ORIGINAL ARTICLE

COMPARISON OF MACULAR THICKNESS BETWEEN HIGHLY MYOPIC AND NORMAL CHILDREN AGED 5 TO 8 YEARS USING OPTICAL COHERENCE TOMOGRAPHY

Maria Sultan[1], Syed Amir Hamza[2], Mir Ali Shah[3], Mohammad Naeem Khan[4], Nasir Saeed[5]

[1,2,4,5] Department of Ophthalmology, Hayatabad Medical Complex, Peshawar – Pakistan.
[3] Department of Ophthalmology, Lady Reading Hospital, Medical Teaching Institution, Peshawar – Pakistan.
Address for correspondence:
Dr. Mir Ali Shah
Associate Professor,
Department of Ophthalmology, Lady Reading Hospital, Medical Teaching Institution, Peshawar – Pakistan.
Email: drmashahpsh@hotmail.com
Date Received:
October 30, 2017
Date Revised:
March 03, 2018
Date Accepted:
March 10, 2018

ABSTRACT

Objective: To compare of macular thickness between highly myopic and normal children aged 5 to 8 years using optical coherence tomography.

Methodology: A prospective case control comparative study was performed in the Department of Ophthalmology, Hayatabad Medical Complex, Peshawar from July 2015 to June 2016. Children meeting the inclusion criteria of both genders were selected from outpatient department using non-probability purposive sampling after complete ophthalmological examination. Children aged 5 to 8 years were divided in two groups. Group1: high myopic children (>-6.00 D) and Group 2: healthy age matched controls (-1 to +2 D). Optical coherence tomography (OCT) macula was performed on children in both groups, measuring average thicknesses of the fovea (central 1 mm), inner (1 to 3 mm) and outer parafoveal area (3 to 6 mm), in all the four quadrants. Calculations were also done for total volume of scanned macular area. The macular thickness of these two groups was compared and Mann–Whitney U test (two tailed test, unpaired/independent) was used to calculate the differences between the two groups.

Results: There were 25 patients in high myopic group and 25 patients in control group. Thickness of 1mm central foveal ring was significantly greater in children included in high myopia group. The parafoveal thickness was significantly thinner in all four quadrants of inner and outer circles in high myopia group. The calculated macular volume (average) of the highly myopic children was significantly smaller as compared to control group.

Conclusions: There was thicker fovea, thinner parafoveal macular area and smaller macular volume in children having high myopia aged 5 to 8 years as compared to age matched healthy controls.

Key Words: Optical coherence tomography, Macular thickness, Myopic children

This article may be cited as: **Sultan M, Hamza SA, Shah MA, Khan MN, Saeed N. Comparison of macular thickness between highly myopic and normal children aged 5 to 8 years using optical coherence tomography. J Postgrad Med Inst 2018; 32(1): 76-9.**

INTRODUCTION

Myopia more than -6.00 Diopters is usually defined as high myopia, can be linked with diseases like macular hole, retinal detachment, amblyopia, cataract, glaucoma, macular degeneration, that may lead to severe visual impairment[1,2]. Axial increase in eye ball's anterior posterior diameter is responsible for retinal stretching which leads to retinal thinning in patients having myopia leading to changes like degeneration[3,4]. Previously in many studies OCT was used to reveal these retinal morphological changes by measuring macular volume and retinal thickness[5,6]. Most of studies are done in older population or in children above 11-12 years, results show that myopia is associated with relatively increased thickness of fovea, decreased volume of macula and decreased parafoveal macular thickness. We therefore conducted this study in children 5 to 8 years old, having high myopia. By using OCT in this study we have compared thickness of macula and volume of macula in children.

METHODOLOGY

This case control comparative prospective study was conducted in Department of Ophthalmology, Hayatabad Medical Complex, Peshawar, from July 2015 to June 2016. There were total 50 patients, which are divided in 02 groups; group 1 had high myopic children (n=25), while group 2 (n=25) had age-matched controls.

Patients in this study included children having age of 5 to 8 years who came to Paediatric Ophthalmology Department. Sampling technique was purposive non probability sampling. Children were assigned to one of the two groups. Group1: high myopic children having cycloplegic, spherical equivalent (SE) refraction >-6.00 Diopters. Group 2: age matched healthy controls having cycloplegic SE refraction range of -1 and +2 D. Children having history of previous ocular disease, ocular trauma or ocular surgery, children having premature birth history and uncooperative children while performing OCT were excluded from the study. From each child's guardian informed consent was taken. Each child included in this study had complete ophthalmological examination including best corrected visual acuity (BCVA) using Snellen or tumbling E chart later changed to log MAR logarithm of the minimal angle of resolution (logMAR) values, slit-lamp examination including fundus examination using 78D lens, indirect ophthalmoscopy, and cycloplegic refraction from which spherical equivalent was calculated (cycloplegic refraction was done after 40, when two drops of 1% cyclopentolate are installed in eyes with 5 minutes interval).

A-scan ultrasonography was used to calculate mean axial length for each eye (mean of 5 repeated readings). OCT was done on every patient's both eyes with dialated pupils (>5 mm diameter) after cycloplegic refraction. Spectaralis OCT (Heidelberg, Germany) was used to calculate macular thickness. Single skilled consultant did all macular scans. After centration of macular topographer on fovea, macular scans were taken to get retinal thickness map. Average foveal thickness of central 1 mm foveal ring along with average macular thickness of all the four quadrants of macula , within 3- and 6-mm diameter circle, outside central ring of fovea was determined. Calculations were done for total volume of macular scanned area. The final outcome readings were measured and data was entered in proforma. SPSS 20 was used for data analysis. The macular thickness of these two groups was compared and Mann–Whitney U test (two tailed test, unpaired/independent) was used to calculate the differences between the two groups. P value <.05 was considered statistically significant.

RESULTS

There were 25 patients in group 1: high myopic children (13 boys and 12 girls) and 25 patients in group 2: age matched controls (12 boys and 13 girls). There was no significant difference in age and gender between two groups. The calculated values determined for right eyes of patients were considered for further evaluation, as the difference between the measurement for fellow eyes was not significant.

The mean SE refraction was -9.39 ±2.79 D in high myopic group and +0.81 ±1.00 D (P <.05) in control group. The mean axial length was 26.39 ±0.70 mm in high myopic group and 22.00 ±1.12 mm in the control group (P <.05). In right eyes of high myopia group mean visual acuity was 0.31 logMAR and in right eyes of control group mean visual acuity was 0.09 logMAR (P <.05). In high myopia group central 1 mm thickness of fovea was significantly greater. Whereas macular thicknesses of inner 1 to 3 mm circle and outer 3 to 6 mm circle in all four quadrants was significantly less in children having high myopia. In highly myopic eyes average macular volume was significantly smaller as compared to eyes in control group (Table 1).

Table 1: Mean macular thickness (micrometer) and mean macular volume (mm3)

Location	High Myopia Group	Control Group	P Value
Fovea (central 1mm)	193.15	163.90	< 0.05
Inner Macula (1 to 3 mm)			
Superior	206.49	249.66	< 0.05
Nasal	211.55	265.29	< 0.05
Inferior	209.82	243.02	< 0.05
Temporal	194.35	231.47	< 0.05
Outer Macula (3 to 6mm)			
Superior	238.59	276.75	< 0.05
Nasal	232.89	266.11	< 0.05
Inferior	237.29	274.93	< 0.05
Temporal	224.59	264.38	< 0.05
Macular Volume	5.98	7.10	< 0.05

DISCUSSION

In our study, we measured macular thickness and volume in children aged 5 to 8 years having high myopia and compared it to macular thickness and volume of age matched normal controls. Due to increase in antero-posterior elongation of eye ball in highly myopic eyes there is increase in axial length of eye resulting in mechanical stretching, thinning of retina which can be seen as retinal degenerative changes on fundus examination[7,8]. OCT is very useful tool which is used to measure changes in macular morphological characteristics in myopic patients. It is also very useful for evaluation of younger children[9,10].

Lim et al[11] conducted a study in 2005 and stated that there are no significant retinal changes in myopic patients as compared to normal population. They used 1st generation OCT for retinal thickness measurements. Same findings were reported by Wakitani et al[12] in another study. This may be because of comparatively low scanning resolution of devices used by them, giving less reliable results. In our study we used Spectaralis OCT, with improved scanning resolution and lesser scanning time giving more reliable retinal thickness measurements[13,14]. In latest studies using relatively 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. Lam et al[15] stated that in high myopes having age of 35 to 54 years, foveal thicknesses was greater but the macular thicknesses was considerably less. Luo et al[7] also did the same study on children having age of 11 to 12 years and noted that there is decreased macular thickness in all quadrants and smaller macular volume and greater foveal thickness in children having increasing axial myopia.

Cheng et al[16] 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. These studies have similar results to our study in which we included children having age of 5 to 8 years. In myopic eyes smaller macular volume and thinner retina as demonstrated by OCT scans is because of increased chorioretinal atrophic changes associated with increase in scleral and retinal thinning[8,17].

Why fovea is thicker in myopic eyes, the reason is still not very clear. Pathological changes in subfoveal chorioretinal area can be the one reason. It was noted that in myopic form deprived animals, blood–retinal barrier permeability in sub foveal region was considerably more as compared to control group[7,18]. One other reason can be outer segments photoreceptors elongation related to retinomotor movements[19]. Cheng et al[16] study on myopes, demonstrated the presence of considerably thicker middle layer of inner retina in foveal area. Wu et al[5] suggested that internal limiting membrane's stretching and posterior hyloid phase centripetal force causes foveal elevation. Panozzo et al[2] also suggested that in degenerative myopia epiretinal traction is cause of increased foveal thickness (more than 200 microns) which leads to myopic traction maculopathy and macular hole formation.

A study was conducted by Wang et al[20] in which macular thickness of unilateral highly myopic amblyopic eye was compared to that of normal fellow eye in children having unilateral high myopia in age range of 5 to 18 years. It was found that retinal thickness in foveal area was greater whereas it was less in perifoveal macular areas. But they were not able to prove whether these macular changes in children having amblyopia with unilateral high myopia were because of high myopia, amblyopia or combination of both factors[20]. Other studies on same topic have variable results[21-25]. More research work is needed to understand underlying pathology leading to macular abnormalities in children having high myopia.

CONCLUSION

There was thicker fovea, thinner parafoveal macular area and smaller macular volume in children having high myopia aged 5 to 8 years as compared to age matched healthy controls. This study shows that there were anatomic retinal changes even in young children having high myopia. These structural retinal changes of myopic eyes should be a consideration in the evaluation of children for retinal diseases or glaucoma, while interpreting their OCT findings.

REFERENCES

1. Coppe AM, Ripandelli G, Parisi V, Varano M, Stirpe M. Prevalence of asymptomatic macular holes in highly myopic eyes. Ophthalmology 2005; 112:2103-9.
2. Panazzo G, Mercanti A. Optical coherence tomography findings in myopic traction maculopathy. Arch Ophthalmol 2004; 122:1455-60.
3. Pierro L, Camesasca FI, Mischi M, Brancato R. Peripheral retinal changes and axial myopia. Retina 1992; 12:12-7.
4. Kobayashi K, Ohno-Matsui K, Kojima A, Shimada N, Yasuzumi K, Yoshida T et al. Fundus characteristics of high myopia in children. Jpn J Ophthalmol 2005; 49:306-11.
5. Wu PC, Chen YJ, Chen CH, Chen YH, Shin SJ, Yang HJ et al. Assessment of macular retinal thickness and volume with third-generation optical coherence tomography. Eye (Lond) 2008; 22:551-5.

6. Xie R, Zhou XT, Lu F, Chen M, Xue A, Chen S et al. Correlation between myopia and major biometric parameters of the eye: a retrospective clinical study. Optom Vis Sci 2009; 86:E503-8.
7. Luo HD, Gazzard G, Fong A, Aung T, Hoh ST, Loon SC et al. Myopia, axial length, and OCT characteristics of the macula in Singaporean children. Invest Ophthalmol Vis Sci 2006; 47:2773-81.
8. Yanoff M, Fine BS. Ocular Pathology: A Text and Atlas, 3rd ed. Lippincott PJB. Surv Ophthalmol; 1989:737.
9. Wang XY, Huynh SC, Burlutsky G, Ip J, Stapleton F, Mitchell P. Reproducibility of and effect of magnification on optical coherence tomography measurements in children. Am J Ophthalmol 2007; 143:484-8.
10. Huynh SC, Wang XY, Burlutsky G, Mitchell P. Symmetry of optical coherence tomography retinal measurements in young children. Am J Ophthalmol 2007; 143:518-20.
11. Lim MC, Hoh ST, Foster PJ, Lim TH, Chew SJ, Seah SK et al. Use of optical coherence tomography to assess variations in macular retinal thickness in myopia. Invest Ophthalmol Vis Sci 2005; 46:974-8.
12. Wakitani Y, Sasoh M, Sugimoto M, Ito Y, Ido M, Uji Y. Macular thickness measurements in healthy subjects with different axial lengths using optical coherence tomography. Retina 2003; 23:177-82.
13. Gurses-Ozden R, Teng C, Vessani R, Zafar S, Liebmann JM, Ritch R. Macular and retinal nerve fiber layer thickness measurement reproducibility using optical coherence tomography(OCT-3). J Glaucoma 2004; 13:238-44.
14. Paunescu LA, Schuman JS, Price LL, Stark PC, Beaton S, Ishikawa H et al. Reproducibility of nerve fiber thickness, macular thickness, and optic nerve head measurements using Stratus OCT. Invest Ophthalmol Vis Sci 2004; 45:1716-24.
15. Lam DS, Leung KS, Mohamed S, Chan WM, Palanivelu MS, Cheung CY et al. Regional variations in the relationship between macular thickness measurements and myopia. Invest Ophthalmol Vis Sci 2007; 48:376-82.
16. Cheng SC, Lam CS, Yap MK. Retinal thickness in myopic and non-myopic eyes. Ophthalmic Physiol Opt 2010; 30:776-84.
17. Curtin BJ. The posterior staphyloma of pathologic myopia. Trans Am Ophthalmol Soc 1977; 75:67-86.
18. Kitaya N, Ishiko S, Abiko T, Mori F, Kagokawa H, Kojima M et al. Changes in blood-retinal barrier permeability in form deprivation myopia in tree shrews. Vision Res 2000; 40:2369-77.
19. Liang H, Crewther DP, Crewther SG, Barila AM. A role for photoreceptor outer segments in the induction of deprivation myopia. Vision Res 1995; 35:1217-25.
20. Wang XY, Huynh SC, Burlutsky G, Stapleton F, Mitchell P. Reproducibility of and effect of magnification on optical coherence tomography measurements in children. Am J Ophthalmol 2007; 143:484-8.
21. Huynh SC, Samarawickrama C, Wang XY, Rochtchina E, Wong TY, Gole GA et al. Macular and nerve fiber layer thickness in amblyopia: the Sydney Childhood Eye Study. Ophthalmology 2009; 116:1604-9.
22. Altintas O, Yuksel N, Ozkan B, Caglar Y. Thickness of the retinal nerve fiber layer, macular thickness, and macular volume in patients with strabismic amblyopia. J Pediatr Ophthalmol Strabismus 2005; 42:216-21.
23. Dickmann A, Petroni S, Salerni A, Dell'Omo R, Balestrazzi E. Unilateral amblyopia: an optical coherence tomography study. J Am Assoc Pediatr Ophth Strab 2009; 13:148-50.
24. Kee SY, Lee SY, Lee YC. Thicknesses of the fovea and retinal nevre fiber layer in amblyopic and normal eyes in children. Korean J Ophthalmol 2006; 20:177-81.
25. Aguirre F, Mengual E, Hueso JR, Moya M. Comparison of normal and amblyopic retinas by optical coherence tomography in children. Eur J Ophthalmol 2010; 20:410-8.

CONTRIBUTORS

MS and SAH conceived the idea, planned the study, did data collection and final approval of manuscript. MAS did literature search, statistical analysis and drafted the manuscript. MNK did literature search and critically revised the manuscript. NS supervised the study and did corrections in references writing. All authors contributed significantly to the submitted manuscript.