

Traumatic Skull Base Encephaloceles: Outcomes and Management of a Rare Phenomenon



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Introduction

- Traumatic encephaloceles, defined as the herniation of brain tissue, meninges, and cerebrospinal fluid (CSF) through an opening in the skull, are rare but serious complications of head trauma.
- Skull base fractures occur in ~20% of head injuries, typically following high velocity trauma (motor vehicle accidents, penetrating injuries, falls).
- While the management of congenital and spontaneous encephaloceles is well described, traumatic encephalocele management and natural history are underreported.
- Anterior skull base (frontal, ethmoid, sphenoid) encephaloceles are associated with vision changes, CSF rhinorrhea, and pneumocephalus, while lateral skull base (temporal bone) lesions are associated with hearing loss, CSF otorrhea, and facial nerve involvement.
- Management can be conservative or surgical. Conservative management includes observation and CSF diversion, while surgical management aims to close the skull defect and reposition the herniated tissue.
- Prior literature of presentation, management, and outcomes of traumatic skull base encephaloceles has primarily consisted of small case series.

Methods

A retrospective chart review of patients who presented to the R. Adams Cowley Shock Trauma Center at the University of Maryland Medical Center from January 1st, 2015 to December 31st, 2024 was performed. To obtain the operative group, a database of all patients who underwent CSF leak repair in the anterior and lateral skull base regions according to CPT codes was queried. A database of non-operative patients was queried using encephalocele and CSF leak diagnosis codes and encounters with ENT and trauma services. Patients without radiographically confirmed encephaloceles and patients with non-traumatic or congenital encephaloceles were excluded. Electronic medical record data collected included demographics, injury etiology and characteristics, associated otolaryngologic and neurologic symptoms, and operative details if applicable, as well as post-discharge follow-up outcomes.

Results

22 patients were included in the study; 86% were (19/22) male. The mean age was 33.3 years (SD 11.1).

The most common mechanism of injury was gunshot wound (8/22, 36%), followed by motor vehicle accident (6/22, 27%), fall (5/22, 23%), and other (3/22, 14%). The mean length of hospital stay was 18.2 days (SD 17.6). 65% (15/22) of patients were diagnosed with traumatic encephalocele within 7 days of injury; the mean time to diagnosis for diagnoses made >7 days post injury was 160.5 days (SD 280).

Table 1. Patient outcomes

Inpatient	Anterior (n=18)	Lateral (n=4)	Total (n=22)
Pneumocephalus	18 (100%)	1 (25%)	19 (86%)
CSF leak	14 (78%)	3 (75%)	17 (77%)
Vision changes	11 (61%)	1 (25%)	12 (55%)
Hearing loss	2 (11%)	4 (100%)	6 (27%)
Post-Discharge	Anterior (n=18)	Lateral (n=4)	Total (n=22)
Disposition			
Rehab	9 (50%)	1 (25%)	10 (45%)
Home	8 (44%)	3 (75%)	11 (50%)
Deceased	1 (6%)	0 (0%)	1 (5%)
Return to Work/School at Last Follow-up	8 (44%)	2 (50%)	10 (45%)
Encephalocele Recurrence	2 (11%)	0 (0%)	2 (9%)

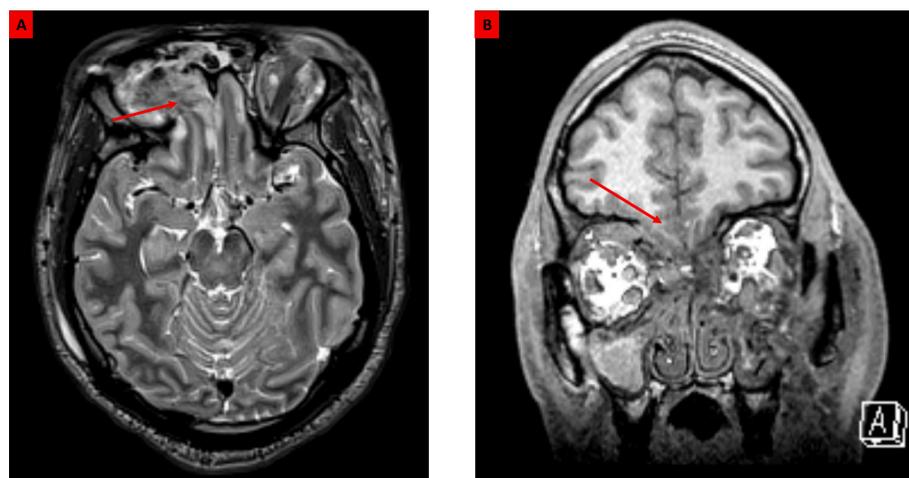
Results Continued

Table 2. Encephalocele Characteristics

Location	Number of Encephaloceles
Total	23
Anterior skull base	19 (83%)
Ethmoid bone	7
Orbital roof	6
Sphenoid bone	4
Frontal sinus	2
Lateral skull base, all temporal bone	4 (17%)
Tegmen mastoideum	2
Tegmen tympani	1
Combined	1

Operative management was pursued for 17/23 (74%) encephaloceles, 79% (15/19) of anterior and 50% (2/4) of lateral. 11/15 anterior operative encephaloceles were repaired using a transcranial approach, while 4/15 were endonasal. The post-auricular approach was employed for both lateral operative encephaloceles.

Figure 1. T1 axial (A) and coronal (B) non-contrast MRI of patient presenting with craniofacial gunshot wound, facial fractures, and CSF leak. Large right frontal-ethmoid and small left ethmoid traumatic encephaloceles are observed.



Summary

- Pneumocephalus occurred significantly more often in patients with anterior encephaloceles compared to lateral encephaloceles ($p = 0.0026$; OR 86, 95% CI 2.9-2582).
- Operative management was pursued in 74% (17/23) of cases. Non-operative management was pursued in 26% (6/23) of cases due to no active clinical concerns ($n=3$), stable head CT ($n=2$), and management with external ventricular drain ($n=1$).
- At the most recent follow-up, the most common neurological symptoms reported were headache (3/23) and vision decline (3/23). 2/4 lateral encephalocele patients reported profound hearing loss on most recent follow-up.

Discussion and Conclusion

- This study represents the largest series of traumatic skull base encephaloceles to date, highlighting the heterogeneity between anterior and lateral lesions in fracture patterns, symptoms, and complications.
- Anterior encephaloceles demonstrated significantly higher rates of pneumocephalus, which may warrant heightened radiographic surveillance.
- Operative repair was done in most cases in this cohort, suggesting that traumatic encephaloceles frequently necessitate operative management.
- Regardless of management strategy, the majority of encephaloceles did not recur and most patients reported improved outcomes.
- Due to the morbidity of traumatic facial injury, concurrent lesions and critical illness may obscure encephalocele-related symptoms.
- These findings provide important insight into the outcomes of this rare but serious complication, offering guidance for clinical care.

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