



In-fracture and Out-fracture: Novel Conceptions of Nasoorbitoethmoid Injury

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Introduction

- Nasoorbitoethmoid (NOE) fractures are commonly categorized by the Markowitz-Manson classification system which grades severity of injury by degree of comminution and involvement of the medial canthal tendon.¹
- However, this system does not account for directionality of bony injury, which may impact clinical findings, such as nasal airway obstruction.
- Among the possible patterns of displacement, these fractures may be non-displaced, impacted, or blown-out.

Hypothesis:

Type I fractures are more frequently impacted (“in-fractured”), whereas Type III fractures are more often blown-out (“out-fractured”).

Methods

Study Design:

Retrospective analysis of NOE fractures at a Level I trauma center from 2011 - 2022.

- Inclusion criteria: all patients ≥ 18 years old with diagnosis of a NOE fracture based on high-resolution computed tomography (CT) scans and 3D reconstruction.
- Exclusion criteria: all patients with repeat facial trauma or previous surgical facial fracture fixation.
- Each CT scan reviewed by the senior surgeon and a trained plastic surgery resident.
- Axial, coronal, and three-dimensional reconstructions were evaluated.
- First, NOE fractures were defined based on their Markowitz-Manson classification. Second, fractures were subsequently analyzed for vector displacement of the central fragment relative to the nasofrontal junction. Possible vectors included none (“non-displaced”), impaction (“in-fracture”), or blowout (“out-fracture”).

NOE Injury

Type I, II, III?

Non-displaced,
In-fracture,
Out-fracture?

Results

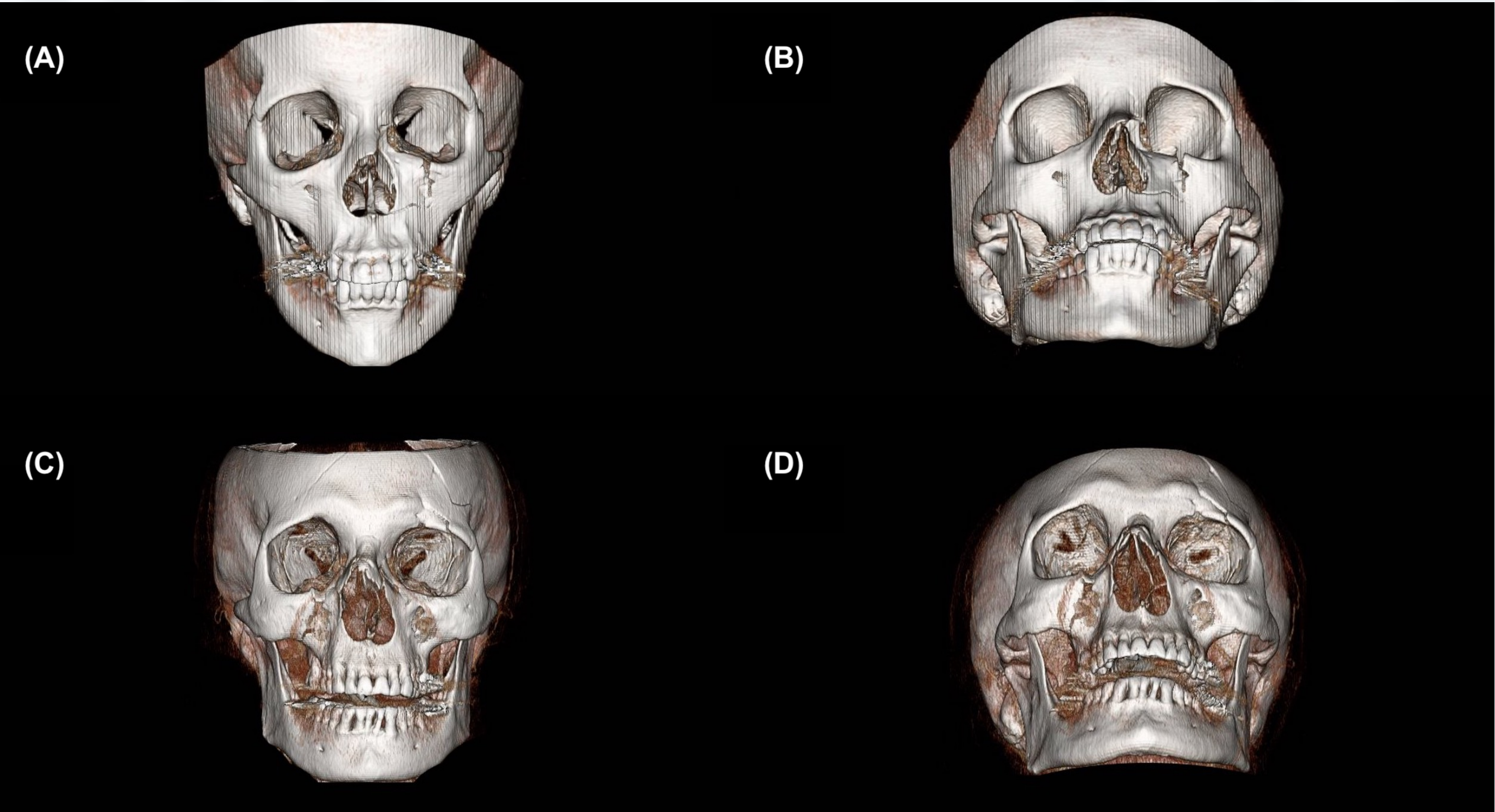


Figure 1. 3D reconstructions of CT images demonstrating Type I in-fracture from (A) anterior and (B) inferior views, and Type I out-fracture from (C) anterior and (D) inferior views.

Total Cohort (n = 112)	Frequency (n)	%
Age (mean $\pm$ SD)	47.9 $\pm$ 22.0	
Sex		
Male	83	74.1%
Female	29	25.9%
Mechanism of Injury		
Fall	32	28.6%
Vehicle Trauma	33	29.5%
Assault	26	23.2%
Other	19	17.0%
NOE Injury (n = 142)		
Type I	116	81.7%
Type II	20	14.1%
Type III	6	4.2%
Operative Intervention	42	29.6%

Table 1. Demographic and clinical data.

NOE Type	Non-displaced	In-fracture	Out-fracture
Type I	38 (32.8%)	57 (49.1%)	21 (18.1%)
Type II	4 (20.0%)	10 (50%)	6 (30.0%)
Type III	0	1 (16.7%)	5 (83.3%)

Table 2. Distribution of central fragment vector displacement by NOE fracture type.

NOE Type	In-fracture	Out-fracture	p-value
Type I	57	21	p = 0.0039
Type III	1	5	

Table 3. Comparison of central fragment vector displacement between displaced Type I and Type III fractures.

Conclusions

Takeaways:

- Type III fractures are rare, accounting for only 4.2% of NOE injuries.
- Type I fractures are more common, accounting for 81.7% of this injury type.
- Type I NOE fractures more frequently present with non-displacement or in-fracture, whereas comminuted injuries such as Type III are typically out-fractured.
- While clinical suspicion for traumatic telecanthus in the setting of NOE injury is warranted, this symptom is only present among a minority of these fractures (ie. type III).
- Given that the majority of NOE injuries are classified as Type I, and these injuries are most often in-fractured, clinicians ought to be suspicious for symptoms relating to central fragment impaction, such as nasal airway obstruction, rather than traumatic telecanthus.

81% of NOE Injuries are Type I

Type I fractures are most often non-displaced or in-fractured

Increased clinical suspicion for nasal airway obstruction—not traumatic telecanthus

Future directions:

- Further study will validate these findings in a larger cohort and correlate radiography with clinical symptoms

References

- Markowitz, BL., Manson, PN et al., Management of the Medial Canthal Tendon in Nasoethmoid Orbital Fractures: The Importance of the Central Fragment in Classification and Treatment. Plastic and Reconstructive Surgery 87(5):p 843-853, May 1991.