

# FREQUENCY OF SEIZURE IN SURGICALLY MANAGED DEPRESSED SKULL FRACTURE IN SULAYMANIYAH CITY



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## ABSTRACT

### *Background*

Depressed skull fracture (DSF) is one of the conditions which results from various types of trauma in which the outer table of the depressed part lies beneath the line of the inner table. It can be treated conservatively or surgically according to some set of indications. One of its complications is a seizure.

### *Objectives*

Our study tried to find the frequency of seizures in patients who sustained a depressed skull fracture and were surgically treated.

### *Patients and Methods*

A retrospective observational study was conducted in Sulaymaniyah hospitals. Forty eight patients were enrolled in it with male to female ratio of 4.3:1. There were 7 patients who developed seizure, five had immediate seizure and 2 had late seizure. Those with late seizure were placed on antiepileptic drugs (AED).

### *Results*

The position of depressed skull fracture (DSF), statistically, showed significant association with the time of seizure regardless of its type (P-value 0.009), there were also significant association between the presence of dural tear and associated brain injury with seizure type, (P- value= 0.041and 0.036) respectively.

### *Conclusion*

The frequency of developing seizures after DSF was 14.59% regardless of its type.

**Keywords:** *Depressed skull fracture (DSF), Traumatic brain injury, Post-traumatic seizure (PTS).*

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## INTRODUCTION

Depressed skull fracture (DSF) is one of the severe head injury types. When any portion of the outer table of the line of fracture lying below the standard anatomical position of the table, it is considered a depressed skull fracture <sup>(1)</sup>.

It usually constitutes about 11% of severe head injuries <sup>(2)</sup>. In those inflicted with DSF, 25% lose consciousness for less than one hour, and 25% do not show any loss in their level of consciousness <sup>(2,3)</sup>.

Motor vehicle accident (MVA) occurrences with non-helmeted riders are prevalent in our locality. Together with assaults and falling from heights are other modes of injury commonly causing DSFs <sup>(4)</sup>.

Depending on the absence or the presence of overlying scalp laceration, a depressed fracture may be closed or open, respectively. When it comes to the anatomical location of depressed fractures, they occur in the frontoparietal region in (75%), temporal (10%), occipital (5%), and other regions (10%). Open fractures, which are about (75- 90%), are the most common type <sup>(3)</sup>.

Open scalp wounds, comminution, dural tear, cerebral parenchymal lesions, epidural hematoma, subdural hematoma, cerebrospinal fluid (CSF) leakage, or other intracranial injuries are the presentations that are commonly associated with depressed skull fractures and directly impact the outcome in these patients <sup>(5)</sup>.

One known complication of DSF and other traumatic brain injuries is seizure (post-traumatic seizure PTS) which is classified into immediate, early, and late <sup>(6)</sup>. According to Jennet <sup>(7)</sup> early was 10%, and late was 15%. PTS occurring within the first 24 hours of trauma are immediate, while those occurring within seven days of trauma and after that period are classified as early and late PTS, respectively <sup>(6)</sup>.

Depressed skull fractures are diagnosed on skull X-rays and head CT scans which is the gold standard. Depressed skull fracture could be managed either surgically or conservatively <sup>(8)</sup>.

DSF treatment depends on communication with the exterior environment, neurological deficit, and the degree of depression. Indications of surgery in DSF are the presence of focal neurological signs, cosmetic purposes, e.g., over the forehead, associated other lesions like EDH (Epidural hematoma), depression more than the inner table of non-depressed bone, CSF

leakage, and compound depressed fracture <sup>(9)</sup>.

When it comes to surgical treatment of DSF, there are multiple steps in its treatment which can be as follow: elevation of depressed bone, removal of bone fragments, dural tear repair, hematoma evacuation, hemostasis, debridement of the wound margins, and primary repair if possible <sup>(9)</sup>.

In our study, we wanted to know the frequency of seizure occurrences after operative management and their correlation with the position of fractures.

## PATIENTS AND METHODS

This retrospective observational study was conducted in Sulaymaniyah surgical emergency, Shaheed Dr. Aso, and Shar Teaching Hospitals.

This study included 48 patients with DSFs, who were managed surgically from October 2016 to January 2020. Patients' data were taken with regards to age, sex and address, cause of DSF, the position of DSF, GCS score, time of seizure, type of seizure (partial or generalized), attacks of seizure, associated brain injuries, clinical condition, surgical procedure and postoperative complications like (seizure, wound infection, and other complications), medications taken for controlling seizure and CT scan findings were documented. Seizure attacks were either informed by the patients or their relatives.

The decision of operation was made based on standard indications. Surgical procedures included; linear, S-shaped, or horseshoe flap incisions according to type and size of DSFs and overlying skin laceration. All patients were given prophylactic antibiotics.

Patients with minor head injuries were treated in the hospital for 3-4 days. Those with moderate-to-severe head injuries were treated in hospital for 10–30 days, depending on the severity of the head injury. After discharge, they were followed up in the neurosurgery outpatient department.

The “IBM SPSS Statistics version 25” was used to analyze the data, and both descriptive and inferential statistics were used. Furthermore, a P-value of ( $\leq 0.05$ ) was considered statistically significant associations. Also, Pearson Chi-Square was used to determine the significance of the association between independent and dependent variable pairs.

## RESULTS

A total of 48 patients were enrolled in this study; there were 39 (81.25%) males and 9 (18.75%) females with a male to female ratio of 4.3:1. The mean age was 19.72 ± 14.22. The age group most affected was 1-9 years and included 18 patients (37.5%), followed by 20-29 years and 10-19 years, having 20.83% and % 16.67, respectively (Table 1).

Motor vehicle accident (47.9%) was the most common cause of DSFs followed by fall from height (31.25%). Others, in the order of decreasing frequency, included: Falling heavy objects on the head (12.5%), bullet injury (6.25%), and stab wound (2.08 %).

Among the studied population, 60.42% presented with mild head injury (GCS score of 14-15), 31.25% had a moderate head injury (GCS score of 9-13), and 8.33% with severe head injury (GCS score of less than 8).

, the most common site of fracture is the frontal region which was seen in 19 patients (39.58%), followed by the parietal region in 17 patients (35.41%). Dura was found to be torn in 30 patients (62.5%) and intact in 18 patients (37.5%), Table 2.

Some of the patients (19%) had no associated brain injuries; others were associated with the following: brain contusions (27.08%), epidural hematoma (14.58%), subarachnoid hemorrhage (8.33%), and one patient had associated superior sagittal sinus injury, (Table 3).

The seizures were observed in 7 patients; 5 immediate seizures (10.42%) and 2 late seizures (4.17%). Two of the patients with immediate seizures were partial (4.17%), and the rest were generalized seizures (10.47%), (Table 3).

The patients with late seizures receive medication, and their seizures are controlled. Postoperatively, apart from seizure, majority of the patients (93.7%) had no other complications, including infections. One patient developed stroke after cranioplasty, which had been performed six months after the accident, and one patient developed right eye blindness and retrograde amnesia.

According to our statistical results, the position of DSF showed significant association with the time of seizure regardless of its type (P-value 0.009); there was also a significant association between the presence of dural tear and associated brain injury with seizure type (P-value 0.041 and 0.036 respectively) (Tables 4, 5 and 6).

There was an insignificant association between dural tear and associated brain injury with seizure time (P-value 0.534 and 0.421), respectively. In addition, the position of DSF showed non-significant association with seizure type (P-value 0.068) (Tables 7, 8, and 9).

Associated brain injury showed non-significant association with control of the seizure (P-value 0.335) (Table 10).

**Table 1. Age distribution and frequencies of the patients with DSF.**

Age groups (year)	Frequency	Percent
<b>1 - 9</b>	18	37.50
<b>10 - 19</b>	8	16.67
<b>20 - 29</b>	10	20.83
<b>30 - 39</b>	6	12.50
<b>40 - 49</b>	5	10.42
<b>50 - 53</b>	1	2.08
<b>Total</b>	<b>48</b>	<b>100</b>

Table 2. DSF positions, frequency, and percentage.

Depressed skull fracture position	Frequency	Percent
Left frontal	6	12.50
Left occipital	4	8.33
Left parietal	7	14.58
Left temporal	1	2.08
Right frontal	13	27.08
Right frontoparietal	2	4.17
Right occipital	1	2.08
Right parietal	10	20.83
Right parieto-occipital	3	6.25
Right temporoparietal	1	2.08
<b>Total</b>	<b>48</b>	<b>100</b>

Table 3. DSF associated with intracranial injuries, types of seizures, and seizure time.

Fit type			Fit time (%)		
			Immediate	Late	None
<b>Partial</b>	<b>Associated brain injury</b>	Contusion	1 (50)	0 ( )	0 (0)
		Epidural hemorrhage + Contusion	1 (50)	0 ( )	0 (0)
		<b>Total</b>	2 (100)	(0)	0 (0)
<b>Generalize</b>	<b>Associated brain injury</b>	Contusion	0 (0)	2 (40)	0 (0)
		None	2 (40)	0 (0)	0 (0)
		Subarachnoid hemorrhage	1 (20)	0 (0)	0 (0)
	<b>Total</b>	3 (60)	2 (40)	0 (0)	
<b>No fit</b>	<b>Associated brain injury</b>	Epidural hemorrhage	0 (0)	0 (0)	7 (17.1)
		Basal skull fracture	0 (0)	0 (0)	1 (2.4)
		Contusion	0 (0)	0 (0)	10 (24.4)
		Epidural hemorrhage + intracerebral hemorrhage	0 (0)	0 (0)	1 (2.4)
		Intracerebral hemorrhage + contusion + subarachnoid hemorrhage	0 (0)	0 (0)	1 (2.4)
		None	0 ( )	0 (0)	17 (41.5)
		Subarachnoid hemorrhage	0 (0)	0 (0)	3 (7.3)
		Superior sagittal sinus injury	0 (0)	0 (0)	1 (2.4)
		<b>Total</b>	0 (0)	0 (0)	41 (100)
<b>Total</b>	<b>Associated brain injury</b>	Epidural hemorrhage	0 (0)	0 (0)	7 (14.6)
		Basal skull fracture	0 (0)	0 (0)	1 (2.1)
		Contusion	1 (2.1)	2 (4.2)	10 (20.8)
		Epidural hemorrhage + Contusion	1 (2.1)	0 (0)	0 (0)
		Epidural hemorrhage + intracerebral hemorrhage	0 (0)	0 (0)	1 (2.1)
		Intracerebral hemorrhage + contusion + subarachnoid hemorrhage	0 (0)	0 (0)	1 (2.1)
		None	2 (4.2)	0 (0)	17 (35.4)
		Subarachnoid hemorrhage	1 (2.1)	0 (0)	3 (6.3)
		Superior sagittal sinus injury	0 (0)	0 (0)	1 (2.1)
<b>Total</b>	5 (10.4)	2 (4.2)	41 (85.4)		

**Table 4. shows a statistically significant association between depressed skull fracture position and seizure time.**

Depressed skull fracture position	Seizure time N(%)			P-value
	Immediate	Late	None	
Left frontal	0(0)	0(0)	6(13)	<b>0.009</b>
Left occipital	1(2)	0(0)	3(6)	
Left parietal	2(4)	0(0)	5(10)	
Left temporal	0(0)	0(0)	1(2)	
Right frontal	0(0)	0(0)	13(27)	
Right frontoparietal	1(2)	0(0)	1(2)	
Right occipital	0(0)	0(0)	1(2)	
Right parietal	1(2)	1(2)	8(17)	
Right parieto-occipital	0(0)	0(0)	3(6)	
Right temporoparietal	0(0)	1(2)	0(0)	
<b>Total</b>	<b>5(10)</b>	<b>2(4)</b>	<b>41(85)</b>	

**Table 5. shows a statistically significant association between dural tear and seizure type.**

Dural tear	Seizure type N(%)			P-value
	partial	generalized	none	
Yes	0(0)	5(10.4)	25(52.1)	<b>0.041</b>
No	2(4.2)	0(0)	16(33.3)	
<b>Total</b>	<b>2(4.2)</b>	<b>5(10.4)</b>	<b>41(85.4)</b>	

**Table 6. shows a statistically significant association between associated brain injury and seizure type.**

Associated brain injury	Seizure type N(%)			P-value
	partial	generalized	none	
Epidural hematoma	0(0)	0(0)	7(14.6)	<b>0.036</b>
Basal skull fracture	0(0)	0(0)	1(2.1)	
Contusion	1(2.1)	2(4.2)	10(20.8)	
Epidural hematoma + Contusion	1(2.1)	0(0)	0(0)	
Epidural hematoma + intracerebral hemorrhage	0(0)	0(0)	1(2.1)	
Intracerebral hemorrhage + contusion + subarachnoid hemorrhage	0(0)	0(0)	1(2.1)	
None	0(0)	2(4.2)	17(35.4)	
Subarachnoid hemorrhage	0(0)	1(2.1)	3(6.3)	
Superior sagittal sinus injury	0(0)	0(0)	1(2.1)	
<b>Total</b>	<b>2(4.2)</b>	<b>5(10.4)</b>	<b>41(85.4)</b>	

Table 7. Association between dural tear and seizure time.

Dural tear	Seizure time N(%)			P-value
	Immediate	Late	None	
Yes	3(6)	2(4)	25(52)	<b>0.534</b>
No	2(4)	0(0)	16(33)	
<b>Total</b>	<b>5(10)</b>	<b>2(4)</b>	<b>41(85)</b>	

Table 8. Associated brain injury and seizure time.

Associated brain injury	Seizure time N(%)			P-value
	Immediate	Late	None	
Epidural hemorrhage	0(0)	0(0)	7(15)	<b>0.421</b>
Basal skull fracture	0(0)	0(0)	1(2)	
Contusion	1(2)	2(4)	10(21)	
Epidural hemorrhage + Contusion	1(2)	0(0)	0(0)	
Epidural hemorrhage + intracerebral hemorrhage	0(0)	0(0)	1(2)	
Intracerebral hemorrhage + contusion + subarachnoid hemorrhage	0(0)	0(0)	1(2)	
None	2(4)	0(0)	17(35)	
Subarachnoid hemorrhage	1(2)	0(0)	3(6)	
Superior sagittal sinus injury	0(0)	0(0)	1(2)	
<b>Total</b>	<b>5(10)</b>	<b>2(4)</b>	<b>41(85)</b>	

Table 9. Depressed skull fracture position and seizure type.

Depressed skull fracture	Seizure type N(%)			P-value
	Partial	Generalize	No seizure	
Left frontal	0(0)	0(0)	6(12.5)	<b>0.068</b>
Left occipital	0(0)	1(2.1)	3(6.3)	
Left parietal	1(2.1)	1(2.1)	5(10.4)	
Left temporal	0(0)	0(0)	1(2.1)	
Right frontal	0(0)	0(0)	13(27.1)	
Right frontoparietal	1(2.1)	0(0)	1(2.1)	
Right occipital	0(0)	0(0)	1(2.1)	
Right parietal	0(0)	2(4.2)	8(16.7)	
Right parieto-occipital	0(0)	0(0)	3(6.3)	
Right temporoparietal	0(0)	1(2.1)	0(0)	
<b>Total</b>	<b>2(4.2)</b>	<b>5(10.4)</b>	<b>41(85.4)</b>	

Table 10.Type of brain injury and seizure control.

Associated brain injury	Seizure control N(%)		P-value
	Controlled	No seizure	
Epidural hemorrhage	0(0)	7(15)	
Basal skull fracture	0(0)	1(2)	
Contusion	3(6)	10(21)	
Epidural hemorrhage + Contusion	1(2)	0(0)	
Epidural hemorrhage + intracerebral hemorrhage	0(0)	1(2)	
Intracerebral hemorrhage + contusion + subarachnoid hemorrhage	0(0)	1(2)	<b>0.335</b>
None	2(4)	17(35)	
Subarachnoid hemorrhage	1(2)	3(6)	
Superior sagittal sinus injury	0(0)	1(2)	
<b>Total</b>	<b>7(15)</b>	<b>41(85)</b>	

## DISCUSSION

Head injury is a common cause of morbidity and mortality, especially in the young age population. Due to their more freedom in engaging in adventurous activities, Males in our society are more prone to accidents. And as a result, more head injuries, including DSFs. In our study male to female ratio was 4.3:1. Almost similar results were obtained by other authors like Asif<sup>(2)</sup> and Hussein et al.<sup>(8)</sup> which were (5: 2 and 4: 1), respectively.

The pediatric population is the most common age group that sustains DSFs. We concluded that those between 1-20 years of age comprise (54.17%) of the cases. Other literature also points to the same conclusion as ours, like Al-Hadad<sup>(10)</sup> and Mushtaq<sup>(3)</sup>.

When it comes to the admission GCS scores, 60.42% of our cases had a mild head injury, 31.25% had a moderate head injury, and 8.33% with a severe head injury. Hossain<sup>(9)</sup> stated the percentages to be (50%, 31%, and 19%) respectively, while the results from Manne et al.<sup>(4)</sup> were a bit different (74%, 14%, and 12%) respectively.

Depressed skull fractures can occur anywhere within the bones of the cranium. In our study, the most common area was frontal (40%), followed by the parietal, which was (36%). Asif<sup>(2)</sup> stated that the majority of cases were parietal and frontal (67%), while in the study by Rolekar<sup>(11)</sup>, the frontoparietal position was (64%).

Motor vehicle accidents followed by falling from heights are the two most common causes of DSFs in our locality. Non-helmeted motorcycling is a common

practice in our locality despite regulation measures. Those two were among the major causes which were inflicting DSFs. Similar causes are mentioned to be the commonest in other studies like Rolekar<sup>(11)</sup>, Braakman<sup>(12)</sup>, and Ersahin<sup>(13)</sup>.

Depressed skull fractures are also associated with other intracranial lesions. However, the majority of our patients did not have any (39.58%). The most common associated lesion was contusion (27.08%), followed by epidural hematoma (14.58%) and subarachnoid hemorrhage (8.33%). Similar results were found by Asif<sup>(2)</sup>, and Manne et al.<sup>(4)</sup>.

Dura was found to be torn in (62.5%) of our patients. Other studies like Manne et al.<sup>(4)</sup>, Rehman<sup>(5)</sup>, and Hossain<sup>(9)</sup> found it to be (55.3%, 33.2%, and 25%), respectively.

Seizure development is one of the complications of DSF. Therefore, we did not use any prophylactic antiepileptic drugs (AED) preoperatively. In our study, we had (5) patients who developed immediate-type seizures (10.42%) and (2) of the lately developed seizure (4.17%), out of these (7) patients (2) were partial and (5) were generalized. Those who had late-type were placed on AED. Janette<sup>(7)</sup> concluded that 10% had an early-type seizure, and 15% had a late-type in their study. Hossain<sup>(9)</sup> reported a 0% incidence of seizures in his series. In contrast, Al-Hadad<sup>(10)</sup> reported early to be (12.3%) and (6.9%) late-type in their study. Rolekar<sup>(11)</sup> reported (26%) immediate seizure in their study. At the same time, Shukla<sup>(14)</sup> had (4%) early and (2%) late patients who had a seizure.

In our study, we have found that the position of DSF had a significant correlation with the time of seizure. Also, the type of seizure was significantly associated with the presence of dural tear and associated brain injuries, statistically. Dural tear and associated brain injuries did not correlate with the timing of the seizure, and also, the positions of DSF and seizure type were statistically insignificant in correlation. Al-Haddad<sup>(10)</sup> found no statistical correlation with a dural tear. Temkin<sup>(15)</sup> stated that DSF, along with acute subdural hematoma and epidural hematoma, collectively had the highest risk for seizure, especially early-type seizure.

like any other studies, we have limitations—first, the small sample size of patients. Second, shortage of information in the case sheets of the participants, absence of electronic medical records or databases that provide the past medical and surgical history of our patients. Third and last, the hesitancy of some of the participants' follow up.

Inconclusions, Seizure is one of the complications of DSF, whether it occurs before or after surgical management. In our study, we had immediate and late seizures after DSF (10.42% and 4.17%).

All those who had late seizures were placed on AED and were controlled. We also found that the presence of other associated intracranial lesions and dural tears had a significant association with seizure type; in addition to that, the time of seizure and position of DSF was also in correlation.

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