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Original research article

Incidence and outcome of cranial nerve injury in mild to moderate head injury

[1]Dr. Mayank Agarwal, [2]Dr. Kalangri Murali Krishna, [3]Dr. Gaurav Dhakre, [4]Dr. Tarun Kumar Patel
[1]Assistant Professor, Neurosurgery, SN Medical College, Agra, Uttar Pradesh, India
[2]Assistant Professor, Surgery, Government Medical College, Ongole, Andhra Pradesh, India
[3]Associate Professor, Neurosurgery, SN Medical College, Agra, Uttar Pradesh, India
[4]Junior Resident, Surgery, SN Medical College, Agra, Uttar Pradesh, India

Corresponding Author:
Dr. Gaurav Dhakre (gauravdhakregd@gmail.com)

Abstract

Background: Comparative analysis of three different fixation techniques for femoral tunnel widening following hamstring graft anterior cruciate ligament reconstruction.
Materials and Methods: The prospective comparative study was used. All the patients operated from November 2021 to October 2022 at Department of Orthopedics, Lakshmi Narayana Institute of Medical Sciences, Puducherry, India, with unilateral Anterior Cruciate Ligament tears which fit into the criteria were included in the study.
Results: 15 patients had interference screws, 13 had rigidfix, and 23 had endobutton on the femoral side of 51 patients. In the Endobutton group, the IKDC 2000 Subjective Knee Evaluation score improved by 37.82 points (range, 23 to 48), in the Transfix group by 40.92 points (range, 32 to 50), and in the bioscrew group by 38.5 points (range, 27 to 48). Transfix group (31.56%) has larger midlevel (C2S2) widening than interference screw (22.45%) and endobutton (20.01%). Interference screws (35.89%) had larger tunnel widening than transfix (30.26%) and endobutton (21.85%) at aperture level (C3S3).
Conclusion: Endobutton reduced femoral tunnel widening more than Transfix and Interference screws. Transfix group's sagittal sections had higher tunnel widening at the aperture and midway than coronal sections due to transtibial technique's obliquity, which caused more tunnel widening. Screw entrance at aperture level caused interference group tunnel widening. However, at one year, all groups had similar clinical findings and knee laxity. These findings need more large-scale controlled investigations.
Keywords: Head injury, cranial nerve injury, outcome and recovery

Introduction

In developing countries like India cranio-cerebral trauma is an important cause for significant morbidity and mortality. Among these cranio-cerebral trauma cranial nerve injuries occupies significant amount of morbidity with incidence of 5-23% [1]. Initial evaluation by history, clinical and neurological evaluation effectively assesses the sensorium, cortical function and hemodynamic status. Added to this, a rapid evaluation of ocular movements, pupils, facial symmetry and laryngeal function establishes the functional integrity of the cranial nerves. Subjective information cannot be obtained in an unconscious patient and history from witnesses, medical personnel and police can supply valuable information. Complete evaluation of individual cranial nerves, a time consuming and elaborate exercise even in a conscious patient may not be feasible in comatose patient or in one altered sensorium. Injury to cranial nerves can occur by shearing forces, rapid acceleration /deceleration, injury to skull base, penetrating cranio-cerebral injuries especially those through the skull base and as a sequel to various surgical procedures. The consequences of cranial nerve injuries are mild to severe morbidity. Most of these injuries do not require active intervention in acute stage, but requires long term follow up and repetitive reconstructive procedures.
The aim of this study is to evaluate the incidence and outcome of traumatic cranial nerve deficits.

Material and Method

This prospective study was based on 35 patients with cranial nerve injuries who were admitted in Neurosurgery Unit, S.N. Medical College and Hospital, Agra. The duration of study was 2020 to 2022.

Inclusion criteria
All patients presented with cranial nerve injuries after head trauma with GCS ≥9.

Exclusion criteria
Severe head injury patients (GCS ≤8) were excluded from the study.
Computed tomography scanning using brain and bone windows were performed when at least one of the following risk factor was present-post traumatic amnesia, loss of consciousness, post traumatic seizures, headache, vomiting, focal neurological deficit, skull fracture, coagulopathy and anticoagulation therapy. Cranial nerve assessment done promptly.

Follow-up: After first and third month, the patient is followed up every six months for a period of two years (3 months to 2 years).

Recovery: Assessed in the form of complete recovery, partial recovery and no recovery.

Observation and Results
1,360 patients were admitted to our hospital with head injury between 2020 and 2022, among them, 1080 had mild to moderate head injury. 35 patients had cranial nerve injuries.

1. AGE: The median age was 36 years.

Age	No. of Patients (%)
0-10Y	0 (0%)
11-20Y	2 (5.7%)
21-30Y	14 (40%)
31-40Y	11 (31.4%)
41-50Y	5(14.3%)
51-60Y	2 (5.7%)
61-70Y	1 (2.6%)
Total	35 (100%)

2. Sex
There was a preponderance of male patients; 7 patients were female and 28 patients were male.

Sex	No. of Patients
Male	28 (80%)
Female	7 (20%)

3. Mode of Injury

Mode of Injury	No. of Patients
Motor vehicle accidents	27 (77.14%)
Fall from height	5 (14.28%)
Assault	3 (8.57%)

Mode of injuries was predominantly motor vehicle accidents 27(77.14%), followed by fall from height 5(14.28%). Among the motor vehicle accidents 25(92.6%) members had not taken any protective measures (wearing of helmet).

4. Presenting GCS
Initial presenting injury was mild in 25 (71.4%) patients and moderate in 10(28.57%) patients.

Glasgow Coma Scale (GCS)	No. of Patients
Mild (14-15)	25(71.4%)
Moderate (9-13)	10(28.57%)

5. Cranial Nerve Injuries
A. Single Cranial Nerve Involvement

Cranial Nerve	No. of Patients
Olfactory	2
Optic	4
Oculomotor	2
Trochlear	1
Trigeminal	1

Abducens	1
Facial	18
Vestibulocochlear	1

B. Multiple cranial nerves involvement

Cranial Nerves	No. of Patients
I, II and III	1
III, IV and V	1
VI and VII	1
II, III, IV and VI	1
VII and VIII	1

6. Management

Type of Management	No. of Patients
Conservative	35
Surgical	0

7) Outcome

Outcome	No. of Patients
Improved	24
Not improved	11

Discussion

Cranial nerve injury following severe head trauma has been extensively studied in the literature, but less attention has been given to cranial nerve injuries after mild to moderate head trauma. In 2005, Patel *et al*. [2]. Reported on a series of 100 patients with cranial nerve injury following head injury; 50 patients had mild, 26 had moderate and 24 had severe head injury. Incidence was 12.6%.There was a preponderance of male patients, (87 male and 13 females). Sixty seven (67%) patients had single cranial nerve injury; thirty three patients had multiple cranial nerve injuries. The single nerve most commonly affected was CN VII and the most frequent associations were II, III, IV, VI and VII, VIII.

We studied 35 patients with cranial nerve injury following mild to moderate head trauma to document its incidence, correlate CN lesion with CT scan findings, and evaluate the clinical outcome of each cranial nerve injuries. Among the total 35 patients, 25 patients had mild and 10 patients had moderate head injury with incidence of 3.24%. There was male preponderance with 28 (80%) male and 7 (20%) female. 30 patients (85.7%) had single cranial nerve injury and 5 patients (14.29%) had multiple cranial nerve injuries. The single nerve most commonly affected is CN VII. These results are consistent with Patel *et al*. series.

Olfactory nerve injury

The olfactory nerve is the most frequently injured cranial nerve in the literature with a wide range from 4% to 60% [3]. In our study, 3 patients presented with olfactory nerve dysfunction. This is the 3rd commonest cranial nerve to be injured in head trauma patients. Out of 3 patients 2 patients (66.67%) showed partial improvement after follow up of 12-18 months, remaining one patient has shown no improvement after follow-up of 3 to 24 months. Kern *et al*. [4] found that recovery occurred in more than one-third of their cases.

Optic nerve injury

In our study 6 patients (0.56%) had post traumatic optic nerve injury. Out of which 2 patients had other cranial nerve injuries also. All patients of traumatic optic neuropathy treated conservatively with methyl prednisolone. Among these patients two patients partially improved after 24 months follow up, in remaining 4 patients there was no improvement in vision. Mahapatra and Tandon showed that spontaneous visual recovery occurred in 51-57% of cases following conservative management [5]. Poor prognostic factors include blood in the posterior ethmoidal cells, age over 40 years, loss of consciousness, absence of recovery within 48 hours of steroid treatment and significant visual loss with afferent pupillary defect [6].

Oculomotor nerve injury

5 patients (0.5%) developed post traumatic oculomotor nerve injury. In these patients, 3 patients had multiple cranial nerve palsies. Incidence of oculomotor palsy was 2.9% in patel *et al*. [2]. All patients had managed conservatively. Out of 5 patients 1 patient recovered partially, 4 patients had not recovered even over a period of 24 months of follow-up. Among recovered patients medial gaze recovered early

compared to upward and downward gaze. The prognosis of traumatic oculomotor palsy is poor and full recovery is uncommon. A prolonged period (up to years) of healing is usually anticipated. This is also correlating with recovery rate <50%, that is also partial [7].

Trochlear nerve injury
Overall 3 patients had 6th nerve palsy. 2 patients had multiple cranial nerve injury. All patients were conservatively managed. Recovery was good in mild head injury patients, 2 patients improved (66.67%) compared with moderate head injury patients, who were not recovered. Syndor *et al*. [8]. Reported that spontaneous recovery occurs in 65% of patients with unilateral trochlear nerve injury.

Trigeminal nerve injuries
In our study only 2 patients presented with trigeminal nerve injury at V2 area.
Both the Patients were managed conservatively, later patients developed cutaneous hyperaesthesia, which was managed successfully with carbamazepine for 6 months. In literature review craniofacial trauma is the most common form of injury and 70% patients suffers from paresthesias [9].

Abducens nerve injury
In our study 3 patients presented with abducens palsy, among them 1 patient had isolated sixth nerve palsy, remaining 2 had multiple cranial nerve palsies. All patients presented with diplopia. All are managed conservatively. Among them 2 (66.67%) were improved over 6-12 month period. These findings are consistent with reports from Bhatoe [10] and Chung *et al*. [11]; who suggested an observation period of 6-12 months to allow sufficient time for maximal spontaneous recovery. This is also correlating with reports from Holmes JM *et al*. [12], who stated that conservative management results in 71% spontaneous recovery.

Facial nerve injury
Trauma is the second most common cause of facial paralysis after Bell's palsy [13]. In our study 20(1.9%) patients suffered from facial nerve injury, among them 18 patients had isolated facial nerve injury, one patient had vestibulocochlear nerve injury and one patient had abducens nerve injury also, making it as the most common cranial nerve to be injured in head trauma. This is consistent with reports from Patel *et al*. [2]. 18 cases presented as immediate onset facial nerve palsy, whereas 2 cases presented with late onset facial nerve palsy. All cases were managed conservatively. Immediate onset cases were managed with physiotherapy, facial exercise and electrical stimulation. Delayed onset cases were managed with oral steroids. Among 18 patients of immediate onset 10(55%) patients improved partially and in delayed onset patients both were improved to near normal level (HOUSE-BRACKMANN: I, II). Recovery time also is shorter in patients with delayed onset (4 months) compared to the patients with immediate onset (12-18 months). This finding is consistent with study of Turner [14].

Vestibulocochlear nerve injury
In our study total 2(0.19%) patients were suffered from hearing loss, among them one had isolated cochlear nerve injury and the other one had facial nerve injury also. All patients were evaluated with audiometry and managed conservatively. One patient recovered and the remaining other hadn't.

Lower cranial nerve injuries
Traumatic injury to the glossopharyngeal, vagus and spainal accessory is infrequent and usually follows a fracture through the jugular foramen [10, 11, 15, 16]. None of the patients suffered from these injuries in our study.

Hypoglossal nerve injury
Isolated unilateral hypoglossal nerve palsy after fracture of the occipital condyle is rare and usually occurs after a major trauma [17]. No one patient in our study had affected by hypoglossal nerve palsy.

Conclusion
The incidence of cranial nerve injury following mild to moderate head injury is 3.24%. Young people (71%) were most commonly affected. Motor vehicle accident (77.14%) is the most common cause of injury. The cranial nerves that presented with the highest incidence of palsy in our study were the facial, optic and oculomotor nerves in that order. In contrast, the trigeminal was least affected and lower cranial nerves were not injured. Most of the cranial nerve injuries were managed conservatively with acceptable outcome. Most of the cranial nerve injuries were due to fracture of the base of the skull which is a high impact head injury hence few preventive measures like wearing helmet and not driving while drunk are very crucial in prevention of head injuries and cranial nerve injuries.

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