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Clinical and Demographic Profile of Indirect Traumatic Optic Neuropathy: A Prospective Observational Study

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ABSTRACT
Indirect traumatic optic neuropathy (ITON) is a serious complication of blunt trauma, often leading to visual impairment or blindness. It is commonly associated with road traffic accidents, especially involving two-wheelers, in regions like India. Diagnosis includes the presence of a relative afferent pupillary defect (RAPD) with a normal fundus. Aim of the study was to assess the clinical and demographic characteristics of ITON patients in a tertiary care setting, focusing on etiology, associated injuries, and clinical outcomes. This prospective study included 50 patients diagnosed with ITON following trauma. Data on age, gender, cause of trauma, injury laterality, duration of unconsciousness, associated injuries, RAPD and fundus findings were analyzed. The majority of patients (78%) were aged 20-40 years (mean age 35) and 96% were male. Two-wheeler accidents were the predominant cause (76%). Right eye involvement was more common (60%) with no bilateral cases. Loss of consciousness was observed in 50% of patients and associated injuries included facial bone fractures (40%) and head injuries (24%). All patients exhibited RAPD and fundus examination was normal in all cases. ITON primarily affects young males involved in two-wheeler accidents. RAPD with a normal fundus is a consistent finding. More research is needed to guide optimal management and improve outcomes.

INTRODUCTION

Indirect traumatic optic neuropathy (ITON) is a relatively rare but serious complication of blunt head trauma, leading to visual impairment or blindness. Unlike direct optic nerve injuries, ITON occurs without overt damage to the optic nerve itself, often due to transmission of mechanical forces from adjacent structures such as the skull or orbital bones[1]. The diagnosis is largely clinical, based on a history of trauma and subsequent visual disturbances, often accompanied by a relative afferent pupillary defect (RAPD). Despite advancements in imaging techniques and therapeutic interventions, ITON remains a challenging condition due to the variable outcomes of visual recovery and the lack of a universally accepted treatment protocol[2]. The management typically includes observation, corticosteroids, or surgical decompression, but the effectiveness of these interventions remains controversial[3].

The exact incidence of ITON is difficult to establish, as it is often underdiagnosed, particularly in cases where visual symptoms are overshadowed by more severe craniofacial injuries. Previous studies have reported varying etiologies, with road traffic accidents being the leading cause in most cases[4]. However, the role of other contributing factors, such as the presence of associated injuries and duration of unconsciousness, is less well-studied[5]. A few studies have attempted to analyze these clinical parameters, but the small sample sizes and retrospective designs limit their generalizability.

Although previous research has highlighted the prevalence of ITON in trauma cases[6], there is a noticeable gap in understanding the demographic and clinical patterns specific to certain populations, especially in countries like India where road traffic accidents are a major public health concern. Most studies on ITON have been conducted in Western countries, with limited data available from South Asian populations. Additionally, there is a lack of consensus on the optimal timing and type of intervention, particularly in the context of associated injuries and varying durations of loss of consciousness.

Studies conducted earlier laid the groundwork for understanding the clinical presentation and outcomes of ITON. Both studies emphasized the high incidence of ITON following road traffic accidents and the uncertainty surrounding treatment efficacy[7]. More recent studies, have expanded on these findings but continue to highlight the need for larger, population-specific studies to validate treatment protocols and better understand patient outcomes[8].

The aim of this study is to evaluate the clinical and demographic profile of patients with ITON in a tertiary care setting, with a focus on the etiology, associated injuries and clinical outcomes. This study seeks to fill the research gap by providing insight into the patterns of ITON in an Indian population, with the goal of contributing to the development of more effective diagnostic and treatment strategies.

MATERIALS AND METHODS

Study Design: This study was a prospective observational study conducted at Department of Ophthalmology, Mamata Medical College, Khammam, tertiary care hospital to evaluate the demographic characteristics, etiology and clinical features of patients diagnosed with indirect traumatic optic neuropathy (ITON). Data were collected from patients who presented with suspected ITON following trauma. A total of 50 patients with a clinical diagnosis of ITON were included in the study. The inclusion criteria consisted of.

- Patients aged 20 years and above.
- Patients presenting with visual disturbances following trauma and showing signs of optic nerve involvement.
- Only cases with a history of indirect trauma were included (i.e., there was no direct penetrating injury to the optic nerve).

Exclusion Criteria Included:

- Patients with a history of pre-existing optic neuropathy.
- Those with direct trauma to the eye or optic nerve.
- Cases of bilateral indirect traumatic optic neuropathy.

Data Collection: The demographic details (age, gender) and clinical findings (visual symptoms, relative afferent pupillary defect, fundus examination) were documented. Detailed histories were taken to record the cause and nature of trauma, the duration of loss of consciousness and associated injuries.

- **Age and Gender Distribution:** Age was classified into four groups: 20-30, 31-40, 41-50 and >50 years, with gender distribution noted as male or female.
- **Lateralization of Injury:** The eye affected (right, left, or bilateral) was recorded for each patient.
- **Etiology:** The cause of trauma was classified into road traffic accidents (two-wheeler, four-wheeler, and cycle accidents), self-fall and assault.
- **Loss of Consciousness (LOC):** Patients were categorized based on the duration of LOC into three groups: less than 6 hours, 7-12 hours and >12 hours.
- **Associated Injuries:** The presence of additional injuries, such as facial bone fractures, head injuries and facial abrasions, were documented.

- **RAPD (Relative Afferent Pupillary Defect):** Presence or absence of RAPD was assessed in all patients.
- **Fundus Examination:** Fundoscopy was performed to assess any optic nerve abnormalities before starting treatment.

Statistical Analysis: The data collected were analyzed using simple descriptive statistics. Age, gender, laterality of injury, etiology and clinical findings were expressed as percentages. The analysis was performed using statistical software SPSS 25.0 version and results were displayed in tabular form for clarity, $p<0.05$ was considered as significant.

RESULTS AND DISCUSSIONS

Table 1: Distribution of Subjects According to Age Wise.

8Age group	No .of Patients	Percentage
20 -30	15	30%
31 -40	24	48%
41 -50	7	14%
> 50 years	4	8%
Gender		
Male	48	96%
Female	2	4%
Total	50	100%

Age wise Distribution of the 50 patients studied, showed that majority of patients were in 20-40 years age group, with 30% in 20-30 years age group and 24 patients (48%) were in 31-40 years age group. Patients in 41-50 years of age constituted 14% of total cases, whereas only 4 patients constituting 8% of total cases were >50 years age. The mean age of patients studied was 35 years with minimum age of 20 years and maximum age of 58 years. Sex distribution showed 96% patients in the study were males, with 2 % female patients being diagnosed with indirect traumatic optic neuropathy during the study period.

Table 2: Laterality of Indirect Traumatic Optic Neuropathy in Patients.

Eye involved	No. of Patients	Percentage
Right Eye	30	60%
Left Eye	20	40%
Bilateral	0	0%
Total	50	100%

Table 2 presents the distribution of laterality in patients diagnosed with indirect traumatic optic neuropathy (ITON). Among the 50 patients studied, 60% (30 patients) had involvement of the right eye, while 40% (20 patients) had left eye involvement. Notably, no patients exhibited bilateral optic nerve involvement in this study. This finding highlights a predominance of unilateral optic nerve damage, with a slightly higher incidence of right eye involvement. The absence of bilateral cases underscores the rarity of bilateral ITON in trauma settings.

Table 3: Etiology of Indirect Traumatic Optic Neuropathy in Patients.

Etiology	No. of Patients	Percentage
Two Wheeler Accident	38	76%
Cycle Accident	1	2%
Four Wheeler Accident	4	8%
Self Fall	5	10%
Assault	2	4%
Total	50	100%

Table 3 shows, study of cause of indirect traumatic optic neuropathy in 50 patients showed that commonest etiology was road traffic accident. Among road traffic accidents commonest was that involving two wheeler accident which constituted 76 % cases. Cycle accidents were of 2 % and car accidents were of 8%. The study showed 5 patients constituting 10% of total cases developed optic neuropathy following self fall and 4% from assault.

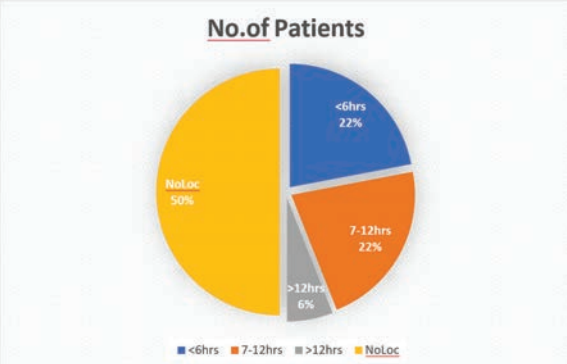

Fig. 1: Duration of Loss of Consciousness

Loss of consciousness was noted in 25 (50%) patients. 11 patients (22%) showed loss of consciousness for <6 hours, while another 11 patients (22%) showed loss of consciousness for a duration in the range of 7-12 hours. Only 3 (6%) patients showed loss of consciousness lasting for >12 hours (Fig. 1).

Table 4: Associated Injuries in Patients with Indirect Traumatic Optic Neuropathy.

Injury	No. of Patients	Percentage
Facial bone fractures	20	40%
Head injuries	12	24%
Facial Abrasion/ laceration /contusion	12	24%
Sub conjunctival hemorrhage	3	6%
No injury	3	6%
Total	50	100%

This table 4 outlines the types of associated injuries observed in patients diagnosed with indirect traumatic optic neuropathy (ITON). Among the 50 patients, 40% had facial bone fractures, making it the most common associated injury. Head injuries and facial abrasions, lacerations, or contusions were present in 24% of the patients each. Subconjunctival hemorrhage was noted in 6% of cases, while 6% of the patients had no detectable associated injuries. These findings highlight the frequent occurrence of craniofacial trauma in conjunction with ITON, emphasizing the need for comprehensive assessment of head and facial injuries in patients with ITON.

Table 5: Presence of Relative Afferent Pupillary Defect (RAPD) in Patients with Indirect Traumatic Optic Neuropathy

RAPD	No. of Patients	Percentage
Present	50	100%
Absent	0	0%
Total	50	100%

This table 5 shows the prevalence of relative afferent pupillary defect (RAPD) in patients diagnosed with indirect traumatic optic neuropathy (ITON). In all 50 patients (100%), RAPD was present, with no patients showing the absence of RAPD. RAPD is a key clinical sign of ITON and indicates optic nerve dysfunction, highlighting its diagnostic importance in cases of indirect optic nerve trauma. The presence of RAPD in all patients underscores its consistent role in the clinical assessment of ITON.

Table 6: Fundus Examination Findings in Patients with Indirect Traumatic Optic Neuropathy

Fundus	No. of Patients	Percentage
Normal	50	100%
Abnormal	0	0%
Total	50	100%

This table presents the results of fundus examinations in patients with indirect traumatic optic neuropathy (ITON). All 50 patients (100%) had normal fundus findings, with no abnormalities detected. Despite the presence of optic nerve dysfunction indicated by visual disturbances and RAPD, fundus examination was unremarkable in every case. This finding is consistent with the nature of ITON, where optic nerve damage often occurs without visible changes in the retina or optic disc. This emphasizes the importance of using clinical signs like RAPD, alongside imaging and other diagnostic tools, for accurate diagnosis of ITON.

In this study, we analyzed 50 cases of indirect traumatic optic neuropathy (ITON) with a focus on age, gender, etiology, lateralization of injury, duration of loss of consciousness, associated injuries, presence of RAPD and fundus findings. The majority of patients (78%) were aged between 20-40 years, with a mean age of 35 years, which aligns with findings from previous studies where ITON was most commonly reported in younger, active age groups, especially due to their involvement in road traffic accidents[9]. Our study also revealed that 96% of patients were male, reflecting the higher incidence of trauma among males, which has been consistently observed in other research[10].

The leading cause of ITON in our study was road traffic accidents, particularly two-wheeler accidents, accounting for 76% of cases. This result is consistent with other studies from developing countries, such as Sujithra *et al.* (2023), where motor vehicle accidents, particularly involving two-wheelers, were identified as the predominant cause of trauma-related optic neuropathy[11]. In contrast, in studies conducted in Western countries, four-wheeler accidents tend to feature more prominently[12]. This difference may be due to variations in transportation patterns and road safety measures between regions.

Our findings on the laterality of optic nerve involvement showed a higher incidence of right eye involvement (60%) compared to the left eye (40%), with no cases of bilateral involvement. Similar findings were reported by Yu-Wai-Man *et al.* (2004), who also found a predominance of unilateral involvement, though the reasons for this lateralization preference remain unclear[13]. Bilateral cases of ITON are exceedingly rare, further underscoring the importance of early diagnosis and focused management in cases of unilateral optic neuropathy following trauma.

Loss of consciousness (LOC) was documented in 50% of our patients, with an equal distribution of patients experiencing LOC for <6 hours and 7-12 hours (22% each). This is consistent with studies that show LOC as a common feature associated with more severe head trauma, which can increase the likelihood of developing ITON[14].

Associated injuries such as facial bone fractures (40%), head injuries (24%) and facial abrasions or lacerations (24%) were frequent in our cohort. These injuries are often reported in conjunction with ITON in similar studies[15], supporting the concept that ITON typically occurs in the setting of significant craniofacial trauma. However, 6% of our patients showed no associated injuries, which suggests that ITON can still occur without extensive external trauma, likely due to the indirect transmission of mechanical forces to the optic nerve.

All patients (100%) in our study presented with a relative afferent pupillary defect (RAPD), which has been established as a hallmark of ITON[16]. Despite the clinical severity of the condition, fundus examination was normal in all patients, which is also consistent with previous studies, as optic nerve damage in ITON typically occurs without immediate visible changes in the retina or optic disc[17].

Our study results are largely in agreement with earlier research on ITON, particularly in terms of the demographic profile, etiology and clinical features. Earlier studies have highlighted the role of road traffic accidents in the etiology of ITON, though our study places more emphasis on two-wheeler accidents, reflecting regional differences[18]. Yu-Wai-Man *et al.* (2015) also reported a higher incidence of male patients and a mean age similar to our findings[7]. However, differences in the distribution of associated injuries and outcomes underscore the need for population-specific studies to tailor management protocols.

CONCLUSION

This study highlights the demographic and clinical profile of indirect traumatic optic neuropathy in an Indian population, with road traffic accidents, particularly two-wheeler accidents, being the leading cause. The majority of patients were young males, and all presented with RAPD, while fundus examination was normal in all cases. The findings of this study are consistent with existing literature, although regional differences in the etiology and associated injuries underscore the need for further research. There remains no consensus on the optimal management strategy for ITON and future studies are warranted to explore the long-term visual outcomes and treatment efficacy in larger, diverse populations.

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