

## **The Study of Visual Functions in the Normal Eye of Patients with Unilateral Optic Neuritis.**

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### **Abstract :**

**Background:** Comprehensive data on fellow eyes in unilateral optic neuritis is lacking. Aims: Evaluation of visual function of fellow eyes of patients with unilateral optic neuritis and response to treatment. Material and **Methods:** This was a retrospective study which included 20 patients with unilateral optic neuritis from a database of 34 patients of acute optic neuritis (bilateral or unilateral). All patients had assessment of visual acuity, contrast sensitivity, color vision, visual fields, visual evoked potentials (VEP) at presentation in affected and asymptomatic eyes. Patients were followed up at 1 month, 3 months and 6 months after treatment with corticosteroids (IV Methylprednisolone followed by oral prednisone in rapid tapering doses), and then visual tests were repeated. Data was expressed as mean (95% confidence limit) and; analyzed by Mann-Whitney U test and paired t-test as appropriate. The probability level of <0.05 was set for statistical significance.

**Result:** Most of the apparently normal asymptomatic fellow eyes at baseline had abnormal visual parameters [visual fields (90%), visual acuity (70%), contrast sensitivity (10%), color vision tests (10%) and VEP (40%)]. Mean values ( $\pm$ standard deviation) of visual parameters were reduced [visual acuity, 0.31 ( $\pm$ 0.280) logmar values; contrast sensitivity, 1.36 ( $\pm$ 0.26) log units and visual fields, mean deviation -10.03 ( $\pm$ -7.39) dB respectively]. Most common field defect in fellow eye was peripheral scotoma, in contrast to affected eyes in which diffuse scotoma were predominant. None of the patient had dyschromatopsia. After IV Methylprednisolone, all visual parameters showed recovery which was maximum at 1 month, however only visual acuity showed a near significant trend ( $p=0.07$ ).

**Conclusion:** Patients with 'unilateral' optic neuritis have subtle bilateral affliction, detailed evaluation of fellow eye is warranted in all cases.

**Keywords-** optic neuritis, unilateral, fellow eyes, Methylprednisolone

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### **I. Introduction**

Unilateral & bilateral optic neuritis has been extensively studied and described by several authors in the past and recent times; however despite extensive literature search we could not find comprehensive data on fellow eyes in unilateral optic neuritis [1-4]. Only in Optic Neuritis Treatment Trial (ONTT) authors purposely tried to evaluate the visual function in fellow eyes of unilateral acute optic neuritis eyes [5]. Now there is some evidence to suggest that so called asymptomatic normal fellow eyes also demonstrate abnormal visual parameters. We have tried to study fellow eye abnormalities and response to standard treatment in some detail.

### **II. Methods**

This retrospective study included patients from a data base of 34 case of acute optic neuritis (bilateral, 14 cases; unilateral, 20 cases) evaluated and followed up for 6 months after intravenous (IV) Methylprednisolone in an ophthalmology unit of a tertiary care referral hospital in Jaipur city of north India. Data of fellow eyes of 20 patients of acute unilateral optic neuritis was analyzed. Informed consent was obtained from each subject before their inclusion in the study. The study was conducted in accordance with the guidelines lay down by ICMR (2006) and Helsinki declarations (2013).

The diagnosis of optic neuritis was based on clinical symptoms and signs, fundus examination and contrast magnetic resonance imaging of optic nerve whenever feasible [6]. Patients who had symptomatic fellow eyes, previous history of optic neuritis, multiple sclerosis, previous treatment, patients with preexisting ocular abnormalities and other causes of optic neuropathies were excluded.

Each of affected and fellow eyes were tested for visual acuity (Snellen's chart), contrast sensitivity (Pelli-Robson's chart), visual field defects (Humphrey field analyzer), color vision (Ishihara pseudo-isochromatic plates) and pattern stimulated VEP (60" check size). For statistical analysis, the visual acuity score was converted to logmar units. Visual acuity was considered to be abnormal if the logmar value was greater than 0 (equivalent to 6/6). For contrast sensitivity, scores less than 1.75 log units were considered abnormal. Visual fields values of mean deviation less than -3.00 dB were considered abnormal. Color vision was considered to be abnormal when patient was not able to identify 1 or more Ishihara plates correctly. IV Methylprednisolone was given as per protocol (IV Methylprednisolone 1 gram infusion for 3 days, followed by oral prednisone 1

mg/kg/day for 11 days followed by rapid 3 day tapering ) and fellow eyes were followed at 1 month, 3 months and 6 months, all visual tests were then repeated.

Data was expressed as mean (95% confidence interval). For continuous variables, a Mann–Whitney U test for unpaired data was used. Paired data was analyzed by paired t-test. The probability level of  $< 0.05$  was set for statistical significance. SPSS 10 (SPSS Inc, Chicago, IL) was used for statistical computations.

### **III. Results**

This retrospective study enrolled 20 patients from a database of 34 acute unilateral or bilateral optic neuritis patients who were admitted under ophthalmology services of a tertiary care center in Jaipur, India and then were followed for six months. The clinical and demographic characteristics of patients enrolled in the study are shown in Table 1. The age of the patients ranged from 8 years to 67 years. The mean ( $\pm$ standard deviation [SD]) age of the patients was 32.94 ( $\pm$ 11.45) years. There was a predominance of male patients (60%). Of the 20 patients, 50% had papillitis, 30% had retrobulbar neuritis and 20% patients had neuroretinitis. Etiology was unknown in majority of patients (65%). Sinusitis was found in 30%, maxillary and ethmoid sinuses were commonly involved. Left eye was affected approximately more than twice as common as right eye (14 versus 6). All the patients of unilateral optic neuritis at presentation reported loss of vision in the affected eye. Pain in and around the eye and headache was also seen in high number of patients (80%). None of the patient had any fellow eye complaint.

When visual parameters were analyzed, visual fields were abnormal in most of the fellow eyes (90%). Visual acuity was also unexpectedly abnormal in 70% of apparently normal asymptomatic eyes. Contrast sensitivity and color vision tests were abnormal in only 10 % eyes. VEP was abnormal in 40% of unaffected eyes. Mean ( $\pm$ SD) values of visual parameters were found to be 0.31 ( $\pm$ 0.2807) in visual acuity (logmar values), 1.36 ( $\pm$ 0.26) in contrast sensitivity (log units) and -10.03 ( $\pm$ 7.39) in visual fields (mean deviation-dB) respectively. These abnormalities were significantly milder when compared to abnormalities in affected eyes [visual acuity, 2.3708 ( $\pm$ 1.001) logmar values; contrast sensitivity, 0.25 (0.4998) log units; visual fields, -26.39 (10.64) mean deviation-dB;  $p < 0.05$ ] (Table 2).

Among eyes having decreased visual acuity (14 eyes), maximum (10 eyes) had mild vision loss (6/18 to  $< 6/6$ ); none had severe vision loss ( $< 6/60$ ). In eyes having moderate (6/60 to  $< 6/18$ ) visual loss all the visual parameters were abnormal. In eyes having normal vision and mild visual loss (6/18 to  $< 6/6$ ) visual field testing was able to test abnormality when contrast sensitivity and color vision tests were normal (Table 3).

After administration of high dose IV steroid therapy, there was near significant trend in visual acuity improvement [0.180 ( $\pm$ 0.289) logmar value] over one month ( $P = 0.077$ ). Thereafter no change in mean visual acuity was noted. There was no significant change in values of contrast sensitivity and visual field testing. Abnormal patterns of field defects were also observed at baseline, during follow up and after treatment. At baseline peripheral rim scotoma was the commonest (40%) followed by central (20%) and multiple foci pattern (20%) and but a 6 months no preponderance was seen. In contrast to affected eyes where diffuse pattern (79.16%) was the commonest, none of the fellow eye had this pattern.

At six months visual acuity remained abnormal in (40%) of all fellow eyes. At study entry only 10% of fellow eyes had normal visual fields. At 3 months, over all 60% eyes had normal visual fields but on further follow up, no additional eye improved to have a normal visual field. Two eyes which had abnormal contrast sensitivity at baseline remained abnormal, after 6 months of treatment. After 6 months visual acuity became normal in those 42.8% eyes, which had reduced vision at baseline. Overall abnormal visual fields became normal in 66.6% eyes and 2 eyes which had abnormal color vision became normal at 6 months (table 5). Visual fields testing was again able to detect abnormal fellow eye in patients with normal or near normal vision when other test (contrast sensitivity and color vision testing) failed to do so (table 6).

### **IV. Discussion**

This retrospective study has demonstrated that fellow eyes in cases of so called unilateral acute optic neuritis do not escape from inflammatory process; there is nothing normal about them. Most of the visual parameters are abnormal in fellow eyes and these tend to persist even after treatment with IV Methylprednisolone.

Beck et al (1984), Sanders et al (1986) have reported long back that asymptomatic visual dysfunction may be detected in the fellow eyes of a patient with acute unilateral optic neuritis [1,2]. In ONTT, abnormal visual acuity was seen in 13.8% and abnormal color vision (Ishihara plates) in 20.1% of fellow eyes. Visual field involvement was seen in maximum number of fellow eyes (68.3%). Authors also demonstrated that when abnormalities were present in fellow eyes, these were mild [5]. In a study of 26 patients of optic neuritis (19 unilateral and 7 bilateral) in India by Sethi et al, abnormal visual fields and contrast sensitivity abnormalities were seen in more than 50 % of fellow eyes of unilateral optic neuritis. Abnormal color vision and abnormal visual acuity was seen in 26.3% and 15.78% fellow eyes respectively [3]. These studies have suggested that

fellow eyes in large number of patients of optic neuritis have subclinical involvement in all visual parameters, mostly in visual fields. We have observed similar facts, but in our study visual acuity was abnormal in more number of eyes, although severity was less. It suggested that most of our patients were not aware of the mild vision loss in fellow eyes, being more concerned with the severe vision loss in affected eyes. Testing for visual field was more rewarding in detecting the subclinical abnormality in fellow eyes as it was abnormal in the eyes having normal or near normal vision when other tests failed to do so. The pattern of field defect is different than what we see in affected eyes. As in our study, in ONTT also diffuse pattern was seen in less number of fellow eyes (18.8% of total eyes) and among localized defects peripheral rim was commonest (22.5%) [5].

Recently Saxena R et al. in a study of 99 eyes of 83 patients of optic neuritis (67 unilateral) followed for 3 years demonstrated that among fellow eyes of unilateral cases only 19.4% had decreased contrast sensitivity; there was no defect in visual field and color vision; and there was no comment on visual acuity. Since the authors have used Goldman visual fields, the subtle changes that could have been picked up on Humphrey visual fields may have been missed in their study [4].

We showed that with treatment, all the abnormal visual parameters tend to improve; however near significant trend of improvement was observed only in visual acuity. Maximum improvement in acuity was seen at one month; thereafter no further improvement was noted. Non-significant improvement in field defect though, was sustained through 6 months. Reduced visual acuity and visual field defects were the commonest abnormalities to persist at 6 months (seen in 40% fellow eyes each). Visual field testing again detected subclinical abnormality in apparently unaffected eyes (having visual acuity of 6/18 or better) at 6 months of follow up.

Sethi et al. demonstrated significant reduction in fellow eye's visual abnormalities at 6 months along with simultaneous improvement of various visual functions of affected eyes after treatment with IV Dexamethasone [3]. Saxena et al. also showed that contrast sensitivity in fellow eyes of unilateral acute optic neuritis improved after treatment with IV Dexamethasone; mean contrast sensitivity improved from 1.2±0.2 to 1.6±0.1 [4]. However Sethi et al. reported persistently abnormal visual parameters (visual acuity in 10.5%, contrast sensitivity in 26.3%, visual field defect in 21% and color vision in 10.5% of fellow eyes) at 3 months of follow up[3]. In a study by Sanders et al. also; reduced contrast sensitivity was seen in 27%, visual field defects in 5% and abnormal color vision in 14% of unaffected eyes after 6 months of treatment of optic neuritis [2]. As evident from these studies, abnormalities in all visual parameters improve, but even after treatment they persist in fellow eyes.

At six months visual acuity became normal in 43% of fellow eyes having reduced vision at baseline. Visual field defects recovered mostly and became normal in 66.6% eyes having abnormal fields at baseline. In ONTT also maximum recovery occurred in visual fields (72.8% fellow eyes). Visual acuity recovered in 61.4% eyes, which had decreased vision at baseline [5]. Sethi et al. noted that at 6 months recovery occurred in 40% of fellow eyes having reduced visual acuity at base line, which is comparable to our study [3].

In detection of subclinical abnormality in fellow eye, VEP was also found to be useful; in our study 40% eyes had abnormal VEP at baseline. Sethi et al showed that pattern VEP was abnormal in 63.16% unaffected eyes; it improved with treatment, yet at 3 months follow up 31.58% eyes had abnormal VEP [3].

Despite its merits, this study has few limitations. This was a retrospective study and the sample size was small, it probably reflected in insignificant improvement in visual parameters after treatment with steroids. The patients were followed for six months; a further follow up could have shown significant improvement in visual parameters. A prospective study with long term follow up with adequate sample size is warranted if we want to study the natural history of fellow eye abnormalities in acute unilateral optic neuritis and recurrence. Colour vision testing was done with Ishihara test, which is not as sensitive as FM 100-hue test; neither it could quantitate color vision loss. Furthermore VEP was not studied at 6 months. Hence effectiveness of these parameters in depicting improvement in fellow eyes after treatment could not be studied in detail.

### Tables

**Table 1:** Clinical and demographic characteristics of patients with unilateral acute optic neuritis (n=20)

Parameters	No. (%) / Mean (±SD)
Age ( in yrs)	32.94 (±11.45)
Sex (male: female)	3:2
Etiology	
Idiopathic	13 (65)
Sinusitis	06 (30)
Syphilis	01 (05)
Types	
Papillitis	10 (50)
Retrobulbar Neuritis	06 (30)
Neuroretinitis	04 (20)
Abnormal findings	

Decreased Visual acuity	14 (70)
Abnormal Color vision	02 (10)
Abnormal Contrast sensitivity	02 (10)
Visual field changes	18 (90)
Visual evoked potentials	08 (40)

Data are expressed as mean ± standard deviation (95% confidence interval), ratio or numbers (%)

**Table 2:** Visual parameters of affected eyes and fellow eyes in unilateral acute optic neuritis patients at baseline.

Visual parameters	Affected eyes (n=20)		Fellow eyes (n=20)	
	Mean±SD	Abnormal parameters (%)	Mean±SD	Abnormal parameters (%)
Visual acuity (logmar units)	02.370 ±01.001	20 (100)	00.310 ±00.280	14 (70)
Contrast sensitivity (log units)	00.250 ±00.499	18 (90)	01.365 ±00.259	02 (10)
Visual field (dB)	26.390 ±10.640	20 (100)	10.027 ±07.396	18 (90)
Color vision	-	18 (90)	-	02 (10)

Data are expressed as mean ± standard deviation (95% confidence interval), ratio or numbers (%)

**Table 3:** Abnormal results on contrast sensitivity, visual fields and color vision testing by visual acuity level in fellow eyes at base line (n=20)

Visual acuity	No. of fellow eyes (%)	Contrast Sensitivity (%)	Visual fields (%)	Color vision Testing (%)
PL -	00 (00)	00 (00)	00 (00)	00 (00)
PL +	00 (00)	00 (00)	00 (00)	00 (00)
HM to < 6/60	00 (00)	00 (00)	00 (00)	00 (00)
6/60 to < 6/18	04 (20)	02 (10)	02 (10)	02 (10)
6/18 to < 6/6	10 (50)	00 (00)	08 (40)	00 (00)
6/6 or better	06(30)	00 (00)	08 (40)	00 (00)
Total	20 (100)	02 (10)	18 (90)	02(10)

Data are expressed in numbers (%). Visual acuity checked on Snellen's chart. PL-, perception of light absent; PL+, perception of light present; HM, hand movement.

**Table 4:** Trends in visual parameters before and after treatment of fellow eyes (n=20)

Visual parameters	BASELINE	1 <sup>st</sup> week	1 <sup>ST</sup> Month	3 <sup>rd</sup> Month	6 <sup>th</sup> Month	p value
Visual acuity in logmar units (±SD)	00.310 (0.2807)	00.220 (0.274)	00.180 (0.289)	00.180 (0.289)	00.180 (0.289)	0.077
Contrast sensitivity in log units (±SD)	01.365 (0.259)	01.365 (0.259)	01.425 (0.276)	01.425 (0.276)	01.425 (0.276)	0.104
Visual field in dB (±SD)	-10.030 (7.396)	-	-07.939 (6.186)	-06.496 (6.614)	-06.184 (6.709)	0.101

Data are expressed as mean (standard deviation, 95% confidence limit). Standard deviation, SD; Mean deviation, dB

**Table 5:** Changes in visual parameters in fellow eyes from baseline to six months (n=20)

	Visual acuity	Contrast sensitivity	Visual fields	Color vision
No of abnormal eyes at baseline (%)	14 (70)	02 (10)	18 (90)	02 (10)
Eyes becoming normal at 6 month (%)	06 (42.8)	00 (00)	12 (66.6)	02 (100)

Data are expressed in numbers (%).

**Table 6:** Abnormal results of contrast sensitivity, visual fields and color vision testing, by visual acuity level in fellow eyes at six months (n= 20)

Visual acuity	No. of affected eyes (%)	Contrast Sensitivity (%)	Visual fields, (%)	Color vision Testing (%)
PL -	00 (00)	00 (00)	00 (00)	00 (00)
PL +	00 (00)	00 (00)	00 (00)	00 (00)
HM to < 6/60	00 (00)	00 (00)	00 (00)	00 (00)
6/60 to < 6/18	04 (20)	02 (10)	04 (20)	00 (00)
6/18 to < 6/6	04 (20)	00 (00)	02 (10)	00 (00)
6/6 or better	12 (60)	00 (00)	02 (10)	00 (00)

Total	20	01 (10)	04 (40)	00 (00)
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Data are expressed in numbers (%). Visual acuity checked on Snellen's chart. PL-, perception of light absent; PL+, perception of light present; HM, hand movement.

## V. Conclusion

Mild visual loss was seen in most of the fellow eyes. Visual field testing detected subclinical optic nerve dysfunction in most of so called normal fellow eyes even when other parameters were normal. Good recovery was seen in fellow eyes after treatment; some abnormalities persisted but were mild. Visual field testing again detected residual optic nerve dysfunction in apparently normal fellow eyes after completion of follow up. Therefore detailed and careful ophthalmologic examination and various visual function tests are indispensable and can detect evidence of optic nerve dysfunction even in asymptomatic eyes as we have seen above.

## References

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