Article published online: 2022-09-09

Case Report

Elevated Skull Fractures - Too Rare to Care for, Yet too Common to Ignore

Abstract

Elevated skull fractures form a rare subset of compound skull fractures owing to the paucity of cases studied and reported. In this article, we present 17 cases of elevated skull fracture in a mixed population of adult and pediatric age groups which were operated over a period of 5 years (2012–2017) at our institute. We have discussed the mode of injury, clinical presentation, clinicoradiological findings, and treatment options highlighting the appropriate management strategies opted. Although elevated fractures are rare; issuing definite treatment protocol can reduce the morbidity and mortality of the patients.

Keywords: *Elevated skull fracture, head injury, skull fracture*

Viraat Harsh*, Vanya Vohra*, Prashant Kumar, Jayendra Kumar[1], Chandra Bhushan Sahay, Anil Kumar

Department of Neurosurgery, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand, [1]Department of Neurosurgery, Narayanan Medical College and Hospital, Sasaram, Bihar, India

**Both authors have contributed equally to this article*

Introduction

Elevated skull fractures (ESFs) are rare compound skull fractures in which the fractured segment is elevated above the level of the remaining skull topography. Most of the standard medical literature describes the classification of skull fractures as linear, comminuted, or depressed[1] and does not include ESFs. ESFs may be caused due to injuries by a sharp, heavy object, or rotation of the head while hitting the object and is not restricted to any particular type/mode of injury. It is highly underreported, and definite protocols to guide its management are not yet in place. In recent years, these fractures have drawn increased interest of neurosurgeons. We present a series of seventeen cases treated during 2012–2017 in the Department of Neurosurgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi. The study is performed to analyze the presence of any specific pattern in the etiology, epidemiologic, or clinico-radiological profile.

Patients and Methods

This is a retrospective study. All the patients admitted in the Department of Neurosurgery at RIMS, Ranchi, between January 2012 and April 2017 were considered and all patients confirmed to be cases of ESFs by plain computed tomography (CT) scans were included in the study. There were no exclusions. Patient's age, gender, mode of injury, extent of injury, Glasgow coma scale (GCS) score at admission, clinico-radiological findings, and treatment modalities opted were noted. Postoperative complications such as seizures, neurological deficits, cerebrospinal fluid leak, meningitis, bone flap osteomyelitis, and infection at surgical site, etc., were looked for in all patient records. All patients had received antibiotics and antiepileptic drugs. Patients were followed up for at least 6 months after the event.

Results

Seventeen patients in a mixed population of adults (n = 10) and children (n = 7) with elevated skull fractures were included in the study. All of our patients were males. At the time of presentation, three patients had severe head injury with GCS ≤8, four had moderate head injury (GCS >8 but ≤12), and 10 patients had mild head injury (GCS >12 and ≤15).

The major cause of injury among adult age group was road traffic accidents (RTAs) (n = 8). Among the pediatric age group, the major cause of injury was fall from height (n = 4) and assault (n = 2).

The most common location of fracture was frontal (n = 8). Other locations for the fracture were temporoparietal (n = 3), parietal (n = 3), frontotemporal (n = 2),

How to cite this article: Harsh V, Vohra V, Kumar P, Kumar J, Sahay CB, Kumar A. Elevated skull fractures - Too rare to care for, yet too common to ignore. Asian J Neurosurg 2019;14:237-9.

Address for correspondence:
Prof. Anil Kumar, Department of Neurosurgery, Rajendra Institute of Medical Sciences, Bariatu, Ranchi - 834 009, Jharkhand, India.
E-mail: dr.anilkumarranchi@gmail.com

Access this article online

Website: www.asianjns.org

DOI: 10.4103/ajns.AJNS_242_17

Quick Response Code:

and frontoparietal (n = 1) [Figure 1]. EDH underlying elevated bone segment was seen in five patients while contusion was seen in six patients and one later developed abscess [Figure 2]. Most vulnerable age group was 21–40 years (n = 8) followed by 0–20 years (n = 7) and 41–60 years (n = 2) [Figure 3]. Mainstay of treatment included depression or excision of elevated fragment and titanium mesh cranioplasty.

Discussion

Fracture of skull bones following trauma is a common finding. In neurosurgical practice, we come across depressed fractures quite often. In some cases, however, the bone fragment is elevated above the intact skull bone; this type of fracture is known as elevated skull fracture. It was described as early as 1650-1550 BC in the renowned surgical treatise "the Edwin Smith surgical papyrus." This fracture remained unreported in surgical texts till 1976 when Ralston mentioned its occurrence and reviewed the pathology.[2] Elevated fractures are still rare and underreported. The mode of injury causing elevation of intact skull bones may include the injury made by a sharp heavy objects or weapons which elevate the skull fracture by its lateral pull, elevation of free segment while retrieving the weapon, tangential force acting on the intact calvarium in association with rotation of head. The amount of force transmitted to the brain and its overlying structures is more when applied perpendicular to the brain's surface than tangentially.[3-5] Thus, injury to brain and associated structures may be less severe in elevated fracture having tangential impact compared to depressed fractures having a perpendicular impact.

ESFs are less contaminated than depressed fractures of the skull because the tangential direction of force tends to drive less dirt in the wound than the perpendicular force, thus decreasing the chances of associated infection. Factors affecting the good outcome are amount of contamination, presence or absence of dural breach, trauma-surgery time gap, quality of wound debridement, and appropriate and timely antibiotic and antiepileptic medication.[6] A secondary insult from hypoxia, fluid and electrolyte disturbances, fever, and seizures requires special care.

In our series, the mode of injury in pediatric age group was fall from height (including fall in well, fall from tree and roof) in four patients, assault by sharp weapon (sword) in two patients, and RTA in one patient. Tangential force acting on the intact calvarium in association with rotation of head seems to be the probable mechanism in five cases and lateral pull of weapon while retrieving it was the mechanism of injury in two pediatric cases. The mode of injury in the adult age group was RTA in eight patients and injury by a sharp, heavy object in two patients. In total, nine patients in our series were involved in RTA which accounts for more than half of the patients. On investigation, we found seven patients were not wearing helmets at the time of accident. ESFs are found commonly in patients not wearing helmets. The patients wearing helmet mostly got injured in the frontal area. In our series, all patients were males and cause of injury was assault by sword, RTA, fall from height which depicts the involvement of males more than females in outdoor activities, especially in rural areas of developing countries like India. CT scan of head is the investigation of choice in all age groups of ESF [Figure 4]. ESFs are rare and may present in a myriad of forms. Often, isolated elevated fractures without any underlying extradural bleed and which does not leave any cosmetic defect are managed nonsurgically. The decision of surgical intervention also depends on whether the elevation is of full thickness of skull or involving the outer table only. If the inner table is in line with the contour of the skull despite outer table being massively disrupted, no surgical intervention may be needed except for cosmetic reasons. However, a fracture which is concomitantly elevated and depressed at opposite ends or which has underlying extradural bleed or is applying pressure on the dura may be operated on other than for cosmetic defects alone.

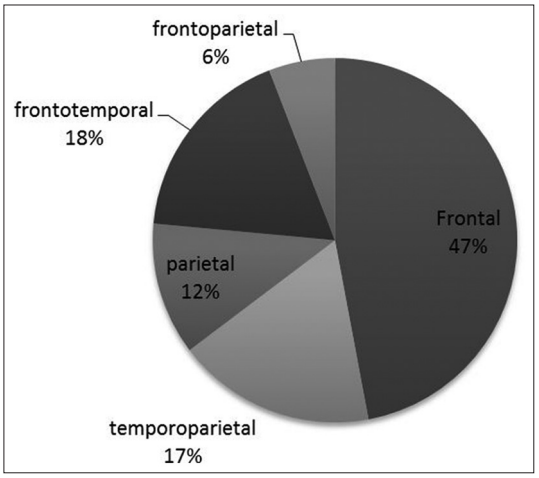

Figure 1: The most common site of elevated skull fractures

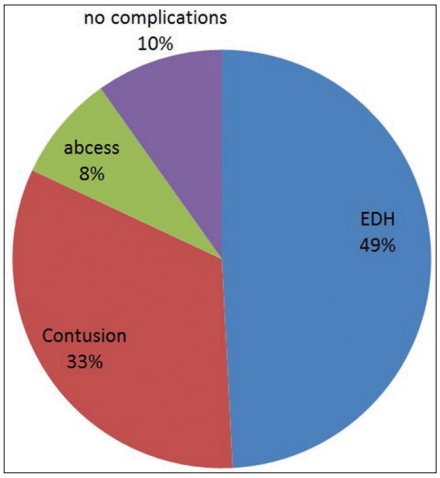

Figure 2: The most common associations of elevated skull fractures

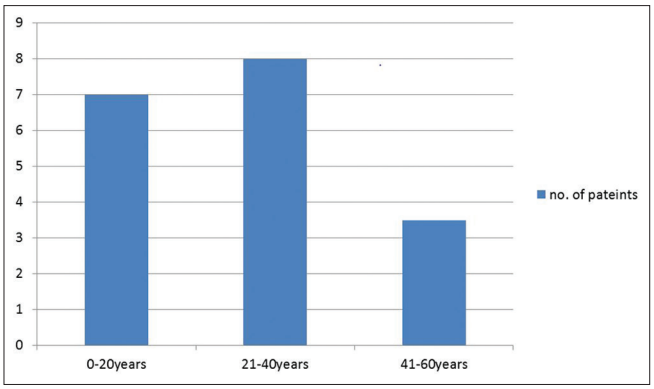

Figure 3: The most vulnerable age groups affected by elevated skull fractures

Surgery typically involves excising the part of the elevated fragment that is extruding the general topography of the surrounding area of the skull. In a concomitant depressed cum elevated skull fracture or in case there is underlying EDH, the bone fragment is freed from the rest of the skull (bleed evacuated if present) and bone repositioned. Grossly contaminated bone fragments should generally be removed. Proper aseptic wash and dural closure are of utmost importance. Rarely, elevated fragment is excised, and titanium mesh cranioplasty is done either in the same sitting or interval cranioplasty may be done. Occasionally, the elevated fragment may leave the skull like part of the jigsaw puzzle and may reposition itself leaving only little cosmetic defect. Similar rare case of jigsaw depressed fracture has been reported.[7]

Conclusion

ESFs constitute uncharacteristic neurosurgical emergencies, associated with head injuries due to RTA, assault, fall from height, and various other forms of trauma. It is easily detectable by CT scan and requires prompt treatment. Although a rare entity, the evidence of scarcity of these cases should not be taken as an excuse to not include them in the classification of skull fractures. We encountered 17 such cases at our institute in over 5 years and this clearly obviates the necessity of discussion of these cases in world medical literature and towing of attention of neurosurgeons in defining an objective protocol for the management of ESF. Definite protocol and appropriate management of this type of skull fracture will prevent unnecessary morbidity and mortality. Reporting of all such cases should be done so that the variety of cases of this entity may be seen in world medical literature.

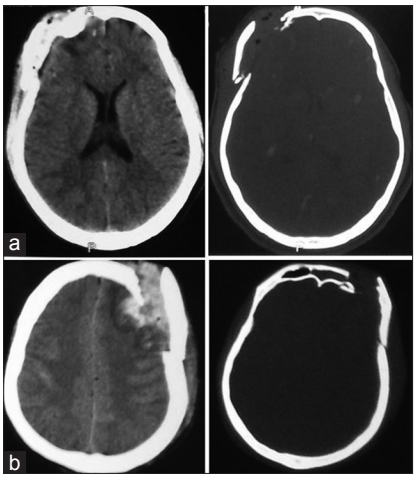

Figure 4: Computed tomography scans (brain and bone window) showing elevated skull fractures. (a) Brain window right and bone window left showing right frontal elevated skull fractures. (b) Brain window on the right showing left frontal elevated skull fractures with underlying contusion, bone window on the left

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Geisler FH. Skull fractures. In: Wilkins RH, Rengachary SS, editors. Neurosurgery. Vol. II. New York: McGraw Hill; 1996. p. 2741-54.
2. Ralston BL. Compound elevated fractures of the skull. J Neurosurg 1976;44:77-9.
3. Adeolu AA, Shokunbi MT, Malomo AO, Komolafe EO, Olateju SO, Amusa YB, *et al.* Compound elevated skull fracture: A forgotten type of skull fracture. Surg Neurol 2006;65:503-5.
4. Chhiber SS, Wani MA, Kirmani AR, Ramzan AU, Malik NK, Wani AA, *et al.* Elevated skull fractures in pediatric age group: Report of two cases. Turk Neurosurg 2011;21:418-20.
5. Bhaskar S. Compound "elevated" fracture of the cranium. Neurol India 2010;58:149-51.
6. Kumar J, Prakash A, Harsh V, Kumar A. Elevated fracture of skull in pediatric age group: A series of five patients with review of literature. Asian J Neurosurg 2016;11:75.
7. Harsh V, Besra SK, Kumar J, Kumar A. A curious case of spontaneously resolving closed "jigsaw" depressed skull fracture in an adolescent. Asian J Neurosurg 2016;11:76.