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Original Research Article

To Study the Effectivity of Contrast Sensitivity as Marker of Preperimetric Glaucoma Compared to Ancillary Diagnostic Test Like OCT of Optic Nerve Head and RNFL Thickness

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Abstract:

Background: In this study, we wanted to correlate contrast sensitivity and RNFL thickness in preperimetric glaucoma cases and consider contrast sensitivity as an easily available early marker of preperimetric glaucoma.

Methods: This was a hospital-based cross-sectional study conducted at a tertiary care hospital in Mumbai, over a period of two years after obtaining clearance from institutional ethics committee and written informed consent from the study participants.

Results: In comparison of age wise distribution of contrast sensitivity in cases and controls, the mean contrast sensitivity was significantly reduced in case group compared to the age-matched control group. In comparison of age wise distribution of average RNFL thickness in cases and controls, the mean RNFL thickness (average) was significantly reduced in case group compared to the age-matched control group. In comparison of RNFL (avg) and CS in cases and controls, a drop in the RNFL thickness (average) in the case group from 75 microns to 65 microns (approximately 13% drop in RNFL thickness) reduced the contrast sensitivity from 1.65 log units to 1.50 log units.

Conclusion: Contrast sensitivity alone cannot be used to diagnose a case of preperimetric glaucoma. OCT for RNFL thickness is a better tool for diagnosing cases of preperimetric glaucoma. In a diagnosed case of preperimetric glaucoma, contrast sensitivity can be used as a marker of progression of glaucoma. A drop in contrast sensitivity from previous values mandated a repeat OCT for RNFL thickness to check for glaucoma progression. Assessment of contrast sensitivity by Pelli-Robson's chart for progression of preperimetric glaucoma is cost-effective.

Keywords: Contrast Sensitivity, Preperimetric Glaucoma, Ancillary, Diagnostic Test OCT, Optic Nerve, RNFL Thickness.

Introduction

Glaucoma is an eye disease in which the optic nerve is damaged in a characteristic pattern. This can permanently damage vision in the affected eye(s) and lead to blindness if left untreated. The damage to the ganglion cells and nerve fibres is irreversible. The nerve damage involves loss of retinal ganglion cells in a characteristic pattern. Glaucoma has been called the "silent thief of sight" because the loss of vision often occurs gradually over a long period of time, and symptoms only occur when the disease is quite advanced. It is normally associated with increased fluid pressure in the eye (aqueous humour). [1] Worldwide, glaucoma is the second-leading cause of blindness after

cataracts. [2] Damage to the retinal nerve fibre layer (RNFL) has been shown to precede visual field loss. Up to 30-50 % nerve fibre loss might have occurred before the first detectable field defect. [3] It is therefore important to diagnose glaucoma before the appearance of field defects. Optical Coherence Tomography (OCT) is a useful tool for the diagnosis of preperimetric glaucoma. The usefulness of this tool increases in the presence of other risk factors like family history of glaucoma, large cup disc ratio and high intraocular pressure. Contrast sensitivity has been studied extensively to determine its effectiveness as a test for diagnosing glaucoma, since the first study by Campbell and Green of reduced contrast sensitivity (CS) in patients with open-angle glaucoma. [4]

Aims and Objectives

- To correlate contrast sensitivity and RNFL thickness in preperimetric glaucoma cases.
- To consider contrast sensitivity as an easily available early marker of preperimetric glaucoma.

Materials & Methods

This was a hospital-based cross-sectional study conducted at a tertiary care hospital in Mumbai, over a period of two years after obtaining clearance from institutional ethics committee and written informed consent from the study participants.

Inclusion Criteria

Patients included in the study should fulfil the following criteria:

- Case of preperimetric glaucoma.

- Suspicious cup disc ratio
- Raised intraocular pressure.
- Open angles on gonioscopy
- Reduced RNFL thickness on OCT
- No defects on perimetry
- BCVA of 20/40 minimum

Exclusion Criteria

- Glaucoma with visual field defect.
- Visual acuity less than 20/40
- Any disease affecting the fundus and visual pathway, known to affect contrast sensitivity viz diabetic retinopathy, hypertensive retinopathy, cataract, optic neuritis.

Statistical Methods

Data analysis was done with the help of SPSS Software version 15. Quantitative data was presented with the help of Mean, SD, Median and IQR Correlation among study groups was assessed with Pearson's correlation coefficient. Qualitative data was presented with the help of Frequency and Percentage table. P value less than 0.05 was taken as significant level.

Results

Table 1: Comparison of age wise distribution of contrast sensitivity in cases and controls

AGE	CS			Control		P Value
	Cases	Control	Std Dev	N	Std Dev	
Up to 40 Yrs.	1.56	1.69	0.14	8	0.07	0.030
41 to 50 Yrs.	1.54	1.67	0.07	18	0.05	0.000
51 to 60 Yrs.	1.60	1.65	0.09	14	0.00	0.000

The mean contrast sensitivity of eyes in the case group in the age group of less than 40 years was 1.56 log units while it was 1.69 log units in the control group. The mean contrast sensitivity of eyes in the case group in the age group of 41-50 years was 1.54 log units while it was 1.67 log units in the control group. The mean contrast sensitivity of eyes in the case group in the age group of 51-60 years was 1.60 log units while it was 1.65 log units in the control group. The mean contrast sensitivity was significantly reduced in case group compared to the age-matched control group.

Table 2: Comparison of age wise distribution of average RNFL thickness in cases and controls

AGE	RNFL avg			Control		P Value
	Cases	Control	Std Dev	N	Std Dev	
Up to 40 Yrs.	72.13	109.63	8.46	8	4.14	0.000
41 to 50 Yrs.	68.33	108.72	5.99	18	7.42	0.000
51 to 60 Yrs.	70.86	106.86	4.37	14	6.30	0.000

The mean RNFL thickness (average) of eyes in the case group in the age group of less than 40 years was 72 microns while it was 109.63 microns in the control group. The mean RNFL thickness (average) of eyes in the case group in the age group of 41-50 years was 68.33 microns while it was 108.72 microns in the control group. The mean RNFL thickness (average) of eyes in the case group in the age group of 51-60 years was 70.86 microns while it was 106.86 microns in the control group. The mean RNFL thickness (average) was significantly reduced in case group compared to the age-matched control group.

Table 3: Comparison of RNFL (avg) and CS in cases and control

CS	Cases		RNFL avg		Control		P Value
	N	Mean	Std Dev	N	Mean	Std Dev	
1.35	3	62.00	2.00	0	-	-	
1.50	17	65.00	1.50	0	-	-	
1.65	20	75.40	3.33	36	107.28	6.03	0.000
1.80	0	-	-	4	117.00	1.41	

None of the eyes in the case group had contrast sensitivity of 1.80 log units while none of the eyes in the control group had contrast sensitivity of less than 1.65 log units

In 20 eyes of case group with contrast sensitivity of 1.65 log units, their mean RNFL thickness (average) was 75 microns, however in 36 eyes of the control group with the same contrast sensitivity of 1.65 log units, the mean RNFL thickness (average) was of 107.28 microns.

In 17 eyes of the case group with contrast sensitivity of 1.50 log units, their mean RNFL thickness (average) was 65 microns.

A drop in the mean RNFL thickness (average) from 107.28 microns to 65 microns (approximately 40% drop in RNFL thickness) reduced the contrast sensitivity from 1.65 log units to 1.50 log units.

A drop in the mean RNFL thickness (average) from 107.28 microns to 75 microns (approximately 30% drop in RNFL thickness) had no change in the contrast sensitivity.

However, a drop in the RNFL thickness (average) in the case group from 75 microns to 65 microns (approximately 13% drop in RNFL thickness) reduced the contrast sensitivity from 1.65 log units to 1.50 log units.

Table 4: Correlation of contrast sensitivity and average RNFL thickness in cases

Study Parameters	N	Mean	Std. Dev
CS	40	1.55	0.14
RNFL avg	40	69.60	6.89
Study Parameter		CS	
	Pearson Correlation	P Value	Correlation is
CS			
RNFL avg	0.870	0.000	Significant

In 40 eyes of the case group, the mean contrast sensitivity was found to be of 1.55 log units with a standard deviation of 0.14 and mean RNFL thickness (average) was found to be 69.6 microns with standard deviation of 6.89.

In the case group, a positive correlation of contrast sensitivity with RNFL thickness (average), was established which was statistically significant ($p<0.05$) on application of the chi-square test.

Discussion

In our cross-sectional study, we have tried to correlate contrast sensitivity by Pelli-Robson's chart with RNFL thickness(average) measured by OCT in 40 eyes of preperimetric glaucoma cases and 40 eyes of age group and gender matched control cases.

Cases with visual acuity of 20/40 or more who were diagnosed as a case of preperimetric glaucoma were included. Cases with doubtful colour vision or other disease affecting the fundus and visual pathway, known to affect contrast sensitivity viz diabetic retinopathy, hypertensive retinopathy, cataract, optic neuritis were excluded.

Contrast sensitivity does seem to be selectively affected by the glaucoma process to a greater extent than is Snellen (high contrast) visual acuity.

The Pelli-Robson chart represents a low tech, reasonably available method of measuring spatial contrast sensitivity that is compatible with clinical practice. It has been shown to yield reliable and reproducible results.

A study by Jacob T. Wilensky et al [2] Comparison of contrast sensitivity, visual acuity, and Humphrey visual field testing in patients with glaucoma 2001. 213 showed that glaucomatous eyes with visual acuity of 20/40 or better, a decrease in the contrast sensitivity correlates with increased visual field loss and that there is good evidence that contrast sensitivity abnormalities often precede glaucomatous visual field loss in early glaucoma.

The quantitative assessment of retinal nerve fibre layer (RNFL) loss in early and advanced glaucoma by optical coherence tomography is accurate and reproducible and can be directly related to the severity of the disease.

Another study by Dr. S J. Saikumar et al [4] Diagnosis of Preperimetric Glaucoma using Optical Coherence Tomography, Kerala Journal of Ophthalmology Vol. XX, No. 1, showed that Optical

Coherence Tomography is a useful tool for preperimetric diagnosis of glaucoma. The usefulness of this tool increases in the presence of other risk factors like family history of glaucoma, large cup disc ratio and high intraocular pressure. The specificity of this tool in this study was 92 % which makes it a good tool to rule out those who do not have glaucoma.

Compared to OCT for RNFL thickness for follow-up of progression, Pelli-Robson's chart is more cost-effective and easily available.

In our study, we observed that a drop in the normal average RNFL thickness from 107.28 microns to 65 microns (approximately 40% drop in RNFL thickness) reduced the contrast sensitivity from 1.65 log units to 1.50 log units. We also studied that a drop in the normal average RNFL thickness from 107.28 microns to 75 microns (approximately 30% drop in RNFL thickness from normal mean RNFL thickness) had no change in the contrast sensitivity. This shows that contrast sensitivity can still be normal even if there is a considerable drop in RNFL thickness, thus contrast sensitivity alone cannot be used to diagnose a case of preperimetric glaucoma and OCT is a better tool in diagnosing cases of preperimetric glaucoma.

We also studied that a drop in the RNFL thickness (average) in the case group from 75 microns to 65 microns (approximately further 13% drop in RNFL thickness) reduced the contrast sensitivity from 1.65 log units to 1.50 log units, hence further drop in contrast sensitivity compared to previous mandates a repeat OCT for RNFL thickness, for progression of glaucoma. This also obviates the need of repeat OCT if contrast sensitivity remains same and thus makes assessment of contrast sensitivity by Pelli-Robson's chart for progression of preperimetric glaucoma cost-effective.

In our study, we observed that in the case group on comparison of contrast sensitivity with RNFL thickness (average), a positive linear correlation was established which was statistically significant($p<0.05$) on application of the chi-square test.

Conclusion

Contrast sensitivity can still be normal even if the is a considerable drop in RNFL thickness from normal, thus contrast sensitivity alone cannot be used to diagnose a case of preperimetric glaucoma and OCT is a better tool in diagnosing cases of preperimetric glaucoma. In the case group, a positive correlation of contrast sensitivity with RNFL thickness(average) was established which was statistically significant($p<0.05$) on application of the chi-square test. Once a diagnosis of preperimetric glaucoma is done on the basis of RNFL thickness, a drop in the contrast sensitivity correlates with the drop in the average RNFL thickness. If the contrast sensitivity remains same as before in cases of already documented reduced RNFL thickness of preperimetric glaucoma on OCT, there is no need to repeat OCT for RNFL thickness. Assessment of contrast sensitivity by Pelli-Robson's chart for progression of preperimetric glaucoma is cost-effective.

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