

STUDY OF CHANGES IN RETINAL NERVE FIBRE LAYER THICKNESS BY OCT AND ITS CORRELATION WITH VISUAL FUNCTIONS IN CASES OF OPTIC NEURITIS

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ABSTRACT

Aim: This study was conducted to evaluate & compare changes in retinal nerve fibre layer thickness (RNFL) thickness in cases of optic neuritis and to correlate it with visual function changes in Indian patients.

Methods: This prospective observational study was carried out at a tertiary care facility over the course of September 2020 to August 2022. The written as well as informed consent was taken from all the patients who participated in the present study.

Results: In the present study, there were more females 53.33% as compared to males 46.7%. Majority of the patients 36.66% in 41-50 age group followed by 13.33% in 31-40 age group. 16.66% patients were in 20-30 and 51-60 age groups. The majority of the affected eyes in the current research, or 60% of them, had vision between 6/36 - 6/18.

Conclusion: In the current study, the mean baseline RNFL thickness, gradually reduced from 4 weeks to 3 months. The diffuse depression had reduced post the intervention, none of the participants had diffuse or localised depression at 3 month follow up. The optic disc edema in acute anterior neuritis is confirmed by OCT, which is reflected as a thickening of the RNFL even in subclinical cases. The RNFL thickness is a reliable indicator of neurological and visual impairment. 16.6% affected eyes in the present study had intact colour vision and 83.34% had impaired colour vision.

Keywords: retinal nerve, optic neuritis, OCT

INTRODUCTION

An acute inflammatory disease of the optic nerve is known as optic neuritis (ON). Acute loss of vision, either unilaterally or bilaterally, that is frequently accompanied by periorbital pain is the disease's hallmark.¹ Depending on whichever part of the optic nerve is involved, the disease can be categorised as retrobulbar, affecting the optic nerve head (papillitis), or affecting the nerve head and retinal nerve fibre layer (neuro-retinitis).² Young adults between

the ages of 18 and 45 are commonly affected by optic neuritis, with a mean age of 30 to 50 years seen more in female gender.³ ONTT was the first significant research that shed light on the genesis of MS, its presentation, natural course and role of steroids in the treatment and progression of the disease.⁵ Demyelination of the optic nerve, either from multiple sclerosis or idiopathic, is the most frequent cause of optic neuritis which may be due to infections, autoimmune reactions to para-infectious or para vaccination, autoimmune diseases such as systemic lupus erythematosus and other less frequent conditions. Only one-third of patients report with optic disc oedema; the majority (64.7% in the ONTT) had retrobulbar optic neuritis (normal fundus acutely).⁴ Visual contrast is the greatest functional characteristic to assess lasting dysfunction caused by optic neuritis because while visual acuity, fields, and colour vision returns to normal, visual contrast frequently stays substantially decreased.⁵

All individuals with optic neuritis should undergo magnetic resonance imaging (MRI). MRI is not required to detect optic-neuritis, it is necessary to assess the risk of MS and help direct therapy in this regard.³ Macular evaluation is crucial for ruling out neuro-retinitis.

Optic neuritis can occur in as many as 50% of MS patients, and in 20% of cases, it is the first warning sign of MS.⁶

Many current and future therapies, including steroids and immuno-modulatory therapy aim to decrease the frequency and severity of attacks as well as prevent axonal damage and resultant impairment in both ON and MS. The ONTT was created to help understand if treatment with oral or IV steroids led to better vision or a faster recovery of vision after an acute attack of ON, as well as whether there were any side effects of the medication.⁷

The recovery of vision typically begins during the first month. Within three weeks of the ONTT, 79% of participants had made significant progress, and by five weeks, 93% had. Even while the majority of patients experience satisfactory functional vision recovery,⁵ Visual acuity, contrast sensitivity, colour vision, and visual field tests were performed to assess the visual recovery rate and the long-term visual outcome.⁸⁻¹²

Particularly in patients who developed MS, Optic neuritis can appear as a single episode or as a chronic disorder, affecting either the ipsilateral or contralateral eye. According to the ONTT, 28% and 35% of patients respectively experienced ON recurrences within 5 to 10 years.^{9,13}

Acute typical ON should not be treated with oral steroids alone in usual doses due to the increased risk of ON relapse. Oral steroids at higher dosages have a similar recurrence rate to placebo when compared to lower doses.⁸⁻¹²

This study was conducted to evaluate & compare changes in retinal nerve fibre layer thickness (RNFL) thickness in cases of optic neuritis and to correlate it with visual function changes in Indian patients.

MATERIAL AND METHODS

This prospective observational study was carried out at a tertiary care facility over the course of September 2020 to August 2022. The written as well as informed consent was taken from all the patients who participated in the present study.

Optic Neuritis was diagnosed based on the patient's medical history and clinical examination, which included sudden unilateral or bilateral loss of vision of less than 4 weeks duration. A detailed history of each patient obtained from either the patient or the relative. History of the patient included demographic details including age, sex, area of residence and occupation. History of previous similar episodes in the same or other eye was taken.

INCLUSION CRITERIA-

- All clinically diagnosed cases of Optic Neuritis

EXCLUSION CRITERIA-

- Patients with Glaucoma or other Optic neuropathies and Optic Atrophies
- Patients with hazy media like Cataract, Corneal opacity, vitreous haemorrhage preventing Perimetry, OCT and fundus evaluation
- Patients with vision less than 1/60 preventing OCT and Perimetry

Complete ophthalmic examination was done

- Snellen's Visual Acuity Assessment.
- Pupillary Reflex Assessment to detect presence of Relative Pupillary Pathway Defect.
- Extra-ocular Movements in all cardinal gazes to detect presence of pain in or around the eye.
- Colour Vision Test to detect Dyschromatopsia using Ishihara pseudo chromatic Charts / Plates.
- Slit Lamp Bio microscopy for Anterior Segment Examination.
- Slit Lamp Bio microscopy with +90D and +78D for Optic Nerve Head evaluation to rule out presence or absence of Optic Disc Oedema.
- Intra ocular pressure is measured with Goldmann applanation tonometer.

After clinical diagnosis was made based on history and clinical ophthalmic examination, additional investigations were done to support the diagnosis.

- Visual Fields were recorded using Automated perimetry
- Optical Coherence Tomography (OCT) to understand the Retinal Nerve Fibre Layer (RNFL) thickness status in Optic Neuritis to quantify the axonal loss after an attack of optic neuritis
- Visual Evoked Potential.
- Magnetic Resonance Imaging (MRI) of Brain and Orbit Study (T1 with Gadolinium Contrast + Fat Suppression).

Following diseases were ruled out

1. Ischemic Optic Neuropathy.
2. Para infectious cause of Optic Neuritis.
3. Post Vaccination cause of Optic Neuritis (Rabies Vaccine).
4. Patients on medications or substance abuse proven to cause toxic optic neuropathy (Tobacco consumption, Ethambutol, Amphotericin)
5. Patients with Nutritional Deficiency Optic Neuropathy (B12 deficiency).
6. Patients with Traumatic Optic Neuropathy.

All patients received steroids according to ONTT. Following which visual acuity, colour vision, fields were tested and fundus examination was done using +90 D and pupillary assessment was done at 4 weeks, 6 weeks and 3 months. OCT was done on all patients at the end of 4 weeks, 6 weeks and 3 months.

The thickness of the retinal nerve fibre layer was assessed, and the results were compared with visual outcomes and functions.

RESULTS

Table 1: Demographic details

Gender	Frequency	Percent
Male	14	46.7
Female	16	53.3
Age in years		
20-30	03	10
31-40	04	13.33
41-50	11	36.66
51-60	02	6.66

In the present study, there were more females 53.33% as compared to males 46.7%. Majority of the patients 36.66% in 41-50 age group followed by 13.33% in 31-40 age group. 16.66% patients were in 20-30 and 51-60 age groups.

Table 2: Visual Acuity and Colour Vision after Treatment

Visual acuity	4 weeks	6 weeks	3 months
<6/60	5 (16.7%)	3 (10%)	1 (3.3%)
6/36-6/18	20 (66.7%)	22 (73.3%)	12 (40%)
>6/12	5 (16.7%)	5 (16.7%)	17 (56.7%)
Colour vision			
Intact	15(53.33%)	17 (56.6%)	26 (86.7%)
Impaired	15 (53.33%)	13 (16.7%)	4 (13.3%)

The improvement in colour vision occurred in higher number of people between 4th and 6th week follow up than the 6th week and 3rd month follow up. The proportion of people with impaired colour vision gradually decreased from 4th week to 12th week follow up period.

Table 3: Visual acuity vs RNFL thickness at 4 weeks, 6 weeks and 3 months

Mean Thickness of RNFL at 4 weeks	Visual acuity	Number patients	of	Percentage
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145.5	<6/60	5	16.7
129.7	6/36-6/18	20	66.7
130.8	>6/12	5	16.7
Mean Thickness of RNFL at 6 weeks			
125.8	<6/60	3	10.0
121.4	6/36-6/18	22	73.3
120.9	>6/12	5	16.7
Mean Thickness of RNFL at 3 months			
111.3	<6/60	1	3.3
105.5	6/36-6/18	12	40.0
103.7	>6/12	17	56.7

In the current study, the mean baseline RNFL thickness with respect to visual acuity gradually reduced from 4 weeks to 3 months.

Table 4: Colour vision vs RNFL thickness at 4 weeks, 6 weeks and 3 months

Mean Thickness of RNFL at 4 weeks	Colour vision	Number of patients	Percentage
130.4	Intact	15	(53.33%)
137.4	Impaired	15	(53.33%)
Mean Thickness of RNFL at 6 weeks			
121.1	Intact	17	(56.6%)

125	Impaired	13	(16.7%)
Mean Thickness of RNFL at 3 months			
106.5	Intact	26	86.7
92.6	Impaired	4	13.3

In the current study, the mean baseline RNFL thickness with respect to colour vision gradually reduced from 4 weeks to 3 months.

Table 5: Fundus Examination vs RNFL thickness at 4 weeks

Mean Thickness of RNFL at 4 weeks	Fundus Examination	Number of patients	Percentage
117.6	normal	5	16.7
136.4	disc margins blurred	22	73.3
128.3	hyperaemic disc	3	10.0
Mean Thickness of RNFL at 6 weeks			
117.9	normal	15	50.0
127.4	disc margins blurred	13	43.3
116.5	hyperaemic disc	1	3.3
111	Pale disc	1	3.3
Mean Thickness of RNFL at 3 months			
106.8	normal	26	(86.7%)
94	Pale disc	4	(13.3%)

The mean baseline RNFL thickness with respect to fundus gradually reduced from 4 weeks to 3 months.

Table 6: Automated Perimetry vs RNFL thickness at 4 weeks, 6 weeks and 6 months

Mean Thickness of RNFL at 4 weeks	Automated Perimetry	Number of patients	Percentage
132.9	Central Scotoma	18	60.0
146	Centro caecal scotoma	1	3.3
140.2	diffuse depression	5	16.7
128	Localized Depression	2	6.7
117	Partial arcuate	1	3.3
121	Peripheral Depression	3	10.0
Mean Thickness of RNFL at 6 weeks			
121.8	Central Scotoma	19	63.3
138.5	diffuse depression	1	3.3
122.3	Localized Depression	3	10.0
127.6	Peripheral Depression	2	6.7
115.6	WNL	5	16.7
Mean Thickness of RNFL at 3 months			
110.1	Central Scotoma	10	33.3
101.9	WNL	20	66.7

The mean baseline RNFL thickness with respect to automated perimetry gradually reduced from 4 weeks to 3 months.

DISCUSSION

The study was done on a sample of 60 eyes of which 30 eyes had optic neuritis and the other 30 eyes were normal. Regarding fellow eye, in the current study all 30 unaffected eyes had a visual acuity > 6/12. In the current study, majority, i.e. 60% of affected eyes had a visual acuity between 6/36 – 6/18. In the study to evaluate clinical profile of optic neuritis¹⁵ majority of about 28.8% had a visual acuity of about 6/12-6/60. Reduction in visual acuity is also one of the early clinical manifestation of optic neuritis. In the current study, following the treatment at 4 weeks and 6 weeks majority had a visual acuity of 6/36-6/18. At the end of 3 months, majority showed improvement in visual acuity and 56.7% had a visual acuity greater than 6/12. In accordance with the current findings, the study by Kupersmith MJ, et al.,¹⁶ also showed that the visual acuity improved from baseline during 1 month follow up in those with optic neuritis.

Clinical examination of baseline pupillary reaction showed that majority of optic neuritis patients (56.7%) Grade 1 RAPD, followed by 26.7% with Grade 2 RAPD. Yoo YJ, et al.,¹⁷ reported that RAPD was significantly correlated with optic neuritis. Yoo YJ, et al.,¹⁷ also reported that among optic neuritis patients, the abnormal pupillary constriction was significantly associated with other factors such as visual acuity, color vision and visual field defects. But however, this pupillary constriction delay was not associated with RNFL thickness. The reason for majority of the people having pupillary delay was postulated to be due to the conduction delay that is prominent in optic neuritis as the disease causes optic neuropathy.

In the current study baseline fundus examination revealed that majority 83.3% had blurred disc margins and 6.7% had hyperaemic disc. The optic neuritis study group⁽⁵¹⁾ reported that 35.3% of the patients had swollen disc. In the study to evaluate clinical profile of optic neuritis.¹⁸ 64.7% had normal optic disc on fundal examination whereas the current study had only 10% with normal fundus at baseline. In the current study only 10% had disc hyperaemia at 4weeks post intervention. But, in the study by Kim MK, et al.,¹⁹ hyperaemia of any grade was present in about 70% of the optic neuritis patients. In the current study blurring of disc margin was seen in 73% in the first follow up and decreased gradually thereafter.

In the current study, visual acuity following ONTT improved in the 4th week follow up post intervention and the proportion of people with better vision increased at 3 months post intervention. The optic neuritis treatment trial study reported that visual recovery begins within 2– 3 weeks, is maximal by 4–6 weeks, and continues for up to 1 year after ON.²⁰

The perimetry was not done at baseline in the current study, and during the follow up it was seen that the diffuse depression reduced from 16.7% in 4 weeks to 3.3.% in 6 weeks. In the study by Optic neuritis study group(2) among patients who had vision of hand movement perception or better 44.8% of the field defects were classified as diffuse and 55.2% as local. Kim MK, et al.,¹⁹ also reported that diffuse swelling of disc was present in about a similar proportion of about 70% of optic neuritis patients. In the current study, on perimetry at 3 months post the intervention, none of the participants had diffuse or localised depression. In accordance with the current findings, the study by Kupersmith MJ, et al.,¹⁶ also showed that the automated perimetry findings improved from the baseline during the 1 month follow up. In the current study perimetry showed that there was improvement in the follow up period after ONTT.

Similarly in the study by Keltner JL, et al.,²¹ also reported that a significant proportion of eyes with defects on perimetry at baseline had reduced at the baseline follow up at 1 month.

The mean RNFL thickness was higher among those with better visual acuity and decreased as acuity improved in all the point of time during the follow up. Hanson JVM, et al.,²² reported that retinal nerve fibre thickness was correlated with visual acuity.

On comparing RNFL thickness with automated perimetry findings, it was seen that RNFL thickness was consistently thicker in those with scotoma or diffuse depression at 4th week, 6th week and 3rd month follow up after the intervention. Hanson JVM, et al.,²² reported that retinal nerve fibre thickness was correlated with visual field as well. The RNFL thickness was least in those having perimetry findings within normal limits. It was also seen that on perimetry the proportion of people with peripheral or localised depression and partial arcuate lesions reduced on follow up and almost none had these lesions after 3 months of follow up.

The RNFL thickness was lower in those with normal disc and pale disc at 4th week, 6th week and 3rd month post intervention follow up. The proportion of people with hyperaemic disc and blurred disc margin decreased gradually with time and at the end of 3rd month all the participants either had pale or normal disc.

CONCLUSION

The majority of the affected eyes in the current research, or 60% of them, had vision between 6/36 - 6/18. Visual acuity following ONTT improved in the 4th week follow up & get increased at 3 months post intervention. The proportion of people with impaired color vision gradually decreased from 4th week to 12th week follow up period. The improvement in color vision occurred in higher number of people between 4th and 6th week follow up than the 6th week and 3rd month follow up. In the current study, the mean baseline RNFL thickness, gradually reduced from 4 weeks to 3 months. The diffuse depression had reduced post the intervention, none of the participants had diffuse or localised depression at 3 month follow up. The optic disc edema in acute anterior neuritis is confirmed by OCT, which is reflected as a thickening of the RNFL even in subclinical cases. The RNFL thickness is a reliable indicator of neurological and visual impairment.

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