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A CROSS SECTIONAL STUDY OF MACULAR MORPHOLOGY ON SD-OPTICAL COHERENCE TOMOGRAPHY IN PATIENTS WITH HIGH MYOPIA

Dr. Nivisha Bandodkar — Ex-PG M.S. Ophthalmology Resident doctor, T.N.M.C. & B.Y.L. Nair ch. Hospital, Mumbai.

Dr. Anamika Agrawal — Professor Addl. , T.N.M.C. & B.Y.L. Nair ch. Hospital, Mumbai.

Dr. Anuja Gharat* — Associate Professor, T.N.M.C. & B.Y.L. Nair ch. Hospital, Mumbai.
*Corresponding Author

ABSTRACT

High myopia is one of the leading causes of blindness because of its associated ocular co-morbidities, most prominently in the retina. We conducted a cross-sectional study to study the macular morphology on SD-OCT and to correlate it with visual acuity and degree of myopia.

Material And Methods: The patients in the age group between 18 to 50 years having refractive error ranging from -6D to -23D with a mean SE of -12.2±4.6 D were included. Eyes with retinal pathology, uveitis, glaucoma were excluded. BCVA was assessed on Snellens chart. Indirect ophthalmoscopy was done to see the fundus changes in disc, macula and peripheral retina. SD-OCT macula was performed and Central subfield thickness(CST) indicating the foveal thickness, average of the four-quadrant macular thickness in the inner macular ring(1–3mm, AIM) and outer macular ring(3–6 mm, AOM) were recorded.

Results: Visual acuity was found to be significantly affected by the degree of myopia; lower degrees of myopia had better visual acuity. The frequency of degenerative myopic lesions in the fundus was found to be higher in groups with higher degree of myopia. A strong correlation was found between the degree of myopia and the foveal thickness, the inner macular thickness and the outer macular thickness with {r=-0.491, r=0.513, r=0.514 (p<0.001) respectively}

Conclusion: Degenerative fundus changes at macula are common in high myopia. OCT provides noninvasive, accurate imaging of retinal abnormalities in high myopia. With en face OCT, localization and relation of retinal lesions can be precisely defined especially in myopic eyes.

KEYWORDS :

INTRODUCTION

With the emergence of new technologies such as Optical coherence tomography(OCT), it has made possible to explore the changes in ocular layers and enhanced our understanding by providing information not readily available by conventional imaging techniques or fundus examination.

A correlation between macular thickness and different grades of myopia has been reported by a number of studies from China, South East Asian countries and some of the European countries, using OCT. There are very few reports on macular thickness measurement on OCT in myopia in Indian centres. We conducted a cross-sectional study to investigate the macular morphology using spectral domain-OCT (SD-OCT) and its correlation with degree of myopia & visual acuity.

MATERIALS AND METHODS:

A cross-sectional study was conducted in ophthalmology outpatient department of tertiary care hospital after getting the approval of Institutional Ethics Committee. 198 eyes with age ranging from 18 to 50 years, refractive error of >-6 D were included after written informed consent.

Patients with history of intraocular surgeries, media opacities, or retinal pathologies were excluded. Visual acuity was checked on Snellen's chart and its decimal notation was derived. Streak retinoscopy was done after dilatation and post-mydriatic test was done at follow-up.

Anterior segment examination was done using slit lamp. Indirect ophthalmoscopy was done to see the fundus changes at the posterior pole (disk and macula) and the peripheral retina. SD-OCT was performed using Cirrus SD-OCT system and macular cube 512 × 128 protocol. Central subfield thickness (CST) indicating the foveal thickness, average of the four-quadrant macular thickness in the inner macular ring (1–3 mm, AIM) and outer macular ring (3–6 mm, AOM) were recorded according to ETDRS macular mapping.

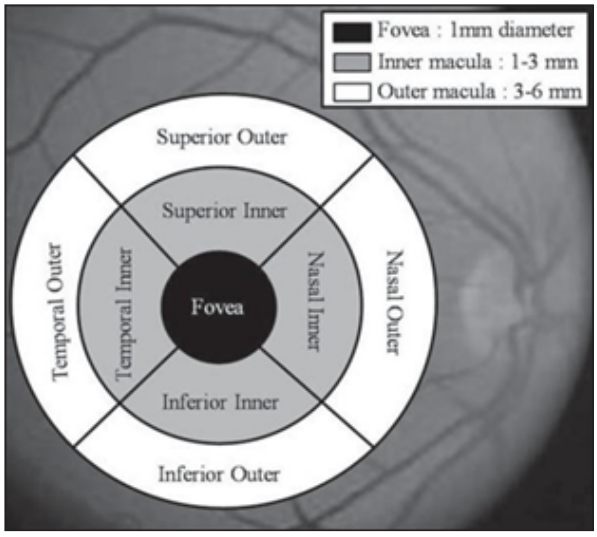

Figure 1: ETDRS Macular Map

Statistical analysis was done using SPSS statistical software program (SPSS 21.0; SPSS Inc., Chicago, IL) by Pearson correlation analysis and the significance levels were tested by independent-samples *t*-test, and ANOVA test.

RESULTS

Spherical equivalent was calculated and classified into 4 groups: -6D to ≤-10D, -10 to ≤-15D, -15 to ≤-20D and >-20D. Out of 198 eyes, 89, 64, 28 and 17 eyes belonged to group1,2,3,4 respectively. The mean SE was -12.2±4.6 D. Amongst the disc pathologies, temporal myopic crescent was found to be most common [53.5%], followed by large or tilted disk (31.5%,29%,)respectively . Amongst pathological changes at macula and posterior pole, tessellated fundus was the commonest finding (50.5%), followed by chorioretinal

atrophy (6.5%), pigmentary changes (5%), posterior staphyloma (3.5%), CNVM (2%), Foster-Fuchs spot and macular hole (1%).

Table 1: Correlation Between Regional Macular Thickness And Vision.

Macular regions (Mean +/- SD)	Good VA (6/6 to 6/12)	Moderate VA (6/18 to 6/36)	Poor VA (<6/60)	P value
CST	234.27 ±20.81	211.74± 32.176	217.39± 30.92	0.049
Inner Macula Average	280.63± 18.34	276.77± 19.5	268.7± 28.58	0.036
Outer Macula Average	249.38 ± 18.24	245.69±19.86	237.45+/2 8.85	0.037

In our study, lower degrees of myopia had better visual acuity than the higher (p<0.001). The average inner and outer macular thickness was highest (280.63+/- 18.34, 249.38 +/- 18.24 respectively) in eyes with good visual acuity.

Table 2: Correlation Between Foveal Thickness (CST), AIM, AOM, And Myopia (SE)

Spherical equivalent	Group 1 (-6D to ≤ -10D)	Group 2 (-10D to ≤-15D)	Group 3 (-15D to ≤-20D)	Group 4 (> -20D)	P-Value
CST (Mean +/- SD)	211.13 +/- 23.706	229.36+/- 22.553	237+/- 31.865	256.06 +/- 26.75	<0.001
Average inner macula (AIM)	281.48+/- 12.729	278.35+/- 20.355	273.11+/- 11.484	226.72 +/- 31.231	<0.001
Average outer macula (AOM)	250.23+/- 12.729	247.3+/- 20.77	241.86+/- 11.484	195.47 +/- 31.231	<0.001

In our study it was observed that the mean central subfield thickness progressively increased across groups 1-4 of SE, whereas mean of average inner macular thickness and outer macular thickness progressively decreased. Pearson's correlation was applied to these parameters and the results were plotted in a scatter diagram . There was a strong positive correlation observed between the SE, and the average inner macular (AIM) (r=0.513, P<0.001), and the average outer macular (AOM) thickness (r=0.514). A strong negative correlation (r=-0.491) was found between the SE and central subfield thickness (CST).

DISCUSSION

Pathological myopia is usually defined as *spherical equivalent > 6.00 diopters or axial length >26.5mm*, accompanied by excessive axial elongation resulting in chorioretinal stretching and subsequent thinning involving the ora-equatorial area and the posterior pole. Many clinical studies, namely TYY Lai et al[1] confirm that posterior polar and peripheral **fundus lesions** in high myopia are significantly associated with **severity of refractive error**. These results are according to the histological hypothesis that the retina thins and degenerates in myopic eyes, at the posterior pole and periphery and therefore lesions are seen more in higher degrees of myopia. Furthermore, scleral thinning may cause deformation of the posterior pole leading to staphyloma formation and chorioretinal atrophy and it increases proportionally with increase in axial length[2].

Visual acuity(VA) in high myopia may be subnormal even before advanced myopic maculopathy sets in. This may be due to excessive stretch in the posterior pole causing alteration in the arrangement of photoreceptors (Stiles–Crawford effect)[3].

Myopic foveoschisis(MFS) describes a schisis-like splitting of neurosensory retina into thicker inner layer and thinner outer layer at macula in highly myopic eyes with posterior staphyloma[4]. Its prevalence ranges from 9% to 34% [5]& tends to occur in eyes with severe myopic retinopathy.

Although MFS has been alternatively described as **myopic traction maculopathy (MTM),** in addition it includes vitreomacular traction(VMT), retinal thickening, lamellar or full-thickness macular hole formation, and foveal detachment[5]. MTM always occurs within a posterior staphyloma. The **pathogenesis** behind MTM is probably splitting of retina(at the level of the ELM) over time due to relative tautness and noncompliance of the inner retina compared with outer retina within the posterior staphyloma attributable to VMT from incomplete PVD, remnant preretinal cortical vitreous layer after PVD, epiretinal membranes, taut internal limiting membrane (ILM), and shortened and stiff retinal arterioles(vascular microfolds)[6]. Visual complaints are minimal and progress gradually. Patients may complain of blurring of vision or distortion of vision (metamorphopsia). Vision loss occurs with outer lamellar hole formation or foveal detachment. The diagnosis is confirmed on OCT, which shows the typical splitting of neurosensory retina, bridging columns, and intraretinal. Early stages may be easily **underestimated by biomicroscopic examination & OCTexamination would be crucial**. Macular hole formation in myopic eyes tends to occur at a younger age & may be related to the early onset of vitreous degeneration with development of tangential traction at the level of the premacular cortex[7].

In latest studies using new improved OCT machines, results are similar to our study. According to Wu et al[5] in myopic eyes fovea is thicker but macular thickness and volume is decreased in young adults. As a possible explanation as to why this morphology occurs (thicker in the center – thinner in the periphery), Wu et al propose that as the eye stretches with increased axial length, an increased tangential force across the retinal surface causes the foveal pit to become shallower while the peripheral macula thins. He suggested that ILM stretching and posterior hyaloid phase centripetal force causes foveal elevation. This explanation is consistent with the COMET data as well as with previous reports of decreased macular volume and foveal pit depth[8] in myopes. Panozzo et al[8] also suggested that in degenerative myopia epiretinal traction is cause of increased foveal thickness(>200 microns) which leads to myopic traction maculopathy and macular hole formation. Lam et al[9] stated that in high myopes having age of 35 to 54 years, foveal thickness was greater but the macular thickness was considerably less. Cheng et al[10] did comparison between retinal thickness of eyes of highly myopic and non-myopic individuals having age between 18 to 30 years.

They concluded that the myopic eyes have thicker fovea as compared to non-myopic eyes, but retinal thickness was significantly less in all four quadrants of parafoveal macular areas in myopes. Thinning of the perifoveal region can be explained by the hypothesis that in myopic eyes the retina thins and degenerates, especially at the posterior pole.

CONCLUSION:

There is a strong correlation between the degree of myopia and the regional macular thickness. As the degree of myopia increases, the foveal thickness increases, whereas the inner and outer macular thickness decreases. SD-OCT provides accurate imaging of retinal abnormalities in high myopia. It allows width measurement and point-to-point localization of changes that is crucial in detecting minimal changes during

follow-up of myopic patients.

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