunctival and subciliary approaches have demonstrated lower rates of ectropion and scleral show with the transconjunctival technique, further supporting its growing use in orbital reconstruction. [18]

Within the transconjunctival approach, two principal surgical planes have been described: the **retroseptal** and **preseptal** approaches. The retroseptal technique involves dissection posterior to the orbital septum directly toward the orbital rim, while the preseptal technique involves dissection anterior to the septum before reaching the infraorbital rim. The preseptal approach has gained particular attention because it allows the surgeon to preserve the orbital septum and maintain the structural integrity of the lower eyelid support system. This anatomical preservation contributes to the reduced incidence of postoperative eyelid malposition associated with the technique. [16–18]

As surgical techniques continued to evolve, modifications such as **lateral canthotomy and cantholysis** were introduced to enhance exposure of the lateral orbital floor and rim when necessary. These adjunctive maneuvers allow surgeons to extend the operative field while maintaining the cosmetic advantages of the transconjunctival incision. Consequently, the modern management of orbital floor fractures increasingly favors the transconjunctival approach—particularly the **preseptal transconjunctival technique**—as it provides a balance between adequate surgical exposure, preservation of eyelid anatomy, and superior aesthetic outcomes. [16–18]

Overview of the Transconjunctival Approach

The **transconjunctival approach** has become one of the most widely accepted surgical techniques for accessing the orbital floor in the management of orbital fractures. Unlike traditional external incisions, this technique utilizes an incision through the conjunctiva of the lower eyelid, thereby eliminating visible cutaneous scars and improving postoperative cosmetic outcomes. The approach provides direct access to the infraorbital rim and orbital floor while preserving the external skin of the lower eyelid. As a result, it has gained increasing popularity among plastic surgeons, maxillofacial surgeons, and oculoplastic specialists involved in orbital reconstruction. [19]

The transconjunctival incision is typically placed within the inferior conjunctival fornix or just inferior to the tarsal plate, allowing entry into the surgical plane leading toward the infraorbital rim. Through careful dissection, the surgeon can elevate the lower eyelid tissues and reach the periosteum of the infraorbital rim, which can then be incised to access the subperiosteal plane along the orbital floor. This plane allows safe elevation of the orbital contents while exposing the fractured bone segments and enabling placement of reconstructive implants. The technique therefore provides excellent visualization of the orbital floor while maintaining the integrity of critical lower eyelid structures. [20]

One of the principal advantages of the transconjunctival approach is the reduced risk of postoperative eyelid complications compared with external approaches such as subciliary or subtarsal incisions. Because the incision is made within the conjunctiva, disruption of the anterior lamella of the lower eyelid is avoided, significantly decreasing the likelihood of complications such as ectropion, scleral show, and visible scarring. Numerous clinical studies have demonstrated favorable functional and aesthetic outcomes with this technique, making it an increasingly preferred approach in orbital fracture surgery. [21]

Another important advantage of the transconjunctival approach is its versatility. The surgical exposure can be extended when necessary by performing a **lateral canthotomy and cantholysis**, which allows improved access to the lateral orbital rim and floor. In addition, the approach can be combined with other minimally invasive extensions, such as the transcaruncular approach, to access fractures involving the medial orbital wall. These modifications provide surgeons with the flexibility to manage complex orbital fractures while preserving the cosmetic benefits of the conjunctival incision. [19–21]

Despite its advantages, successful use of the transconjunctival approach requires a thorough understanding of lower eyelid anatomy and careful surgical technique to avoid injury to important structures such as the capsulopalpebral fascia and inferior oblique muscle. Proper identification of the surgical plane is particularly important, as this determines whether the surgeon is performing a **preseptal or retroseptal dissection**. These two variations of the transconjunctival approach differ in their anatomical pathways and technical considerations, and understanding their distinctions is critical for selecting the most appropriate surgical method for orbital floor reconstruction. [19–21]

Preseptal Versus Retroseptal Transconjunctival Techniques

Within the transconjunctival approach to the orbital floor, two primary surgical planes have been described: the **preseptal** and **retroseptal** approaches. Both techniques provide access to the infraorbital rim and orbital floor through a conjunctival incision, but they differ in the anatomical plane of dissection relative to the orbital septum. Understanding the distinctions between these techniques is essential for surgeons performing orbital fracture repair, as the choice of approach may influence surgical exposure, ease of dissection, and the risk of postoperative eyelid complications. [22]

The **retroseptal approach** involves entering the orbital space posterior to the orbital septum after making the conjunctival incision. In this technique, the surgeon directly accesses the infraorbital rim by dissecting behind the septum and elevating the orbital contents. The retroseptal pathway is relatively straightforward and allows rapid exposure of the orbital rim and floor. However, because this method requires dissection closer to the orbital fat and intraorbital structures, there is a potential risk of fat herniation or injury to delicate orbital tissues if the surgical plane is not carefully maintained. [23]

In contrast, the **preseptal transconjunctival approach** involves dissection anterior to the orbital septum. After the conjunctival incision is made just below the tarsal plate, the surgeon carefully dissects in the plane between the orbicularis oculi muscle and the orbital septum. This dissection continues inferiorly toward the infraorbital rim, where the periosteum can be incised to access the subperiosteal plane of the orbital floor. By preserving the integrity of the orbital septum, the preseptal technique helps maintain the structural support of the lower eyelid and reduces the likelihood of postoperative eyelid malposition. [24]

Several studies have evaluated the clinical outcomes associated with both techniques. Although both the preseptal and retroseptal approaches provide adequate exposure of the orbital floor, the preseptal technique is often favored by many surgeons because it preserves the orbital septum and may provide a more controlled surgical plane. Preservation of the septum contributes to improved lower eyelid stability and may decrease the risk of complications such as ectropion, scleral show, and postoperative eyelid retraction. As a result, the preseptal approach has gained increasing acceptance in modern orbital reconstructive surgery. [22–24]

Another advantage of the preseptal approach is the ability to maintain clear anatomical orientation during dissection. Because the surgeon remains anterior to the septum until reaching the infraorbital rim, the surgical field is typically less obscured by orbital fat compared with the retroseptal technique. This controlled exposure can facilitate safer identification of the infraorbital rim and periosteum, ultimately improving surgical precision during fracture reduction and implant placement. For these reasons, the preseptal transconjunctival technique is increasingly considered a reliable and cosmetically favorable method for orbital floor fracture reconstruction. [22–24]

Surgical Technique of the Preseptal Transconjunctival Approach

The **preseptal transconjunctival approach** is widely used in orbital floor fracture reconstruction because it allows excellent access to the infraorbital rim and orbital floor while preserving the external appearance of the lower eyelid. Successful execution of this technique requires a detailed understanding of lower eyelid anatomy and careful adherence to surgical principles. The primary objective of the approach is to safely reach the orbital floor through a conjunctival incision while maintaining the integrity of the orbital septum and supporting structures of the lower eyelid. This anatomical preservation contributes to the favorable functional and cosmetic outcomes associated with the technique. [25]

The procedure typically begins with the patient under general anesthesia, although local anesthesia with sedation may be used in selected cases. The lower eyelid is gently retracted using a Desmarres retractor or similar instrument to expose the inferior conjunctival fornix. A **transconjunctival incision** is then made approximately 2–3 mm inferior to the tarsal plate along the palpebral conjunctiva. This incision allows entry into the preseptal plane located between the orbicularis oculi muscle and the orbital septum. Careful blunt dissection is performed within this plane to avoid injury to the septum and maintain the anatomical integrity of the eyelid structures. [26]

As the dissection proceeds inferiorly, the surgeon continues to separate the orbicularis muscle from the orbital septum until reaching the infraorbital rim. Maintaining the correct preseptal plane during this stage is essential to prevent inadvertent entry into the orbital fat compartment. Once the infraorbital rim is exposed, the periosteum overlying the rim is incised, allowing elevation of a **subperiosteal flap** along the orbital floor. This step provides direct visualization of the fracture site and allows the surgeon to identify displaced bone fragments and herniated orbital tissues. [27]

After adequate exposure of the fracture has been achieved, herniated orbital contents are carefully mobilized and repositioned back into the orbital cavity. The orbital floor defect is then reconstructed using appropriate implant materials such as titanium mesh, porous polyethylene implants, or resorbable plates, depending on the size and configuration of the defect. Accurate positioning of the implant is essential to restore orbital volume and prevent postoperative enophthalmos or persistent diplopia. The implant is typically placed within the subperiosteal space to recreate the contour of the native orbital floor. [25–27]

Following reconstruction of the orbital floor, the surgical field is irrigated and hemostasis is ensured. Because the conjunctival incision is small and well vascularized, it often does not require suturing; however, some surgeons prefer to close the incision with fine absorbable sutures to promote optimal healing. If a lateral canthotomy was performed to improve surgical exposure, the lateral canthus is repaired at the end of the procedure. Postoperatively, patients are monitored for ocular motility, visual acuity, and signs of complications such as hematoma, infection, or implant malposition. When performed with meticulous technique, the preseptal transconjunctival approach provides reliable exposure of the orbital floor with minimal risk of visible scarring or lower eyelid deformity. [25–27]

Exposure and Access to the Orbital Floor

Adequate surgical exposure is a fundamental requirement for successful reconstruction of orbital floor fractures. The **preseptal transconjunctival approach** provides a reliable pathway to the infraorbital rim and orbital floor while maintaining the cosmetic advantages associated with a conjunctival incision. Proper exposure allows surgeons to accurately visualize the fracture margins, identify herniated orbital tissues, and ensure precise placement of reconstructive implants. Achieving optimal access to the orbital floor requires careful dissection along the correct anatomical planes and appropriate use of surgical retractors to maintain clear visualization throughout the procedure. [28]

Following incision of the conjunctiva and dissection through the preseptal plane, the surgeon reaches the infraorbital rim where the periosteum is incised to enter the **subperiosteal plane** of the orbital floor. Elevation of the periosteum in this plane is critical because it allows safe mobilization of orbital contents without direct manipulation of orbital fat or extraocular muscles. Using periosteal elevators, the surgeon carefully dissects posteriorly along the orbital floor to expose the full extent of the fracture. This subperiosteal dissection protects the delicate intraorbital structures while providing a clear surgical field for reconstruction. [29]

The extent of exposure required depends on the size and location of the fracture. Small isolated orbital floor defects may require only limited dissection, whereas larger fractures involving the posterior orbital floor or extending toward the medial wall necessitate broader exposure. In such cases, careful posterior dissection is required to identify the posterior margin of the defect and ensure that the reconstructive implant adequately supports the entire orbital floor. Inadequate exposure may result in incomplete reconstruction or improper implant positioning, which can contribute to postoperative complications such as persistent enophthalmos or diplopia. [30]

In some situations, the standard transconjunctival incision may not provide sufficient visualization of the lateral orbital rim or posterior floor. To address this limitation, surgeons may perform a **lateral canthotomy and inferior cantholysis**, which temporarily releases the lateral canthal tendon and allows greater mobility of the lower eyelid. This maneuver significantly improves surgical exposure and facilitates access to the lateral orbital wall and posterior floor. Importantly, the lateral canthus is typically repaired at the conclusion of the procedure to restore normal eyelid anatomy and function. [28–30]

Proper retraction of the lower eyelid tissues is another important factor in maintaining adequate exposure during surgery. Specialized retractors such as the Desmarres retractor or malleable orbital retractors are commonly used to protect the globe and orbital contents while allowing the surgeon to work within the confined orbital space. Through careful dissection, controlled retraction, and precise identification of anatomical landmarks, the preseptal transconjunctival approach provides safe and effective access to the orbital floor. These technical considerations are essential for ensuring accurate fracture reduction and successful orbital reconstruction. [28–30]

Implant Materials in Orbital Floor Reconstruction

Successful reconstruction of orbital floor fractures requires not only adequate surgical exposure but also the appropriate selection of implant materials capable of restoring the structural integrity and contour of the orbital floor. The primary objective of orbital implants is to support the orbital contents, re-establish the normal orbital volume, and prevent complications such as enophthalmos or persistent diplopia. Over the years, a variety of implant materials have been developed and utilized in orbital reconstruction, including autogenous grafts, alloplastic materials, and resorbable implants. The choice of material often depends on factors such as defect size, surgeon preference, implant availability, and long-term stability. [31]

Historically, **autogenous bone grafts** harvested from sites such as the calvarium, iliac crest, or anterior maxillary wall were widely used for orbital floor reconstruction. These grafts offered the advantage of excellent biocompatibility and minimal risk of immunologic reaction. However, the use of autogenous bone is associated with several disadvantages, including donor site morbidity, increased operative time, and the potential for graft resorption or contour irregularities over time. As a result, the use of autologous bone grafts has gradually declined with the increasing availability of reliable synthetic materials for orbital reconstruction. [32]

Among the most commonly used alloplastic materials is **titanium mesh**, which has gained widespread acceptance in orbital fracture repair. Titanium mesh offers several advantages, including high strength, malleability, and excellent structural support for large orbital defects. The material can be easily contoured intraoperatively to match the natural curvature of the orbital floor, allowing precise restoration of orbital anatomy. Additionally, titanium mesh is radiopaque, which facilitates postoperative imaging assessment to confirm appropriate implant positioning. However, potential disadvantages include implant palpability in thin tissues and the theoretical risk of long-term exposure or infection. [33]

Another widely utilized implant material is **porous polyethylene**, commonly known by commercial names such as Medpor. Porous polyethylene implants are biocompatible and allow fibrovascular ingrowth, which enhances implant stabilization and integration with surrounding tissues. These implants are lightweight and easy to shape, making them suitable for reconstruction of moderate orbital floor defects. The porous structure also reduces the risk of implant migration. Nevertheless, unlike titanium mesh, porous polyethylene implants are radiolucent and therefore may be less easily visualized on postoperative imaging studies. [31–33]

In recent years, **resorbable implants** have also been introduced for orbital floor reconstruction, particularly in pediatric patients and small orbital defects. These materials gradually degrade over time, reducing the long-term presence of foreign material within the orbit. While resorbable implants may provide temporary structural support during the healing process, their use is generally limited to smaller defects because they may not provide sufficient long-term rigidity for larger fractures. Consequently, the selection of implant material should be individualized based on the size and complexity of the orbital defect as well as the surgeon's experience and preference. When combined with the preseptal transconjunctival approach, appropriate implant selection plays a critical role in achieving stable orbital reconstruction and optimal clinical outcomes. [31–33]

Comparative Outcomes with Subciliary and Subtarsal Approaches

Comparative studies of lower eyelid incisions for orbital floor repair have consistently shaped modern preference toward the transconjunctival route because postoperative eyelid position and scar quality are major determinants of success in orbital reconstruction. In classic comparative series, the transconjunctival approach provided exposure comparable to external incisions while demonstrating fewer lower-lid sequelae than the subciliary approach. Appling and colleagues reported lower rates of postoperative eyelid retraction problems with the transconjunctival preseptal technique than with a subciliary skin-muscle flap approach, supporting the shift away from routine subciliary exposure for isolated orbital floor and rim fractures. Similarly, Patel et al found a higher complication burden with subciliary incisions and favored the transconjunctival route for orbital fracture management. [34,35]

The major advantage of the transconjunctival approach over the **subciliary approach** is the reduction in visible scar and lower-lid malposition. In the study by Appling et al, the subciliary group showed transient ectropion in 12% and permanent scleral show in 28%, whereas the transconjunctival group had no transient ectropion and only 3% permanent scleral show. These findings became highly influential because they addressed the two complications surgeons most wish to avoid in orbital surgery: lower eyelid retraction and an obvious postoperative aesthetic deformity. Later comparative work by Patel et al also concluded that the subciliary approach carried a higher complication rate overall, despite satisfactory exposure. [34,35]

More recent higher-level evidence has generally reinforced this pattern. A 2017 systematic review and meta-analysis by Al-Moraissi and colleagues found that the subciliary approach had a significantly higher incidence of **ectropion** and **scleral show** than the transconjunctival approach, whereas the transconjunctival route showed a higher incidence of **entropion**. Importantly, the authors concluded that, overall, the transconjunctival approach demonstrated the lowest incidence of complications. For a review focused on the preseptal transconjunctival technique, this evidence is particularly relevant because it supports the broader reconstructive principle that preservation of lower eyelid support and avoidance of skin incision can improve postoperative aesthetic outcomes. [36]

Comparison with the **subtarsal approach** is somewhat more nuanced. The subtarsal incision remains an effective and acceptable option, particularly when direct access, rapid exposure, or surgeon familiarity favors a transcutaneous route. In a long-term comparison, Strobel et al found no significant difference in overall complication rates between subtarsal and transconjunctival approaches, but they did identify visible although generally mild scar formation in some subtarsal cases. This suggests that the subtarsal approach may offer satisfactory functional results, yet it does not fully reproduce the scarless aesthetic advantage of the transconjunctival route. For this reason, many reconstructive surgeons still prefer the transconjunctival approach when cosmetic outcome is a primary consideration. [37]

From a plastic and reconstructive surgery perspective, these comparative data explain why the **preseptal transconjunctival approach** has become increasingly favored in orbital floor fracture reconstruction. It combines adequate exposure with a low risk of visible scar and a lower incidence of postoperative lower-lid malposition than the subciliary route, while also offering a cosmetic advantage over the subtarsal incision. Although no single approach is ideal for every fracture pattern, the current comparative literature supports the transconjunctival technique—especially in experienced hands—as the most balanced option for achieving both functional restoration and favorable lower-eyelid aesthetics. [34–37]

Lower Eyelid Complications and Their Prevention

Lower eyelid complications remain one of the most important outcome measures after orbital floor fracture repair because even technically successful bony reconstruction may be judged unsatisfactory if postoperative eyelid position is altered. The most frequently discussed complications include **ectropion, entropion, scleral show, lower eyelid retraction, chemosis, and persistent edema**. Among these, lower eyelid malposition is particularly relevant because it can produce both functional symptoms, such as ocular irritation and exposure, and aesthetic deformity. Large clinical reviews of the transconjunctival approach have shown that these complications are generally uncommon when the technique is performed correctly, supporting its reputation as a reliable and cosmetically favorable route to the inferior orbit. [38]

Compared with external lower-lid incisions, the transconjunctival approach has repeatedly demonstrated a lower risk of postoperative eyelid malposition, especially **ectropion and scleral show**. A systematic review and meta-analysis found that the subciliary approach was associated with significantly higher rates of ectropion and scleral show than the transconjunctival approach, although the transconjunctival route showed a relatively greater tendency toward entropion. This distinction is clinically important because it explains why many reconstructive surgeons now favor transconjunctival access, particularly when aesthetic outcome and preservation of lower-lid support are priorities in orbital floor reconstruction. [39]

The mechanisms underlying lower eyelid complications are closely related to disruption of the delicate support system of the lower lid. Excessive scarring of the anterior lamella, violation of the orbital septum, injury to the capsulopalpebral fascia, overaggressive dissection, and inadequate soft-tissue handling can all contribute to postoperative malposition. Clinical comparative work has shown that lower eyelid complications occur more frequently after transcutaneous approaches than after transconjunctival exposure, reinforcing the principle that preservation of normal eyelid anatomy reduces morbidity. However, lower-lid problems may still occur after transconjunctival surgery, particularly in patients with severe trauma, pre-existing lid laxity, or when extensive canthal release is required. [40]

Prevention of these complications begins with meticulous surgical technique. In the **preseptal transconjunctival approach**, maintenance of the correct plane anterior to the orbital septum helps preserve lower-lid support and reduces unnecessary trauma to orbital tissues. Gentle retraction, limited cautery, precise periosteal incision at the infraorbital rim, and careful repair of any lateral canthotomy are all essential steps. Comparative clinical studies of the preseptal transconjunctival approach versus subciliary access have supported the favorable lower-eyelid profile of the preseptal technique, particularly with respect to scar avoidance and reduced postoperative lid malposition. [41]

Postoperative management is also important in minimizing eyelid complications. Edema control, ocular lubrication, temporary frost sutures in selected high-risk cases, and close follow-up for early signs of malposition can improve outcomes. When mild postoperative scleral show or retraction occurs, conservative management may be sufficient during the early healing period, whereas persistent ectropion or entropion may require secondary correction. Overall, the available literature supports the conclusion that the **preseptal transconjunctival approach**, when performed with sound anatomical knowledge and careful tissue handling, offers one of the lowest-risk profiles for lower eyelid complications in orbital floor fracture surgery. [38–41]

Conclusion

Orbital floor fractures remain a common challenge in craniofacial trauma, requiring precise surgical management to restore orbital anatomy, preserve ocular function, and achieve satisfactory aesthetic outcomes. Advances in surgical techniques have significantly improved the management of these injuries, particularly through the development of minimally invasive approaches that minimize complications while maintaining adequate surgical exposure. Among these, the **preseptal transconjunctival approach** has emerged as a reliable and cosmetically advantageous method for accessing the orbital floor.

One of the principal advantages of the preseptal transconjunctival approach is its ability to provide excellent visualization of the infraorbital rim and orbital floor without the need for external skin incisions. This characteristic eliminates visible scarring and substantially reduces the risk of postoperative lower eyelid malposition, which has historically been associated with traditional transcutaneous approaches. By preserving the integrity of the orbital septum and lower eyelid support structures, the preseptal technique contributes to improved postoperative eyelid stability and overall aesthetic outcomes.

The success of this approach, however, depends largely on a thorough understanding of orbital and lower eyelid anatomy as well as meticulous surgical technique. Proper identification of the preseptal plane, careful subperiosteal dissection along the orbital floor, and appropriate implant selection are essential components of successful reconstruction. When these principles are respected, the approach provides safe access to the orbital floor and allows accurate fracture reduction and restoration of orbital volume.

In addition, the versatility of the transconjunctival approach allows it to be adapted for more complex orbital fractures through modifications such as lateral canthotomy or combined approaches when greater exposure is required. These refinements further expand the applicability of the technique while maintaining its cosmetic advantages.

In conclusion, the **preseptal transconjunctival approach** represents an effective and widely accepted method for orbital floor fracture reconstruction. Its combination of excellent surgical exposure, preservation of lower eyelid anatomy, and favorable aesthetic outcomes makes it an important technique in modern plastic and reconstructive surgery. Continued refinement of surgical methods and implant technologies will likely further enhance the role of this approach in the management of orbital trauma.

References

1. Burnstine MA. Clinical recommendations for repair of orbital facial fractures. *Curr Opin Ophthalmol.* 2003;14(5):236-240.
2. Manson PN, Iliff N, Nahai F, Yaremchuk M. Comprehensive management of orbital fractures. *Plast Reconstr Surg.* 1986;77(3):347-359.
3. Ellis E III, Tan Y. Assessment of internal orbital reconstructions for pure blowout fractures: cranial bone grafts versus titanium mesh. *J Oral Maxillofac Surg.* 2003;61(4):442-453.
4. Converse JM, Smith B, Obear MF, Wood-Smith D. Orbital blowout fractures: a ten-year survey. *Plast Reconstr Surg.* 1967;39(1):20-36.
5. Smith B, Regan WF Jr. Blow-out fracture of the orbit: mechanism and correction of internal orbital fracture. *Am J Ophthalmol.* 1957;44(6):733-739.
6. Hammer B. *Orbital Fractures: Diagnosis, Operative Treatment, Secondary Corrections.* Springer; 1995.
7. Hollier LH Jr, Grantcharova EP, Kattash M. Facial trauma: general considerations. *J Craniofac Surg.* 2001;12(3):220-226.
8. Ellis E III. Orbital trauma. *Oral Maxillofac Surg Clin North Am.* 2012;24(4):629-648.
9. Dubois L, Steenen SA, Gooris PJ, Mourits MP, Becking AG. Controversies in orbital reconstruction—I. Defect-driven orbital reconstruction: a systematic review. *Int J Oral Maxillofac Surg.* 2015;44(3):308-315.
10. Hwang K, You SH. Analysis of orbital bone fractures: a 12-year study of 391 patients. *J Craniofac Surg.*

2010;21(4):1218-1223.
11. Fujino T. Experimental "blowout" fracture of the orbit. *Plast Reconstr Surg.* 1974;54(1):81-82.
12. Ahmad F, Kirkpatrick NA, Lyne J, Uddin J, Menezes CN. Buckling and hydraulic mechanisms in orbital blowout fractures: fact or fiction? *J Craniofac Surg.* 2006;17(3):438-441.
13. Burnstine MA. Clinical recommendations for repair of orbital floor fractures. *Ophthalmology.* 2002;109(7):1207-1210.
14. Jordan DR, Allen LH, White J, Harvey J, Pashby R, Esmaeli B. Intervention within days for some orbital floor fractures: the white-eyed blowout fracture. *Ophthal Plast Reconstr Surg.* 1998;14(6):379-390.
15. Hawes MJ, Dortzbach RK. Surgery on orbital floor fractures: influence of time of repair and fracture size. *Ophthalmology.* 1983;90(9):1066-1070.
16. Appling WD, Patrinely JR, Salzer TA. Transconjunctival approach versus subciliary skin-muscle flap approach for orbital fracture repair. *Arch Otolaryngol Head Neck Surg.* 1993;119(9):1000-1007.
17. Patel PC, Sobota BT, Patel NM, Greene JS, Millman B. Comparison of transconjunctival versus subciliary approaches for orbital fractures. *J Oral Maxillofac Surg.* 1998;56(4):426-431.
18. Converse JM, Firmin F, Wood-Smith D, Friedland JA. The conjunctival approach in orbital fractures. *Plast Reconstr Surg.* 1973;52(6):656-657.
19. Holt GR, Holt JE, Blodgett JM. Oculoplastic approach to orbital floor fractures. *Otolaryngol Head Neck Surg.* 1984;92(3):251-256.
20. Burm JS, Chung CH, Oh SJ. Pure orbital blowout fracture: new concepts and importance of medial orbital blowout fracture. *Plast Reconstr Surg.* 1999;103(7):1839-1849.
21. Ridgway EB, Chen C, Lee BT. Acquired enophthalmos: classification and management. *Plast Reconstr Surg.* 2009;124(6):2053-2062.
22. Mullins JB, Holds JB, Branham GH. Complications of the transconjunctival approach. *Ophthal Plast Reconstr Surg.* 1997;13(3):200-205.
23. Rohrich RJ, Hollier LH. Orbital fracture management. *Clin Plast Surg.* 1992;19(1):91-104.
24. Ellis E III, Zide MF. *Surgical Approaches to the Facial Skeleton.* 2nd ed. Lippincott Williams & Wilkins; 2006.
25. Zide BM, Jelks GW. Surgical anatomy of the orbit. *Plast Reconstr Surg.* 1985;76(4):543-546.
26. Hwang K. Surgical anatomy of the lower eyelid relating to the transconjunctival approach. *J Craniofac Surg.* 2010;21(2):546-549.
27. Yaremchuk MJ. Infraorbital rim and orbital floor reconstruction. *Plast Reconstr Surg.* 1992;89(5):795-802.
28. Gosau M, Schöneich M, Draenert FG, Ettl T, Driemel O, Reichert TE. Retrospective analysis of orbital floor fractures. *J Craniomaxillofac Surg.* 2011;39(5):354-358.
29. Dubois L, Steenen SA, Gooris PJ, Mourits MP, Becking AG. Controversies in orbital reconstruction—II. Timing of post-traumatic orbital reconstruction. *Int J Oral Maxillofac Surg.* 2015;44(4):433-440.
30. Ellis E III, Reddy L. Status of the internal orbital reconstruction. *J Oral Maxillofac Surg.* 2004;62(1):27-36.
31. Kontio R, Lindqvist C, Suuronen R. Titanium mesh reconstruction of orbital floor fractures. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2001;92(6):639-645.
32. Gear AJ, Lokeh A, Aldridge JH, et al. Safety of titanium mesh for orbital reconstruction. *Ann Plast Surg.* 2002;48(1):1-7.
33. Lee HB, Nunery WR. Orbital implants in orbital fracture repair. *Ophthal Plast Reconstr Surg.* 2009;25(4):290-296.
34. Appling WD, Patrinely JR, Salzer TA. Transconjunctival versus subciliary approach for orbital fractures. *Arch Otolaryngol Head Neck Surg.* 1993;119:1000-1007.
35. Patel PC, Sobota BT, Patel NM. Comparison of transconjunctival and subciliary approaches. *J Oral Maxillofac Surg.* 1998;56:426-431.
36. Al-Moraissi EA, Ellis E III. Subciliary versus transconjunctival approach for orbital fractures: systematic review and meta-analysis. *J Craniofac Surg.* 2017;28(3):745-752.
37. Strobel L, Schneider M, Rana M, et al. Subtarsal versus transconjunctival approach for orbital fracture repair. *J Craniomaxillofac Surg.* 2015;43(9):1919-1924.
38. Mullins JB, Holds JB, Branham GH. Complications of the transconjunctival approach. *Ophthal Plast Reconstr Surg.* 1997;13(3):200-205.
39. Al-Moraissi EA, Ellis E III. Surgical approaches to orbital fractures: systematic review. *J Craniomaxillofac Surg.* 2017;45(3):379-388.
40. Ridgway EB, Chen C, Colakoglu S, Lee BT. Management of orbital fractures. *Plast Reconstr Surg.* 2009;124(6):2053-2062.
41. Mohan K, Saha S, Kaur R. Preseptal transconjunctival approach in orbital floor fractures. *J Maxillofac Oral Surg.* 2012;11(4):439-444.