

A Prospective Study of Frontal Lobe Injury: Clinical and Radiological Predictors and Outcome

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Abstract

Background: The frontal lobes are considered our emotional control centers and home to our personality. There is no other part of the brain where lesions can cause such a wide variety of symptoms. The frontal lobes are involved in motor function, problem solving, spontaneity, memory, language, initiation, judgment, impulse control, and social and sexual behavior. One of the most common effects of frontal damage can be a dramatic change in social behavior. A person's personality can undergo significant changes after an injury to the frontal lobes, especially when both lobes are involved. **Material and Methods:** The study was conducted in the Department of Neurosurgery at the Institute of Traumatology and Orthopedics, SMS Medical College Jaipur, Rajasthan (India). The study was conducted from July 2020 to December 2020. The duration of follow-up was a minimum of 6 months. 34 patients were included in this study. All included patient was evaluated for the following factor- Demographic Features (Age, Sex), Clinical Features, Radiological, Decision of Management. **Result:** Age Distribution Patients were divided into 7 age groups according to their age. 2 (5.88%) patients were in the age group of 15-20 years, all 2 patients had a good recovery. 2 (5.88%) patients were in the age group of 21-25 years, all had a good recovery. Sex Distribution, 76% of patients were male and 24% were female. Mode of Injury, RTA 16(47.05%) patient and fall from height 15 (44.11%) patient were the commonest modes of injury followed by assault (8.82%). **Conclusion:** In this study concluded that the favorable prognosis and outcome in frontal lobe injury depend on -Young age of the patient, Moderate to good GCS, Focal contusion operated before clinical deterioration. Contusion volume has a significant effect on outcome because the patient with large volume contusion had a poor outcome, Early CT scanning is the optimal investigation and has greatly improved prognosis

Keywords: Frontal lobe, Contusion, GCS, MMSE, GOS

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Introduction

The frontal lobes are considered our emotional control centers and home to our personality. There is no other part of the brain where lesions can cause such a wide variety of symptoms [1]. The frontal lobes are involved in motor function, problem solving, spontaneity, memory, language, initiation, judgment, impulse control, and social and sexual behavior. The frontal lobes are extremely vulnerable to injury due to their location at the front of the cranium, proximity to the sphenoid wing, and their large size. MRI studies have shown that the frontal area is the most common region of injury following mild to moderate traumatic brain injury [2]. There are important asymmetrical differences in the frontal lobes. The left frontal lobe is involved in controlling language-related movement, whereas the right frontal lobe plays a role in non-verbal abilities. Some researchers emphasize that this rule is not absolute and that with many people, both lobes are involved in nearly all behaviour. One of the most common effects of frontal damage can be a dramatic change in social behaviour. A person's personality can undergo significant changes after an injury to the frontal lobes, especially when both lobes are involved. There are some differences in the left versus right frontal lobes in this area. Left frontal damage usually manifests as pseudo-depression and right frontal damage as pseudo psychopathic. Sexual behaviour can also be affected by frontal lesions. Orbital frontal damage can introduce abnormal sexual behaviour, while dorsolateral lesions may reduce sexual interest. Stronger imitative response tendencies[3]

MRI studies have shown that the frontal area is the most common region of injury following mild to moderate traumatic brain injury [4]. Disturbance of motor function is typically characterized by loss of fine

movements and strength of the arms, hands, and fingers [5]. Complex chains of motor movement also seem to be controlled by the frontal lobes [6]. Patients with frontal lobe damage exhibit little spontaneous facial expression, which points to the role of the frontal lobes in facial expression [7]. Broca's Aphasia may be associated with frontal lobe damage. An interesting phenomenon of frontal lobe damage is the insignificant effect it can have on traditional IQ testing. Researchers believe that this may have to do with IQ tests typically assessing convergent rather than divergent thinking. Frontal lobe damage seems to have an impact on divergent thinking or flexibility and problem-solving ability. There is also evidence showing lingering interference with attention and memory even after a good recovery from a TBI [8]. The frontal lobes are also thought to play a part in our spatial orientation, including our body's orientation in space [9].

Material and Methods

The study was conducted in the Department of Neurosurgery at the Institute of Traumatology and Orthopedics, SMS Medical College Jaipur, Rajasthan (India)

1. To study demographic features, neurological status, investigation, and outcome in patients with frontal lobe injury.
2. To assess predictors of the outcomes of frontal lobe injury.

Enrollment of the Patients Includes- Patients who had frontal lobe injury and attending the Neurosurgery clinics were enrolled for the study. The patient who had developed frontal lobe injury and came to the Institute of Traumatology and Orthopedics, SMS Medical College Jaipur, Rajasthan (India) were enrolled for this study. **Duration of the Study-**The study was conducted from

July 2020 to December 2020. Duration of follow-up was a minimum of 6 months. 34 patients were included in this study.

All included patient was evaluated for the following factor –**Demographic Features** (Age, Sex)

Clinical Features-Detailed clinical history and examination were done with special reference to the mechanism of trauma, Glasgow coma score at presentation, the interval between injury and presentation, and neurological deficit. **Radiological** In all cases, frontal lobe injury was diagnosed with a Non-contrast CT scan of the Head repeated when indicated. **The decision of Management**-Treatment varied considerably depending on many factors. Smaller contusion was managed medically while large contusion required surgical intervention. The decision-making process involved many factors including patient GCS, repeat CT scan findings. Effect of the lesion – midline shift, status of the basal cistern, status of ventricles, and status of the peripheral sulci.

Patient Neurological status- GCS, Pupil status, localizing signs vital signs (pulse rate blood pressure, Respiratory rate. **Follow up**-Patient were evaluated by Glasgow come score, Glasgow outcome scale, Mini-mental state examination and by frontal assessment battery, Non-contrast CT scan imaging. Each patient was evaluated and followed by 2 weeks 1 month, 3 months, and 6 months.

The result was Analyzed As –Any score greater than or equal to 27 points (out of 30) indicates a normal cognition. Below this, scores can indicate severe (≤ 9 points), moderate (10–18 points), or mild (19–24 points) cognitive impairment. The raw score may also need to be corrected for educational attainment and age. That is, a maximal score of 30 points can never rule out dementia. Low to very low scores correlate closely with the presence of dementia, although other mental

disorders can also lead to abnormal findings on MMSE testing. The MMSE has been able to differentiate different types of dementias. **Frontal Assessment Battery**-The Frontal Assessment Battery (FAB) is a brief battery of six neuropsychological tasks designed to assess frontal lobe function at the bedside. The FAB subtests are individually scored, and the sum of these subtests provides the total FAB score. Each subtest can be scored 0 to 3 points, with 3 points indicating the best score for that subtest. When total, a maximum of 18 points can be earned. Determined that a score of 15 or below best-discriminated controls from patients with frontal-lobe damage. Using that cut-off, the FAB has been reported to have an 89.1% correct classification rate between controls and patients. In addition, the FAB was found to have good internal consistency.

Result:

Age Distribution-

Patients were divided into 7 age groups according to their age. 2 (5.88%) patients were in the age group of 15-20 years, all 2 patients had a good recovery. 2 (5.88%) patients were in the age group of 21-25 years, all had a good recovery. 5 (14.70%) patients were in the age group of 26-30 years, all 5 patients had good recovery. 5 (14.70%) patients were in the age group of 31-35 years, all 5 patients had good recovery. 6 (17.64%) patients were in the age group of 36-40 years, out of which 5 had a good recovery and 1 had Moderate disability. 7 (20.58%) patients were in the age group of 41-45 years, out of which 6 patients had a good recovery, 1 had a moderate disability. 2 (5.88%) patients were in the age group of 46-50 years; out of which 1 Patient had a good recovery, 1 had moderate disability. 5 (14.70%) patients were in the age group of 51-55 years out of which 2 patients had a good recovery, 3 had a moderate disability.

Sex Distribution-

In this study 76% of patients were male and 24% were female. **Mode of Injury-** RTA 16(47.05%) patient and fall from height 15 (44.11%) patient were the commonest modes of injury followed by assault (8.82%). The most common mode of fall was from stairs. The least common mode of injury was an assault in our study. **Clinical Course** Clinical course was divided according to Hooper et al

1. Acute course: presented to hospital within 24 hours of injury, 2. Subacute course: presented to hospital within 1-7 days of injury. 3. Chronic course: presented to hospital weeks or later of injury.

In our study most of the patients had an acute course (64.70%) followed by a subacute course (30%). 2 (5.88%) of the patients had a chronic course. **Clinical presentation:** Loss of consciousness was the most common presentation seen in 29 cases (85.29%) cases, followed by vomiting 22 (64.70%), Oro-nasal bleed 8 (23.52%) cases, Ear bleed 5 (14.70%), seizure (11.76%), neurological deficit 4 (11.76%) cases. Transient loss of consciousness was seen in 85% of cases and altered sensorium since RTA was seen in 10 (29.41%) cases. Neurological deficit was seen in the form of pupillary anisocoria in 4 patients. Seizure is an uncommon association with frontal lobe injury was recorded in 4 patients. There was no hemiparesis no sensory loss seen in our study. **Headache-**Headache was seen in 26 (76.47%) cases and the 2nd commonest mode of presentation. It did not apply to 23.52% of cases because of low GCS at the time of presentation. **Glasgow Coma Scale at Admission-**Range of GCS was 8 to 15. Most of the patients in our study had good

GCS. 23.52% had GCS of 14-15, 71.42% had 9 to 13, and one patient had poor GCS. **Frontal Tenderness-**Frontal tenderness was seen in 16 (47 %) cases, absent in 10 (29.41%) cases, and not assessed in 8 cases due to low GCS. **The volume of Frontal Contusion-** Volume of frontal contusion is noted in the initial CT scan and compared with CT scan done at 24 hours or at any time the patient deteriorates or failed to improve post-resuscitation; it was also noted postoperatively to check residual volume. 23 patients were managed surgically and 11 patients were managed conservatively did not show any increase in the size of hematoma in repeat CT scan at 24 hours Volume of hematoma was found to be between 8 ml to 36 ml in our study. Hematoma volume was divided into 3 categories-

Post Treatment GCS-Post treatment GCS 14 to 15 in 30 patients (93.9%), four patients had GCS 13 and rest one patient had GCS 11(E4V1M6). **Post Treatment Neurological Deficit-**Post treatment neurological deficit was seen in 2 patients in the form of restricted eye movement. One patient had anosmia. Most of the patients had a good recovery. **Mortality and Morbidity- Glasgow Outcome Scale**

At the end of 6 months of follow up 33 patients treated had good recovery (GOS-5) either treated surgically or conservatively. 1 patients had (GOS -4) moderate recovery. There was no mortality in our study. The overall outcome was good in our study, with only 2 patients showing restricted eye movement. This could be considered as a good result when compared with the other series in the literature ⁽¹⁶⁾.

Table 18: Outcome according to Glasgow Outcome Scale

GOC	Outcome	No. Of pt	Percent
V	Good recovery	32	94.12
Iv	Moderately disabled	02	5.88
III	Severely disabled	00	00
II	Vegetative life	00	00
I	Dead	00	00

Mini-Mental Score-In our study MMSE examination was done at 3,6 months. At three months the MMSE score 27-30 in 28 pt, 19-26 in 4 pt .10-18 in 2 pt, and no patient have less than 9 MMSE score. At six months the MMSE score 27-30 in 32 pt, 19-26 in 1 pt .10-18 in 1 pt, and no patient have less than 9 MMSE score. **Frontal Assessment Battery-**In our study FAB examination was done at 3,6 months. At one three months, the FAB score 17-18 in 26 patients, 15-16 in 6 patients, and 6-14 in 2 patients. At six months the FAB score 17-18 in 30 patients, 15-16 in 3 patients, and 6-14 in 1 patient. **Management:** In our study 23 (67.64%) patients were managed by surgical evacuation of haematoma and the remaining 11 (32.35%) were managed conservatively. The patients, who were operated on, assessed clinically and radiologically.

Discussion

The outcome after frontal lobe injury reported in this study is comparable with the findings of other author's study.

Age It is well known that there is a strong positive correlation between age and mortality in brain injury[10]. This holds for the frontal lobe injury and hematoma, as seen in our study as well. In the present study 2 (5.88%) patients were in the age group of 15-20 years, all 2 patients had a good recovery. 2 (5.88%) patients were in the age group of 21-25 years, all had a good recovery. 5 (14.70%) patients were in the age group of 26-30 years, all 5 patients had a good recovery. 5 (14.70%) patients were in the age group of 31-35 years,

all 5 patients had a good recovery. 6 (17.64%) patients were in the age group of 36-40 years, out of which 5 had a good recovery, 1 had a moderate disability. 7 (20.58%) patients were in the age group of 41-45 years, out of which 6 patients had a good recovery, 1 had a moderate disability . 2 (5.88%) patients were in the age group of 46-50 years; out of which 1 patient had a good recovery, 1 had a moderate disability. 5 (14.70%) patients were in the age group of 51-55 years out of which 2 patients had a good recovery, 3 had a moderate disability[11]. This is concluded that in the present study good Glasgow outcome score in younger age group patient (<40yr) and moderate disability more common in older age group.No patient was in the age group of above 55 years in our study. No mortality in this study[12].

Gender In the present study 79% male and 21% were female patients. A moderate recovery was seen in 12% of cases, all were male. All-female patients had a good recovery.[13] This predilection can be explained by an inherent ruffian and risk-taking behavior in male, however, this predilection become less obvious in young age group[14]. **Mechanism of Injury** In the present study, RTA (47%) and fall from height (44.11%) were the commonest modes of injury followed by assault (8.82%). The least common mode of injury was an assault in our study[15]. So in the present study maximum number of patients had road traffic accidents as other studies showed. RTA (47%) and fall from height (44%) were the commonest modes of injury[16]. **Clinical**

Course -The rapidity of onset and initial GCS are the main factors that determine the overall prognosis. Acute contusion often carries a high mortality risk. In our study most of the patients had an acute course (64.70%) followed by a sub-acute course (30%). 2 (5.88%) of the patients had a chronic course. No patient was admitted with poor GCS in our study[17]. **Clinical Evaluation**-Loss of consciousness was the most common presentation seen in 29 cases (85.29%) cases, followed by vomiting 22 (64.70%), Ear bleeds 8 (32.35%), Oro-nasal bleeds 8 (23.52%) cases, seizure (11.76%), neurological deficit 4 (11.76%%) cases[18]. Transient loss of consciousness was seen in 85% of cases and altered sensorium since RTA was seen in 10 (29.41%) cases. Neurological deficit was seen in the form of papillary anisocoria in 4 patients. Seizure is an uncommon association with frontal lobe injury was recorded in 4 patients. There was no hemiparesis no sensory loss seen in our study[19].

GCS at the Time of Admission-In present study 23.52% of patients present with GCS Scores of 14-15, in which 100% patients had good recovery (GOS-5) and 74% of patients present with GCS 9-13 in which 70% had a good recovery and 30% patient had moderate recovery[20]. One patient with poor GCS (<8) presented in our study had moderate recovery. These findings were compared with the other study groups. **Operative/Conservative** In our study also, we operated 23 (67.64%) patients with midline shift, presence of effaced basal cistern, compressed ventricular system, and hematoma volume more than 20 ml and patients not improving or worsening neurologically who were under observation. In this 21(86.18%) patients have a good outcome (GOS -5) and 2 patients have a moderate disability (GOS-4). In medically managed patients 10 (32.35%) patients have

good outcomes and 1 patient had a moderate disability[21].

Radiological Findings-In our study Volume of frontal contusion is noted in the initial CT scan and compared with a CT scan done at 24 hours or at any time the patient deteriorates or failed to improve post-resuscitation; it was also noted postoperatively to check residual volume. 23 patients were managed surgically and 11 patients were managed conservatively did not show any increase in the size of hematoma in repeat CT scan at 24 hours Volume of haematoma was found to be between 8 ml to 36 ml in our study. 17.64% patients' hematoma volume less than 10cc, 23.52% patients had hematoma volume 11-20cc and 58.82% had more than 20cc volume[22].

In the present study, 19 patients (56.87%) had a midline shift >5 MM, ventricle was compressed in 20 patients (58.82%), and Basal cistern was effaced in 18 patients (52.94%)[23]. **Mortality and Morbidity - Glasgow Outcome Scale**-In our observation, at the end of 6 months of follow up most of the patients (94.12%) treated surgically or conservatively had good recovery (GOS-5). 5.88% of patients show moderate disability (GOS-4)[24]. There was no mortality in our study. The overall outcome was good in our study. **Mini-mental score** -In our study MMSE examination is done at 3, 6 months. At three months the MMSE score 27-30 in 28 patients, 19-26 in 4 patients. 10-18 in 2 patients and no patient have less than 9 MMSE scores. At six months the MMSE score 27-30 in 32 patients, 19-26 in 1 patient .10-18 in 1 patient, and no patient have less than 9 MMSE scores[25]. **Frontal assessment battery**-In our study FAB examination was done at 3, 6 months. At three months the FAB score 17-18 in 26 patients, 15-16 in 6 patients, and 6-14 in 2 patients. At six months the FAB score 17-18

in 30 patients, 15-16 in 3 patients, and 6-14 in 1 patient[26].

We believe this outcome can be explained: 1) Good GCS at the time of presentation.2) our active CT scan usage protocol and consequent early diagnosis.3) Early surgical intervention.

4) Exclusion of another associated intracranial injury such as diffuse axonal injury and multiple contusions.

Conclusions

This study concluded that the favorable prognosis and outcome in frontal lobe injury depends on:-

1. The young age of the patient.
2. Moderate to good GCS.
3. Focal contusion operated before clinical deterioration.
4. Normal pupil,
5. Normal cisterns.
6. Exclusion of another intracranial injury.
7. Contusion volume has a significant effect on outcome because the patient with large volume contusion had a poor outcome.
8. Early CT scanning is the optimal investigation and has greatly improved the prognosis

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