



## Assessment of Visual Acuity and Contrast Sensitivity in Optic Neuritis

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### Abstract

**Background:** Optic neuritis is the inflammation of the optic nerve. It can be associated with causes such as auto-immune disorders, infectious and inflammatory conditions. The aim of this study was to evaluate contrast sensitivity and visual acuity changes in patients diagnosed with optic neuritis, and to find out which type is the most prevalent among optic neuritis.

**Purpose:** The purpose of this study is to assess changes in many areas of visual function in individuals with optic neuritis before and after medical treatment, including visual acuity, contrast sensitivity, color vision

**Methodology:** Patients meeting eligibility criteria were selected in this research which was done in various public sector hospitals. A self-designed proforma was used to collect data from the patients that includes history, examination of visual acuity and contrast sensitivity. Patient's visual acuity was assessed with Snellen log Mar chart and contrast sensitivity using Pelli-Robson chart. After assessment data was collected and data analysis was done with IBM SPSS version 25.0 software.

**Results:** It is found that the males accounted for 12 of the total sample of 32, while females accounted for 20 in a hospital based, cross-sectional study. The ages ranged from 15-45 years. VA of both eyes was categorized as mild (<0.20), moderate (0.30-0.60), severe (0.70-1.00) and it was found that 46.9% had VA severe in left eye than right eye (21.9%). Contrast sensitivity was also presented in terms of categories of mild ( $\geq 2$  log unit), moderate (<1.50 log unit), severe (<1.0 log unit). Contrast sensitivity in left eye suffered from severity (62.5%) than right eye (53.1%). The most prevalent type of optic neuritis found in our study was retro-bulbar neuritis 43.8% other were papillitis (34.4%) and neuro-retinitis (21.9%).

**Conclusion:** Thus, from the present study, it is concluded that There is reduction in contrast sensitivity and visual acuity due to optic neuritis.

**Keywords:** Contrast Sensitivity; Optic Neuritis; Visual Acuity

### Introduction

Vision is the formation of images by the eye when the light rays are focused by the lens on the retina, inverted images are formed

on the retina, so these images are converted into nerve impulses that are transmitted to the brain where the images are interpreted and become erect. In a normal eye, light enters through cornea

and then passes to the pupil. The amount of light reaching the eye is regulated by the iris then it strikes the transparent lens which has an ability of focusing light on to the retina [1].

Visual acuity is the capability of the eye to discern forms and details at a peculiar distance. One eye at a time is examined [2].

In optic neuritis, visual acuity can range from 0 to 1.5 in two-thirds of patients. The patient's VA usually restore. About 60% of patients had their vision restored after two months; only 6% of patients in the Optic Neuritis Treatment Trial (ONTT) had acuity of less than 0.5 six months after onset. Color perception, contrast sensitivity CS, and VFs all improved [3].

Contrast sensitivity is a type of test that is so valuable for the examination and that allows to discern numerous visual dysfunctions earlier after onset and obtain a complete picture of patient's vision quality. The ability to distinguish low-contrast objects may be impaired in certain disorders, but the ability to recognize high-contrast objects may be unaffected [4].

Optic neuritis, a common inflammatory condition affecting the optic nerve, is frequently linked to demyelinating illnesses. It is now becoming more common. It can develop because of autoimmune, infectious, or inflammatory diseases. Women between the ages of 15-45 are more likely to develop optic neuritis. The most common symptom is a sudden loss of eyesight, which gets worse during the first week and then gradually improves. According to several research, there is no link between initial visual acuity or treatment and lasting visual function impairments [5].

Optic neuritis produces significant visual impairment and may result in long-term visual abnormalities, as well as serving as an essential prognostic indication for the progression of demyelinating illnesses like multiple sclerosis. Fortunately, optic neuritis usually heals on its own or with therapy usually. Recovery can be partial or complete, depending on the severity of the disease and any co-existing conditions. Most individuals with optic neuritis (>85%) will have a final visual acuity of 20/25 or greater in the affected eye, with less than 1% of patients being legally blind in that eye. Visual symptoms usually start off mild and gradually worsen over the course of a few weeks. In the third or fourth week, many patients will see a significant improvement in their vision. Up to one year

following the onset of optic neuritis, improvements can be noted [6].

Neuro-retinitis is characterized by abrupt unilateral vision loss in the presence of optic disc enlargement and hard exudates arranged in a star form around the fovea. It is classed as one type of optic neuritis, with the more prevalent retrobulbar neuritis and papillitis being the other types. These have plainly different management and prognosis principles. Although not consistent, the prognosis for vision recovery is said to be favorable [7].

The optic nerve's involvement with fluctuating vision loss has been linked to a variety of viral diseases. Anterior optic neuritis, retrobulbar optic neuritis (normal optic disc), neuro-retinitis (optic disc edema with the macular star), and anterior optic neuropathy are all possible symptoms. Indirect engagement of the optic nerve with erythrogenic, deteriorative, as well as direct involvement with a pathogen, may result in optic nerve involvement. Acute retinal necrosis (ARN) is associated with optic neuropathy in 11 percent to 57 percent of patients. It can show up as papillitis, neuro-retinitis, retrobulbar optic neuropathy RON, or optic disc atrophy a few weeks after the ARN. Direct nerve inflammation or an ischemic process leading to inflammatory thrombosis can cause optic nerve involvement in herpes zoster. The optic nerve has been shown to be involved in 17 percent of eyes with progressive outer retinal necrosis [8].

Papillitis can be an optic neuritis, which is frequently linked to the onset or coexistence of MS. Optic neuritis, in disparity to papilledema, is sometimes severe in start and is correlated with retro-bulbar ache that can be worse with eye movement; it is not accompanied by headache. Visual obscurations that last only a few seconds are unusual. Optic neuritis is most usually retrobulbar (behind the globe), and the optic nerve seems normal [9].

In virtually all unilateral cases, a RAPD is present, but the lack of the deficiency recommended advance/early or simultaneous optic neuropathy in the other eye. Although retrobulbar optic neuritis (normal disc appearance) is more common, disc edema (papillitis) affects a large proportion of patients, especially in this region of the world. Patients with optic neuritis have a wide range of visual field defects. Subnormal color vision or contrast sensitivity is observed in the diseased eye and occasionally in the fellow eye, indicating that the fellow eye is involved sub clinically [10].

The main goal of this research is to presents a unique perspective of the assessment of visual changes in Optic neuritis, and to evaluate their contrast sensitivity. similar study have not been performed in Lahore Pakistan.

### Problem statement

Optic neuritis produces significant visual impairment and may result in long -term visual abnormalities, as well as serving as an essential prognostic indication for the progression of demyelinating illnesses like multiple sclerosis [11].

Visual acuity is the capability of the eye to discern forms and details at a peculiar distance. One eye at a time is examined [12].

Contrast sensitivity is a type of test that is so valuable for the examination and that allows to discern numerous visual dysfunctions earlier after onset and obtain a complete picture of patient's vision quality. The ability to distinguish low-contrast objects may be impaired in certain disorders, like optic neuritis [13].

Therefore, this research is conducted to assess the visual acuity and contrast sensitivity in Optic neuritis.

### Research objective

The study was guided by the following research objective:

- To assess the visual acuity and contrast sensitivity in Optic neuritis.

### Literature search

Wilhelm H., *et al.* reviewed articles on the basis of selective search of the PubMed data base and author's clinical experience. He studied that ON is diagnosed on a basis of cluster of clinical information. The direct pupillary light reflex in the pretentious eye is weaker in unilateral optic neuritis. In 95 percent of cases, the visual disturbance resolves. Acute, severe vision disturbance with no obvious diagnostic signs on ocular examination is typical with optic neuritis. It generally affects young, otherwise healthy people [14].

Owidzka M., *et al.* studied that contrast sensitivity is a type of test so valuable for the examination which allows the practitioner

to get a complete picture of a patient's vision quality. Contrast sensitivity was measured using a Vision Analyzer in photopic (with and without glare) and mesopic conditions (with and without glare). Contrast sensitivity was found to be significantly reduced in all spatial frequencies with optic neuritis in both mesopic and photopic conditions (with and without glare) [15].

Abrishami M., *et al.* studied to assess alterations in several areas of visual function in patients with optic neuritis such as VA and CS. It was a non-comparative case in which 31 eyes of 30 patients were assessed. Changes in VA and CS were obtained by using a Cambridge low contrast grating to assess visual function. The results were that the affected eyes had significantly lower visual acuity (3/10) than the unaffected eyes (8/10)  $p < 0.01$ . In the unaffected eyes, contrast sensitivity was also significantly higher. It was then concluded that Optic neuritis impairs various aspects of visual function, including visual acuity and contrast sensitivity. Narayan S.K., *et al.* (2008) assessed that Neuro-retinitis is a lesser-known clinical condition that might be confused with papillitis or papilledema when examined. He reported that two young patients came with blurry eyesight that appeared suddenly. An ophthalmic examination revealed a characteristic image of neuro-retinitis. Fundoscopy revealed significant inflammatory alterations in the retina and optic nerve head [16].

Beck R.W., *et al.* did a study where they identified CS in 41 subject's eyes diagnosed with acute ON by using Arden grating and 51 subjects with resolved ON. Regardless of visual acuity, the values of 93% had an aberrant effect in the eyes in acute stage and 78% of the eyes in a resolved juncture. Even when the neuritis was resolved and the visual deficiencies regained normality to 6/7 or even better than that, 67 percent up to this time had aberrant CS. Because visual acuity is the CSs function's finer resolution frequency end, when vision advances to 6/6 with ON resolution, could have difficulty perceiving items with lesser brightness or at limited image frequency [17].

Vanikieti K., *et al.* (2020) evaluated subjects with acute ON in a retrospective observational study. Patients were handed over to the hospital in a span of 10 years from 2010 to 2020 in which socio-economic details were evaluated. In the study, total of 171 patients were included (78.4% [n=134] females with mean age 45 years [standard deviation 15.4 years], and 32.2% [n=55] bilateral

involvement). The most common type of acute ON was idiopathic (51.5%). In the idiopathic group, 38.6% developed single isolated ON, 1.8% relapsing isolated ON. It was then concluded that the most common form of acute ON was idiopathic [18].

Trobe J.D., *et al.* determined the intercorrelation of vision tests in optic neuritis. He calculated the linear correlation of paired vision tests from baseline and 6months measurements of Snellen VA and Pelli-Robson CS in 438 patients from 1988 to 1991. The results were that vision test results were highly correlated with one another, and CS had the greatest rate of abnormalities in the start. Based on the study, it was concluded that high intercorrelation of vision tests suggests that optic neuritis has an impact on broad range of visual functions. Pelli-Robson CS test proved to be an indicator of visual dysfunction in optic neuritis [19].

Sanders E.A.C.M., *et al.* determined spatial contrast sensitivity function in 53 patients with optic neuritis. Contrast sensitivity disorders were discovered in both unrecovered and recovered eyes, as well as in affected and un-affected eyes. The contrast sensitivity function's high frequency was related to visual acuity. Further it was concluded that despite having normal Snellen visual acuity, these subjective complaints of having foggy vision etc. were common [20].

Arden G.B did a retrospective study of 57 patients with retrobulbar neuritis. It was conducted using a new contrast sensitivity test that makes use of printed sinusoidal gratings. Visual abnormality was found in 18 "affected" eyes and 12 apparently un-affected eyes of 21 patients with multiple sclerosis (MS). In 29 of the 36 patients with retrobulbar neuritis, abnormalities were discovered. The grating tests revealed bilateral impairment in 7 of these cases [21].

## Methodology

- **Study Design:** The fundamental purpose of the study was to focus on assessing the visual acuity and contrast sensitivity in Optic neuritis. So, a cross-sectional, research design was selected.
- **Study Site:** The study is conducted at University of Lahore teaching hospital Lahore.

- **Duration:** This study was carried out for 4 months, from January 2022 to April 2023.
- **Population:** The population of this study was Only patients with optic neuritis.
- Age between 15-45 years.
- Both genders included.
- Patients with systemic and Auto-immune disorders
- **Sampling:** A convenient sampling method was used for this study.
- **Research Instrument:** A Self designed questionnaire was used to collect data from the patients with the help of following equipment.
  - log MAR Chart
  - Peli Robson chart
  - Auto refractometer (AR)
  - Ocluder
  - Indirect Ophthalmoscope
  - Slit lamp with condensing lens.
  - Pen torch
  - Trial frame

## Sample size

The formula for determining the sample size  $n=z^2 \frac{I-d}{2 P(1-P)}$

$I-d/2 P(1-P)$

P is the assumed population proportion in countries having Optic neuritis disorder. 0.86-1.018

d= Margin of error

with a confidence interval (CI) of 95%  $z= 1.9650$

$z^2= 1.96 \times 1.96 = 3.84$

now,  $n= (1.96)^2 \times 0.86(1.086)/ (0.05)^2$

Sample Size = 32

## Data gathering procedure

On the very first day of collection, patients meeting the criteria were observed, consent forms were given to them to continue the

process of the collection of data. In case the patient denied, next patient was selected for the examination. After taking the consent of patients, the process of visual assessment was started. There were 12 males and 20 females included with the given sample size of 32 patients. Their age limit varied from 15 years - 45 years. A hospital based cross sectional study was conducted where visual acuity and contrast sensitivity was assessed in optic neuritis patients. VA was measured with log Mar while CS was measured with PR contrast chart. Optic neuritis was further divided into categories depending on its types papillitis, retrobulbar-neuritis, neuro-retinitis.

At the start of examination, patient was asked to sit on a chair and was asked few questions to get his demographic data and medical history. The patient was asked to see the log Mar chart in 4 meters with his right eye occluded. How many lines does the patient see was then recorded and the same procedure was repeated with his left eye? The patient who had glasses worn were examined with their glasses and then without glasses to see the difference in their Snellen acuity. After the visual assessment, contrast sensitivity was assessed in the affected eye using Pelli-Robson chart. The patient was asked to occlude his one eye and see the templates on the charts in 3 meters. Depending upon the severity of optic neuritis, distance was also reduced. If the patient sees 1 template out of 3 triplets, then the value of previous template was recorded, if the patient sees 2 templates out of 3 triplets, then the value of that template was recorded.

**Ethical consideration**

After getting IRB approval the rules and regulations set by the ethical committee of university of Lahore were followed while conducting the research and the rights of the research participants were respected. Permission for data collection was taken from all the participants on the attached consent form. All the data and information taken from participants was kept confidential. Throughout the study participants remained anonymous. It is informed that no disadvantages and risks of the study were considered. Participants were informed that any time they will free hand to withdraw from process of study.

**Results**

The results are based on the primary data collected for the research. 32 people became the respondents of the research. Out

of 32 people, 12 respondents are male, and 20 respondents are female. Table 1 shows the frequency of gender description of the respondents.

**Section 1**

Gender	Frequency(n)	Percent%
Males	12	37.5%
Females	20	62.5%
Total	32	100%

**Table 1:** Gender wise frequency of participants.

Table 1 shows that, out of 32 participants, 20 were females and 12 were males. Percentages of males was 37.5% and for females was 62.5%.

**Section 2**

Optic neuritis		
	Frequency (n)	Percent %
Papillitis	11	34.4
Retro-bulbar neuritis	14	43.8
Neuro-retinitis	7	21.9
Total	32	100.0

**Table 2:** Distribution of optic neuritis on basis of its types.

Table 2 shows that, out of 32 participants examined 11 of them had Papillitis (34.4%), 14 had Retro-bulbar neuritis (43.8%) and 7 had been diagnosed with Neuro-retinitis (21.9%).

**Section 3**

Table 3 shows the visual acuity distributed with 17(53.1%) of them having mild VA, 8 (25.0%) having moderate and 7 (21.9%) having severe visual acuity in right eye.

**Section 4**

Table 4 shows the division of visual acuity in categories with 12(37.5%) of them having mild VA, 5(15.6%) having moderate and 17(46.9%) having severe visual acuity in left eye.

V.A_RE		
	Frequency (n)	Percent %
Mild <0.20	17	53.1
Moderate 0.30-0.60	8	25.0
Severe 0.70-1.00	7	21.9
Total	32	100.0

**Table 3:** Categorical division of visual acuity in the right eye.

V.A_LE		
	Frequency (n)	Percent%
Mild <0.20	12	37.5
Moderate 0.30-0.60	5	15.6
Severe 0.70-1.00	15	46.9
Total	32	100.0

**Table 4:** Categorical division of visual acuity in left eye.

**Section 5**

CS_RE		
	Frequency (n)	Percentage %
Mild $\geq 2$ log unit	1	3.1
Moderate <1.5 log unit	14	43.8
Severe <1 log unit	17	53.1
Total	32	100.0

**Table 5:** Categorical division of Contrast sensitivity in Right eye.

Table 5 shows categories of contrast sensitivity are shown in terms of mild, moderate and severe. Out of 32 cases which were examined, 1 participant had mild CS (3.1%), 14 participants had moderate CS (43.8%) and 17 of them had severe CS (53.0%).

**Section 6**

CS_LE		
	Frequency (n)	Percentage %
Moderate <1.5 log unit	12	37.5
Severe <1 log unit	20	62.5
Total	32	100.0

**Table 6:** Categorical division of Contrast sensitivity in Left eye.

Table 6 shows categories of contrast sensitivity are shown in terms of mild, moderate and severe. Out of 32 cases which were examined, 12 participants had moderate CS (37.5%) and 20 of them had severe CS (62.5%).

**Section 7**

In this table 7 Mean, Maximum value, Minimum value and standard deviation is shown n VA and CS in optic neuritis. Mean and Standard deviation for age is  $8.3473 \pm 29.7500$ , for VA in right eye mean and standard deviation is  $0.4281 \pm 0.36565$  and mean and standard deviation is  $0.5394 \pm 0.37888$ , Mean and standard deviation of CS in right eye is  $1.0031 \pm 0.60534$  and left eye is  $0.7969 \pm 0.58461$ . Mean and SD of Optic neuritis is  $1.8750 \pm 0.7513$ , respectively.

**Discussion**

The study is conducted in public hospital in Lahore, the questionnaire was made for the collection of data. The questionnaire includes the questions related to the demographics, medical history, The questionnaire was close ended according to which the respondents have to give to the specific answer.

		Age	Gender	VISUAL.ACUITY _RE	VISUAL.ACUITY _LE	CONTRASTSENSI- TIVITY _RE	CONTRASTSENSI- TIVITY _LE	OPTIC NEURITIS
N	Valid	32	32	32	32	32	32	32
	Missingg	0	0	0	0	0	0	0
Mean		29.75 00±8. 34730	1.6250± .49187	.4281±.36 565	.5394±.37 888	1.0031±.6053 4	.7969±.58461	1.8750 ±.7513 4
Minimum		15.00	1.00	.00	.00	.15	.15	1.00
Maximum		45.00	2.00	1.00	1.00	2.10	1.80	3.00

**Table 7:** Mean, Maximum value, Minimum value and standard deviation of Visual acuity and Contrast sensitivity.

A sample size of 32 patients took part in the research, with a gender split of 12 males and 20 females, ranging in age from 15-45 years.

In a previous study conducted at the Neuro-Ophthalmology Facility, Eye Hospital, and the Department of Ophthalmology and Neurology in the US, CS was witnessed in ON, even though there was no certainty about a review that contrasted its duration in intense to settled optic neuritis. Arden and Gucukoglu [15] reported that 57 of 70% cases of resolved ON had mean CS. Abnormal outcomes too were determined within the person eyes of 56 percent of cases with signs and symptoms and symptoms of a MS and 19 percent of those without [22].

Zimmern RL, *et al.* also observed 8 subjects that were treated with ON with having VA of 6/6 and examined average CS with inside the concerned eyes of eight and with inside the man eye of one. Hess and Plant studied nine eyes of eight patients with optic neuritis and decided that impaired contrast sensitivity turn out to be relying on the spatial and temporal frequency of the stimulus. Two studies have measured CS in subjects diagnosed with MS without having any previous history of appearing ON. Kupersmith MJ, *et al.* examined 14/18 cases having an average CS, and Regan D, *et al.* 20 validated same deficiencies in 20/48 cases. Every patient with inside the erstwhile with inside the letter has seen vision of 6/6. In an observation, they evaluated and assessed CS by

using Arden grating plates and brought into attention an eye fixed to be abnormal if each ordinary score or interocular difference surpassed the necessities set with the aid of Arden [23].

Female majority was seen in our research, which was comparable to that observed in Japan (Suehiro S, *et al.* Previous Nepalese investigations, however, revealed a male majority (Das H., *et al.* 2010). In our analysis, most cases (24%) were between the age of 21-30, which was consistent with the study conducted in Kathmandu center (Shrestha R, *et al.* 2007). The average age found on that study was 34.32 ± 13.72 years, which was comparable [24].

Arden stated ordinary population endorses score of 69-8 for his test booklet. To endorse the score of the ordinary fellow eyes in our series is quite similar. Several of the fellow eyes in each of it did score within the average range. Visual acuity turned out to be ordinary in each of these eyes, but the average score is suggestive of a previous subclinical optic neuritis. The length of contrast sensitivity represents a further method for assessing feature. In this observation we decided that, although contrast sensitivity improves with selection of optic neuritis, it often remains average. This also can moreover be the cause many patients after having recovered from optic neuritis report that vision is not ordinary, being 'washed out' or 'dull', however acuity of 6/6. In most cases, according to other studies, there was no root cause. Unlike investigations from China, none of the case studies were labelled with MS Zhang, *et al.* [25].

Two cases of MS were identified in Indian investigations Saxena R., *et al.* Another of the explanations for not recognizing MS as the etiology of ON might be that our investigation was cross-sectional. Corresponding to a western experiment found deficient CS in 93% of cases (Beck RW., *et al.*) and an Indian study, CS was lowered in 94% of cases. We measured contrast sensitivity via way of the usage of Arden grating plates in 41 eyes with acute optic neuritis and in 51 eyes with resolved optic neuritis. The ratings were average in 93% of eyes in the extreme phase and 78% with inside the resolved phase regardless of visual acuity. Even as acuity advanced to 6/7.5 or better with selection of the neuritis, 67% of eyes showed average contrast sensitivity. Since Snellen acuity represents virtually one component at the immoderate spatial frequency end of the contrast sensitivity feature, an affected individual in whom acuity improves to 6/6 with selection of optic neuritis also can moreover although you have trouble seeing devices of low contrast or at relatively lower resolutions [26].

### Conclusion and Recommendations

Thus, from the present study, it is concluded that the In case of visual loss, there were many cases presented with mild visual loss which restored after treatment in short duration of time. The most effected type of optic neuritis was retro- bulbar neuritis. Many occurrences of ON occurred in people with aged 21-39, only 6% occurring in children. females were found to be more prevalent. Adults were more likely to have unilateral ON. In adults and children Papillitis and RBN was the most common kind.

Contrast sensitivity drops over the whole frequency spectrum in optic neuritis. The extent of impairment appeared to be roughly correlated to visual acuity in acute phase of disease, but acuity tends to improve more rapidly towards normal levels during resolution.

Eye care practitioners should in our opinion enhance public awareness of macular edema. There should be conducts more eye camps. Eye professionals should guide people to check their eyesight at least once every six months.

Patients are recommended to visit as early as the first sign of visual loss so that it can be diagnosed early.

Counselling should be done to educate people about this disease and how it should be managed with proper treatment.

### Limitations

This study has the following limitations.

- The results are based on self-reported data from participants, which limit the validity of the data.
- Our study was a comparative one, and as such the study design limits some of the conclusions.
- The sample size was less, more than this sample size will improve the accuracy of the study and results.
- The conducted study method not organized follow-ups for the participants further studies must perform follow-ups to improve the accuracy of results.

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