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Dural Tears in Patients Presenting with Depressed Skull Fracture after Head Injury

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Abstract

Background: Incidence of trauma is on the rise with the passage of time. Head injury being the most important resultant of trauma, is associated with the maximum morbidity and mortality. Head trauma leading to a depressed skull fracture carries a significant chance of underlying dural breach and tear, which is associated with dreadful complications, and is hence an integral issue that needs to be meticulously dealt with

Objective: To determine the incidence of dural tears in patients presenting with depressed skull fracture after head injury at a tertiary care hospital.

Materials & Methods: This study was conducted at Department of Neurosurgery, Civil Hospital Karachi. All the patients, between 13-60 years of age of either gender, who presented with head injury and diagnosed as a case of depressed skull fracture on the basis of CT scan brain plain findings and were managed surgically were included in the study. Patients with severe brain injury were excluded from the study.

Results: Study was conducted from 8th March 2022 to 7th March 2023. A total of 309 patients were included in the study. Male to female ratio is 2.32. Road traffic accident was the most common mechanism of injury, followed by fall from height. Most common site of depressed fracture was frontal bone. Simple DSF was found in 197 (63.8%) patients while 112 (36.2%) patients had compound DSF. Dural tear was observed in a total of 174 (56.3%) patients and was absent in 135 (43.7%).

Introduction:

Incidence of trauma has increased in both developing and developed countries such that it has become a worldwide health and social issue [1].

Head injury is any sort of injury to brain, skull or scalp which can range from a minor bruise or laceration to a traumatic brain injury. Traumatic brain injury (TBI) is an acquired insult to the brain from an external mechanical force. It may be associated with altered or loss of sensorium and can lead to impairment of physical and psychosocial function [2]. Traumatic brain injury is a serious issue

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around the world [3, 4]. It is not only recognized as one of the biggest causes of morbidity and mortality but also poses a great economic loss worldwide which is estimated to be $30 billion annually in the developed countries only [5]. Global incidence of mortality after head injuries ranges from 91-546 per 100,000 [6]. This rate is drastically increasing in developing countries and the affected victims are mostly males in their second and third decade of life [7].

Actual data for head injuries available in Pakistan is inadequate. The annual incidence in Pakistan is estimated as 50/100,000 population. The data being available from the public sector hospitals only, and due to poor record keeping and reporting, the magnitude of problem is overtly underestimated and understated [8]. Victims mostly are the males in their most productive years of their life and the breadwinners for the family [9].

In the patients with head injury, depressed skull fracture (DSF) is an important marker for intracranial lesions such as contusions, hemorrhage, and for the morbidity and mortality [10, 11]. Cranial fractures are of two types, linear or depressed, depending upon the presence or absence of depression of the fractured segments between the bone edges. A fracture is said to be depressed when the displacement of bone fragment is greater than the full thickness of the adjacent cranium. When a scalp laceration and galeal disruption is present with DSF it is known as compound DSF [11, 12].

DSF are found to occur in 11% cases of TBI [13]. It causes increased pressure on the brain and carries a risk of damage to the delicate tissues. Complex DSF are those in which dura matter is torn [14]. DSF can be open or closed. Open DSF is the one in which either overlying skin laceration is present or the fracture extends to the paranasal sinuses or the middle ear cavity, hence resulting in a communication between cranial cavity and the external environment. Open DSF may either be clean or contaminated [13, 14]. Patients can present with neurological symptoms like headache and vomiting or with seizures, CSF or brain matter may come out through the wound.

Assessment of dural integrity carries a major importance in the management of patients with compound DSF. If the dura is torn there may be brain matter coming out from the wound or CSF leak and needs proper surgical management which otherwise can lead to dreadful complications like meningitis, cerebral abscess, CSF fistula and pseudomeningiocele [16, 17].

Considering that dural tears in depressed skull fractures leads to horrendous complications, its early diagnosis and proper management carries an utmost importance. Literature is full of studies to determine how frequently they are seen in clinical practice. Hossain et al in their study reported it as 25% [18]. Gul Muhammad et al also reported similar results as 33.7% patients who presented with depressed skull fractures had dural tears [17]. On the other hand Nayak et al reported frequency of dural tears in depressed skull fractures to be 68.5% [20] while even a larger value for frequency of dural tears in depressed skull fractures was reported by Imran et al as 72.2% [21]. Meanwhile, Ahmad et al reported somewhat in between results, as compared to other studies, and found frequency of dural tears in depressed skull fractures to be 48.9% [19].

Materials and Method:

Setting: Department of Neurosurgery, DOW University of Health Sciences, SMBB Trauma Center/ Dr. RKMP Civil Hospital Karachi.

Duration: Study was conducted from 8th March 2022 to 7th March 2023 for a total duration of one year.

Sample Size: The sample size was calculated using WHO software for sample size calculation version 2.0, taking confidence interval as 95%, absolute precision as 0.05 and frequency of dural tears in patients with depressed skull fractures after head injury as 72.2% [21] (anticipated population proportion), the sample size came out to be 309

Sampling Technique: Non-probability consecutive.

Inclusion Criteria: All the patients, between 13-60 years of age of either gender, who presented with head injury and were diagnosed as a case of

depressed skull fracture on the basis of CT scan brain plain findings and were managed surgically.

Exclusion Criteria:

- Patients with severe brain injury with a GCS of 6/15 or less at presentation. (GCS was determined on the basis of best eye, motor and verbal response elicited by the patient)
-

Study Design: Cross sectional study

Data collection procedure: A total of 309 patients, with head brain injury, who presented to emergency room and were diagnosed as having depressed skull fracture on CT scan brain plain findings and underwent surgical intervention, fulfilling the inclusion criteria, were included in the study.
All patients received similar pre-operative care, including baseline labs, antibiotics and were intubated in ER if they were unable to maintain airway. They were taken to emergency OR and surgical management of the depressed skull fracture was done as per associated intracranial lesions such as contusions, intracranial hemorrhage, extradural hematoma, acute subdural hematoma. Contusions and intracerebral hemorrhage were described as the blood clots within the brain parenchyma. EDH was found as blood clot between bone and dura and ASDH as blood clot between cortex and the dura. Dura was meticulously examined for break in continuity and water tight repair was done either primarily or by using pericranial grafts subjected to per op findings. Post-operative care was given to the patients depending on the severity of injury, operative findings and type of surgery performed.

A proforma was used to record patients' demographics like age, gender, hospital registration number. It also included mechanism of injury (RTA, fall from height, blunt trauma from physical assault, penetrating trauma), GCS at presentation, location of depressed skull fracture (parietal, temporal, frontal, occipital or posterior fossa), depressed skull fracture open or close, presence of other brain injury (EDH, SDH, SAH, contusions) and whether dural tear was present or absent.
To reduce bias, CT scan brain plain findings were reported and confirmed by a radiologist with 5 years post fellowship experience, all surgical interventions were performed by a neurosurgeon with more than 5 years post fellowship experience and all data was filled by an independent observer, not directly involved in the research process.

Data analysis procedure: Data was analyzed using SPSS version 22 on computer. Mean and standard deviation were calculated for numerical data like age, whereas frequency and percentages were calculated for categorical data like gender, mechanism of injury, simple or compound depressed skull fracture, location of depressed skull fracture, presence of any other brain injury and final outcome whether dural tear present or absent. Stratification was done according to age, gender, mechanism of injury, GCS at presentation, depressed skull fracture simple or compound, location of depressed skull fracture and presence of any other brain injury to assess the effect of these modifiers on the final outcome, using chi-square test and taking p-value <0.05 as statistically significant.

Results

A total of 309 patients with head injury with radiological evidence of DSF were included in the study, of which 216 (69.9%) were male and 93 (30.1%) were female patients. Male to female ratio is 2.32.
Severity of injury was divided on the basis of GCS at presentation as mild, moderate and severe. 93 (30.1%) had mild injury, 173 (56%) had moderate injury and 43 (13.9%) had severe injury. Mean age of presentation was 25.28 ± 11.32 years (Fig 1).

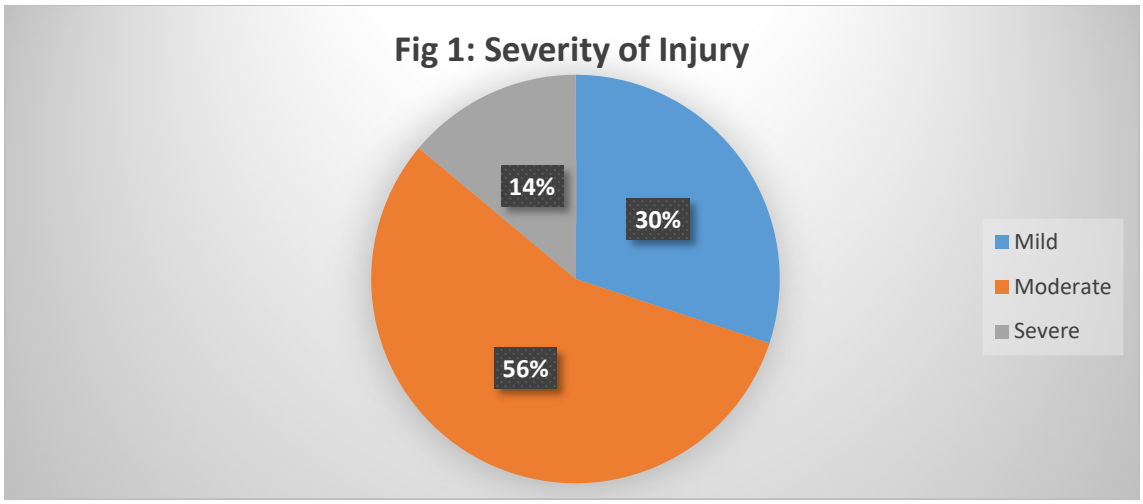

Figure: 1

Road traffic accident was the most common mechanism of injury, observed in 179 (57.9%) patients followed by fall in 100 (32.4%), assault in 20 (6.5%) and penetrating injury in 10 (3.2%) of patients.
Most common site of depressed fracture was frontal bone, present in 122 (39.5%) followed by parietal region in 103 (33.3%), temporal in 62 (20.1%) and occipital in 22 (7.1%) patients.

	Frequency	Percentage (%)
Frontal	122	39.5
Parietal	103	33.3
Temporal	62	20.1
Occipital	22	7.1
Total	309	100

Table 1: Frequency of Depressed Skull Fracture on the basis of location

Simple DSF was found in 197 (63.8%) patients while 112 (36.2%) patients had compound DSF.

	Frequency	Percentage (%)
Simple	197	63.8
Compound	112	36.2
Total	309	100

Table 2: Frequency of DSF

63 (20.4%) patients had DSF only and no other intracranial lesion was present. Contusions was the most common finding seen in 103 (33.3%) patients followed by extradural hematoma in 61 (19.7%) patients. 40 (12.9%) patients had EDH with contusions while 20 (6.5%) had ASDH with contusions. Sub-arachnoid hemorrhage and ASDH was present in 12 (3.9%) and 10 (3.2%) patients respectively.
Dural tear was observed in a total of 174 (56.3%) patients and was absent in 135 (43.7%) (Fig 2).

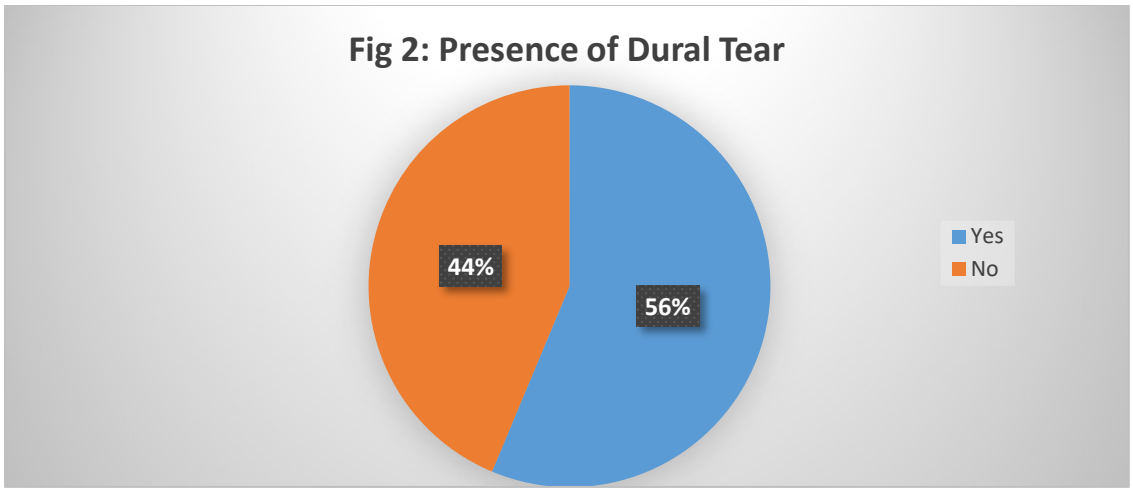

Figure 2

Stratification done according to age, gender, mechanism of injury, GCS at presentation, depressed skull fracture simple or compound, location of depressed skull fracture and presence of any other brain injury, showed statistically significant p-value (<0.05) for all modifiers except for age, gender and mechanism of injury which turned out to be 0.17, 1.0 and 0.52 respectively.

Stratification of data was done by age. Age was divided in to 5 groups on the basis of decades of life. Most of the patients belonged to the age group of 13-20 years (46.8%) followed by 27.8%, 14.6%, 4.9% and 5.8% belonging to age groups of 21-30, 31-40, 41-50 and 51-60 years respectively. Of 145 patients belonging to the ages of 13-20 years with DSF, 87 (60%) had dural tear (Fig 3).

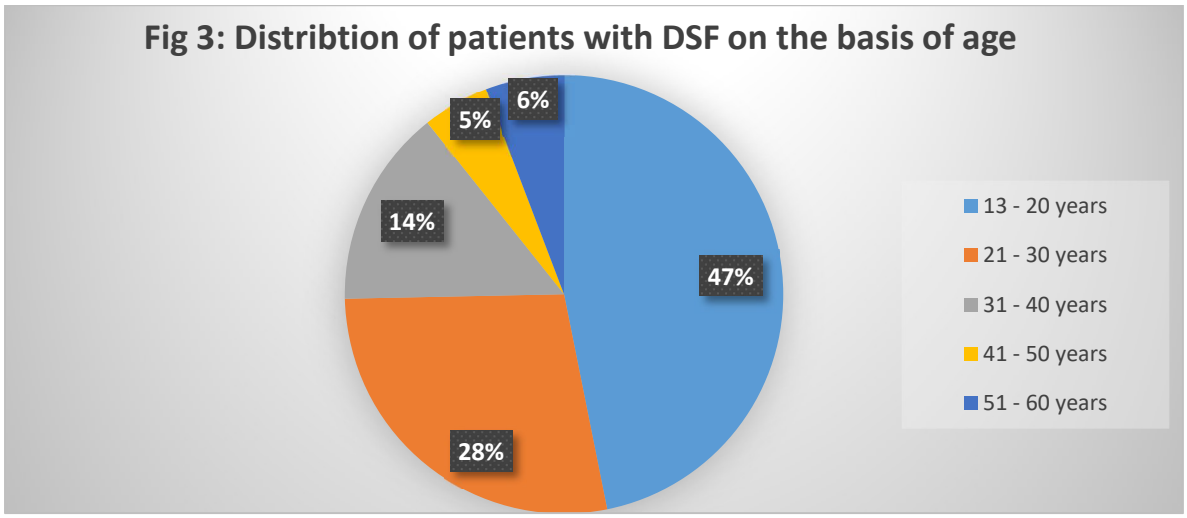

Figure 3

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80% of the patients with fall had dural tear present along with DSF. This was followed by assault and RTA in which 50% and 46.9% patients had dural tear with DSF (Fig 4).

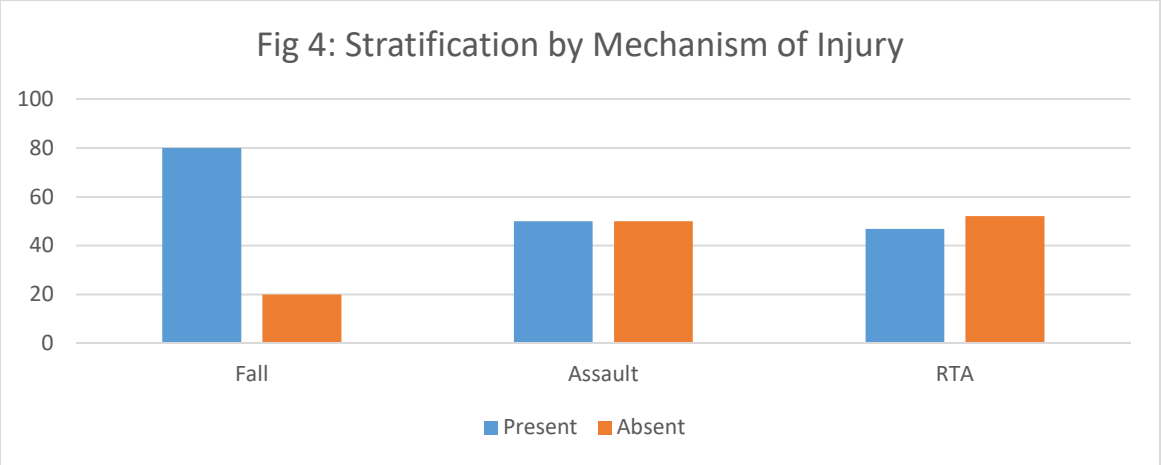

Figure 4

All the patients who presented with severe TBI had presence of dural tear with DSF, while 52% patients with moderate and 44.1% with mild injury had dural tear present (Fig 5).

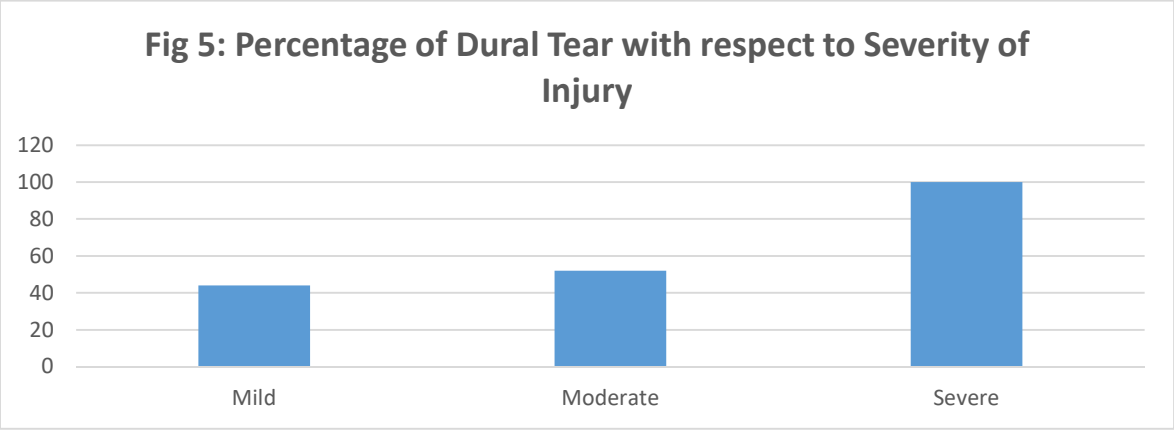

Figure 5

Presence of dural tear was 100% in occipital DSF followed by a significant percentage of 82.3% in temporal region DSF. 51% and 50% of patients with parietal and frontal DSF respectively, had dural tear. All the patients who had ASDH and SAH along with depressed skull fracture had dural tear. 59.2% of those who had contusion only as the other intracranial lesion with DSF had dural tear too, where as those patients who had contusions with EDH, and contusions with ASDH had dural tear in 75% and 50% cases respectively. Only 32.8% patients who had EDH were found to have dural tear, whereas 49.2% patients who had no other intracranial lesion with DSF had the presence of dural tear.

Conclusion

Dural tear has a strong association with depressed skull fracture and hence every DSF should be meticulously dealt with to avoid complications. There is no significance effect of age, gender, mechanism of injury on the presence of dural tear in DSF.

Patients in the second decade of life however, were observed to have DSF more commonly as compared to the rest of the age groups. From our study we also found that co-existing ASDH and SAH with DSF is a rare finding, but all such patient had dural tear present. Hence presence of ASDH and SAH with DSF is a strong predictor for dural tear with a p-value <0.05.

We also figured out that low GCS at presentation represents severity of injury which is mostly due to high amount of energy transfer which is associated with greater damage to skull and underlying brain tissue and its coverings. And for this reason all patients who presented with severe TBI had presence of dural tear with DSF.

Compound (open) depressed fractures have a strong association with underlying dural tear. Occipital region DSF have the highest incidence of dural tear followed by the temporal region.

We conclude from our study that young patients mostly in second decade of life presenting with DSF, patient with co-existing ASDH and SAH with DSF, patients with DSF presenting at low GCS and the patients with compound DSF specially at the occipital and temporal have significantly higher chances of underlying dural tear. Hence appropriate surgical intervention and management should be done for the high risk patients.

Discussion

Trauma has proven to be a global problem these days, with an incidence rising at an alarming rate in this post industrialization era. Head injury being the most lethal outcome of trauma has significant associated morbidity and mortality. Many studies have analyzed head injuries and resulting skull fractures. Road traffic accidents (RTA) is by far the most common mechanism of head injury, with different studies quoting different figures. Umerani et al[7] reported RTA as 62.6% of the etiology for skull fractures while Ahmad et al[17] reported it to be 80%. We found RTA as the leading mechanism of injury comprising of 57.9% of patients included in our study.

Frontal region was the most common site of depressed skull fracture in our patients (39.5%) which is quite similar to as reported by Imran et al[21], Ahmad et al[19] whereas Ali et al[16] and Muhammad et al[17] found Parietal region predominance.

We report contusions as the most common associated intracranial lesion with depressed skull fracture (33%) which is similar to as reported by Ahmad et al[19] (38.8%).

Dural tear in patients presenting with depressed skull fractures after head injury in our study was present in 576.3% patients. Ahmad et al[19] reported this incidence as 48.9% while Muhammad et al[17] reported as 33.7%.

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PROFORMA

Dural tears in patients presenting with depressed skull fracture after head injury.

S.no: **Hospital registration no.:**
Age: **Gender:**

Mechanism of injury:
(RTA, fall from height, blunt trauma from physical assault, penetrating trauma)

Location of depressed skull fracture:
(frontal, parietal, temporal, occipital, posterior fossa)

Depressed fracture: open/close

Presence of other brain injury:
(EDH, SDH, SAH, contusion)

GCS at Presentation:

Dural tear present (yes or no):

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References:
1. Ali M, Ali L, Roghani IS. Surgical management of depressed skull fracture. JPMI. 2003;17(1).
2. Medscape. Traumatic Brain Injury (TBI) - Definition, epidemiology, pathophysiology, 2011. Available from Medscape, eMedicine Web Site: http//emedicine.medscape.com/article/ 326510-overview. Accessed March 24, 2012
3. Yuan Q, Liu H, Wu X, Sun Y, Yao H, Zhou L, et al. Characteristics of acute treatment costs of traumatic brain injury in Eastern China--a multi-centre prospective observational study. Injury. 2012;43(12):2094-99.
4. Perez K, Novoa AM, Santamarina-Rubio E, Narvaez Y, Arrufat V, Borrell C, et al. Incidence trends of traumatic spinal cord injury and traumatic brain injury in Spain, 2000-2009. Accid Anal Prev. 2012;46:37-44.
5. Hoyt DB, Holcomb J, Abraham E, Atkins J, Sopko G. Working group on trauma research program summary report. J Trauma. 2004;57(2):410–5.

6. Shukla D, Devi BI. Mild traumatic brain injuries in adults. J Neurosci Rural Pract. 2010;1(2):82–8.
7. Umerani MS, Abbas A, Sharif S. Traumatic brain injuries: experience from a tertiary care centre in Pakistan. Turk Neurosurg. 2013;24(1):19–24.
8. Raja IA, Vohra AH, Ahmed M. Neurotrauma in Pakistan. World J Surg. 2001;25(9):1230–7.
9. Jooma R, Ahmed S, Zarden AM. Comparison of two surveys of head injured patients presenting during a calendar year to an urban medical centre 32 years apart. J Pak Med Assoc. 2005;55(12):530–2.
10. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, et al. Surgical management of depressed cranial fractures. Neurosurg. 2006;58(3):2–56.
11. Hung CC, Chiu WT, Lee LS, Lin LS, Shih CJ. Risk factors predicting surgically significant intracranial hematomas in patients with head injuries. J Formos Med Assoc. 1996;95(4):294–7.
12. Rodriguez ED, Stanwix MG, Nam AJ, St Hiaire H, Simmons OP, Christy MR, et al. Twenty-six–year experience treating frontal sinus fractures: a novel algorithm based on anatomical fracture pattern and failure of conventional techniques. Plastic Reconstr Surg. 2008;122(6):1850–66.
13. Tseng WC, Shih HM, Su YC, Chen HW, Hsiao KY, Chen IC. The association between skull bone fractures and outcomes in patients with severe traumatic brain injury. J Trauma. 2013;71(6):1611–4.
14. Mehdi SA, Ahmed B, Dogar IH, Shaukat A. Depressed skull fracture; interrelationship between CT evaluation of & its clinical findings. Prof Med J. 2010;17(4):616–22.
15. Syed AA, Arshad A, Abida K, Minakshi S. Paraperesis: a rare complication after depressed skull fracture. Pan Afr Med J. 2012;12:106.
16. Ali M, Ali L, Roghani IS. Surgical management of depressed skull fracture. J Postgrad Med Inst. 2011;17(1):116–23.
17. G Muhammad, A Aurangzeb, SA Khan, R Suhail, I Hussain, S Alam, EAK Afridi, B Khan, SN Bhatti: dural tears in patients with depressed skull fractures. J Ayub Med Coll. 2017;29(2):311–5
18. Hossain MZ, Mondle M, Hoque MM. Depressed skull fracture: outcome of surgical treatment. J Teach Assoc. 2008;21(2):140–6.

19. Ahmad S, Afzal A, Rehman L, Javed F. Impact of depressed skull fracture surgery on outcome of head injury patients. Pak J Med Sci. 2018;34(1):130-134.
20. Nayak PK, Mahapatra AK. Primary reconstruction of depressed skull fracture- the changing scenario. Indian J Neurotrauma. 2008;5(1):35–8.
21. Imran M, Khan A, Ahmed S, Ghouri S, Khan A, Farooqui M. Compound depressed fractures; the outcome of delayed repair of compound depressed fractures; a tertiary care experience from Karachi, Pakistan. Professional Med J. 2018;25(5):633-38.