

Astudy ofPrognostic Factors Influencing Visual Outcome inPatients ofIndirect Traumatic Optic Neuropathy

Dr.V.Karthikeyan¹, Dr.S.Padmanaban², Dr.Anupama Vinupal³,
Dr.Divya Natarajan⁴

¹ Assistant Professor, Department Of Ophthalmology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India

² Professor, Department Of Ophthalmology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India

³ Resident, Department Of Ophthalmology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India

⁴ Resident, Department Of Ophthalmology, Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India

Corresponding Author: Dr.S.Padmanaban

Abstract: Aim: To Analyse The Various Prognostic Factors Which Will Influence The Visual Outcome In Patients With Indirect Traumatic Optic Neuropathy. Design: Hospital Based Prospective Study. Materials And Methods: Patients More Than 20 Years Of Age, Admitted In Coimbatore Medical College Hospital With Head Injury And Diagnosed As Indirect Traumatic Optic Neuropathy Underwent Detailed Ophthalmic Evaluation Including Visual Acuity, Anterior Segment Examination, Colour Vision Testing, Visual Field Charting And Fundus Examination. Results And Conclusion: Visual Improvement Was Found To Be Good When Steroids Were Started Within 48 Hours Of Injury. It Was Also Observed That If Visual Improvement Did Not Occur Within 48 Hours Of Initiation Of Steroids, Further Visual Improvement Was Unlikely. An Initial Visual Acuity Of More Than Counting Fingers Was Associated With A Good Visual Prognosis.
Key Words: Indirect Traumatic Optic Neuropathy, Initial Visual Acuity, Steroids

Date of Submission: 22-04-2018

Date of acceptance: 07-05-2018

I. Introduction

Blindness Due To Trauma Is An Important Menace In The Industrialised World. Trauma Causes Various Manifestations In Eyes. It Can Be A Direct Mechanical Injury To The Eyes Or An Indirect Effect Due To The Transmission Of Forces Following Concussive Blow To Head Or Orbit. Optic Nerve Is An Important Structure Involved In Trauma And The Sequelae Of Optic Nerve Injury Is Severe As It Can Cause Permanent Visual Impairment¹. Injury To The Optic Nerve Can Be Direct Or Indirect. Direct Injuries To The Optic Nerve Are Caused By Penetrating Trauma And Orbital Fractures. Indirect Injury, Being The More Common Type Is Due To The Transmission Of Force From The Blow To Head Or Orbit¹. The Rise Of Road Traffic Accidents In The Industrialized World Has Led To An Increase In The Incidence Of Optic Nerve Injuries. There Have Been Various Studies Analysing The Causes Of Optic Nerve Injury And Most Of Them Have Concluded Motor Vehicle Accidents To Be The Most Common Cause Of Optic Nerve Injury^{2,3}. The Initial Visual Acuity Is An Important Parameter To Be Assessed As It Influences The Improvement With Treatment. Results From Various Studies Show That The Improvement In Visual Acuity Following Treatment Was Better In Patients With An Initial Visual Acuity Of Perception Of Light Than In Patients With Visual Acuity Of No Perception Of Light. The Diagnosis And Treatment Of Optic Nerve Injuries Can Be Challenging Especially In Unconscious Or Comatose Patients. Numerous Studies Have Been Published Comparing The Efficacy Of Various Modalities Of Management Of Optic Neuropathy I.E Conservative Management, Steroids Alone, Combination Of Steroids And Surgery, Surgery Alone. This Study Aims To Analyse The Prognostic Factors Influencing Visual Outcome In Patients With Indirect Traumatic Optic Neuropathy.

II. Materials And Methods

This Prospective Study Was Conducted In Patients More Than 20 Years Of Age, Admitted In Coimbatore Medical College Hospital With Head Injury And Diagnosed As Indirect Traumatic Optic Neuropathy During The Period Of August 2014-July 2015. A Total Of 50 Patients Were Included In The Study.

Study Design: Hospital Based Prospective Study

Study Location:Coimbatore Medical College Hospital, Coimbatore, Tamil Nadu, India, Which Is A Tertiary Care Centre And Regional Referral Centre.

Study Duration:August 2014 – July 2015

Sample Size: 50

Sample Selection:Patients To Be Included In The Study Were Selected Among Those Admitted In Trauma Ward With Head Injury. Ophthalmic Examination Was Done And Those Patients Diagnosed As Indirect Traumatic Optic Neuropathy Were Selected For The Study, Based On Inclusion And Exclusion Criteria.

Inclusion Criteria:

1. Patients With Head Injury
2. Age More Than 20 Years
3. Normal Anterior Segment Anatomy
4. Diagnosis Of Indirect Traumatic Optic Neuropathy

Exclusion Criteria:

1. Penetrating Eye Injury And Globe Rupture
2. Blunt Trauma To The Globe
3. Patients With Optic Canal Fracture
4. Past History Of Eye Diseases, Surgery
5. History Of Loss Of Consciousness For More Than 72 Hours
6. History Of Diabetes Mellitus, Hypertension, Cardiac Disorders, Neurological Disorders
7. Patients Not Willing For Regular Follow Up
8. Comatose Patients

III. Procedure Methodology:

After Getting Informed Consent From The Patients In Their Own Language, Detailed History Was Elicited From The Patients Or Their Relatives In Case Of Comatose Patients, Using A Questionnaire Which Included Characteristics Such As Age And Sex Of The Patient; Time And Cause Of Injury; Loss Of Consciousness And Its Duration If Present, With Associated Seizures, ENT Bleed; Immediate Amaurosis Following Injury; Previous Eye Disorders, Refractive Error Or Surgery; Previous Head Injury Or Neurological Disorders; Past History Of Diabetes Mellitus, Systemic Hypertension, Any Other Systemic Disorders.

General Examination Of The Patient Was Done Including Assessment Of Cardiovascular Status And Respiratory Status, BP Measurement, Detailed Neurological Evaluation. Injuries Over The Forehead And Temple Were Noted.

Detailed Ophthalmic Examination Was Done Which Included Uncorrected And Best Corrected Visual Acuity In Both Eyes, Anterior Segment Examination Using Slit Lamp, Detailed Pupillary Examination, Extraocular Movements, Detailed Fundus Examination Using Direct And Indirect Ophthalmoscope, Colour Vision Testing Using Ishihara Chart, And Visual Field Assessment Using Automated Perimetry Or Confrontation Method.

Investigations Done Included Blood Investigations Such As Blood Count, Blood Sugar And Renal Function Tests; Electrocardiogram; X Ray Orbit; CT, MRI Scan Of The Orbit.

After Detailed Evaluation, Patients With Indirect Traumatic Optic Neuropathy Were Started On Treatment With High Dose On Injection IV Methyl Prednisolone, After Ruling Out Contraindications For The Same, And With The Consent Of Neurosurgeon.

The Treatment Regimen Of Steroids Is As Follows:

Injection Methyl Prednisolone 1gm IV OD X 3 Days Followed By Tab. Prednisolone 1mg/Kg/Day Per Oral X 11days. After 11 Days, The Steroids Were Tapered And Stopped.

The Patients Were Monitored By Testing Visual Acuity Using Snellen's Visual Acuity Chart At 24, 48 And 72 Hours After Starting High Dose Methyl Prednisolone Therapy. Patients Were Examined Daily During The First Week With Recording Of Visual Acuity. The Patients Were Followed Up Weekly During The First Month And Monthly Once For Three Months. During Follow Up, Visual Acuity, Anterior Segment Examination, Pupillary Assessment, Fundus Examination Was Done Along With Colour Vision And Visual Field Charting.

Improvement In Best Corrected Visual Acuity By One Line After Treatment, From The Baseline Visual Acuity Was Considered As Improvement In Vision.

Statistical Analysis:

At The End Of The Study Period, The Data Were Subjected To Statistical Analysis. The Differences In Quantitative Variables Between Groups Were Assessed By Unpaired Test. Comparison Between Groups Was

Made By Non-Parametric Mann Whitney Test. A Chi-Square Test Was Used To Assess Differences In Categorical Variables Between Groups.

III. Results

Age Wise Distribution Of The 50 Patients Showed That Majority Of Patients Were In The 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 Age Group Constituted 14% Of Total Cases, Whereas Only 4 Patients (8%) Were More Than 50 Years Of Age. The Mean Age Of Patients Studied Was 35 Years With Minimum Age Of 20 Years And Maximum Age Of 58 Years.

Table 1: Age Wise Distribution

Age Group	Number Of Patients	Percentage
20 – 30	15	30%
31 – 40	24	48%
41 – 50	7	14%
>50 Years	4	8%
Total	50	100%

Sex Distribution Showed All Patients In The Study To Be Males, With No Female Patients Being Diagnosed With Indirect Traumatic Optic Neuropathy During The Study Period.

Table 2: Sex Distribution

Gender	Number Of Patients	Percentage
Male	50	100%
Female	0	0%
Total	50	100%

There Was An Evidence Of Injury Over Forehead In 92% Patients. Among Them Abrasion Was The Most Common Constituting 48% Of The Total. Laceration Was Seen In 16 (32%) Patients And 8% Patients Had No Injury.

Table3:Injury Over Forehead

Injury	Number Of Patients	Percentage
Abrasion	24	48%
Laceration	16	32%
Contusion	6	12%
No Injury	4	8%
Total	50	100%

Best Corrected Visual Acuity Of Patients Was Assessed Using Snellen’s Chart Immediately Following Injury. It Was Found That BCVA Was <6/60 In 38 (76%) Patients. In 17 (34%) Patients, Vision Was In The Range Of 6/60 – CFCF, Whereas 12 (24%) Patients Had Vision Of Hand Movements To Perception Of Light. 9 (18%) Out Of 50 Patients Had No Perception Of Light. Only 4(8%) Patients Had Vision Of 6/36, Whereas 8 (16%) Had Visual Acuity Of 6/60. No Patients Had Visual Acuity Better Than 6/36.

Table 4:BCVA At Presentation

Vision	Number Of Patients	Percentage
6/36	4	8%
6/60	8	16%
<6/60 – CFCF	17	34%
HM – PL	12	24%
No PL	9	18%
Total	50	100%

All Patients Diagnosed As Indirect Traumatic Optic Neuropathy Were Started On Steroids After Ruling Out Contraindications For The Same. Steroids Were Started In 8(16%) Patients Within A Period Of 12 Hours. In 18(36%) 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, Steroids Could Be Started Between 49 – 72 Hours In 5(10%) And After 72 Hours In 4 (8%).

Table 5:Interval Between Injury And Starting Treatment

Duration	Number Of Patients	Percentage
<12 Hours	8	16%
12-24 Hours	18	36%

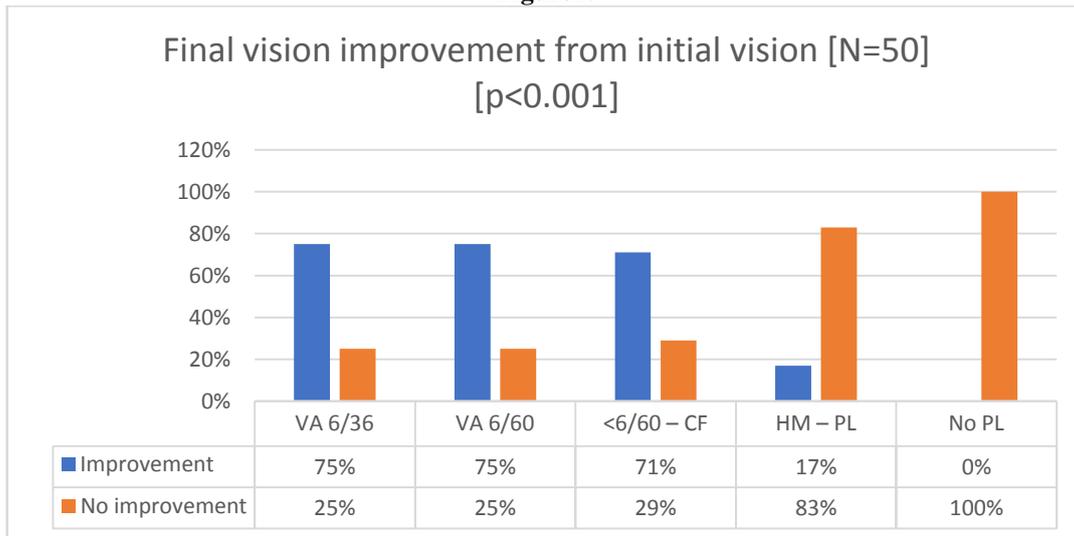
25-48 Hours	15	30%
49-72 Hours	5	10%
>72 Hours	4	8%
Total	50	100%

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 17% Of Patients In This Group. Among Patients With Initial BCVA Of 6/36 And 6/60 There Was Improvement In 75% 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 Less Than 0.001.

Table6: Association Of Final Visual Improvement (At 3 Months Follow Up) With Initial BCVA

Initial Vision	Visual Acuity At Three Months		Total	Percentage
	Improvement	No Improvement		
6/36	3 (75%)	1 (25%)	4	8%
6/60	6 (75%)	2 (25%)	8	16%
<6/60 – CF	12 (71%)	5 (29%)	17	34%
HM – PL	2 (17%)	10 (83%)	12	24%
No PL	0 (0%)	9 (100%)	9	18%
Total	23	27	50	100%

Figure1:



Visual Improvement At 3 Months In All Patients Were Compared With Initial Visual 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 Less Than 6/60. All Patients With Initial BCVA Of 6/36 Who Improved With 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 Who Had Initial BCVA Ranging From HM – PL There Was Visual Improvement In Only Two Patients In Which One Showed Final BCVA Of 6/36 And The Other Patient Showed 6/60.

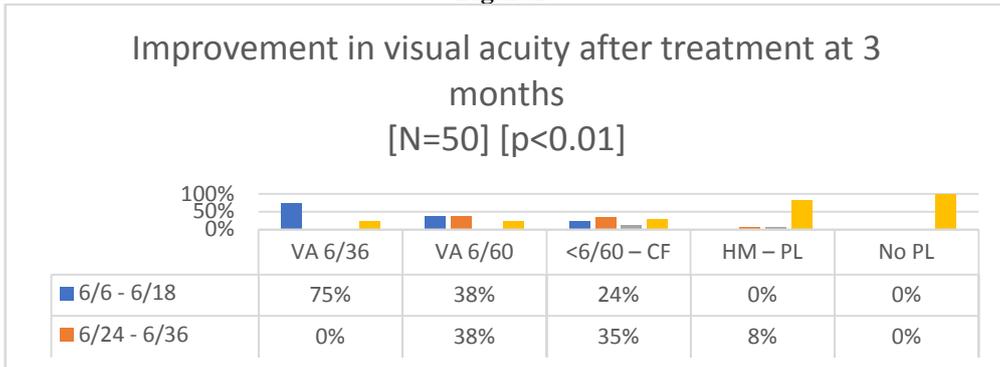
There Was No Visual Improvement In All Patients Without Initial Perception Of Light. The Analysis Showed Very Strong Statistical Correlation Between Baseline Visual Acuity And Final BCVA Achieved At 3 Months With P Value Less Than 0.001.

Table 7: Association Of Final BCVA With Initial Vision

Initial Vision	Visual Acuity At Three Months Follow Up				Total	Percentage
	6/6 – 6/18	6/24 – 6/36	6/60	No Improvement		
VA 6/36	3 (75%)	0	0	1 (25%)	4	8%
VA 6/60	3 (38%)	3 (38%)	0	2 (25%)	8	16%
<6/60 – CF	4 (24%)	6 (35%)	2 (12%)	5 (29%)	17	34%

HM – PL	0	1 (8%)	1 (8%)	10 (83%)	12	24%
No PL	0	0	0	9 (100%)	9	18%
Total	10	10	3	27	50	100%

Figure2:



Patients With Indirect Traumatic Optic Neuropathy Were Treatedwith Full Course Of High Dose Steroids As Per Our Treatment Regimen. PatientsWere Regularly Followed Up And Best Corrected Visual Acuity Was Assessed Regularly. Improvement Of One Line In Snellen’s Chart Wasconsidered As Improvement In Visual Acuity. According To That Criteria23 Patients Showed Improvement In BCVA At 3 Months, Constituting46% Of Study Population. But There Was No Visual Improvement In 27(57%) Of Patients In Spite Of Steroid Treatment.

Table 8:Improvement Of BCVA With Steroid Treatment

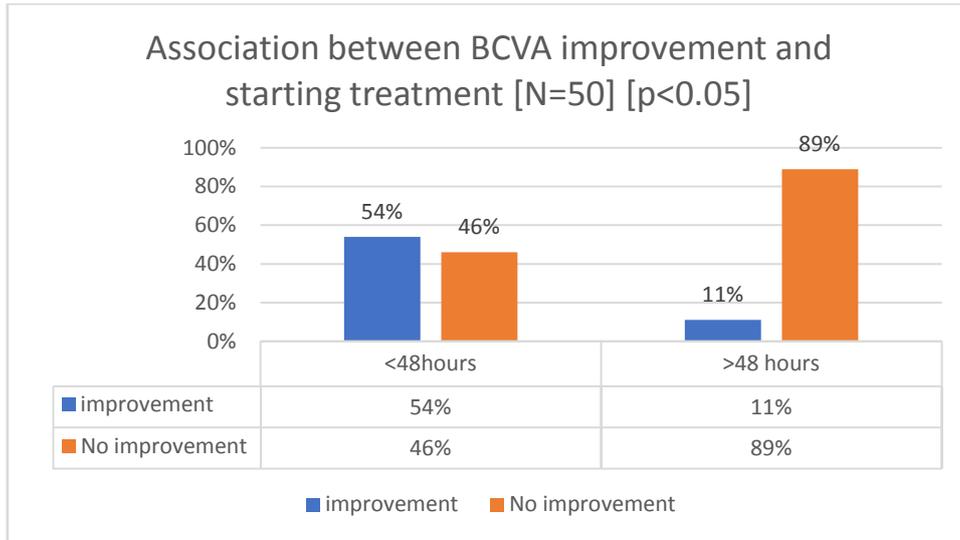
Status	Number Of Patients	Percentage
Improvement	23	46%
No Improvement	27	54%
Total	50	100%

There Was A Strong Statistical Association Between Improvement Of Visual Acuity At 3months 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 48hours, There Was Improvement In 22 Patients Which Account For 54%. But Among The 9 Patients In Whom Steroids Was Started After 48hours There Was Improvement In Only 1 Patient.

Table 9: Association Between Final BCVA Improvement And Duration Of Starting Treatment

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

Figure3:

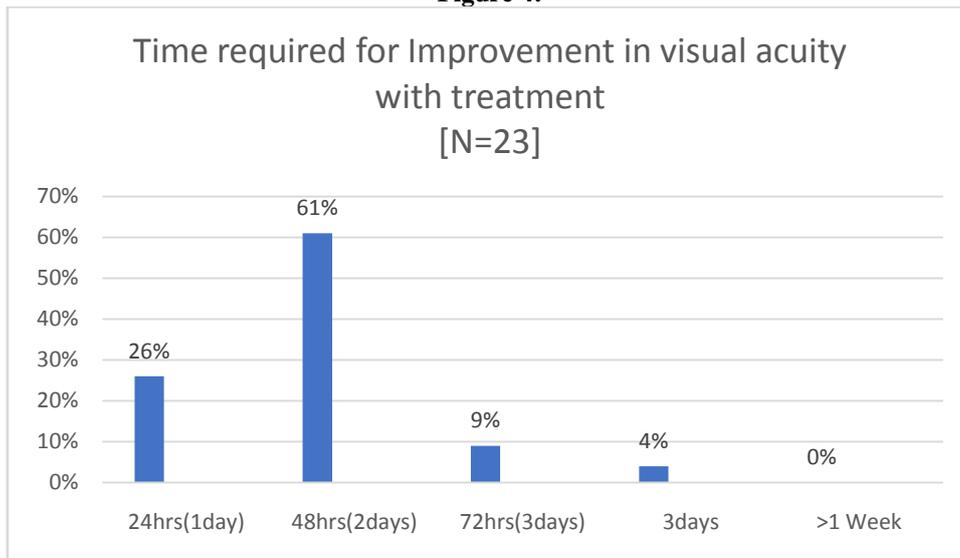


Visual Acuity Improvement Was Assessed Every 24 Hours Following Initiation Of Steroid Treatment In All Patients. Analysis Showed That 6 Among The 23 Patients (26%) Showed Improvement Within First 24 Hours. Majority Of Patients (71%) Among Those With Improved Vision Showed Improvement On The Second Day Of Starting Treatment. Only 2 Patients Showed Improvement On The 3rd Day, While There Was Improvement In Vision In Only One Patient From 3 To 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 More Than 0.05 Which Was Statistically Significant.

Table 10: Time Required For Initial BCVA Improvement After Initiation Of Treatment

Duration	No. Of Patients	Percentage	Cumulative (%)
24hrs(1day)	6	26%	26%
48hrs(2days)	14	61%	87%
72hrs(3days)	2	9%	96%
3days	1	4%	100%
>1 Week	0	0%	0%
Total	23	100%	

Figure 4:



IV. Discussion

Indirect Traumatic Optic Neuropathy Is Due To Closed Head Trauma Which Results In Transmission Of Forces From Forehead To The Optic Nerve In The Optic Canal Or In The Intracranial Portion Of The Optic Nerve. It Causes Severe Visual Morbidity In The Form Of Vision Loss, Field Defects, Colour Vision Defects.

The Diagnosis Of Indirect Traumatic Optic Neuropathy Is Based On The Clinical Finding Of Reduced Visual Acuity With Relative Afferent Pupillary Defect. The Diagnosis Is Mainly Clinical. The Role Of Imaging Is To Rule Out Causes Of Direct Injury To The Optic Nerve Such As Optic Canal Fracture Or Avulsion Of The Optic Nerve.

Treatment Options Of Traumatic Optic Neuropathy Include Conservative Management, Medical Management With High Or Mega Dose Steroids And Surgery. Various Studies Have Shown Variable Results With Different Treatment Options.

A Hospital Based Prospective Study Was Conducted To Analyse The Various Prognostic Factors Affecting The Final Visual Outcome In Patients With Indirect Traumatic Optic Neuropathy. Demographic Profile Showed That All The Patients In Our Study Were Males And The Most Of The Patients Belonged To The Second And Third Decade Of Life. Among The 50 Patients Studied, 78% Belonged To The Age Group Of 20 – 40 Years. Mean Age Of The Patients In Our Study Was 38. This Was Consistent With Other Studies Which Showed A Similar Age And Sex Distribution^{4,5}. There Was A Slight Preponderance In The Involvement Of Right Eye, Which Accounted For 56% Of Cases With No Bilateral Involvement.

The Most Common Cause Of Indirect Traumatic Optic Neuropathy In Our Study Was Motor Vehicle Accidents Which Constituted 92% Of Patients. Among Motor Vehicle Accidents, Two-Wheeler Accidents Were The Most Common Constituting 84%. These Findings Were Consistent With The Studies Done By Matsuzaki Et Al⁶ And Lee Et Al⁵.

Best Corrected Visual Acuity Of All Patients Was Evaluated Following Injury. 76% Of Patients Had BCVA Less Than 6/60 While Only 8% Patients Had BCVA Of 6/36 And 16% Had BCVA Of 6/60. This Observation Was Similar To Other Studies¹.

High Dose Steroid Therapy Was Started In All Patients After Ruling Out Contraindications For The Same. In Conscious Patients, Steroid Therapy Was Started Soon As Possible Following Admission. In 16% Of Patients It Was Started Within 12 Hours. The Delay In Starting Steroid Therapy In Other Patients Was Either Due To Delay In Admission Or Delay In Recovery Of Consciousness. In 8% Of Patients, Steroid Was Started After 72 Hours. All Patients Were Followed Up Daily During The First Week And Periodically Thereafter.

Assessment Of BCVA At 3 Months Showed Visual Improvement In 46% Patients Who Were Started On Steroids. Improvement Of One Line Of Vision In Snellen's Chart Was Considered As Improvement In Visual Acuity. A Study By Fujitami Et Al⁷, Levin Et Al⁸, And International Optic Nerve Trauma Study³ also Showed Improvement In Visual Acuity In 44%, 52% And 52% Patients Respectively.

There Was No Statistically Significant Association Between The Age Of The Patient And Final Improvement In Visual Acuity ($P=0.563$). This Implies That Age Does Not Influence The Final Visual Outcome. This Inference Was Similar To The Study By Wang Et Al⁹.

There Was Found To Be No Statistical Significance Between Loss Of Consciousness Following Injury And Improvement In Visual Acuity. Studies Have Shown That Irrespective Of Level Of Consciousness, Patients Showed Improvement In Vision.

The Timing Of Initiation Of Steroids Following Injury Had An Influence On The Visual Outcome In Patients With Indirect Traumatic Optic Neuropathy. Among The 41 Patients Who Were Started On Steroids Within 48 Hours Of Injury, There Was Improvement In BCVA In 54% Of Them As Against 11% Who Were Started On Steroids After 48 Hours On Injury. The Association Between Time Of Initiation Of Steroids And Final Visual Improvement As Statistically Significant With P Value Less Than 0.05. These Results Were Consistent With Studies Done By Steiff Et Al¹⁰ And Mauriello Et Al¹¹. This Shows The Importance Of Starting Steroids As Soon As Possible And Possibly Within 48 Hours Of Injury.

Among The 23 Patients Who Improved With Steroids, 20 (40%) Of Them Improved Within 48 Hours Of Starting Steroid Treatment. After 48 Hours There Was Improvement In Only 6% And No Patients Showed Improvement After One Week Of Starting Steroids. There Was A Statistically Significant Association Of Poor Visual Improvement After 48 Hours Of Starting Steroid Therapy ($P<0.05$)¹². This Result Suggests That Patients With No Improvement Within 48 Hours Of Starting Treatment Need Not Be Treated With Further Steroids. Surgical Decompression Can Also Be Considered In Patients With Indirect Traumatic Optic Neuropathy Who Do Not Show Improvement With Medical Management Within 48 Hours Of Initiation.

There Was A Strong Statistical Association Between Immediate Amaurosis Following Trauma And Absence Of Final Visual Improvement ($P<0.001$)¹². It Was Also Evident That Patients With Initial Good Vision Had Better Final Visual Recovery Than In Patients With Poor Initial Visual Acuity. The Correlation Of Final Vision Achieved With Initial Visual Acuity Was Highly Statistically Significant ($P<0.001$)⁴. This Result Showed That There Will Be No Improvement In Visual Acuity In Patients With Initial Vision Of No Perception Of Light And The Visual Acuity Improvement Will Be Very Poor In Patients With Initial Vision Of Less Than

Counting Fingers. This Implies That There Is Not Much Use In Treating Patients With Very Poor Initial Vision With High Dose Steroids.

V. Conclusion

Thus It Is Concluded That Indirect Traumatic Optic Neuropathy Has A Better Visual Outcome When Treated With High Dose Systemic Steroid Therapy. Visual Outcome Was Better When The Treatment Was Initiated Within 48 Hours Of Injury. If Response To Treatment Was Not Apparent Within 48 Hours Of Starting Treatment, Improvement Is Unlikely To Occur. An Initial Visual Acuity Of More Than Counting Fingers Was Associated With A Better Visual Prognosis.

References:

- [1]. Walsh FB, Hoyt WF. Clinical Neuro-Ophthalmology. (Ed 3, Vol. 3. Baltimore, Williams &Wilkins, 1969)
- [2]. Wolin MJ, Lavin PJM: Spontaneous Visual Recovery From Traumatic Optic Neuropathy After Blunt Head Injury. Am J Ophthalmol 1990; 109: 430 – 435.
- [3]. Edwards P, Arango M, Balica L, Et Al: Final Results Of MRC CRASH, A Trial Of Intravenous Corticosteroid In Adults With Head Injury Outcomes At 6 Months. Lancet 2005; 365: 1957 – 1959
- [4]. Sundeep, H Niveditha, Nivedhitha Nikhil, B V Vinutha. "Visual Outcome Of Traumatic Optic Neuropathy In Patients Treated With Intravenous Methylprednisolone". Int J Sci Stud; 2(3) 2014;67-70.
- [5]. Lee KF, Muhd Nor NI, Yaakub A, Wan Hitam WH. Traumatic Optic Neuropathy: A Review of 24 Patients. Int J Ophthalmol 3(2)2010: 175-178
- [6]. Matsuzaki H, Kunita M, Kawai K: Optic Nerve Damage In Head Trauma: Clinical And Experimental Studies. Jpn J Ophthalmol Vol: 26, 1982; 447 – 461
- [7]. Fujitami T, Inoue K, Takahashi T, Et Al: Indirect Traumatic Optic Neuropathy –Visual Outcome Of Operative And Nonoperative Cases, Jpn J Ophthalmol Vol:30, 1986;125 – 134
- [8]. Levin, L.A., Beck RW, Joseph MP, Et Al., The Treatment Of Optic Neuropathy: The International Optic Nerve Trauma Study. Ophthalmology, 106(7):1999 P.1268-77.
- [9]. Wang BH, Robertson BC, Giroto JA Et Al: Traumatic Optic Neuropathy: A Review Of 61 Patients. Plast Reconstr Surg 1072001:1655 - 1664
- [10]. Seiff SR. High Dose Corticosteroids For Treatment Of Vision Loss Due To Indirect Injury To The Optic Nerve. Ophthalmic Surg 21 1990:389–395.
- [11]. Mauriello JA, Deluca J, Krieger A Et Al. Management Of Traumatic Optic Neuropathy: A Study Of 23 Patients. Br J Ophthalmol 76; 1992;349–352.
- [12]. Carta A, Ferrigno L, Salvo M, Bianchi-Marzoli S, Boschi A, Carta F. Visual Prognosis After Indirect Traumatic Optic Neuropathy. J. Neural Neurosurg Psychiatry 74; 2003:246-248.