2023
Section: Ophthalmology

Pentacam Topography and Macular Optical Coherence Tomography Findings In Eyes Presenting With Refractive And Axial Myopia

Adel Abd Elaziz Hassouna
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Hassan Metwally Bayoumi
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.

Ammar Ibrahim Mohammed Nassar
Department of Ophthalmology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.,
ammarnassar19915@gmail.com

ORIGINAL ARTICLE

Pentacam Topography and Macular Optical Coherence Tomography Findings in Eyes Presenting with Refractive and Axial Myopia

Adel Abd Elaziz Hassouna, Hassan Metwally Bayoumi, Ammar Ibrahim Mohammed Nassar*

Department of Ophthalmology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: Myopia is circular refractive error in which parallel light rays enter eye and shift point of conjugate focus anteriorly in front of retina. High myopia is usually with (>−6.00 SD) or axial length (AL) more than 26 mm.

Aim and objectives: Goal of research is to identify the results in eyes presenting with refractive and axial myopia using macular optical coherence tomography and pentacam.

Subjects and techniques: Research is prospective research that will be carried out on 60 eyes with high myopia more than or equal -6SD. Ages ranging from 20 to 70 years old. They will be divided into two groups A-refractive myopia B- axial myopia and meeting the inclusion criteria.

Results: There was non-important variation among 2 tested groups concerning anterior segment parameters (CCT, ACD, and WTW). A negative relation between axial length and CMT. While, there was positive relationship among axial length, age and WTW. No relationship was shown among axial length and ACD. There was highly statistically significant RPE thinning were found in axial myopia, While, CNV, RD and MH was with on statistical significance.

Conclusion: Assessing anterior and posterior segment is essential for patients with high myopia to detect various types of diseases or before planning for refractive surgeries, and for prescribing and exactly measuring power of contact lenses and IOLs.

Keywords: Anterior chamber depth, Axial length, High myopia, Myopia, OCT, Pentacam

1. Introduction

Myopia is now recognised as a major public health issue that causes visual loss and is a risk factor for a variety of serious ocular situations. Global occurrence of situation is rising for unknown causes, even if partial decreases in progression rates have been noticed with pharmacologic treatments, optical therapies, and behavioural changes.[1] Most common type of refractive error is myopia. It is a complicated trait that involves both genetic and environmental factors.[2] Even though myopia is simply managed with appropriate optical correction, it is a risk factor for a variety of retinal pathologies and 1 of the leading reasons for visual dysfunction, particularly in studied cases with great myopia.[3]

Recently, with its fine cross-sectional images of retinal structures, optical coherence tomography has highly aided in the assessment of posterior vitreoretinal anatomy in eyes with great myopia. It may identify retinal modifications that would go undetected in asymptomatic studied cases. As a result, it gives information that conventional imaging methods or fundus tests cannot.[4]

Pentacam is a noninvasive, quick, and repeatable optical system that can be used to evaluate the ocular anterior segment from the anterior corneal surface to the posterior lens surface for corneal topography, corneal pachymetry, and anterior chamber depth analysis.[5]

The purpose of this work is to identify the results in eyes presenting with refractive and axial myopia

using macular optical coherence tomography and pentacam topography.

2. Studied cases and techniques

This was cross-sectional research which done at Ophthalmology department at Al Hussein University Hospitals. This study had been conducted on 60 eyes with high myopia more than or equal -6SD. Ages ranging from 20 to 70 years old.

They were separated into 2 groups: Group A- 30 eyes with axial myopia, **Group B-** 30 eyes with refractive myopia.

2.1. Inclusion criteria

Both Sexes were included, adult patients aging above 20 years, normal cornea (no ectasia, no ulcer), high myopia more than or equal -6SD and all patients signed a written informed consent.

2.2. Exclusion criteria

Years old under twenty, patients with dense media opacity, patients who had any ocular surgery in the same eye, patients with systemic diseases as diabetes mellitus or toxoplasmosis, pregnancy and patients refused to participate or complete research.

2.3. Methods

Written informed **consent** was achieved from studied cases before beginning, after clarifying objective of research.

2.4. History taking

Age, sex, the history of any previous eye disease, progression of the condition in the form of diminution of vision, time of spectacle change, contact lens wear and tolerability, symptoms of high myopia such as eyestrain, far vision difficulties, blurring of vision, headaches and co-morbidities (e.g. diabetes, hypertension, cardiac, hepatic or renal pathology).

2.5. Ophthalmologic investigation

For all cases, **Visual acuity:** Uncorrected and best corrected visual acuity. **Refraction:** Cycloplegic refraction objectively by autorefractometer (Topcon). Manifest refraction was determined. **Anterior segment examination** was done by slit lamp Biomicroscopy for detection of any pathology including corneal opacity, lens opacity and anterior chamber activity. **Posterior segment examination** after dilation of pupil with tropicamide eye drops 1% using indirect ophthalmoscope (Keeler Ltd. Windsor, UK) (using handheld +20D lens) thorough examination of peripheral fundus for Degenerations, breaks, retinal detachment hemorrhage, exudate, pigmentary retinopathy, chorioretinal scars. Slit lamp Biomicroscopy using handheld +90D lens (Volk Optical, Mentor, OH) for thorough examination of macula whether it is flat or elevated, if there was hemorrhage, exudate, drusen or atrophy.

2.6. Corneal imaging

Using The Oculus Pentacam with Scheimpflug imaging. **Optical coherence tomography for retinal imaging:** It was performed using Cirrus SD-OCT (Carl Zeiss Meditec, Inc.). It made use of light emitted by infrared broadband Super Luminescent Diode (SLD) source with 830 nm centre wavelength frequency. It had axial resolution of <10 μm and digital on-screen resolution of <6 μm. Twenty micron transverse resolution. **IOL Master** An optical biometer that measures axial length of eye using partial coherence interferometry at wavelength of 780 nm.

2.7. Administrative considerations

An Official permission was obtained from Al-Azhar University, Faculty of Medicine.

2.8. Ethical consideration

Ethics Committee has permitted research. All studied cases delivered informed consent after being informed about research's goals and procedures. Research processes had no negative impacts on participants or service provided. Individual data has been kept private by principal investigators. There was no extra fee to be paid by participants, and investigators covered all costs.

2.9. Data management statistical analysis

SPSS version twenty was used for data entry, processing, and statistical analysis. **(USA Statistical Package for Social Sciences).** The following exams of importance were used: Kruskal-Wallis, Wilcoxon's, Chi square, logistic regression analysis, and Spearman's comparison. Data were presented, and appropriate analysis was performed based on type of data acquired for each variable. P values of less than 0.05 (5%) were deemed significant. **P value: significance level: $P > 0.05$:** nonsignificant, $P < 0.05$: significant, $P < 0.01$: greatly significant.

2.10. Analytical statistics

Kruskal-Wallis test was used to determine statistical significance of non-parametric differential variation among more than two study groups. 1-way ANOVA for distributed continuous variables. Following ANOVA, post hoc was conducted using Tukey test, followed by post hoc analysis using Mann-Whitney U test.

3. Results

The previous table shows that there was no variation among group A and group B concerning Sex of cases with P value = 0.592 while there was variation among both groups concerning mean years old of patients found lower in group B than group A with P value = 0.027 (Table 1).

Table finds that there was no variation among group A and group B concerning CCT, ACD and WTW of studied patients (Table 2).

Table finds that there was no variation among axial myopia (group A) and refractive myopia (group B) cases concerning CMT and incidence of positive MH, RD and CNV while there was variation among both groups concerning incidence of positive thinning of RPE found higher in axial myopia than refractive myopia (Table 3).

Table 1. Comparing among group A and group B relating to demographic data of the studied patients.

Demographic	Group A Number = thirty	Group B Number = thirty	Test value	P value	Sig.
Age					
Mean ± SD	25.97 ± 7.99	22.33 ± 3.65	2.266[b]	0.027	S
Range	18−51	18−30			
Sex					
Female	20 (66.67%)	18 (60.0%)	0.287[a]	0.592	NS
Male	10 (33.33%)	12 (40.0%)			

P value > 0.05: Nonsignificant; P value < 0.05: Significant; P value < 0.01: Greatly significant.
[a] Chi-square test.
[b] Independent t-test.

Table 2. Comparing among group A and group B concerning CCT, ACD and WTW data of the studied patients.

	Group A Number = thirty	Group B Number = thirty	Test value	P value	Sig.
Central corneal thickness (CCT) (um)					
Mean ± SD	0.51 ± 0.02	0.50 ± 0.03	0.738[a]	0.463	NS
Range	0.48−0.58	0.47−0.59			
Anterior chamber depth (ACD) (mm)					
Mean ± SD	3.51 ± 0.35	3.53 ± 0.28	−0.335[a]	0.739	NS
Range	2.96−4	2.79−3.87			
White to white (WTW) (mm)					
Mean ± SD	11.58 ± 0.31	11.42 ± 0.31	1.975[a]	0.053	NS
Range	10.98−12.02	10.92−12.01			

P value > 0.05: Nonsignificant; P value < 0.05: Significant; P value < 0.01: Greatly significant.
[a] Independent t-test.

Table 3. Comparing between group A and group B relating to CMT, RD, MH, & CNV and thinning of RPE of the studied patients.

	Group A Number = thirty	Group B Number = thirty	Test value	P value	Sig.
Central macular thickness (CMT)					
Mean ± SD	248.63 ± 69.42	237.73 ± 13.13	0.845[b]	0.402	NS
Range	213−490	211−263			
Retinal detachment (RD)					
No	29 (96.67%)	30 (100.0%)	1.017[a]	0.313	NS
Yes	1 (3.33%)	0 (0.0%)			
Macular hole (MH)					
No	29 (96.7%)	30 (100.0%)	1.017[a]	0.313	NS
Yes	1 (3.3%)	0 (0.0%)			
Thinning of RPE					
No	20 (66.7%)	30 (100.0%)	12.00	0.001	HS
Yes	10 (33.3%)	0 (0.0%)			
Choroidal neovascularization (CNV)					
No	27 (90.0%)	30 (100.0%)	3.158[a]	0.076	NS
Yes	3 (10.0%)	0 (0.0%)			

P-value >0.05: Nonsignificant; P-value <0.05: Significant; P-value <0.01: Greatly significant.
[a] Chi-square test.
[b] Independent t-test.

Table 4. Relationship among Axial length (mm) and other studied parameters among studied patients.

	Axial length (AL) (mm)	
	R	P value
Age	0.275*	0.033
Central corneal thickness (CCT) (um)	0.036	0.783
Anterior chamber depth (ACD) (mm)	−0.070	0.597
White to white (WTW) (mm)	0.270*	0.037
Central macular thickness (CMT)	−0.364**	0.004

P value > 0.05: Nonsignificant; P value < 0.05: Significant; P value < 0.01: Greatly significant Spearman relationship coefficient.

Table finds that there was no correlation among axial length and central corneal thickness, anterior chamber depth, while there was positive relationship among axial length and age, white to white and also a negative correlation with central macular thickness (Table 4).

4. Discussion

Pentacam, noninvasive, quick, and repeatable optical system can be used to evaluate ocular anterior segment from anterior corneal surface to posterior lens surface for corneal topography, corneal pachymetry, anterior chamber depth analysis, and lens clarification analysis.[5]

Research measured anterior segment parameters of eyes in two high myopic groups (axial and refractive myopia) with spherical equivalent (SE) (>−six D) or axial length more than twenty six mm by using Pentacam Scheimpflug imaging and macular changes in the same groups using OCT.

Research contained 60 studied cases, their age ranging from 20 to 70 with high myopia. In our study there were 22 (36.67%) of the studied cases were males and 38 (63.33%) were females. The mean age was 24.15 ± 6.43 SD with range (18–51).

There was no variation in anterior segment parameters among right and left eyes, according to findings of research. No substantial variations in these parameters were discovered among right and left eyes in research of Indian population.[6]

This study showed that CCT measurements is not influenced by severity of myopia, and this was reinforced by southern Egyptian research that showed CCT to be similar between emmetropes, hyperopes and myopes.[7]

This is as stretching mechanism in myopia, which produces sclera thinning, has no effect on cornea.[8]

There does not show up to be agreement on correlation among CCT and axial length. Chang et al.[9] CCTs were thinner in eyes with higher axial length. They suggested that as surface area of cornea risen,

corneal stroma became thinner, and that as eyeball elongated axially, decreased corneal thickness could be predicted. Their subpopulation can be too small to provide true CCT-axial length correlation in general population. Oliveira et al.[10] There was no relationship among CCT and axial length in studied cases. With P = 0.783, current research shows poor relationship among CCT and axial length.

We found a little correlation between anterior chamber depth in the two groups with axial length (P = 0.597). Hosny et al.[11] it was discovered that rise in axial length enhanced anterior chamber depth to certain extent, whereas rise in anterior chamber depth above certain point (26 mm) did not essentially imply rise in anterior chamber depth. Similarly, Holladay,[12] and colleagues showed that anterior chamber depth did not deal with axial length of globe.

Research described positive association among AL increasing and age (P = 0.033). Consistent with our study, In Central Indian Eye and Medical Research and Mongolian Research, AL rises with birth date Nangia et al.[13] In contrast, Latino Eye research and Liwan Research found no link among AL and birth date.[14]

In our study there was positive relationship among white to white and axial length (P = 0.037). Hosny et al.[11] show that corneal diameter reduces with hyperopia and rises with myopia, however it relates with anterior chamber depth, so when corneal diameter is larger.

Myopic CNV, RD and Macular hole (MH) are very serious sight-threatening complication of myopia, especially pathological myopia (PM) where Avila et al.[15], studies had estimated the prevalence of PM in adults is 1–3%, while 5–11% of them developed myopic choroidal neovascularization (mCNV). Pathogenesis of mCNV is mystery. However, occurrence of lacquer cracks and chorioretinal atrophy may be responsible for mCNV occurrence as stated by Ikuno et al.[16]

In our study, three mCNV, one RD and MH were found in patients with axial myopia with no statistical significance. Abdalla et al.[17] state in his study that four out of five mCNV were women, perhaps because of the higher number of female studied cases in the research or myopia is more related to women. Thinning of RPE and myopic contour are mainly found in high myopia. In our study there was a highly positive statistical significance increase of number of patient with RPE thinning in group A.

4.1. Conclusion

Our study we concluded that in comparison between two high myopic groups (axial and refractive)

there was no significant differences regarding the anterior segment parameters (CCT, ACD, and WTW). There was a negative relation between axial length and CMT. While, there was positive relationship among axial length, age and WTW. No relationship was shown among axial length and ACD. A significant higher incidence of RPE thinning were found in axial myopia, as well, CNV, RD and MH but with no significance.

Authorship

All authors have a substantial contribution to the article.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

The authors declared that there were NO conflicts of Interest.

References

1. Wildsoet CF, Chia A, Cho P. IMI − interventions for controlling myopia onset and progression report. *Invest Ophthalmol Vis Sci*. 2019;60:M106−M131.
2. Pan CW, Ramamurthy D, Saw SM. Worldwide prevalence and risk factors for myopia. *Ophthalmic Physiol Opt*. 2012;32: 3−16.
3. Song AP, Wu XY, Wang JR, Liu W, Sun Y, Yu T. Measurement of retinal thickness in macular region of high myopic eyes using spectral domain OCT. *Int J Ophthalmol*. 2014;7:122−127.
4. Hajizadeh F, Riazi-Esfahani M. Optical coherence tomographic findings in highly myopic eyes. *J Ophthalmic Vis Res*. 2010;5:110−121.
5. Cho YK, Chang HS, La TY. Anterior segment parameters using Pentacam and prediction of corneal endothelial cell loss after cataract surgery. *Kor J Ophthalmol*. 2010;24:284.
6. Hosseini SM, Abolbashari F, Mohidin N. Anterior segment parameters in Indian young adults using the Pentacam. *Int Ophthalmol*. 2013;33:621−626.
7. Mostafa EM. Central corneal thickness in southern Egypt. *Int Ophthalmol*. 2014;34:809−815.
8. Pedersen L, Hjortdal J, Ehlers N. Central corneal thickness in high myopia. *Acta Ophthalmol Scand*. 2005;83:539−542.
9. Chang SW, Tsai IL, Hu FR, Lin LL, Shih YF. The cornea in young myopic adults. *Br J Ophthalmol*. 2001;85:961−970.
10. Oliveira C, Tello C, Liebmann J, Ritch R. Central corneal thickness is not related to anterior scleral thickness or axial length. *J Glaucoma*. 2006;15:190−194.
11. Hosny M, Alió JL, Claramonte P, Attia WH, Pérez-Santonja JJ. Relationship between anterior chamber depth, refractive state, corneal diameter, and axial length. *J Refract Surg*. 2000; 16:336−340.
12. Holladay JT, Gills JP, Leidlein J, Cherchio M. Achieving emmetropia in extremely short eyes with two piggyback posterior chamber intraocular lenses. *Ophthalmology*. 1996; 103:1118−1123.
13. Nangia V, Jonas JB, Sinha A, Matin A, Kulkarni M, Panda-Jonas S. Ocular axial length and its associations in an adult population of central rural India: the Central India Eye and Medical Study. *Ophthalmology*. 2010;117:1360−1366.
14. Chen H, Lin H, Lin Z, Chen J, Chen W. Distribution of axial length, anterior chamber depth, and corneal curvature in an aged population in South China. *BMC Ophthalmol*. 2016;16: 1−7.
15. Avila MP, Weiter JJ, Jalkh AE, et al. Natural history of choroidal neovascularization in degenerative myopia. *Ophthalmology*. 1984;91:1573−1581.
16. Ikuno Y, Jo Y, Hamasaki T, Tano Y. Ocular risk factors for choroidal neovascularization in pathologic myopia. *Invest Ophthalmol Vis Sci*. 2010;51:3721−3725.
17. Abdalla TM, Elawamry AI, Nada OT, Helal MR. A comparative study of OCT findings in low and high myopia. *J Egypt Ophthalmol Soc*. 2020;113:22.