

# A study of the clinical manifestations of closed head injuries and their correlation with Glasgow coma scale scores

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## Abstract

**Objectives:** To study the ocular manifestations of closed head injuries and their correlation with Glasgow coma scale, the demographic profile of head injuries and the neurological lesions associated with head injury. **Materials and Methods:** A cross-sectional study was undertaken on 100 patients with closed head injury. Conscious status was assessed using Glasgow coma scale. The head injury was graded as follows: mild(GCS 14-15), moderate(GCS 9-13), severe (GCS 3-8). Thorough examination of anterior segment, posterior segment, extraocular movements, visual acuity and investigations were carried out for all patients. **Results:** The highest incidence of head injuries was in the age group of 20 to 39 years. There were 87 males and 13 females. The mean age for males is  $33.63 \pm 14.4$  and the mean age for females is  $25.23 \pm 12.44$ . In this study, 85.71% cases of severe head injury had trauma to ocular adnexae, 28.57% cases had anterior segment manifestations, 42.86% cases had posterior segment manifestations and 42.86% cases had neuroophthalmic manifestations. **Conclusion:** In severe head injury (GCS 3-8), it is important to look for neuroophthalmic manifestations. Also the presence of posterior segment findings in all cases of closed head injury shouldn't be missed. There should be a detailed early ophthalmological assessment in all patients with head injury. The importance of road safety both for the passenger and the pedestrian is to be stressed.

**Key Words:** Craniocerebral trauma; Glasgow coma scale; cranial nerve diseases.

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## INTRODUCTION

Man's endeavors to attain greater heights by industrialism and rapid modes of transport have led to a rise in the incidence of head injuries<sup>1</sup>. Head injuries also result in a burden on the family and society, as it is often associated with intellectual and cognitive function loss and also vision problems<sup>1</sup>. Majority of the victims belong to

young, productive group who are more affected by road traffic accidents<sup>1</sup>. A head occurs every 15 seconds and a patient dies of head injury every 12 minutes<sup>2</sup>. Over 50% of all trauma deaths are associated with head injury and close to 60% of trauma deaths are due to head injuries<sup>2</sup>. Head injuries cause the hospitalization of 200–300 persons per 100 000 populations per year and about 25% of these are associated with ocular and visual defects<sup>3</sup>. The role of ocular injuries secondary to head trauma in the causation of blindness has become a subject of immense importance<sup>3</sup>. The eye is frequently involved in head trauma due to proximity of the eye to the head as well as due to the neural connections between the eye and the brain<sup>4</sup>. Clinical correlation of ophthalmic findings is important in early localization of sites of injury, ongoing assessment, management and prognosis of patient with head injury<sup>2</sup>. In non-penetrating or closed-head injury, displacement, stretching, and shearing forces may

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damage areas of the brain, including those associated with vision<sup>4</sup>. The manifestations of head injury and its numerous other systemic complications are so compelling that damage to the visual system is most likely to be ignored<sup>3</sup>. Often times when the eye is examined as part of neurological assessment of a patient with head injury, the purpose is mainly to gauge the severity of the head injury itself<sup>3</sup>. Since the mechanisms underlying ocular manifestations of head trauma are not fully understood, many hypotheses have been advanced to explain these defects<sup>3</sup>. Disorders of eye movement are thought to result from direct trauma to orbital contents, cranial nerves and other brain areas<sup>5</sup>.

### MATERIALS AND METHODS

A cross-sectional study was undertaken on 100 patients with closed head injury admitted to the neurosurgery department of JJM Medical College and referred cases of closed head injury to Ophthalmology outpatient department from 15.10.2013 to 14.10.2015 were taken for the study. These subjects were selected consecutively as and when they present with following inclusion and exclusion criteria

#### Inclusion Criteria

- All patients with closed head injuries with ophthalmic manifestations.

#### Exclusion Criteria

- Patients having open head injuries were excluded.
- Patients with ocular manifestations due to tumours and other pathologies which are precipitated by head injuries are excluded.

**Method of collection of data:** The demographic profile of the patient was collected. Detailed history regarding the injury and cause of injury was taken and the clinical details were entered in to standard clinical proforma. Conscious status was assessed using Glasgow coma scale. The head injury was graded as follows

1. Mild head injury: GCS 14-15
2. Moderate head injury: GCS 9-13
3. Severe head injury: GCS 3-8

Visual acuity was assessed with and without correction. Visual acuity was assessed at bedside for bedridden patients. For ambulatory patients, visual acuity was tested in ophthalmology outpatient department. For comatose patients visual acuity was not recorded. Thorough pupillary examination was carried out for injuries and pupillary reactions. Patient was assessed for ocular alignment and extraocular movement. Extraocular movements assessed are ductions, versions, convergence, saccades and pursuits. Anterior segment examination was done by bright flash light or slit lamp depending upon the status of the patient. Posterior segment examination was

done by direct and indirect ophthalmoscopy. Intraocular pressure was recorded using Schiottz indentation tonometer or Goldmann applanation tonometer when necessary. Diplopia charting is done whenever the patient complains of diplopia or restricted movement. Forced duction and forced generation tests are done whenever patient has abnormal extraocular movements or there is suspected restriction of movements. Gonioscopy was done if necessary for the case studied. Computed tomographic brain scanning and skull and spine roentgenograms was taken by the neurosurgical team treating the patient wherever needed. All patients were assessed until discharge. Any ocular manifestation requiring treatment-medical or surgical are treated as per standard medical and surgical practices. The data collected was analyzed statistically using descriptive statistics like frequency and percentage. The results are depicted in the form of percentages and graphs

### RESULTS

**Table 1:** Age and sex distribution

Age	Total No. of cases	Sex	
		Male	Female
< 10	7	5	2
10-19	11	8	3
20-29	24	21	3
30-39	29	26	3
40-49	15	13	2
50-59	9	9	0
60-69	5	5	0
Total	100	87	13
Mean and SD	32.54 ± 14.4	33.63 ± 14.4	25.23 ± 12.44

The mean age for males is 33.63 ± 14.4 and the median age for females is 25.23 ± 12.44 (Table 1). For men the age ranged from 2 to 65 years and for females the age ranged from 4 to 45 years. The majority of males were in the age group 20-39 (47 cases or 54.02%) and the majority of females were also in the age group 20-39 (6 cases or 46.15%).

**Table 2:** Trauma to ocular adnexae

Trauma To Ocular Adnexae	Frequency	Percent
Ecchymosis	63	63
Lid Laceration	25	25
Periorbital Edema	52	52
Proptosis	2	2
Ptosis	7	7

The most common ocular finding in this study was ecchymosis seen in 63% of the cases followed by periorbital edema in 52% of the cases. Lid laceration was there in 25% cases, proptosis 2%, ptosis in 7% (Table 2).

**Table 3: Anterior segment manifestations**

Anterior Segment Manifestations	Frequency
Subconjunctival Haemorrhage	39
Chemosis	14
Exposure Keratopathy	2
Traumatic Uveitis	1
Phacodonesis	1
Sphincter Tear	1

In the anterior segment, Subconjunctival haemorrhage is seen in 39% of cases, chemosis in 14%, exposure keratitis 2% and traumatic uveitis 1%, phacodonesis 1%, iris sphincter tear 1% (Table 3).

**Table 4: Posterior segment manifestations**

Posterior Segment Manifestations	Frequency	Percent
Retinal Edema	3	3.0
Choroidal Rupture+Vitreous Haemorrhage	1	1.0
Papilloedema	1	1.0
Purtscher Retinopathy	1	1.0
Subretinal Haemorrhage	1	1.0
Vitreous Haemorrhage+Superficial Haemorrhages	1	1.0
Nil	92	92.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

In the posterior segment vitreous haemorrhage is seen in 2%, papilloedema 1%, subretinal haemorrhage 1%, retinal oedema 3%, choroidal rupture with vitreous haemorrhage 1%, purtschers retinopathy 1% and vitreous haemorrhage with superficial haemorrhages 1% (Table 4).

**Table 5: Neuroophthalmic Manifestations**

Neuroophthalmic Manifestations	Frequency	Percent
iii Nerve Palsy	4	4.0
Traumatic Optic Neuropathy	4	4.0
B/L Vi Nerve Palsy	1	1.0
Sympathetic Paralysis Re+ Vi Nerve Palsy+Vii Nerve Palsy	1	1.0
iii, Iv, Vi, Vii Nerves Involved	1	1.0
Nil	89	89.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

In this study 4% patients had traumatic optic neuropathy, 3% had third cranial nerve palsy, 1% had combined traumatic optic neuropathy and third nerve palsy, 1% had bilateral 6<sup>th</sup> cranial nerve palsy, 1% had combined sixth and seventh nerve palsy with sympathetic paralysis of right eye, 1% had paralysis of third, fourth, sixth and seventh cranial nerves and 10 cases had pupillary abnormalities (Table 5).

**Table 6: Pupillary abnormalities**

Pupillary Abnormality	Frequency	
	Frequency	Percent
Present	10	10.0
Absent	90	90.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

Pupillary abnormalities were present in 10% cases (Table 6).

**Table 7: CT findings**

C T Findings	Frequency	Percent
Orbital Fractures	42	42.0
Intracranial Haemorrhage	35	35.0
Cerebral Oedema	24	24.0
Pneumocephalus	15	15.0

Intracranial haemorrhage was present in 35% cases, cerebral edema in 24% cases, pneumocephalus in 15% of cases and orbital fractures in 42% of cases (Table 7)

**Table 8: Visual acuity**

Visual Acuity	Frequency	Percent
Vision Greater Than 6/60	77	77.0
Vision Less Than 6/60	11	11.0
Vision Unrecordable	12	12.0
<b>Total</b>	<b>100</b>	<b>100.0</b>

In this study, Vision greater than 6/60 was present in 77% cases, less than 6/60 in 11% cases and vision was unrecordable in 12% cases (Table 8).

**Table 9: GCS category and trauma to ocular adnexae**

Gcs Category	Total	Cases With Trauma To Ocular Adnexae	Percentage
Mild	81	71	87.64%
Moderate	12	12	100%
Severe	7	6	85.71%

Trauma to ocular adnexae (Table 9) were present in 85.71% cases of severe head injury, 100% cases of moderate and 87.64% cases of mild head injury.

**Table 10: GCS category and trauma to anterior segment**

Gcs Category	Total	Cases With Trauma To Anterior Segment	Percentage
Mild	81	45	55.56%
Moderate	12	8	66.67%
Severe	7	2	28.57%

Anterior segment manifestations (Table 10) were present in 28.57% cases of severe head injury, 66.67% cases of moderate and 55.56% cases of mild head injury

**Table 11: GCS category And Trauma To Posterior Segment**

Gcs Category	Total	Cases With Trauma To Posterior Segment	Percentage
Mild	81	3	3.7%
Moderate	12	2	16.67%
Severe	7	3	42.86%

Posterior segment manifestations (Table 11) were present in 42.86% cases of severe head injury, 16.67% cases of moderate and 3.7% cases of mild head injury.

**Table 12: GCS category And Neuroophthalmic Manifestations**

Gcs Category	Total	Cases With Neuroophthalmic Manifestations	Percentage
Mild	81	7	8.64%
Moderate	12	1	8.33%
Severe	7	3	42.86%

In this study, Neuroophthalmic manifestations (Table 12) were present in 3 (42.86%) cases of severe head injury, 1

(8.33%) case of moderate and 7 (8.64%) cases of mild head injury.

## DISCUSSION

In this study the highest incidence of head injuries was in the age group of 21 to 39 years. There were 87 males and 13 females. The mean age for males is  $33.63 \pm 14.4$  and the median age for females is  $25.23 \pm 12.44$ . For men the age ranged from 2 to 65 years and for females the age ranged from 4 to 45 years. The majority of males were in the age group 20-39 (47 cases or 54.02%) and the majority of females were also in the age group 20-39 (6 cases or 46.15%). In the study by Kulkarni *et al*<sup>2</sup> of 200 cases of closed head injury, 194 (97%) were males and six (3%) were females. The age ranged from 5 to 67 years, with a mean of 28.08 years. The age range for men was 5–67 years with a mean of 27.85 years. For women, the age ranged from 14 to 47 years with a mean of 35.33 years. Young adult males (21–30 years) were more vulnerable to head injury, 62% as opposed to the 41–50-year-old bracket among the females, 2%. In the study by Odebode *et al*<sup>3</sup>, there were 37 (64.9%) male and 20 (35.1%) female subjects giving an approximate male to female ratio of 2 :1. At presentation, the youngest and oldest patients were 9 months and 57 years old, respectively, the mean age being 28 years. In the study by Smitha *et al*<sup>1</sup>, 16 cases (32%) belonged to the age group of 16-30 years, 13 cases (26%) to the age group of 31-45 years, 15 cases (30%) to the age group of 46-60 years, 4 cases (8%) to the age group of <15 years and 2 cases (4%) to the age group of >60 years age group. 92% patients were male and 8% were females. In another study conducted at Trivandrum<sup>6</sup> during 1977-78, peak age group was 21-30 years. There were 33 males (82.5%) and 7 females (17.5%). The youngest age was 5 years and the oldest 78 years. In the study by Masila *et al*<sup>4</sup> there were 136 (92.5%) males and 11 (7.5%) females giving a male to female ratio of 12:1. The mean age of the patients was 33.7 years with a range of 18 years to 77 years. Majority of the patients were young adults, 64 (43.5%) in the age group 18-30 years. The demographic profile of closed head injury correlates with the findings of other studies showing that males are predominantly involved mainly because males move out of their home more frequently for work and men are more likely to be involved in industrial activity. They are more likely to suffer from alcohol abuse which results in road traffic accidents and assaults. The most common ocular finding in this study was ecchymosis seen in 63% of the cases followed by periorbital edema in 52% of the cases and subconjunctival haemorrhage in 39% of cases and orbital fractures in 42 % of cases. Lid laceration was there in 25% cases, chemosis in 14%, ptosis in 7%, proptosis 2%,

exposure keratitis 2%, iris sphincter tear 1%, traumatic uveitis 1%, phacodonesis 1%, vitreous haemorrhage 2%, papilloedema 1%, subretinal haemorrhage 1%, retinal oedema 3%, choroidal rupture with vitreous haemorrhage 1%, purtschers retinopathy 1% and vitreous haemorrhage with superficial haemorrhages 1% In the study by Kulkarni *et al*<sup>2</sup>, the commonest eye finding was ecchymosis in 54/200 (27%) followed by subconjunctival haemorrhages in 38/200 (19%) patients. Orbital fractures were seen in 24 patients (12%). Papilloedema was seen in 11/200 cases (5.5%), macular edema in 4/200 cases (2%), retinal haemorrhage in 1 (0.5%) case, vitreous haemorrhage in 1 (0.5%) case, corneal tear in 2 (1%) cases, scleral tear in 2 (1%) cases, lacrimal gland prolapse in 2 (1%) cases. In the study by Odebode *et al*<sup>3</sup>, the ocular manifestations include soft-tissue injuries to the globe and adnexae in 29 (12.89%) patients, fracture of the orbit with rupture of the eye in 2 (0.89%) patients. The most frequent soft-tissue injuries were periorbital ecchymosis in 17 patients (7.56%), chemosis in 20 patients (8.89%), subconjunctival haemorrhage in 21 patients (9.33%), lid laceration in 10 patients (4.44%), corneoscleral laceration in 5 patients (2.22%), retinal haemorrhage in 2 patients (8.89%), and commotio retinae in 3 (1.33%) patients. Miscellaneous neuroophthalmic complications observed were other pupillary abnormalities in 12 patients (5.33%), partial or complete ptosis in 10 patients (4.44%), and lagophthalmos in 1 patient (0.44%). In the study by Masila *et al*<sup>4</sup> the commonest findings were in the ocular adnexae with ecchymosis occurring most frequently, in 65 (36.1%) eyes. In the anterior segment, corneal epithelial defects (superficial punctate erosions and epithelial defects) were the most frequent finding and occurred in 30 (16.7%) eyes. Corneal and scleral lacerations occurred in 1 eye (0.6%) each. Traumatic cataract was found in 2 eyes (1.1%). In the posterior segment, findings included one patient who had bilateral vitreous haemorrhage (1.1%) and retinal findings included papilloedema 8 (4.4%), optic atrophy 19 (10.6%), retinal haemorrhage 10 (5.6%), retinal detachment 1 (0.6%), commotio retinae 2 (1.1%), macula hole/scar 2 (1.1%), choroidal rupture 2 (1.1%). Orbital fractures were seen in 9 patients (5%). The findings of our study closely correlate with the findings of the other studies. In our study 4% patients had traumatic optic neuropathy, 3% had third cranial nerve palsy, 1% had combined traumatic optic neuropathy and third nerve palsy, 1% had bilateral 6<sup>th</sup> cranial nerve palsy, 1% had combined sixth and seventh nerve palsy with sympathetic paralysis of right eye, 1% had paralysis of third, fourth, sixth and seventh cranial nerves and 10 cases had pupillary abnormalities. In the study by Masila *et al*<sup>4</sup> pupillary abnormalities were found in 39 eyes. 2 patients had oculomotor nerve palsy.

In the study by Kulkarni *et al*<sup>2</sup>, pupillary involvement in 10/200 cases (5%) was the commonest neuro-ophthalmic sign. Abducent nerve palsy is seen in 2% of head injury cases. Traumatic optic neuropathy is seen in 0.5% of cases and third nerve palsy is seen in 1.5% of the cases.

In the study by Odebode *et al*<sup>3</sup> abducens palsy occurring in 8 patients was the most common ocular motor nerve palsy, followed by oculomotor and trochlear nerve palsies, which were encountered in 6 patients each. Other commonly affected cranial nerves in this series were the facial (6 patients) and auditory (2 patients) nerves. Miscellaneous neuro ophthalmic complications observed were other pupillary abnormalities<sup>12</sup>, partial or complete ptosis<sup>10</sup>, and lagophthalmos<sup>1</sup>. In the study by Smitha *et al*<sup>1</sup>, traumatic optic neuropathy was seen in 6 cases (12%). Ocular motor palsy was noted in 6% of cases, of which one had 3rd nerve palsy, one had 6th nerve palsy and one had combined 3rd, 4th and 6th nerve palsy. The findings of our study correlate with the findings of other studies. In this study, 85.71% cases of severe head injury had Trauma to ocular adnexae, 28.57% cases had anterior segment manifestations, 42.86% cases had Posterior segment manifestations and 42.86% cases had Neuroophthalmic manifestations. 100% cases of moderate had Trauma to ocular adnexae, 66.67% cases had Anterior segment manifestations, 16.67% cases had Posterior segment manifestations and 8.33% cases had Neuroophthalmic manifestations. 87.64 % cases of mild head injury had Trauma to ocular adnexae, 55.56% cases had Anterior segment manifestations, 3.7% cases had Posterior segment manifestations and 8.64% cases had Neuroophthalmic manifestations. In the study by Odebode *et al*<sup>3</sup>, 50% of cases of severe head injury had only soft tissue injury to the eye, adnexa and periorbital region, 43.75% of cases of severe head injury had neuroophthalmic manifestations in addition to soft tissue injury to eye, adnexa and periorbital region, 6.25% of cases of severe head injury had ruptured globe and fracture orbit in addition to neuroophthalmic manifestations and soft tissue injury to eye, adnexa and periorbital region. 53.33% of cases of moderate head injury had only soft tissue injury to the eye, adnexa and periorbital region, 40% of cases of moderate head injury had neuroophthalmic manifestations in addition to soft tissue injury to eye, adnexa and periorbital region, 6.67% of cases of moderate head injury had ruptured globe and fracture orbit in addition to neuroophthalmic manifestations and soft tissue injury to eye, adnexa and periorbital region.

85.71% of cases of mild head injury had only soft tissue injury to the eye, adnexa and periorbital region, 38.1% cases of mild head injury had neuroophthalmic manifestations in addition to soft tissue injury to

eye, adnexa and periorbital region and no cases of mild head injury had ruptured globe and fracture orbit in addition to neuroophthalmic manifestations and soft tissue injury to eye, adnexa and periorbital region. In the study by Kulkarni *et al*<sup>2</sup>, 82.7% patients of mild head injury had eye involvement of no neurological significance, including unilateral and bilateral ecchymosis 49 (32.67%), subconjunctival haemorrhages 38 (25.33%), orbital margin fractures in 12 (8%), proptosis in 6 (4%), blow out fractures of the orbit in 4 (2.67%), macular oedema in 3 (2%) cases, unilateral traumatic mydriasis, lacrimal gland prolapse and scleral and corneal tears in 2 (1.33%) cases each, and hyphaema and vitreous haemorrhage in 1 (0.7%) case each. 82.8% of patients of moderate head injury had ocular involvement. 9 (31.03%) patients had pupillary signs. Papilloedema was seen in 3 (10.34%) cases, lateral rectus palsy in 4 (13.79%) cases, ecchymosis and orbital margin fractures in 2 (6.9%) cases each, retinal haemorrhage, macular oedema, ptosis, and traumatic optic neuropathy in 1 (3.45%) case each. 90.48% of patients of severe head injury had ocular involvement. 2 (9.52%) patients had pupillary involvement. Papilloedema was seen in 8 (38.1%) cases, orbital fractures were seen in 6 (28.57%) cases and ecchymosis was seen in 3 (14.29%) cases. The findings of these studies largely correlate with the findings of our study. The mild discrepancy can be contributed to the fact that all the cases in our study were cases of closed head injury with ophthalmic manifestations whereas the cases in the other studies were cases of head injury in which the majority had ophthalmic manifestations. Intracranial haemorrhage was present in 35% cases, cerebral edema in 24% cases, pneumocephalus in 15 % of cases and orbital fractures in 42% of cases. In the study done by Masila *et al*<sup>4</sup>, intracranial haemorrhage with ocular findings were present in 46.2% cases. Cerebral edema with ocular findings were present in 31.5%, pneumocephalus with ocular findings were present in 8.85 cases and orbital fractures with ocular findings were present in 9.7% cases. These findings correlate with the finding of our study. In this study, visual acuity greater than 6/60 was present in 77% cases, less than 6/60 in 11% cases and vision was unrecordable in 12% cases. In the study done by Masila *et al*<sup>4</sup>, 70.8% eyes had normal vision (LogMAR 0.0-0.5), 21.9% had visual impairment (LogMAR 0.5-1.0), 3.4% had severe visual impairment (LogMAR 1.0-1.30) and 3.9% were blind (LogMAR 1.3-NPL). This correlates with the finding of our study.

## CONCLUSION

Various forms of injury occur to the ocular and visual system in patients with closed head injury. There should be a detailed early ophthalmological assessment in all patients with head injury. This study unravels various ocular manifestations and its correlation with head injury, helping in better diagnosis and management. The visual system is likely to be ignored as the surgeon diverts his attention to the systemic complications of closed head injury. In severe head injury (GCS 3-8), it is important to look for neuroophthalmic manifestations. Also the presence of posterior segment findings in all cases of closed head injury shouldn't be missed. The majority of cases were in the age group of 21 to 39 years with a predominance of males over females. This is the most productive age group in the population which takes care of children and the elderly. So, the importance of taking adequate safety precautions both at home and at the work place is to be stressed in order to avoid head injuries.

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