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Visual Outcomes and Prognostic Factors in Patients with Indirect Traumatic Optic Neuropathy Treated with Steroids: A Prospective Analysis

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ABSTRACT
Indirect traumatic optic neuropathy (ITON) is a rare but serious condition resulting from blunt trauma to the head or face, causing visual impairment without direct optic nerve damage. The effectiveness of corticosteroid therapy in improving visual outcomes remains debated. This study evaluates steroid therapy's impact on visual recovery in ITON and examines key prognostic factors influencing outcomes. Aim of the study is to assess visual outcomes at 3 months in ITON patients treated with steroids and identify prognostic factors such as initial best corrected visual acuity (BCVA), timing of treatment, age and loss of consciousness. This prospective observational study included 50 ITON patients treated with high-dose corticosteroids. Patients were categorized based on the timing of treatment and initial BCVA. Visual outcomes were measured at baseline and at 3 months. Factors such as age, loss of consciousness and fundus findings were analyzed using chi-square and logistic regression tests. A p-value <0.05 was considered significant. At 3 months, 46% of patients showed visual improvement, while 54% had no improvement. A significant association was found between earlier steroid administration (within 48 hours) and better visual recovery ($p<0.05$). Improvement was seen in 71% of patients with BCVA better than 6/60-CF, but none in those with no light perception (No PL). Age and loss of consciousness were not significantly associated with outcomes ($p>0.05$). At 3 months, 48% of patients showed optic atrophy and 32% had temporal pallor. Early steroid treatment within 48 hours of injury is associated with better visual outcomes in ITON patients, particularly those with residual vision. Patients with no light perception at presentation have a poor prognosis. Age and loss of consciousness did not significantly influence outcomes. Further research is needed for alternative treatments in non-responders.

INTRODUCTION

Indirect traumatic optic neuropathy (ITON) is a significant cause of vision loss following blunt trauma to the head or face, without any direct injury to the optic nerve[1]. It occurs as a result of mechanical forces transmitted to the optic nerve from distant trauma sites, leading to compression, ischemia, or shearing injuries. The presentation can range from mild visual impairment to complete loss of vision. Despite the serious consequences, the optimal management of ITON remains a subject of debate, with corticosteroids being one of the primary treatment modalities employed to reduce inflammation and improve outcomes[2].

However, the effectiveness of steroids in ITON remains controversial and there is a lack of consensus regarding the timing and dosage of steroid administration. Early intervention with steroids has been hypothesized to improve outcomes, but delayed presentations and varying degrees of visual impairment complicate treatment decisions[3]. Moreover, certain prognostic factors, such as initial best corrected visual acuity (BCVA), time of intervention and the presence of loss of consciousness, may influence the final visual outcome, though their roles are not well-established[4]. There remains a substantial gap in understanding the prognostic factors influencing visual recovery in patients with ITON, particularly in relation to the timing of steroid administration and initial BCVA. Existing literature offers mixed results regarding the role of steroids, with no clear consensus on whether earlier treatment leads to better outcomes or whether certain groups of patients are less likely to benefit from steroid therapy[5]. Additionally, few studies have systematically evaluated how age, loss of consciousness and other clinical variables influence visual outcomes in ITON. Therefore, more evidence is needed to clarify these prognostic factors and their association with final visual acuity in such patients.

Several studies have previously explored the efficacy of steroid treatment in ITON. Levin *et al.* (1999) conducted a retrospective analysis of patients with optic nerve injuries and concluded that steroids may offer benefits in select cases, though their role remains inconclusive[6]. Similarly, Stunkel and Van Stavern (2018) investigated the relationship between timing of steroid therapy and visual outcomes, suggesting that earlier administration might offer better recovery, particularly in patients with some residual vision at presentation[7]. However, these studies did not establish strong predictive factors for final outcomes, and many lacked statistical significance due to small sample sizes or retrospective designs.

The present study aims to evaluate the outcomes of visual recovery in patients with ITON treated with corticosteroids, focusing on the association between initial BCVA, timing of treatment and final visual improvement at three months. Additionally, the study seeks to identify key prognostic factors that may influence the efficacy of steroid treatment, including age, initial vision and loss of consciousness, to provide a clearer understanding of which patient subgroups may benefit most from early intervention. The study intends to fill the existing research gaps by providing prospective data on visual outcomes and their association with clinical variables, thus contributing to more informed treatment strategies for ITON patients.

MATERIALS AND METHODS

This is a prospective observational study conducted at Department of Ophthalmology, Mamata Medical College, Khammam, aimed at evaluating visual outcomes in patients diagnosed with indirect traumatic optic neuropathy (ITON) following blunt head or facial trauma. The study involved assessing the effectiveness of steroid therapy in improving visual acuity and identifying factors that influence visual recovery.

Study Population: A total of 50 patients with clinically diagnosed ITON were included in the study. Patients were recruited based on the following inclusion and exclusion criteria:

Inclusion Criteria:

- Patients aged 20 years and above with indirect traumatic optic neuropathy secondary to blunt trauma.
- Patients with a baseline BCVA worse than 6/36 at presentation.
- Patients without any contraindication to corticosteroid therapy.

Exclusion Criteria:

- Patients with direct traumatic optic neuropathy or associated globe injury.
- Patients with pre-existing ocular conditions or optic neuropathies unrelated to trauma.
- Patients with contraindications for steroid use (e.g., uncontrolled diabetes, severe infections).

Intervention: All patients were started on high-dose corticosteroid therapy following a standard treatment protocol after ruling out contraindications for steroid use. Steroid therapy was initiated as early as possible following presentation to the hospital. The timing of treatment initiation was recorded in hours post-injury and categorized into the following groups:

- <12 hours.
- 12-24 hours.
- 25-48 hours.
- 49-72 hours.
- 72 hours.

Data Collection:

Baseline Assessment: On presentation, each patient's initial BCVA was measured using the Snellen chart. BCVA was categorized as follows: 6/36, 6/60, 6/60-CF (Counting Fingers), HM-PL (Hand Movements to Perception of Light) and No Perception of Light (No PL).

Follow-up Protocol: Patients were followed up regularly for a period of 3 months. Visual acuity was reassessed at each visit, and final BCVA at 3 months was recorded. BCVA improvement was defined as an increase of at least one line on the Snellen chart.

Additional Clinical Parameters:

- The presence or absence of loss of consciousness (LOC) at the time of injury was documented.
- The age of the patient was recorded and stratified into four groups: 20-30 years, 31-40 years, 41-50 years and above 50 years.
- Fundus examination findings at 3 months were documented and categorized as optic atrophy, temporal pallor, or normal fundus.

Outcome Measures: The primary outcome was the final BCVA at 3 months and the secondary outcome was the improvement in BCVA compared to baseline. Visual improvement was assessed based on:

- Association of initial BCVA and final BCVA.
- Association of the timing of steroid therapy and visual improvement.
- Influence of age, loss of consciousness and fundus findings on visual outcomes.

Statistical Analysis: Data were analyzed using statistical software. Categorical variables such as BCVA categories and fundus findings were presented as percentages, while continuous variables like the timing of treatment were expressed as means or medians. Chi-square tests were used to determine associations between categorical variables, such as the relationship between initial BCVA and visual improvement or between timing of steroid administration and final BCVA. A p-value of <0.05 was considered statistically significant. Additionally, logistic regression analysis was performed to evaluate independent predictors of visual improvement.

RESULTS AND DISCUSSIONS

Table 1: Distribution of Initial Best Corrected Visual Acuity (BCVA) in Patients with Indirect Traumatic Optic Neuropathy (ITON)

Vision	No. of Patients	Percentage
6/36	4	8%
6/60	8	16%
6/60-CF	17	34%
HM-PL	12	24%
No PL	9	18%
Total	**50**	**100%**

This table 1 represents the distribution of initial best corrected visual acuity (BCVA) in 50 patients diagnosed with indirect traumatic optic neuropathy (ITON). The visual acuity was assessed using Snellen's chart immediately after the injury. The majority of patients (76%) had significant visual impairment, with BCVA worse than 6/60. Specifically, 34% had visual acuity in the range of 6/60 to counting fingers (CF), while 24% had vision limited to hand movements to perception of light (HM-PL). Notably, 18% of the patients had no perception of light (No PL) at presentation, indicating severe optic nerve damage. Only 8% had a relatively better initial vision of 6/36 and 16% had BCVA of 6/60. These data highlight the severity of visual impairment in ITON patients upon presentation.

Table 2: Duration Between Injury and Initiation of Steroid Treatment in Patients with Indirect Traumatic Optic Neuropathy (ITON)

Duration	No. of Patients	Percentage
<12 hrs	6	12%
12-24 hrs	20	40%
25-48 hrs	15	30%
49-72 hrs	5	10%
>72 hrs	4	8%
Total	**50**	**100%**

All patients diagnosed as indirect traumatic optic neuropathy were started on steroid treatment after ruling out contraindications for steroid. Steroids were started in 6(12%) patients within a period of 12 hours. In 20(40%) of patients it was started between 12-24 hours whereas in 15(30%) patients it was started between 25-48 hours. Due to delay in admission after injury steroid treatment could be started only between 49-72 hours in 5(10%) patients, but only after 72 hrs in 4 (8%) patients.

Table 3: Association of Final Visual Improvement (At 3 Months) with Initial BCVA

	Visual Acuity			
Initial Vision	Improvement	No Improvement	TOTAL	Percentage
6/36	3	1	4	8%
6/60	6	2	8	16%
<6/60-CF	12	5	17	34%
HM-PL	2	10	12	24%
NoPL	0	9	9	18%
TOTAL	**23**	**27**	**50**	**100%**

Analysis of improvement of visual acuity in patients in our study showed that there was no visual improvement in patients who presented with immediate amaurosis following injury with no perception of light. Only 2 among the 12 patients with slightly better vision ranging from HM to PL showed improvement in vision which is only 24% of patients in this group. Among patients with initial BCVA of 6/36 and 6/60 there was improvement in 8%,16% of patients in each of these two group of patients. In the group of patients with initial BCVA of 6/60-CF there was improvement in 12 among 17 patients. There was

significant statistical analysis between initial visual acuity and visual improvement at 3 months with p value >0.001 (Table 3).

Table 4: Association of Final BCVA with Initial Vision

	Visual Acuity at 3 months					
Initial Vision	6/6-6/18	6/24-6/36	6/60	No Improvement	Total	Percentage
6/36	3	0	0	1	4	8%
6/60	3	3	0	2	8	16%
<6/60 -CF	4	6	2	5	17	34%
HM-PL	0	1	1	10	12	24%
NoPL	0	0	0	9	9	18%
TOTAL	**10**	**10**	**3**	**27**	**50**	**100%**

Visual improvement at 3 months in all patients were compared with their initial acuity. It showed that patients with initial BCVA of 6/36 and 6/60 had good improvement of BCVA compared with patients with initial BCVA of <6/60. All patients with initial BCVA of 6/36 who improved with the therapy showed final BCVA of 6/6-6/18. Final BCVA improved to 6/6-6/36 in all patients who had initial BCVA of 6/60 and showed improvement with treatment. Among the 12 patients with initial BCVA ranging from HM-PL there was visual improvement in only two patients in which one patient showed final BCVA of 6/36 and other patient 6/60. There was no visual improvement in all patients without initial perception of light. The analysis showed very strong statistical association between base line visual acuity and final BCVA achieved at 3 months with P value <0.001.

Table 5: Improvement of BCVA with Steroid Treatment (At 3 Months)

Status	No. of Patients	Percentage
Improvement	23	46%
No Improvement	27	54%
Total	**50**	**100%**

Patients with indirect traumatic optic neuropathy were treated with full course of steroids as per our treatment regimen. Patients were regularly followed up and best corrected visual acuity was assessed regularly. Improvement of one line in snellen's chart was considered as improvement in visual acuity. According to that criteria 23 patients showed improvement in BCVA at 3 months, constituting 46% of study population. But there was no visual improvement in 27 (54%) of patients in spite of steroid treatment.

Table 6: Age Wise Distribution of BCVA Improvement (At 3 Months)

	BCVA			
Age	Improvement	No Improvement	Total	Percentage
20-30	8	7	15	30%
31-40	12	12	24	48%
41-50	2	5	7	14%
>50	1	3	4	8%
TOTAL	**23**	**27**	**50**	**100%**

Improvement of BCVA at 3 months was assessed according to age distribution. The study showed that there was visual improvement in 8(53%) out of 15 patients in the age group of 20-30 , whereas there was visual improvement in 50% (12 out of 24) of patients in the age group of 30-40. In the age group of 41-50 there was visual improvement in only 5 out of 7 (29%) patients. Only 1 among the 4 (25%) patients showed visual improvement in patients more than 50 years of age. The analysis showed that there was good visual improvement in patients between 20-40 years of age when compared to patients >40 years of age. But statistical analysis failed to show association between age and final visual improvement with p value >0.05 (P=0.563).

Table 7: Association Between BCVA At 3 Months and Loss Of Consciousness

	Visual Acuity			
LOC	Improvement	No Improvement	Total	Percentage
Present	11	14	25	50%
Absent	12	13	25	50%
TOTAL	23	27	50	100%

Study of association between loss of consciousness following injury and visual improvement at 3 months shows that among 25 patients with loss of consciousness there was visual improvement in only 11 patients which constitutes 44% of those patients. In patients without loss of consciousness there was visual improvement in 12 out of 25 patients which constitute 48% in that group. Study also showed that longer the duration of loss of consciousness, poorer the improvement in visual acuity. But statistical analysis did not show significant association between loss of consciousness and improvement in visual acuity as p value was more than 0.05 (P=0.105).

Table 8: Association Between Final BCVA Improvement and Duration Of Starting Treatment

	Visual Acuity			
Duration	Improvement	No Improvement	Total	Percentage
<48 hrs	22	19	41	82%
>48 hrs	1	8	9	18%
TOTAL	**23**	**27**	**50**	**100%**

There was a strong statistical association between improvement of visual acuity at 3 months and duration of starting steroid treatment after injury with P value of less than 0.05. Among the 41 patients in whom steroid treatment was started before 48 hours, there was improvement in 22 patients which account for 54%. But among the 9 patients in whom steroids was started after 48 hours there was improvement in only 1 patient.

Visual acuity improvement was assessed every 24 hours following initiation of steroid treatment in all patients. Analysis showed that 6 among the 23 patients (26%) showed improvement within first 24 hours. Majority of patients (71%) among those with improved vision showed improvement on the second day of starting treatment. Only 2 patients showed

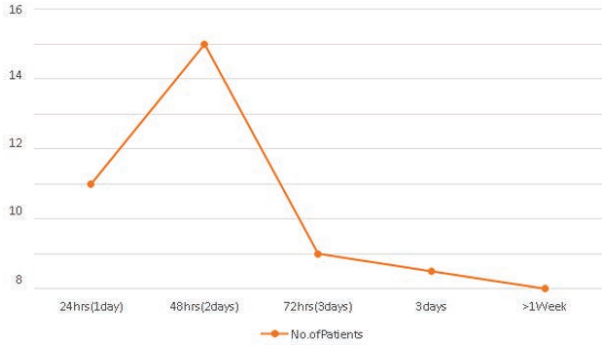

Fig. 1: Association Between Starting Treatment and Initial BCVA Improvement

improvement on the 3rd day, while there was improvement in vision only in one patient from 3-7 days. Those patients who did not show improvement of vision in the first week of starting treatment never showed improvement after first week. The Chi square test of this analysis showed a p value of >0.05 which was statistically significant.

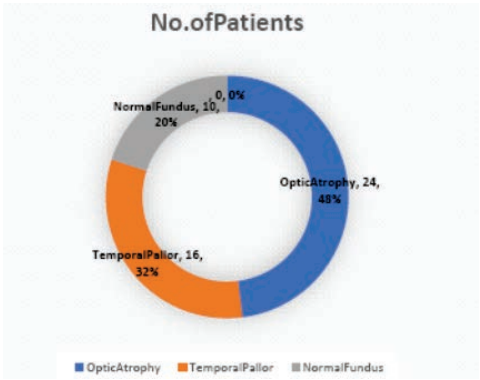

Fig. 2: Fundus Finding at 3 Months

Fundus examination at 3 months post injury showed that there was optic atrophy in 24(48%) patients, whereas 16(32%) patients showed temporal pallor. Normal fundus was seen in 10 (20%) patients.

This study aimed to evaluate the visual outcomes of patients with indirect traumatic optic neuropathy (ITON) following steroid therapy, focusing on factors such as initial BCVA, timing of treatment, loss of consciousness, age and final BCVA at 3 months. The results of our study revealed that 46% of patients showed improvement in visual acuity, while 54% had no improvement despite receiving steroid treatment. There was a significant association between early initiation of steroid therapy (within 48 hours) and better visual outcomes, with 54% of patients showing improvement if steroids were administered within this window. In contrast, only 11% of patients who received steroids after 48 hours showed any improvement, supporting the hypothesis that early intervention leads to better outcomes.

Our findings align with previous studies that suggest early steroid therapy offers benefits in cases of ITON. Saxena *et al.* (2014) conducted a retrospective review that indicated a possible benefit of steroid therapy in select patients, particularly those with less severe initial vision loss. In their study, patients with some residual visual function at presentation had better outcomes compared to those with no light perception. Our study corroborates these findings, as patients with better initial BCVA (6/60-CF or better) had a greater likelihood of visual improvement[8]. Specifically, 12 out of 17 patients in this group showed improvement, compared to no improvement in patients who presented with no perception of light (No PL).

Seiff (1990) also reported a correlation between the timing of steroid therapy and visual outcomes. In their study, patients treated within 24 hours had the highest rates of recovery[9]. Similarly, in our study, 26% of patients showed improvement within the first 24 hours of treatment, while the majority (71%) of those who improved did so within the first 48 hours. This emphasizes the importance of prompt treatment initiation. However, some earlier studies, such as a cohort study by Dale (2018), questioned the efficacy of steroids and found no clear benefit, particularly in cases where patients presented with severe vision loss[10]. Our study partially supports these findings, as patients with no light perception did not show any improvement despite early steroid administration.

Furthermore, our analysis did not find a significant relationship between age and visual improvement, which contrasts with studies like those by Carta et al. (2003), which suggested that younger patients (<40 years) tend to have better visual outcomes[11]. Although our data showed a trend towards better outcomes in younger patients (53% in those aged 20-30 years and 50% in those aged 31-40 years), the association was not statistically significant (p=0.563).

Similarly, the presence or absence of loss of consciousness (LOC) was not a significant predictor of visual recovery in our study (p=0.105). This finding is consistent with the work of Miliaras *et al.* (2013), who found no substantial difference in visual outcomes between patients with or without LOC following head trauma[12].

At 3 months, 48% of our patients demonstrated optic atrophy and 32% had temporal pallor, indicating significant optic nerve damage. These findings were in line with those of Steinsapir and Goldberg (1994), who reported a high incidence of optic atrophy in ITON patients who did not respond to therapy.

CONCLUSION

This study demonstrates that early intervention with high-dose steroids in patients with ITON can lead to significant visual improvement, particularly in those with better initial visual acuity and treatment initiated within 48 hours of injury. However, patients with no perception of light at presentation had poor outcomes and the presence of loss of consciousness or older age

did not significantly influence visual recovery. The study highlights the importance of early diagnosis and prompt treatment, while also pointing to the need for further research to clarify the long-term outcomes of steroid therapy and explore alternative treatments for those who do not respond to steroids.

REFERENCES

1. Burke, E.G., S.M. Cansler and N.K. Evanson, 2019. Indirect traumatic optic neuropathy: modeling optic nerve injury in the context of closed head trauma. Neural Rege Rese., 14(4):593-4.
2. Levin, L.A., R.W. Beck, M.P. Joseph, S. Seiff and R. Kraker, 1999. International Optic Nerve Trauma Study Group. The treatment of traumatic optic neuropathy: the International Optic Nerve Trauma Study. Ophth., 106(7):1268-77.
3. Yu, W.M.P. and P.G. Griffiths, 2013. Steroids for traumatic optic neuropathy. Cochrane Database Syst Rev. 2013(6).
4. Entezari, M., Z. Rajavi, N. Sedighi, N. Daftarian and M. Sanagoo, 2007. High-dose intravenous methylprednisolone in recent traumatic optic neuropathy; a randomized double-masked placebo-controlled clinical trial. Graefes Arch Clin Exp Ophth., 245(9):1267-1271.
5. Wright, A.J., J.H. Queen and E.P. Supsupin, et al. 2022. Prognosticators of Visual Acuity After Indirect Traumatic Optic Neuropathy. J Neuroophthalmol. 42(2):203-207.
6. Hayreh, S.S., 2011. Management of ischemic optic neuropathies. Indian jou ophth., 1;59(2):123-36.
7. Stunkel, L. And S.G.P. Van, 2018. Steroid treatment of optic neuropathies. Asia-Pacific Jou Ophth., 7(4):218-28.
8. Saxena, R., D. Singh and V. Menon, 2014. Controversies in neuro-ophthalmology: Steroid therapy for traumatic optic neuropathy. Indian Jou Ophth., 62(10):p 1028-1030
9. Seiff, S.R., 1990. High dose corticosteroids for treatment of vision loss due to indirect injury to the optic nerve. Ophth Surg., 21(6):389-395.
10. Dale, G.H., T. Petersen, S.K. Bacher, T. Christensen and G. Houen, et al., 2018. Time to steroid treatment in severe acute optic neuritis. Brain Behav.,8(8).
11. Carta, A., L. Ferrigno, M. Salvo, M.S. Bianchi and A. Boschi, et al., 2003. Visual prognosis after indirect traumatic optic neuropathy. Jou Neu Neur Psyc., 74(2):246-8.
12. Miliaras, G., G. Fotakopoulos, I. Asproudis, S. Voulgaris and A. Zikou,et al., 2013. Indirect traumatic optic neuropathy following head injury: report of five patients and review of the literature. Jou Neur Sur Part A: Cen Eur Neur., 74(03):168-74.
13. Rajavi, Z., S. Mokhtari, F. Daneshvar and H. Faghihi, 2014. Management of traumatic optic neuropathy: the role of steroid therapy. Jou Ophth Vision Res., 9(2), 234-238.
14. Steinsapir, K.D. and R.A. Goldberg, 1994. Traumatic optic neuropathy. Survey Ophth., 38(6), 487-518.
15. Wang, M., Y. Liu, Z. Li and W. Zhang, 2009. Prognostic factors for visual recovery after indirect traumatic optic neuropathy. Clin Ophth., 3, 531-535.s
16. Li, Z., L. Xu, Y. Wang and Q.S. You, 2016. Early prediction of visual outcome following indirect traumatic optic neuropathy. Brit Jou Opht., 100(5), 647-651.