

# Elevated Skull Fractures in Pediatric Age Group: Report of Two Cases

## *Pediatric Yaş Grubunda Kalkmış Kafatası Kırıkları: İki Olgunun Sunumu*

Sarbjit Singh CHHIBER, Mohd Afzal WANI, Altaf Rehman KIRMANI, Altaf Umar RAMZAN, Nayil Khursheed MALIK, Abrar Ahmad WANI, Abdul Rashid BHAT, Anil DHAR, Basharat KANTH

*SKIMS, Department of Neurosurgery, Srinager/ J&K, India*

Correspondence address: Sarbjit Singh CHHIBER / E-mail: sarabjitchhiber@gmail.com

### ABSTRACT

Elevated fractures of the skull, which are rarely reported in the literature, are always compound, have maximal neurological deficits at presentation and have been reported only in adults. We report two cases of elevated skull fractures in the pediatric age group, one of which was a simple elevated fracture and presented with delayed neurological deterioration. The etiologies were a fall in first case and an animal attack (bear maul) in the second case as reported for the first time. One of the cases presented with delayed onset of left focal hemispheric signs. The first case underwent debridement, duraplasty and reduction of fracture whereas in the second case the bone flap was not replaced immediately because of gross contamination. Both patients had an excellent outcome. Elevated skull fractures are not uncommon in the pediatric age group. Compound elevated skull fractures should be managed early as open depressed fractures. Reduction of a simple elevated fracture presenting with neurological deficits not explained by any other lesion can result in a good outcome.

**KEYWORDS:** Skull fractures, Elevated skull fractures, Compound fractures, Simple fractures, Pediatric age group

### ÖZ

Literatürde nadir bildirilen kafatasının kalkmış kırıkları her zaman bileşik kırıklardır, maksimum nörolojik defisitleri vardır ve sadece yetişkinlerde rapor edilmişlerdir. Biz burada pediatrik yaş grubunda iki kalkmış kafatası kırığı rapor ediyoruz. Bunlardan biri basit kalkmış kafatası kırığıdır ve gecikmiş nörolojik kötüleşmeyle gelmiştir. İki olgu da pediatrik yaş grubundadır. Etiyolojiler birinci olguda düşme ve ikinci olguda ise ilk kez rapor edilen bir hayvan saldırısıdır (ayı pençesi). Olgulardan biri gecikmiş sol fokal hemisferik bulgularla prezente olmuştur. Birinci olguda debridman, duraplasti ve kırığın yerine yerleştirilmesi yapılmış, ikinci olguda ise kemik flep yaygın kontaminasyondan dolayı hemen yerine konmamıştır. Her iki hastanın da sonuçları mükemmel olmuştur. Kalkmış kafatası kırıkları pediatrik yaş grubunda nadir değildir. Bileşik kalkmış kafatası kırıkları açık çökme kırıkları gibi erken tedavi edilmelidirler. Başka bir lezyonla açıklanamayan nörolojik defisit ile gelen basit kalkmış kırığın redüksiyonu iyi sonuç verebilir.

**ANAHTAR SÖZCÜKLER:** Kafatası kırıkları, Kalkmış kafatası kırıkları, Bileşik kırıklar, Basit kırıklar, Pediatrik yaş grubu

### INTRODUCTION

Skull fractures are traditionally classified into linear, comminuted or depressed which can be either simple or compound. (5) A skull fracture where the bone fragment is elevated above the intact, skull known as elevated skull fracture have been reported infrequently in the literature. (1,2,3,4,6,7,8) Till date all the cases reported in literature were compound elevated fractures, had maximum neurological deficits at presentation with no case showing delayed deterioration, all cases were adults and all were result of either road traffic accident or an assault. We report two more cases of elevated skull fractures which have the following unique features; 1. Both the cases are in pediatric age group. 2. One case presented with delayed neurological deterioration and

was a simple elevated fracture, 3. Mechanism of injury in one case was animal attack (bear maul).

### CASE 1

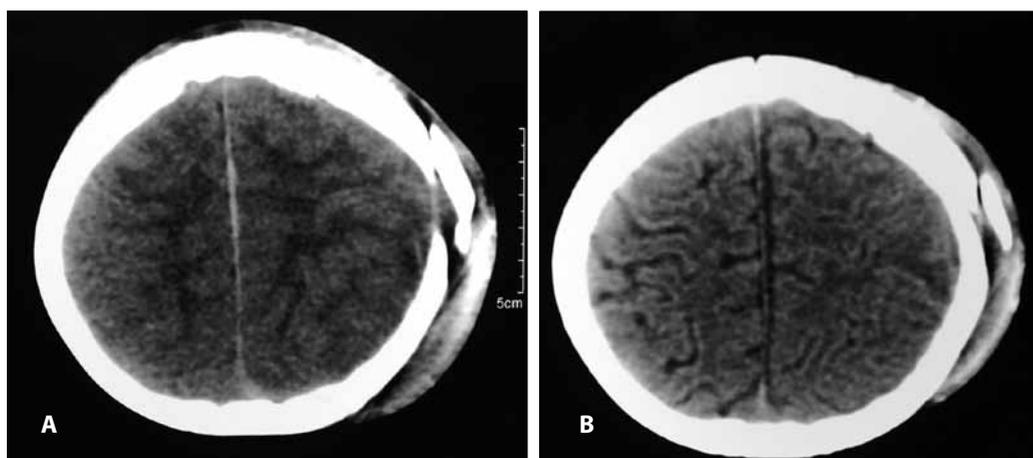
A 3-year-old male presented after a fall from a height of ~ 6 feet with the left side of the head hitting an elevated surface. There was no history of loss of consciousness, vomiting, ear or nose bleed or any seizure. The child was alert, crying and moving all four limbs equally. There was a ~ 2/2 cm fluctuant swelling at the left parietal region. The child was observed for 12 hours and was discharged in the awake, alert state without any motor deficits. No radiological investigation was done at initial admission. Two days later the parents noticed that child was moving his right side less and was not talking. At second admission, the child was conscious, alert but had

grade 3/5 right hemi-paresis and motor aphasia. The scalp swelling had increased to ~ 6/6 cm. NCCT head (Figure 1A,B) showed an elevated fracture of the left fronto-parietal bone with suspicion of brain matter protruding from the fracture site. Note was also made of small superficial contusion with no mass effect. A skin flap was prepared around the swelling. CSF gushed out and brain matter was seen to be herniating linearly along the fracture lines. A bone flap was elevated on the side opposite fracture line. Devitalized herniated brain tissue was debrided and dural edges were identified. Duraplasty was done with a fascia lata graft and the bone flap was replaced. After 2-3 days, the child showed gradual improvement of the weakness to grade 4+/5. At follow-up at 1 month the child also showed marked improvement in his verbal output with slight weakness on the right side (Gr 4+/5).

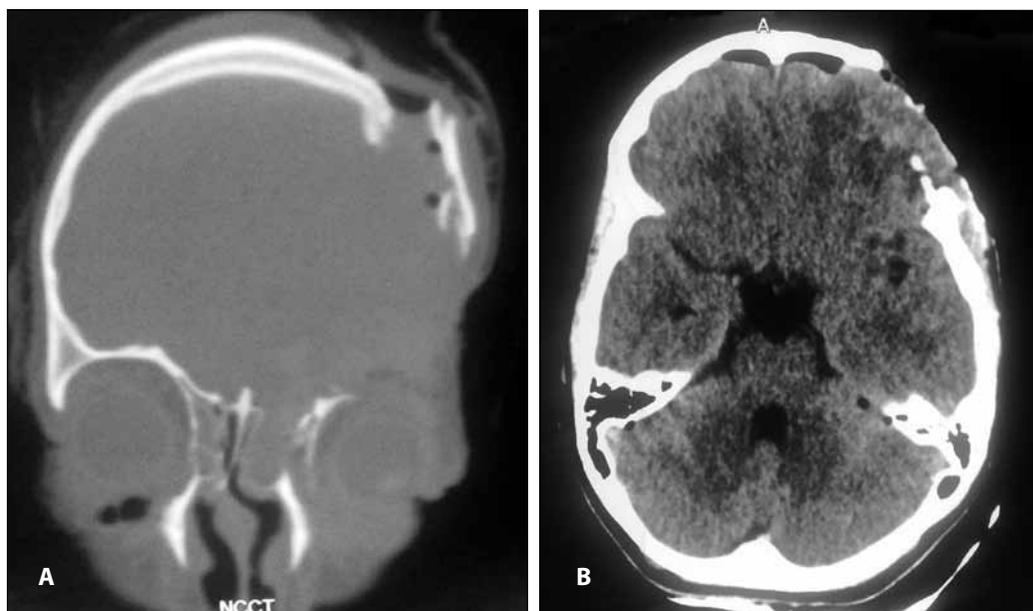
### CASE 2

An 8-year-old girl was brought to the hospital following an attack by black bear. At admission GCS was E2V3M5 with a

large left fronto-temporal wound. Underlying bone along with the scalp was elevated at its upper end and part of the supraorbital bone ~ 2/2 cm was missing. Dura was torn and contused brain was pouting at places. The patient was intubated and resuscitated. NCCT head (Figure 2A,B) showed elevated fronto-temporal bone with underlying brain swelling and superficial contusions. Part of supraorbital ridge along with surrounding frontal bone was also missing. Immediate debridement of the wound and superficial contusions was done. Duraplasty was performed with a fascia lata graft. In view of the gross contamination, the bone flap was not replaced and kept in the bone bank. The patient was covered with anti-meningitic doses of broad spectrum antibiotics including anaerobic cover. The patient improved and was weaned off the ventilator on post-op day 2. She showed gradual improvement and was discharged from hospital on post-op day 10 in a fully conscious and alert state. The wound had healed well with no evidence of a CSF leak. She is under regular follow-up and is scheduled for cranioplasty.



**Figure 1A,B:** CT showing elevated fracture fragment (fronto-parietal) with suspicion of herniated brain matter.



**Figure 2: A)** Coronal CT in bone window showing elevated fronto-temporal bone fragment with part of supraorbital ridge missing. **B)** CT showing elevated fracture and contused, herniated brain.

## DISCUSSION

Fractures of the calvarium are common following trauma. A skull fracture where the bone fragment is elevated above the intact skull bone is rare and has been reported in literature in the form of few case reports only (1,2,3,4,6,7,8). Since the agent of wounding is often directed inwards, the floating fracture fragment is usually driven intracranially by the applied force. This results in depressed fractures. However in some cases the calvarium can be elevated by the following mechanisms; 1. Injury caused by a sharp heavy object which elevates the skull fracture by lateral pull of weapon, 2. Elevation of free fragment while retrieving the weapon, 3. Tangential force applied to the calvarium associated with rotation of head (1).

The tangential force applied to the skull associated with rotation when the head hits some elevated surface seems to be the probable mechanism in our first case. In the second case, the elevated skull fracture from the wild animal attack (bear maul) might have resulted from a combination of tangential hit resulting in fracture followed by pulling out of the injured area by strong claws of bear. This to our knowledge is the first such case of elevated skull fracture caused by a wild animal attack.

Till date all the cases of elevated skull fractures have been reported in adults (1,2,3,4,6,7,8). The reasons for this might be domestic violence and road traffic accidents as the predominant cause of elevated skull fractures in all reported cases. We report for the first time two cases of elevated skull fractures in pediatric age group.

Elevated skull fractures are always compound with injury to the underlying dura (1,2,3,4,6,7,8). Only one case described by Borkar et al (3) had intact dura. One of our cases is unique in that it is the only reported case of simple elevated skull fracture (case no. 1).

All the cases reported in literature had maximum neurological deficits at the time of presentation (1,2,3,4,6,7,8). One of the cases is unique in that the neurological deterioration (aphasia and hemi-paresis) occurred 48 hours after the injury. Although the cause of deterioration is not known, gradual herniation of brain along the elevated skull fracture seems responsible.

CT scan is the investigation of choice as it detects bony abnormalities as well as underlying hematoma or parenchymal injury. In case of fracture near midline, CT venography may demonstrate superior sagittal sinus occlusion as was seen in a case reported by Talha et al. (7).

Compound elevated fractures should be managed as open depressed fractures with extensive debridement and dural repair (1,2,3,4,6,7,8). In view of gross contamination, the elevated bone fragment should not be replaced immediately. Cranioplasty with the preserved and appropriately sterilized bone flap or synthetic material can be performed at a later date (3). The patient should be covered with broad spectrum antibiotics including anaerobic cover (3). Delay or failure to operate may be complicated by intracranial abscess or CSF leak with associated mortality and morbidity (1).

We also report the management of 'simple' elevated skull fracture presenting with delayed neurological deterioration not explained by any other lesion. Improvement of the neurological status can be explained by improvement in the local blood supply to the area around the herniated brain after surgery. This case report demonstrates that reduction of simple elevated skull fracture and dural repair in a patient presenting with delayed deficits that cannot be explained by any other cause can result in significant improvement in the neurological status.

## REFERENCES

1. Adeolu AA, Shokumbi MT, Malomo AO, Komolafe EO, Olateju SO, Amusa YB: Compound elevated skull fracture: A forgotten type of skull fracture. *Surg Neurol* 65:503-505, 2006
2. Aniruddha TJ, B Indira Devi, Arivazhagan A: Traumatic avulsion of cranial bone flap simulating craniotomy. *Indian Journal of Neurotrauma (IJNT)* 5(1): 53, 2008
3. Borkar SA, Sinha S, Sharma BS: Post-traumatic compound elevated fracture of skull simulating a formal craniotomy. *Turkish Neurosurgery* 19(1):103-105, 2009
4. Nitin Garg, B Indira Devi, Praful Maste: Elevated skull fracture. *Indian Journal of Neurotrauma (IJNT)* 4(2): 133, 2007
5. Geisler FH: Skull fractures. In: Wilkins RH, Rengachary SS, eds. *Neurosurgery*. New York: McGraw-Hill, 1996: 2741-2754
6. Ralston BL: Compound elevated fractures of skull. Report of two cases. *J Neurosurgery* 44: 77-79, 1976
7. Abu Talha K, Selvapandian S, Asaduzzaman K, Selina F, Rahman M, Riad M: Compound elevated skull fracture with occlusion of the superior sagittal sinus. A case report. *Kobe J Med Sci* 54(5): E260-E263, 2009
8. Verdura J, White RJ: Letter: Compound elevated skull fractures. *J Neurosurgery* 45:245, 1976