ORIGINAL ARTICLE

DURAL TEARS IN PATIENTS WITH DEPRESSED SKULL FRACTURES

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Background: The presence of skull fracture in patients sustaining traumatic brain injury is an important risk factor for intracranial lesions. Assessment of integrity of dura in depressed skull fracture is of paramount importance because if dura is torn, lacerated brain matter may be present in the wound which needs proper debridement followed by water tight dural closure to prevent meningitis, cerebral abscess, and pseudomeningocoele formation. The objective of this study was to determine the frequency of dural tear in patients with depressed skull fractures. **Methods**: This cross-sectional study was conducted at Department of Neurosurgery Ayub Teaching Hospital Abbottabad**.** All the patients of either patients above 1 year of age with depressed skull fracture were included in this study in consecutive manner. Patients were operated for skull fractures and per-operatively dura in the region of depressed skull fracture was closely observed for any dural tear. The data were collected on a predesigned *pro forma*. **Results:** A total of 83 patients were included in this study out of which 57 (68.7%) were males and 26 (31.3%) were females. The age of the patients ranged from 1-50 (mean 15.71±13.49 years). Most common site of depressed skull fracture was parietal 32 (38.6%), followed by Frontal in 24 (28.9%), 21(25.3%) in temporal region, 5(6.0%) were in occipital region and only 1 (1.2%) in posterior fossa. Dural tear was present in 28 (33.7%) patients and it was absent in 55 (66.3%) of patients. **Conclusion:** In depressed skull fractures, there are high chances of associated traumatic dural tears which should be vigilantly managed.

Keywords: Depressed skull fracture; Dural tear; Head injury; Trauma; Elevation of depressed fracture; Extradural hematoma; Brain contusion.

J Ayub Med Coll Abbottabad 2017;29(2):311–5

INTRODUCTION

Traumatic Brain Injury (TBI) is an acquired insult to the brain resulting from an external mechanical force which may be accompanied by loss or alteration of sensorium. TBI is one of the leading causes of morbidity and mortality. In addition TBI poses great economic losses worldwide and it is estimated to cause an annual loss of $30 billion in developed countries.[1]

Each year more than 1.7 million people in the United States are effected by TBI and out of them each year almost a half million children. In UD alone 52,000 people die annually of TBI.[2] Global incidence of mortality after Head injury ranges from 91–546 per 100,000 population.[3] The rate of head injuries are on rise in developing countries and accounts for one quarter to one third of all accidental deaths. And the worst part is that an overwhelming majority of the victims affected by head injuries are males in second and third decades of life.[4,5]

There is scarcity of actual data about the head injuries from Pakistan, with the annual incidence of head injury in estimated as 50/100,000 population. This data being shown from the public sector hospitals, and the magnitude of problem is readily underestimated because of under reporting and poor record keeping.[6] These victims are again predominantly males in their most productive years of lives, moreover are often the bread-winners for their families.[7]

The mechanical forces during the TBI results in compression and shearing of neuronal and vascular tissue at the time of impact leading to the primary brain damage. A series of further pathological events lead secondary brain insults which are amenable to intervention and may decrease the morbidity and mortality of the patients.[8]

The presence of skull fracture on patients TBI is an important marker for intracranial lesions, such as hematomas, contusions, morbidity and mortality.[9,10] Cranial fractures can be of two types, i.e., depressed or linear based on the fact that whether the fractured segments have displacement between the bone edges or not. Depressed skull fractures (DSF) usually results from blunt injuries, occurs when the extent of bone displacement is greater than the full thickness of the adjacent calvarium. Compound DSF are fractures with an overlying scalp laceration and galeal disruption.[10,11]

Depressed skull fractures are found to occur in 11% of patients with severe head injury.[12] DSF carries a high risk of increasing pressure on the brain, crushing the delicate tissue. Complex depressed skull

fractures are those in which dura mater is torn.[13] DSF are the can be one of two types, i.e., open or closed DSF. In open DSF, either there is skin laceration on the fracture site or the fracture extends to paranasal air sinuses or middle ear structures resulting in communication between cranial cavity and external environment. Open DSF may either be clean or contaminated/dirty.[12,13]

Patients with DSF can present with neurological symptoms and signs like headache, vomiting and loss or obtunded level of consciousness or with seizures, CSF leak or brain matter may come out through the wound in compound depressed skull fractures.[12,13]

Plain X-ray skull can demonstrate the site of fracture and its degree of depression. Computerized Tomography Scan brain is helpful in diagnosis of depressed skull fractures and the intracranial lesions associated with the DSF, CT being much more superior than the plain X-rays.[14] Indication of surgical treatment in depressed skull fractures include the following: (a) compound depressed skull fractures (b) focal neurological signs (c) cosmetic purpose e.g., over the forehead (d) depression more than the inner table of non-depress bone (e) associated other lesions like extra-dural hematoma and (f) cerebrospinal fluid leak.[15]

Different studies have documented varying data regarding the incidence of dural tears in depressed skull fractures. Hossain *et al* reported the incidence of dural tear in depress skull fracture as 25%.[16] Whereas Nayak *et al* documented it as 68.75%.[8]

Assessment of integrity of dura in depressed skull fracture is of paramount importance because if dura is torn, lacerated brain matter may be present in the wound which needs proper debridement followed by water tight dural closure either with pericranium or fascia lata to prevent meningitis, cerebral abscess, and pseudomeningocoele formation. Hence if the dural tears in depressed skull fractures are not dealt with properly it can cause significant morbidity to the patients.

This study aimed to determine the frequency of dural tear in patients with depressed skull fractures This study intended to help us to lay out clear guidelines for the surgical management of depress skull fractures to prevent or to minimize these complications related to depress skull fractures like to prevent meningitis, cerebral abscess, pseudomeningocoele formation, growing skull fracture etc.

MATERIAL AND METHODS

This cross-sectional study was study is conducted in the department of Neurosurgery Ayub Medical College, Abbottabad from 12th Aug. 2014 to 11th Feb. 2015. The study was conducted after approval from hospital's ethical and research committee. Sample size was calculated using the WHO software for sample size calculation in health studies using the formula to evaluate population proportions with absolute precision and following assumptions keeping Confidence Level of 95%, proportion of dural tear in depressed skull fracture $\geq$ 68.75%[8] and absolute precision of 10%. All the patients of either gender with depressed skull fracture were included in this study in consecutive matter. Children below one year of age, and patients presenting after 2 weeks of injury and patients with penetrating type of head injuries were excluded in this study.

Patients fulfilling the inclusion criteria were included in the study. Informed consent was taken from all the patients. Patients were admitted in ward through accident and emergency department and assessed by taking detailed history and performing thorough clinical examination and radiological investigations like X-Rays of skull in antero-posterior and lateral views and CT scan brain. Skull was said to have a depressed fracture when a fragment of skull bone was displaced inward a distance equal to or greater than the width of the adjacent normal calvarium diagnosed on CT-scan of head. Patients were subjected to routine preoperative investigations and preoperative optimization and then later on operated upon. Per-operatively dura in the region of depressed skull fracture was closely observed for any dural tear and dural repair was done. The data were collected on a predesigned *pro forma.* Data were analysed on SPSS-10.0.

RESULTS

A total of 83 patients were included in this study out of which 57 (68.7%) were males and rest of 26 (31.3%) were females. The age of the patients ranged from 1 to 50 years with a mean of 15.71±13.49 years in age groups.

A total of 42 out of 83 patients (50.6%) were in age group of 1–10 years, 16 out of 83 (9.3%) were in age group of 11–20 years, 14 out of 83 (16.9%) were in age group of 21–30 years, 4 out of 83 (4.8%) were in age group of 31–40 years and 7 out of 83 (8.4%) were in age group of 41–50 years. The major bulk of these patients were from District Abbottabad and Mansehra which accounted for 38.2% and 20.5 % respectively.

The different locations of the depressed skull fractures are tabulated in table-1. Frontal depressed skull fractures were 24 (28.9%), 32 (38.6%) were in parietal region, 21 (25.3%) were in temporal region, 5 (6.0%) were in occipital region and only 1 (1.2%) in posterior fossa. Per-operatively

dural tear was present in 28 (33.7%) patients and it was absent in 55 (66.3%) of patients.

There was no significant difference in dural tears in either gender which is shown in cross tabulation in table-2, which shows 19 (33.33%) male patients were having dural tears & 9 (34.61%) females were having dural tears (*p*-value .55)

The frequencies of dural tears in different age groups are shown in table-3, which shows a significant difference in different age groups. In age group 1–10 years 8 (19.02%), in age group 11–20 years 8 (50%), in age group 21–30 years 8 (57.14%), in age group 31–40 years 1 (25%) and in age group 41–50 years 3 (42.85%) patients were having dural tears. (*p*-value 0.044). Similarly, there was no significant difference found in dural tears when different locations of the skull were taken into consideration (table-4).

Table-1: Location of depressed skull fractures

Location	Frequency	Percent
Frontal	24	28.9
Parietal	32	38.6
Temporal	21	25.3
Occipital	5	6.0
Posterior Fossa	1	1.2
Total	83	100.0

Table-2: Gender dural tear cross tabulation

Gender	Dural Tear			Total	*p*-value
	Present	Absent	Percent		
Male	19	38	33.33	57	0.55
Female	9	17	34.61	26	
Total	28	55	100.0	83	

Table-3: Age group dural tear cross tabulation

Age Group		Dural Tear		*p*-value
	Present	Absent	Total	
1–10 years	8	34	42	0.044
11–20 years	8	8	16	
21–30 years	8	6	14	
31–40 years	1	3	4	
41–50 years	3	4	7	
Total	28	55	83	

Table-4: Location of depressed skull fracture and dural tear cross tabulation

Location	Dural Tear		Total	*p*-value
	Present	Absent		
Frontal	10	14	24	0.177
Parietal	12	20	32	
Temporal	5	16	21	
Occipital	0	5	5	
Posterior Fossa	1	0	1	
Total	28	55	83	

DISCUSSION

The global incidence of fatal head injuries is greater than the number of non-fatal cases and head injury is one of the leading cause of severe disability and death in the modern world, the management of TBI has evolved by leaps and bounds in past two decades as a result of knowledge of secondary brain injury and management to prevent the secondary brain injury in critically ill patients. The factors determining the outcome in TBI include the type of head trauma, the type and site of skull fracture, intracranial haemorrhage or associated brain injuries. The most important advancement playing a pivotal role in the management of head injured patients is the availability and advances in diagnostic radiology equipment's like CT and MRI.[17,18]

Yet despite these advances in diagnostics, operative techniques and critical care set-ups, the mortality and morbidity associated with head injury is very high. Noting much could be done about the primary insults to the brain, but secondary injuries could be avoided.[18,19] Depressed skull fractures are one of the most common surgical problem in the patients presenting in neuro-trauma units. They not only show the severity of injury and can be taken as an important risk factor for intracranial lesions, such as hematomas, contusions, unfavourable outcome, and death.[9,10] Different aspects that can cause morbidity in patients with depressed skull fractures need to be addressed so as to avoid the complications associated with them. One such condition is dural tear, which if not managed properly can cause serious infections, CSF fistulas, growing skull fracture etc. The present study aimed to look for the frequency of depressed skull fracture in patient who were operated upon for depressed skull fractures

The most common cause of head injury in our study was fall from the hill in adults and fall from roof in children. This may be because of the hilly areas which are drained to our hospital. In contrast in plain areas the most common cause of traumatic brain injury remains road traffic injury. Igun GO *et al* and Yavuz *et al* both showed road traffic accidents as the most common cause of head injury. Igun GO.[20,21]

In our study 83 patients included in which 68.7% were males and the mean age of the patients was 15.71 years. This male predominance pattern coincides with results from other regional and international studies which show a predominance of male gender in cases of head injury.[19,22,23] Sunay YM *et al*,[21] observed a male to female ratio of 3.1:1, which closely correlates with the results of our study that we had male to female ration. Similarly, another study also showed in his study that more males are suffered from head trauma as compared to females because of more exposure of

males to traffic and outdoor activities then females.[24]

In our study, we observed that parietal bone was most commonly involved accounting for 32 (38.6%) cases; it was followed by frontal region 24 (28.9%) cases, 21 (25.3%) in temporal region, 5 (6.0%) were in occipital region and only 1 (1.2%) in posterior fossa. This is in accord with other studies.[25–28] The location of depressed skull fracture mainly depends on the type of trauma and the region of skull which receives the blow.

Dural tear was present in 28 (33.7%) patients and it was absent in 55 (66.3%) of patients. Different studies have documented varying data regarding the incidence of dural tears in depressed skull fractures. Hossain *et al* reported the incidence of dural tear in depress skull fracture as 25%.[16] Whereas Nayak *et al* documented it as 68.75%.[8] This shows that dural tears are a common finding in the patients operated for depressed skull fracture. Hence operating surgeons should be vigilant and should make it sure that the dural tear is properly closed either primarily or with the help of dural substitutes. So as to prevent the complication which can cause serious morbidities and at time be a reason the mortality.[9,29]

Our study showed that there was no significant difference in dural tears in either gender with 19 (33.33%) male patients 9 (34.61%) females patients having dural tears (*p*-value .55). Similarly, we didn't observe any significant difference in the number of patients with dural tears coming from different draining areas. Likewise, there was no significant difference found in dural tears when different locations of the skull depressed fracture were taken into consideration.

In the current study, we observed the frequency of dural tears in different age groups as: in age group 1–10 years 8 (19.02%), in age group 11–20 years 8 (50%), in age group 21–30 years 8 (57.14%), in age group 31–40 years 1 (25%) and in age group 41–50 years 3 (42.85%) patients were having dural tears. This showed that patients in paediatric age group are less likely to have dural tears associated with the depressed skull fractures, but still 19% were having the tears.

In nutshell, the high percentage of dural tears in all age groups and location of depressed skull fractures warrants cautious inspection of the dural at the site of depressed segment so that no minimal breach is missed.

CONCLUSION

In patients with depressed skull fractures there are high chances of associated traumatic dural tears. These dural rents should be vigilantly looked for at time of surgery and meticulously cared or so as to avoid any untoward post-operative complication.

AUTHORS' CONTRIBUTION

GM, SAK: Conceive the idea, data collection, write-up, AA, IH, SA, EAKF, and BK: data collection, literature search, RS, SNB: Supervised the study, write-up and approved the final draft.

REFERENCES

1. Hoyt DB, Holcomb J, Abraham E, Atkins J, Sopko G. Working Group on Trauma Research Program summary report: National Heart Lung Blood Institute (NHLBI), National Institute of General Medical Sciences (NIGMS), and National Institute of Neurological Disorders and Stroke (NINDS) of the National Institutes of Health (NIH), and the Department of Defense (DOD). J Trauma 2004;57(2):410–5.
2. Greenwald RM, Gwin JT, Chu JJ, Crisco JJ. Head impact severity measures for evaluating mild traumatic brain injury risk exposure. Neurosurgery 2008;62(4):789–98.
3. Shukla D, Devi BI. Mild traumatic brain injuries in adults. J Neurosci Rural Pract 2010;1(2):82–8.
4. Rastogi D, Meena S, Sharma V, Singh GK. Epidemiology of patients admitted to a major trauma centre in northern India. Chin J Traumatol 2014;17(2):103–7.
5. Umerani MS, Abbas A, Sharif S. Traumatic brain injuries: experience from a tertiary care centre in Pakistan. Turk Neurosurg 2013;24(1):19–24.
6. Raja IA, Vohra AH, Ahmed M. Neurotrauma in Pakistan. World J Surg 2001;25(9):1230–7.
7. 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.
8. Nayak PK, Mahapatra AK. Primary reconstruction of depressed skull fracture—The changing scenario. Indian J Neurotrauma 2008;5(1):35–8.
9. Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, *et al*. Surgical management of depressed cranial fractures. Neurosurgery 2006;58(3):2–56.
10. 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.
11. 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.
12. 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 2011;71(6):1611–4.
13. 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.
14. Syed AA, Arshad A, Abida K, Minakshi S. Paraperesis: a rare complication after depressed skull fracture. Pan Afr Med J 2012;12:106.
15. Ali M, Ali L, Roghani IS. Surgical management of depressed skull fracture. J Postgrad Med Inst 2011;17(1):116–23.
16. Hossain MZ, Mondle M, Hoque MM. Depressed skull fracture: outcome of surgical treatment. J Teach Assoc 2008;21(2):140–6.
17. Khan AN. Imaging in Skull Fractures: Overview, Radiography, Computed Tomography [Internet]. [cited 2014

Dec 1] Available from: http://emedicine.Medscape.Com/article/343764
18. Belanger HG, Vanderploeg RD, Curtiss G, Warden DL. Recent neuroimaging techniques in mild traumatic brain injury. J Neuropsychiatry Clin Neurosci 2014;19(1):5–20.
19. Patel HC, Menon DK, Tebbs S, Hawker R, Hutchinson PJ, Kirkpatrick PJ. Specialist neurocritical care and outcome from head injury. Intensive Care Med 2002;28(5):547–53.
20. Tagliaferri F, Compagnone C, Korsic M, Servadei F, Kraus J. A systematic review of brain injury epidemiology in Europe. Acta Neurochir 2006;148(3):255–68.
21. Igun GO. Predictive indices in traumatic intracranial haematomas. East Afr Med J 2000;77(1):9–12.
22. Yavuz MS, Asirdizer M, Cetin G, Günay Balci Y, Altinkok M. The correlation between skull fractures and intracranial lesions due to traffic accidents. Am J Forensic Med Pathol 2003;24(4):339–45.
23. Al-Kuwaiti A, Hefny AF, Bellou A, Eid HO, Abu-Zidan FM. Epidemiology of head injury in the United Arab Emirates. Ulus Travma Acil Cerrahi Derg 2012;18(3):213–8.
24. Langlois JA, Rutland-Brown W, Wald MM. The epidemiology and impact of traumatic brain injury: a brief overview. J Head Trauma Rehabil 2006;21(5):375–8.
25. Mannix R, Monuteaux MC, Schutzman SA, Meehan WP 3rd, Nigrovic LE, Neuman MI. Isolated skull fractures: trends in management in US pediatric emergency departments. Ann Emerg Med 2013;62(4):327–31.
26. Braakman R. Depressed skull fracture: data, treatment, and follow-up in 225 consecutive cases. J Neurol Neurosurg Psychiatry 1972;35(3):395–402.
27. Steinbok P, Flodmark O, Martens D, Germann ET. Management of simple depressed skull fractures in children. J Neurosurg 1987;66(4):506–10.
28. Ersahin Y, Mutluer S, Mirzai H, Palali I. Pediatric depressed skull fractures: analysis of 530 cases. Childs Nerv Syst 1996;12(6):323–31.
29. Tung GA, Kumar M, Richardson RC, Jenny C, Brown WD. Comparison of accidental and nonaccidental traumatic head injury in children on noncontrast computed tomography. Pediatrics 2006;118(2):626–33.
30. Marbacher S, Andres RH, Fathi AR, Fandino J. Primary reconstruction of open depressed skull fractures with titanium mesh. J Craniofac Surg 2008;19(2):490–5.

Received: 16 November, 2016	*Revised: 28 March, 2017*	*Accepted: 30 March, 2017*

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