

## To study the association of CSF leaks in open and closed Frontobasal Skull Fractures

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**Abstract:** *Objective:* To study the association of CSF leaks in open and closed Frontobasal skull fractures. *Background:* Frontobasal skull fractures are a complex entity. CSF leak is common after such injuries. This study examines the relationship between occurrence of CSF leak and different type of frontobasal skull fractures. *Methods:* A prospective study was conducted from November 2014 to May 2016 in patients admitted with head injuries to KIMSDU, Karad, Maharashtra. All data was retrieved using a standardized data collection form. *Results:* Out of the total 55 patients of frontobasal fracture, 39(70.9 %) were found to have CSF leak. Out of these 55, 52 (94.5%) were males and 3 (5.5 %) were females. The mean age of patients with head injury was found to be 36.5± 13.83 years. Out of 55 patients, 43 patients had GCS 12-15, 9 had 7-11 and 5 had <7. Out of 39 patients, 30 patients (54.5%) had closed skull fracture and 9 patients (16.4%) had open skull fracture. Statistical analysis showed no significant association between type of skull fracture and presence of CSF leak ( $p > 0.05$ ). *Conclusion:* No significant association was found between the occurrence of CSF leak and different types of frontobasal skull fractures. Most cases were treated conservatively.

**Keywords:** Frontobasal fractures, CSF leak, Open skull fractures, Closed skull fractures.

### Introduction

Head injuries are one of the leading causes of admission from the accident and emergency. Most of the cases are due to road traffic accidents or physical assault [1-2]. Anterior skull base fractures account for 3.5-24% of patients in this group. This wide variations of incidence arise due to a difference in study population and from a difficulty in obtaining radiographic verification of fractures [3]. Prospective case series of severe head injuries of the traumatic coma data bank reported that 25% had basilar skull fractures. These fractures are often part of polytrauma but may also occur alone.

Frontobasal fractures can be either Closed(simple) or Open(compound). In Khalid et al study [4] 52% had open skull fracture and 48% had close skull fracture. In Brisbane et al study [5] 75% had open skull fracture while 25% had close skull fracture. Difference in percentage of type of skull fracture may be due to difference in number of patients admitted to the hospital due to geographical variation in different studies. Chance of infection and postoperative

complication is higher in cases of open fracture because of risk of introduction of infection from outside. CSF rhinorrhoea is common after head injuries and its incidence in basilar skull fractures is estimated to be 1,50,000 per year in the USA [6]. It creates a permanent pathway for bacteria to the subarachnoid space leading to meningitis or brain abscesses if left untreated.

The advent of better antibiotics has markedly reduced the risk of meningitis/ abscesses in the acute state of frontobasal skull fractures. The management of persistent post surgical CSF fistulas still remains a surgical challenge for the neurosurgeon. A surgical repair of the dura is advocated only in persistent CSF leaks [7]. Repair of these leaks has evolved from that of an intracranial approach to one that is primarily extra cranial and endoscopic.

### Material and Methods

This prospective study was conducted in the Department of Neurosurgery, KIMSDU, Karad from November 2014 to May 2016. All

patients with Frontobasal skull fractures admitted to the Neurosurgery ward or intensive care unit were included in the study. All cases had been subjected to proper history taking. Patient information such as name, age, sex, occupation, income, socio-economic class, total family members and any medical past history of relevant importance are obtained from questionnaire method. Details about place and time of accident, time of arrival at hospital, cause of accident, type of vehicle used, influence of alcohol and Glasgow coma score, Type of head injury, CSF leak, CT head were noted on a standardized form. The parameters assessed were influence of alcohol, Glasgow coma score.

*Statistics:* Statistical software SPSS version 20 was used for data analysis. Proportions and percentages were calculated. Variables were compared by performing chi-square test for small numbers, Fishers exact test was applied whenever applicable. P-value<0.05 was considered as statistically significant.

**Results**

Study included 55 patients of head injury. All the patients were screened for the presence of frontobasal fracture and CSF leak. 39 (70.9%) patients had CSF leak whereas 16 (29.1%) patients had no CSF leak. Statistical analysis done for different variables among patients.

**Table-1: Association of CSF leak and type of head injury (n=55)**

CSF leak	Close head Injury	Open head Injury	Total
Yes	30(54.5%)	9(16.4%)	39(70.9%)
No	15(27.3%)	1(1.8%)	16(29.1%)
Total	45(81.8%)	10(18.2%)	55(100%)

The total 55 patients were divided into seven groups according to age (0-15, 16-25, 26-35, 36-45, 46-55, 56-65 and >65 years). The maximum

numbers of patients (38.2 %) were in the age group 26-35 years. The average age of the patients was 36.5 ± 13.83 years. Out of 55 patients of head injury, 13 patients (23.6%) were under the influence of alcohol. Out of 13 patients who were under the influence of alcohol, 10 patients (18.2%) had mild derangement in Glasgow coma score (12-15). Statistical analysis did not reveal any significant association between Glasgow coma score and influence of alcohol in head injury patients (P>0.05).

Out of 55 patients of head injury, 39 patients (70.9%) had evidence of CSF leak. Out of 39 patients, 30 patients (54.5%) had closed skull fracture and 9 patients (16.4%) had open skull fracture. Statistical analysis showed no significant association between type of skull fracture and presence of CSF leak (p> 0.05). CSF leak could be developed in head injury patients irrespective of open or closed skull fracture

Out of 39 patients of CSF leak, 20 patients (51.3%) had CSF leak for 1 to 5 days, 12 patients (30.8%) had CSF leak for 6-10 days, 7 patients (17.9%) had CSF leak for > 10 days.

Out of 39 patients of head injury, maximum patient had duration of hospitalization between 3-15 days. 18 patients (46.2%) was hospitalized for 9-15 days, 11 patients (28.2%) was hospitalized for 3-8 days, 7 patients (17.9%) was hospitalized for > 15 days, and 3 patients was hospitalized for < 3 days.

Out of 39 patients with CSF leak 21(53.8%) were treated conservatively, 12(30.8%) required only a craniotomy, 5(12.8%) required a lumbar drain placement. Only 1(2.6%) patients were first treated with a lumbar drain and later required a craniotomy.

**Table-2: Treatment modalities**

Type of injury	Conservative management	Operative management	Lumbar drain	Operative +lumbar drain	Total
Open	5 (55.6%)	4 (44.4%)	0	0	9
Closed	16 (53.4%)	8 (26.6%)	5 (16.7%)	1 (3.3%)	30
Total	21(53.8%)	12 (30.8%)	5 (12.8%)	1 (2.6%)	39 (100%)

Out of the 9 patients with a open fracture, 5(55.6%) were treated conservatively while the rest 4(44.4%) required a craniotomy. No patient required a external lumbar drain. Out of the 30 patients with closed fractures 10(53.4%) were treated conservatively, 8(26.6%) patients required a craniotomy only. 5(16.7%) were treated only with lumbar drainage and only 1(2.6%) patient required operative management after the lumbar drain failed to control the CSF leak.

**Table-3: Comparison of % of open and closed fractures with other studies**

Type of fracture	Present study	Khalid's study	Brisbone study
Close	81.8%	48%	25%
Open	18.2%	52%	75%

At the time of discharge out of 55 patients of head injury, 48 patients had Glasgow coma score of 15 (complete recovery). Out of 43 patients who had Glasgow coma score on admission between 12-15, maximum number of patients (95.3%) had complete recovery while 2 patients (4.7%) had mild neurological deficit. Out of 9 patients with Glasgow coma score on admission was between 7-11, 5 patients (55.6%) had complete recovery, 3 patients (33.3%) had mild neurological deficit and 1 patient had moderate neurological deficit on discharge. Out of 3 patients with Glasgow coma score on admission < 7, 2 patients (66.7%) improved completely and one patient (33.3%) had minimal neurological deficit. Statistical analysis showed that association between Glasgow coma score on admission and discharge was highly significant. (p< 0.05) Patient with low Glasgow coma score on admission showed significant improvement after treatment i.e. improved Glasgow coma score on discharge.

Out of 39 patients of head injury with CSF leak, 35 patients (89.7%) completely recovered (GCS 15), 3 patients (7.7%) had mild neurological deficit (GCS 12-14), 1 patient (2.6%) had moderate neurological deficit (GCS 7-11).

**Discussion**

Skull base fractures account for 80% of all CSF fistulas. The diagnosis and treatment of CSF fistulas is a challenge with no agreement on

treatment guidelines. To the best of our knowledge there are no studies on the relation of CSF leak in open and closed frontobasal skull fractures. The study was made mainly in the aspect of studying CSF leaks and its association in open and closed frontobasal skull fractures and the management of CSF leaks in these patients.

Clinically patients were classified as open and closed skull fractures. In our study, total 39 patients (70.9%) had CSF leak in the form of either rhinorrhoea or otorrhoea and 5 patients (9.1%) had ENT bleeding. Out of 39 patients of CSF leak, 38 had CSF rhinorrhoea and 1 had CSF otorrhoea. In Khalid et al study [4] 27 patients (54%) patients had CSF leak. In Velho et al study [8], 32 patients had CSF leak at presentation. In Shisoka et al study [9], 13 patients (13.5%) had CSF rhinorrhoea and 11 patients (11.5%) had CSF otorrhoea. In Bell et al study [10], 34 patients were identified with CSF leak presenting as otorrhoea (25 patients) or rhinorrhoea (9 patients).

Out of 55 patients, 45 patients (81.8%) had close skull fracture and 10 patients (18.2%) had open skull fracture. In Khalid et al study [4], 52% had open skull fracture and 48% had close skull fracture. In Brisbane et al study [5], 75% had open skull fracture while 25% had close skull fracture. Difference in percentage of type of skull fracture may be due to difference in number of patients admitted to the hospital due to geographical variation in different studies. Chance of infection and postoperative complication is higher in cases of open fracture because of risk of introduction of infection from outside. Association of CSF leak and type of head injury statistically was not significant. CSF leak can be present in open or close head injury. The severity of the leak is also not always proportional to the size of the dural tear. Usually the leak is through a dural tear which is associated with a fracture of the anterior cranial fossa involving a paranasal air sinus or the cribriform plate of ethmoid.

Out of 39 patients with CSF leak 21 patients (53.8%) were managed conservatively, 5 patients (12.8%) managed by external lumbar

drainage and 12(30.8%) patients managed by surgical repair. 1 patient was managed by both external lumbar drainage and surgical repair. In Khalid et al study [4] 22 (44%) patients managed conservatively while 28 patients (56%) managed surgically. In Bell et al study[10] 28 patients (84.6%) conservatively, 6 patients (0.8%) underwent CSF diversion via a lumbar drain for a period of 5 to 10 days. Two of these patients were treated successfully; the remaining 4 patients required surgical procedures. In our study bed rest, elevating head 30°, stool softeners and acetazolamide are used as conservative treatment.

The patient was given antibiotics and is cautioned not to sniff or blow his nose. The nose or ear covered with a light dressing but the orifice was not plugged tightly. Simple or minimally depressed fracture without clinical or radiological evidence of CSF leak were managed conservatively ( $n = 16$ ) with antibiotics and anticonvulsants depending on the extent of brain parenchymal damage. Profuse CSF leaks and rhinorrhoea which persisted for more than 5 days were managed by CSF diversion via lumbar drainage for 5 to 7 days. Early operation was performed in patients with compressive hematoma, open trauma, severe bone derangement and profuse CSF discharge.

Fractures associated with CSF leak or presence of significant contusion and significant edema or involvement of frontal sinus was promptly explored. The key step during surgery was preservation of pericranium, exposure of base to delineate fractures, removal of depressed fragments, thorough debridement of dead and devitalized tissue, generous wash followed by exteriorization of frontal sinus, and followed by brain isolation using water-tight dural closure. A majority of patients in our study had frontal sinus injury that was dealt with exteriorization. This included removal of the mucosa of frontal sinus, rinsing it with bactericidal solution, packing it with fat from thigh, gelfoam mixed with chloramphenicol followed by covering it with vascularised pericranial graft that was harvested at the beginning of the surgery or tensor fascia lata from thigh. Decision regarding bony

reconstruction was made depending on the extent of contamination, underlying brain damage and the extent of bony damage and loss.

Out of 39 patients of head injury with CSF leak 35 patients (89.7%) were completely recovered (GCS 15). 3 patients (7.7%) had mild neurological deficit (GCS 12-14); 1 patient (2.6%) had moderate neurological deficit (GCS 7-11). 31 patients who had Glasgow coma score on admission between 12-15 maximum number of patients (96.8%) had complete recovery while 1 patient (3.2%) had mild neurological deficit. Out of 6 patients with Glasgow coma score on admission between 7-11, 3 patients (50%) had complete recovery, 2 patients (33.3%) had mild neurological deficit and 1 patient had moderate neurological deficit on discharge. 2 patients with Glasgow coma score on admission  $< 7$  improved completely. Statistical analysis showed that association between Glasgow coma score on admission and discharge was significant ( $p < 0.05$ ). Patient with low Glasgow coma score on admission showed significant improved after treatment (i.e. improved Glasgow coma score on discharge).

### Conclusion

Frontobasal skull fractures is a complex pathology. They can present as either open or closed fractures depending on the type of injury. Most acute post-traumatic CSF leaks stop spontaneously within 10 days of injury. Bed rest, elevating head 30°, stool softeners, acetazolamide antibiotic and anticonvulsant are used as conservative management. Lumbar drainage used for profuse CSF leak without any other significant intracranial complications. Surgery is reserved for the treatment of CSF leaks that do not stop spontaneously or respond to conservative management with CSF diversion. It was found that there is no association of the chance of CSF leak with either open or closed frontobasal skull fractures.

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