Review Article

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Naso-orbital-ethmoidal (NOE) fractures: Surgical Anatomy, Management, and Controversies

Abstract:
Naso-orbital-ethmoidal (NOE) fractures are among the most complex maxillofacial injuries, involving disruption of the nasal, lacrimal, and medial orbital structures. They often result in telecanthus, nasal flattening, and functional deformities. Accurate diagnosis relies on clinical assessment, the bimanual nasoethmoidal test, and computed tomography. Management has evolved from closed reduction to open reduction with rigid fixation based on the Markowitz classification. Early surgical intervention within two weeks yields optimal results. The coronal approach provides excellent exposure, while autogenous bone grafting—preferably calvarial—is essential in comminuted fractures. Despite advances in fixation and grafting, controversies persist regarding surgical timing, approach selection, and management of the canthal and lacrimal systems. Successful outcomes depend on precise anatomical restoration and multidisciplinary care.

Key-words: Naso-orbital-ethmoidal fracture; medial canthal tendon; telecanthus; open reduction and internal fixation; coronal approach; bone grafting; facial trauma; Markowitz classification; lacrimal system injury; midface reconstruction.

Introduction:

Naso-orbital-ethmoidal (NOE) fractures represent some of the most complex and demanding injuries in maxillofacial trauma. Their intricate anatomy, association with critical functional structures, and challenging fracture fixation make them uniquely difficult to diagnose and manage. The incidence of NOE fractures is steadily rising, largely due to the increasing frequency of high-speed accidents. Effective management requires meticulous attention to both hard and soft tissues, underpinned by a detailed understanding of regional anatomy. Misdiagnosis or delayed and inadequate treatment frequently results in facial deformities and functional deficits that are only partially correctable with secondary interventions [1–4]. Despite decades of clinical experience, the optimal treatment strategy for NOE fractures continues to generate debate. This article reviews the surgical anatomy, clinical considerations, and controversies in management, while aligning current practices with modern maxillofacial trauma principles.

Clinical Diagnosis of NOE Fractures:

Blunt midfacial trauma should always raise suspicion for NOE fractures. Classic clinical features include telecanthus, enophthalmos, shortening of the palpebral fissure, and a flattened or retruded nasal bridge (Figure 1) [1,5–7]. Proper treatment gives good functional and aesthetic results. (Figure 2) Localized ecchymosis and edema are common in isolated fractures, whereas panfacial trauma results in diffuse swelling [8].

The bimanual nasoethmoidal examination remains the gold standard for clinical diagnosis [8,9]. Palpation with the thumb and index finger, combined with an intranasal Kelly clamp helps assess movement of the central canthus-bearing fragment. Instability indicates the need for surgical repair. Accurate placement of the examining finger over the canthal ligament is essential to avoid misdiagnosis.

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Measurement of the intercanthal distance is also crucial. In Caucasians, the normal range is 32–34 mm in females and 33–34 mm in males [5]. Distances greater than 35 mm suggest displacement, while those over 40 mm are highly indicative of fracture [5].

Controversies in Management:

Early Versus Delayed Treatment:

Prior to the 1960s, closed reduction and splint fixation were common [1,6,10]. The paradigm shifted when Mustarde and Dingman demonstrated the superiority of open reduction with internal fixation [11,12]. Stranc further highlighted the importance of addressing medial canthal tendon avulsion with transnasal wiring [13]. While no universal consensus exists on timing, most authors recommend intervention within two weeks [1]. Delay beyond this period complicates reduction and tendon retrieval, particularly in type III injuries [8]. Ideally, repair should occur once edema subsides, but not later than 10–14 days, assuming patient stability.

Closed Versus Open Reduction:

Closed techniques fail to restore nasal projection and often lead to persistent telecanthus, making open reduction the standard of care. The Markowitz classification [2] remains central to guiding treatment:

- Type I: Large tendon-bearing fragment, easily stabilized with three-point fixation.
- Type II: Comminuted fractures with tendon still attached to a larger fragment; requires microplates and wires for fixation.
- Type III: Extensive comminution with tendon attached to a tiny fragment or avulsed; requires transnasal canthopexy or tendon suturing.

Overcorrection of the intercanthal distance is often preferred, as it yields a more aesthetically acceptable result than undercorrection.

Surgical Approaches:

The coronal incision remains the gold standard, providing wide exposure of the nasofrontal junction and medial orbital walls, as well as access for calvarial graft harvest. Alternative incisions, (Figure 3,4,5,6,7) such as the Lynch or open-sky approaches, are more limited but produce satisfactory results, if carried out correctly. Midfacial degloving avoids external scars but provides inadequate access to the orbital floor [14]. Adjunctive approaches—such as transconjunctival, subciliary, or intraoral vestibular incisions—are frequently combined with coronal exposure to achieve three-dimensional visualization and fixation.

Lacrimal System Considerations:

Lacrimal dysfunction is uncommon when management is timely. Prophylactic dacryocystorhinostomy is not recommended, as post-traumatic obstruction occurs in only 5–17.4% of cases [15–18]. Intervention is reserved for cases with clear injury or symptomatic obstruction.

Grafting in Type II and III Injuries:

In type II and III fractures, reconstruction of the nasal dorsum with autogenous bone grafts is essential to restore projection, support weakened septal structures, and prevent saddle deformity [1,3,4,8,17]. Medial orbital wall reconstruction may also be required to support the canthal tendon and prevent enophthalmos [1,3].

The parietal calvarium is the graft of choice, offering strength and proximity during coronal access. Alternative donor sites include the mandible, iliac crest, and ribs [3]. Alloplastic grafts are generally avoided due to higher infection risk. Rigid fixation with screws ensures long-term stability.

Figure 1 Bilateral NOE fracture in a female

Figure 2Post operative frontal profile view

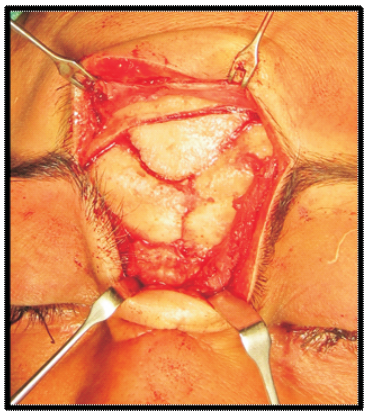

Figure 3 NOE fracture approached through existing laceration

Figure 4 ORIF of NOE fracture

Figure 5 Closure of NOE fracture

Summary:

The management of NOE fractures demands a careful balance of anatomical knowledge, precise diagnosis, and timely intervention. Early repair, broad exposure through aesthetic incisions, and judicious use of bone grafting with rigid fixation are the cornerstones of successful treatment. Despite their complexity, these fractures can be managed with excellent functional and aesthetic outcomes when addressed systematically and promptly.

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