Normal macular thickness of North-East-Indian population

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Abstract

Purpose:
To study the normative values of macular thickness using Spectral Domain Optical Coherence Tomography (SD- OCT) in North East Indian population.

Materials and Methods:

This hospital based analysis evaluated 220 eyes for macular thickness, using SD-OCT system. The results were analysed using SPSS software. Variations in macular thickness by age and gender were determined.

Results:

Total 62 males and 48 females with mean age of 41.45 years (21years-70years) were studied. The average macular thickness being 264.93±24.44µm in right eye and 266.76±23.42µm in left eye with no significant difference (P>0.05).

Average macular cube volume of the two eyes (Right 9.54±0.91mm^3, left 9.69±0.76mm^3) did not show significant difference (P>0.05).

Average macular cube volume in males and females (male right 9.75±1.00mm^3, female right 9.275±1.00mm^3) and (male left 9.82±0.87mm^3, female left 9.82±0.87mm^3) showed that it was more in males right eye (P<0.001) and in males left eye(P<0.001).

The average macular thickness of males and the females (male right 273.12±24.72µm, female right 254.35±19.50µm) and (male left 270.14±25.36µm, female left 262.39±19.80µm) showed that it was more in males right eyes (P<0.001) and in of males left eyes (P<0.001).

Linear regression analysis showed no association of mean macular thickness (P>0.05) with age.

Conclusion:

Our study provides normative database of macular thickness of North East Indian population. Males are associated with larger macular thickness and higher macular volume while macular thickness has no variation with age. There is no difference of macular thickness between the right and the left eyes.

Further investigations with higher number of participating subjects, may be recommended.

Keywords: North East India, Optical Coherence Tomography, Macular thickness, Healthy Eyes.

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Introduction:

Optical Coherence Tomography (OCT) is a non-invasive method which provides us with the accurate measurement of macular status in terms of thickness and volume. It is a gold standard imaging technology to evaluate the biological tissue in-vivo. It helps us tremendously to diagnose, to monitor and to treat many retinal diseases. Optical coherence tomography was first described in 1991 and was first used in ophthalmology practice in 1995. It provides us with an optical biopsy of the macular tissue by the advantage of its differential optical refraction properties. It can examine 10μm thick sections of the retinal structure. It is a noncontact, non-invasive, easily reproducible method that uses only light.

Our study compared macular thickness in healthy eyes of different age group (21-70 years) using OCT and investigated whether age and gender of the population affected the macular structures or not. Simultaneously, it compared the right and the left macula. It measured and defined normal values of macular thickness and its cube volume in healthy eyes using defined protocols of OCT. A normative database of the macular thickness and cube volume in normal North East Indian population is not available till today. The purpose of this study was to assess the macular thickness and its cube volume measurements in normal North East Indian subjects using spectral domain OCT. The purpose also includes comparison of the obtained data (1) between the right and the left eye (2) between males and females.

Materials and Methods:

The study was conducted in the department of Ophthalmology of a Medical College and Hospital, of North East India. It was a hospital based study of 110 patients of North East India who attended the outpatient department of the Ophthalmology department of that college, a tertiary level eye care and referral center of North East India. Subjects aged between 21 to 70 years with the best corrected visual acuity of 6/6 were selected for this study. Both male and female patients were selected. The total 220 eyes of 110 patients from any socio economic background who attended the hospital were included in this investigation. Only the patients who were having baseline ocular characteristics within normal limit were selected. The baseline ocular characteristics included axial length of eyeballs, anterior chamber depth and intraocular pressure of the eye.

Patients below the age group 21 and above 70 were excluded from this study. Patients suffering from hypertension, diabetes, any other systemic diseases or systemic infections were also excluded from this study. Patients suffering from any ocular inflammatory disease and any retinal disease were excluded. One eyed patients were also excluded. Patients with history of any ocular surgery were taken to be ineligible from the selection criteria of this study.

Informed consent was signed by each participant of this study. Institutional ethical clearance was obtained from Ethics Committee of the concerned Medical College Hospital prior to the study. This study complied with the tenets of the Declaration of Helsinki for researches involving human tissue.

All selected patients underwent macular scanning performed by a single experienced optometrist using Fast Macular Thickness (FMT) protocols of a Zeiss Primus 200 OCT system. He assessed the macular thickness and its cube volume measurements. The results were analysed using SPSS v 15 software (SPSS Inc, Chicago, IL, USA). Variations in macular thickness measurement by gender and age were determined. Difference of macular thickness between the right and the left eye were also determined.

Results:

This study was done in 220 eyes of 110 subjects where 62 were males and 48 were females. Out of the 220 eyes 110 were right eyes and 110 were left eyes. The subjects in this study ranged from 21years to 70 years with a mean age of 41.45 years. The average macular thickness of each subject from the total study population was 264.93±24.44µm in the right eye and 266.76±23.42µm in the left eye. While comparing the macular thickness between right and left eyes there was no significant difference (P>0.05). (Figure 1)

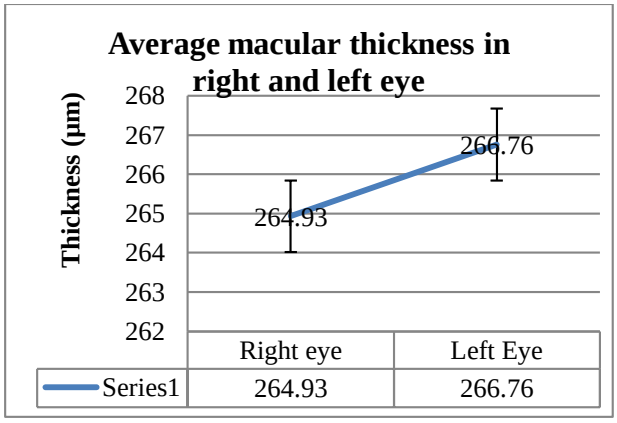


Figure 1: Average macular thickness (µm) in right and left eye in healthy ocular status.

The average macular cube volume of the two eyes (Right 9.54±0.91 mm³, left 9.69±0.76 mm³) did not show any significant difference (P>0.05) (Figure 2) while compared between the right and the left.

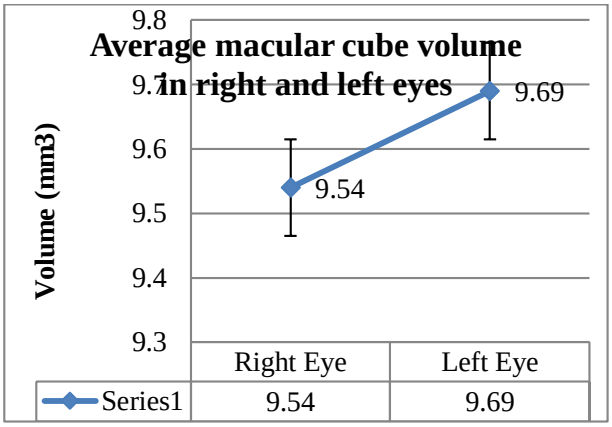


Figure 2: Average macular cube volume (mm³) in right and left eyes in healthy ocular status.

We compared the difference of average macular cube volume between the males and the females (male right eye 9.75±1.00 mm³, female right eye 9.275±1.00 mm³) and (male left eye 9.82±0.87 mm³, female left eye 9.82±0.87 mm³). We found that the difference of total macular cube volume was significantly more in right eyes of males in comparison to that of females (P<0.001) and in left eyes of males comparison to the left eye of females (P<0.001). (Figure 3)

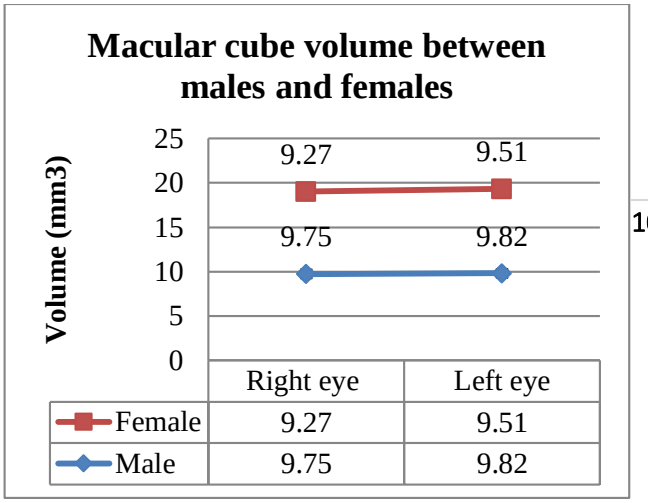


Figure 3: Comparison of macular cube volume (mm³) between males and females.

We compared the average macular thickness between the males and the females (male right eye 273.12±24.72µm, female right eye 254.35 ±19.50 µm), (male left eye 270.14±25.36 µm, female left eye 262.39±19.80 µm). We found that the difference of total macular thickness was significantly more in right eyes of males in comparison to that of females (P<0.001) and in left eyes of males in comparison to the left eye of females (P<0.001). (Figure 4)

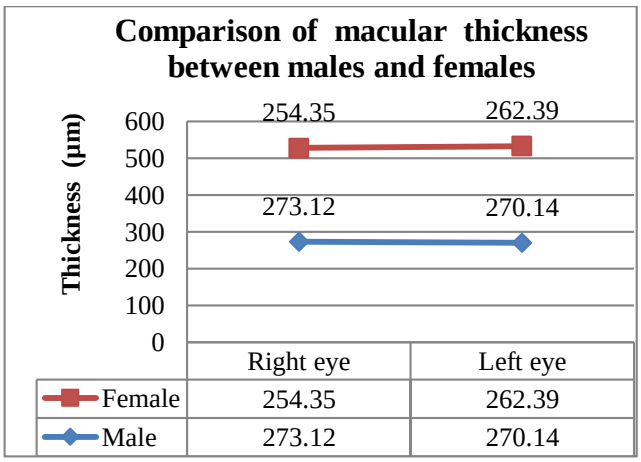


Figure 4: Comparison of macular thickness (µm) between males and females.

By using linear regression analysis we tried to find out if there is any difference of mean macular thickness in different age group. But, we found that there is no association between macular thickness and age of the subjects (p>0.05).

Discussion:

Various ways of examinations are used to investigate the macular thickness. These include slit lamp examinations, photography of the fundii and fundus fluorescein angiography. None of these methods are truly quantitative. These are simply subjective.

High-resolution cross-sectional information about the macula is obtained by using optical coherence tomography (OCT). It gives us reliable and reproducible quantitative retinal thickness measurements[1-5] and it provides us a variety of pathological features.[6]

The optical coherence tomography3 (OCT3), the latest version of OCT, was introduced in the year of 2002 which enhanced imaging speed making it faster. It also improved visualization of the morphological features of the retina. There are numerous publications reporting normative data of the macula with the previous OCT prtotypes[7-10].Our search for review of literature shows that only few articles have been published containing data from OCT3.[11]

In this present study we used the pioneer in ophthalmic OCT3 (PRIMUS® 200 from ZEISS).It is a Spectral Domain OCT, with Super Luminescent Diode (SLD), 840nm, 2.0mm (in tissue), 1024 points,5±1µm (in tissue),5line raster with adjustable orientation methodology which offers patients a visual representation of their macular health. It helps enormously in providing guidelines for treatment and follow up of retinal diseases involving the macula. It also enables clinicians an easy to explain method for communicating complex examination results to patients.

Our results are different from previously published values obtained using earlier versions of OCT machines. In our study, the mean macular thickness was 264.93 ± 24.44µm in the right eye and 266.76± 23.42µm in the left eye which was approximately 30 to 60µm thicker than previously reported values.[12,13]

The examiner has to be cautious about the type discrepancies in data and images obtained by different OCT machines. Macular analysis by OCT of different types may give a little different results. Macular thickness evaluation by OCT were reported by several studies[14,19] Investigators have shown the correlation between macular thicknesses with best-corrected visual acuity in healthy eyes.

Our result shows a mean macular thickness of males 273.12±24.72 µmin the right eye and 270.14±25.36 µmin the left eye. We found that the mean macular thickness of females was 254.35±19.50 µmin the right eye and 262.39±19.80 µm in the left eye. Recently reported macular thickness in a normal person is 266±14.20 µm in males and 258.21±10.03µm in females[20]. These values are comparable to our results.

However, Bindu Appukuttan et al[21] reported macular thickness of 220-300 µm in normal healthy subjects, which varied from that of our results. This variation may be because they used an earlier version of OCT and in subjects of a different geographical region. There is documentation of variation in macular thickness with demographic changes. Kashani et al[22] showed that mean macular thickness at fovea was 181.0± 3.7 µm in African Americans and 200.2±2.7 µm in Caucasians which was analyzed using Stratus OCT.

There are publications reporting comparison of macular data between males and females. However, there is no such literature showing such a comparison of data in North East India. Mehreen Adhi et al[23], using Topcon SD-OCT system in a different geographical region, showed that male gender was associated with greater macular thickness. Our results also showed that males are associated with greater macular thickness than females. Our results are similar to that of Adhi et al.

The type of OCT system in use is an important parameter when comparing macular thickness and macular volume measurements. It is also an important parameter while monitoring macular pathologies. Measurement reproducibility is very essential when determining clinical usefulness of an OCT system, particularly when monitoring retinal pathologies. Studies using Spectral Domain OCT systems have reported better reproducibility for measuring macular thickness in normal and pathologic states than that with the conventional time-domain systems.[24] As with other SD-OCT systems, reproducibility is better with Zeiss primus 200 OCT system. It is due to its rapid speed of scan acquisition.

We used Zeiss primus 200 OCT system to obtain images from each subject as close to the fovea as possible, excluding images with obvious segmentation errors. We adjusted for poor fixation if deemed necessary, with the understanding that slight differences in positioning, eye movements, blinking, artifacts and poor fixation may affect the reliability of the macular thickness measurements. From all these points, the data and pictures of our study relating to the macular thickness and macular volume were reliable and reproducible ones.

Conclusion:

The data of macular thickness obtained from our study varied from those of some other reports which used different OCT system. Nevertheless, our data are comparable to many other studies where similar OCT systems were used. We have demonstrated that males are associated with greater macular thickness and volume than females in healthy eyes, while there is no difference of macular thickness between the right and the left eye and macular thickness has no association with age. This is the first reporting of comparison of data of macular thickness and volume in North East Indian Population.

We have used the Spectral Domain OCT system to provide normative data for macular thickness in healthy eyes. Our study is a novel one in the sense that it is the first study to provide normative data of macular thickness and volume from North East India. It is a benchmark for diagnosing and monitoring macular pathologies of patients of this region. The values obtained in this study may be useful for comparison with other populations, other SD-OCT systems and future imaging technologies.

Further investigations with higher number of participating subjects, use of cross-sectional samples and better imaging technology, if invented, may be recommended to attain a more accurate results and database.

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