

ORIGINAL ARTICLE

ASSESSMENT OF RETINAL FIBRE LAYER THICKNESS WITH THE HELP OF SPECTRAL DOMAIN OPTICAL COHERENCE TOMOGRAPHY IN A GIVEN POPULATION: A CLINICAL STUDY

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ABSTRACT:


Background: Optical coherence tomography is one of the commonly employed imaging device which produces high resolution, cross-sectional images of retinal nerve fibre layer (RNFL) and optic nerve head. Spectral OCT is one of the commercially available spectral domain (SD) having an axial resolution of 5 μm . Great degree of variation exists while comparing the mean RNFL. Hence; we evaluated the retinal Nerve Fibre Layer Thickness using Spectral Domain OCT in North Bengal and adjacent area of Bihar, India. **Materials & Methods:** For this observational, cross-sectional study, 210 volunteers were recruited from the institute staff and patients with refractive error. All the subjects were classified into following groups depending on the visual activity. Subjects with best corrected visual activity of more than 23/30 and with refractive error within plus minus 3 dioptres (D) of sphere were categorized as having normal eyes. Subjects with plus minus 1.5 D of cylinder, intraocular pressure < 21 mmHg, clear ocular media on lens opacities classification system III, open angles on gonioscopy. The sectors were defined in clockwise order for right eye and counterclockwise order for the left eye. Only scans with signal strength of > 7 and no segmentation algorithm failures were included for analysis. In case of scan procedure, the strength of the signal was assessed and reviewed followed by exclusion of signal with strength of lesser than 15. Assessment of all the results was done using SPSS software.

Results: Non-significant results were obtained while comparing the mean value in males and females. The mean value of temporal quadrant in males and females was 70.5 and 70.9 respectively. The mean value of inferior quadrant was 142.2 and 143.8 respectively among males and females respectively. However, non-significant results were obtained while comparing the mean values of nasal quadrant and temporal sector among males and females. The mean value of nasal sector and superior nasal sector among males was 95.2 and 130.8 respectively while value of nasal and superior nasal sector among females was 96.7 and 128.5 respectively. **Conclusion:** For RNFLT, normative database is obtained in Indian eyes using SD-OCT. Future research in this field is recommended for better exploration of this area of medicine.

Key words: Optical coherence tomography, Retinal nerve fibre layer

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This article may be cited as: Saha N. Assessment of retinal fibre layer thickness with the help of spectral domain optical coherence tomography in a given population: A clinical study. J Adv Med Dent Scie Res 2016;4(5):114-117.

Access this article online	
Quick Response Code 	Website: www.jamdsr.com
	DOI: 10.21276/jamdsr.2016.4.6.29

INTRODUCTION

One of the common imaging devices producing high resolution, cross-sectional images of retinal nerve fibre layer (RNFL) and optic nerve head (ONH) is the Optical coherence tomography (OCT).¹ One of the commercially available spectral domain (SD) OCT is the spectral OCT and has axial resolution of 5 μm . It has been well established by the spectral OCT/ SLO about the reproduction of RNFL thickness (RNFLT) measurements.² Age or race related inter-individual variation has been shown by RNFLT.³ Hence; we evaluated the retinal Nerve Fibre Layer Thickness using Spectral Domain OCT in North Bengal and adjacent area of Bihar, India.

MATERIALS & METHODS

For this observational, cross-sectional study, 210 volunteers were recruited from the institute staff and patients with refractive error, from May 2008 to December 2009. Ethical approval was taken from the institutional ethical committee. Written consent was obtained from each patient in written after explaining them the entire research protocol. Comprehensive ophthalmic examination was done in all the volunteer patients through achromatic automated perimetry using Swedish Interactive Threshold Algorithm, Standard 24-2 program with Humphrey visual field analyzer. All the subjects were classified into following groups depending on the visual activity. Subjects with best corrected visual

activity of more than 23/30 and with refractive error within plus minus 3 dioptres (D) of sphere were categorized as having normal eyes. Subjects with plus minus 1.5 D of cylinder, intraocular pressure < 21 mmHg, clear ocular media on lens opacities classification system III, open angles on gonioscopy. Exclusion criteria included subjects with any other systemic illness, any known drug allergy and with ocular pathology or any other previous intraocular surgery. Random selection of any one eye was done following the dilatation of the eyes followed by RNFL scanning of the participants with spectral OCT/SLO. Centring of a circular scan with 3.4 m diameter circle using internal fixation target was done around the ONH and observation of the SLO image was done by locating of the imaging point. Automated OCT software algorithm was used for the assessment of the RNFL for the identification of the anterior and posterior margin of the RNFL. Assessment of the following parameter of RNFL was done;

- Average peripapillary RNFLT
- Four quadrant
- Eight sectors RNFLT

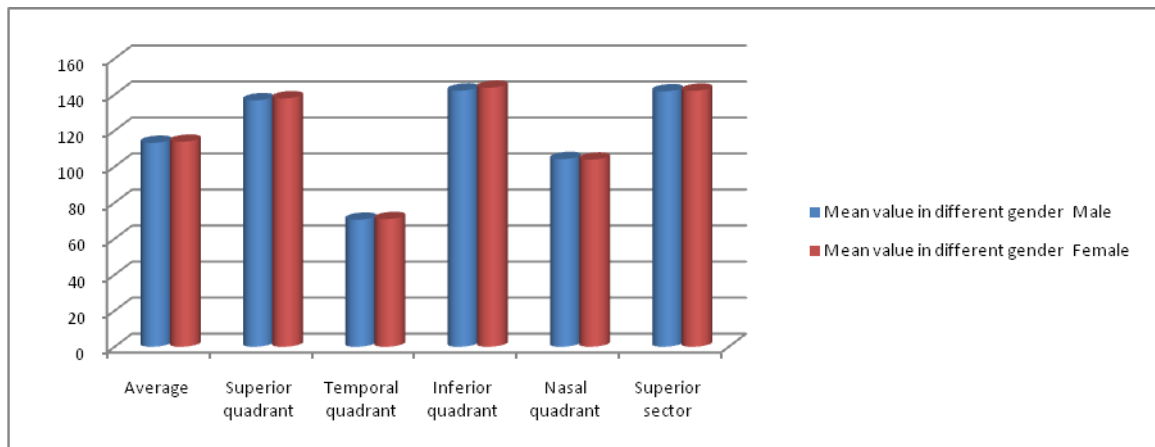
The sectors were defined in clockwise order for right eye and counterclockwise order for the left eye. Only scans

with signal strength of > 7 and no segmentation algorithm failures were included for analysis. In case of scan procedure, the strength of the signal was assessed and reviewed followed by exclusion of signal with strength of lesser than 15. Assessment of all the results was done using SPSS software. Chi-square test was used for the assessment of level of significance.

RESULTS

Mean value for various RNFL parameters are shown in **Graph 1** and **Graph 2**. The average value of superior quadrant in males and females was 136.8 and 137.9 respectively. However, non-significant results were obtained while comparing the mean value in males and females (**Table 1**). The mean value of temporal quadrant in males and females was 70.5 and 70.9 respectively. The mean value of inferior quadrant was 142.2 and 143.8 respectively among males and females respectively. However, non-significant results were obtained while comparing the mean values of nasal quadrant and temporal sector among males and females. The mean value of nasal sector and superior nasal sector among males was 95.2 and 130.8 respectively while value of nasal and superior nasal sector among females was 96.7 and 128.5 respectively.

Graph 1: Mean value of RNFLT for superior and nasal sector



Graph 2: Mean value of RNFLT for temporal sector

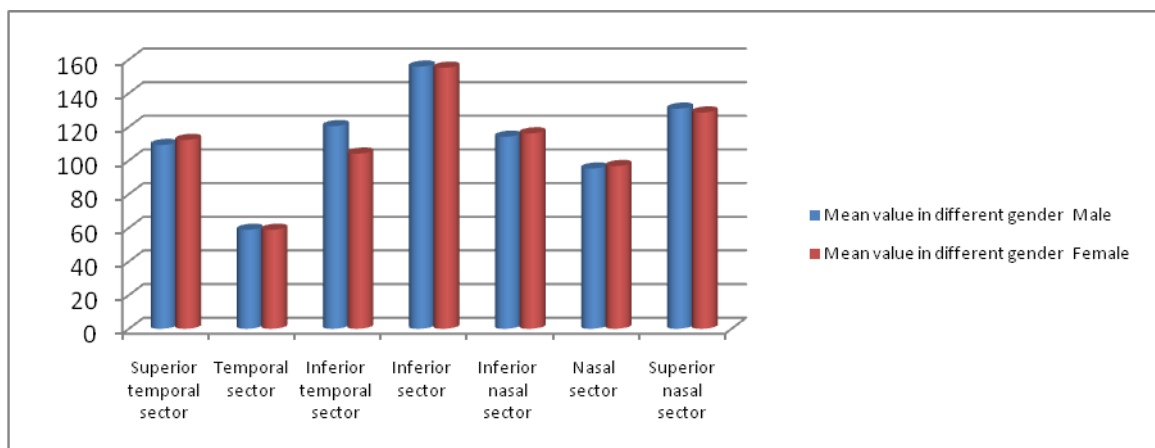


Table 1: P-value for various RNFL parameters

RNFL parameters	Mean value in different gender		p-value
	Male	Female	
Average	113.2	113.8	0.51
Superior quadrant	136.8	137.9	0.53
Temporal quadrant	70.5	70.9	0.37
Inferior quadrant	142.2	143.8	0.71
Nasal quadrant	104.2	103.9	0.49
Superior sector	141.8	142.1	0.47
Superior temporal sector	109.2	112.2	0.21
Temporal sector	58.8	58.8	0.71
Inferior temporal sector	120.4	104.1	0.38
Inferior sector	155.8	155.1	0.72
Inferior nasal sector	114.1	116.1	0.82
Nasal sector	95.2	96.7	0.44
Superior nasal sector	130.8	128.5	0.34

DISCUSSION

One of the most common non-invasive technique which provides accurate measurement of macular and RNFL thickness in vivo is the OCT.⁴ Time-domain OCT is supersede by domain SD-OCT in most parts of the world. In between the various ethnic groups, it has been shown by the past studies that lots of variation exists among the macular and RNFL thickness.⁵⁻⁷ Therefore, demographic variation do exist regarding the data which document the macular and RNFL thickness among individuals of various ethnic origin. Literature has paucity of data that centralizes on the Spectralis OCT in Indian population.⁸ Hence; we evaluated the RNFL Thickness using Spectral Domain OCT (SD-OCT) in North Bengal and adjacent area of Bihar, India.

In the present study, we observed statistically non-significant values of RNFLT in comparison between males and females. Due to difference in the sub-group of population studies, sample size difference and difference in generation of OCT used, this variation of the results can occur.⁹ Alasil et al the determined the effect of demographic details on the RNFL in the normal human eye as measured by the SD-OCT. They evaluated peripapillary SD-OCT RNFL thickness measurements in normal subjects and randomly selected one eye per subject for assessment. They observed that a total of 190 healthy participants were included which aged between 9 to 86 years. 33 percent of the total study participants in their study were males while remaining were females. 97.3 μm was the mean RNFL thickness for the normal population in their study. From the results, they concluded that in the inferior quadrant, thickest RNFLT measurements were observed followed by superior quadrants.¹⁰ Budenz et al evaluated the effect of demographic parameters, optic disc area and axial length on the RNFL in the normal human eye as measured by stratus OCT. An eye was selected randomly from all the participants and peripapillary Fast RNFL scans performed by Stratus OCT with a nominal diameter of 3.46 mm centred on the optic disc were performed. They observed that for the entire population, the mean RNFL thickness was 100.1 micron. Also, older age was

associated with thinner RNFL measurements. From the result, they concluded that significant variation occurs among various retinal nerve fiber layer thicknesses when estimated among various demographic details.¹¹ Salchow et al measured the RNFL thickness among normal children. They conducted a cross-sectional study and evaluated 92 eyes of normal children aged between 4 to 17 years. They measured retinal nerve fiber layer thickness with OCT. They also assessed patient cooperation and signal strength with OCT. They observed that 8 percent of the population belonged to Hispanic origin. 117 out of total 121 subjects gave measurements for OCT. From the results; they concluded that for the measurement of RNFL thickness, OCT can be used. Also large variation exists in normal children regarding the RNFL thickness.¹² Mwanza et al assessed and identified the predictors of the ganglion cell-inner plexiform layer (GCIPL) thickness measured with FD-OCT in normal eyes. They analyzed 282 normal subjects who underwent macular and optic disc scanning in both eyes with Cirrus high-definition (HD)-OCT. For the determination of the association between GCIPL thickness and age, they performed linear regression analysis. They observed that the mean age of the patients was 46.2 years. 82.1 and 80.4 micrometer were the mean and minimum GCIPL thickness respectively. Between macular sectors, statistically significant differences were obtained while comparing the GCIPL thickness except for between the superotemporal and inferonasal sectors. Thinnest and thickest GCIPL was observed in the superonasal and inferionasal sector. From the results, they concluded that thinner RNFL, older age, longer ocular axial length, and being male were the independent factors that were found to be associated with thinner GCIPL.¹³ Wu et al evaluated the reproducibility of the peripapillary RNFL thickness measurements in normal and glaucoma participants. They analyzed peri-papillary thickness of RNFL repeatedly three times in the random eye of the normal participant and patient with glaucoma. They observed that in total of 45 normal participants and 33 of glaucoma patients, the CVs ranged between 1.45 to 2.59%. They didn't observed any significant difference

between RNFL thickness and measurements in all the patients. From the results, they concluded that excellent reproducibility for the measurement of peri-papillary RNFL is shown by Spectralis OCT.¹⁴ Tan et al determined and evaluated the reproducibility of RNFL measurement from 2 spectral domain OCT instruments. They analyzed 50 normal patients and other patients with pre-existing glaucoma and significant cataract. They observed that 4.59 μm and 4.95 μm was the variability of Cirrus and Spectralis OCTs respectively. From the results, they concluded that excellent reproducibility occurs in patients in which RNFL measurement was done.¹⁵ Appukuttan et al evaluated 105 healthy patients with age group of 20 to 75 years and scanned them using standard protocols with certified experienced examiner. They evaluated the mean RNFL and refraction and their alteration with demographic details and observed that in healthy Indian eyes, the normal central foveal thickness when measured with Spectralis OCT was 260 μm . Maximum retinal thickness was observed in the nasal quadrant. Maximum RNFL thickness was observed in the inferior quadrant. A significant gender difference was observed in the value of mean central foveal thickness when compared on the basis of gender. However, non-significant difference was obtained when these parameters were compared on the basis of age. From the results, they concluded that while evaluating the central foveal thickness, special consideration should be given to demographic details of the patient population.¹⁶

CONCLUSION

From the result, the authors conclude that for RNFLT, normative database is obtained in Indian eyes using SD-OCT. Future research in this field is recommended for better exploration of this area of medicine.

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Source of support: Nil

Conflict of interest: None declared

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