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Intraocular Pressure Changes in Different Degrees of Myopia

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ABSTRACT

Myopia is a refractive condition of the eye in which the images of distant objects are focused in front of the retina when accommodation is relaxed. Intraocular pressure (IOP) is the pressure within the eyeball. This study was carried out to investigate the intraocular pressure changes in the different degrees of myopia. The study was a clinical study carried out at the Department of Optometry Teaching Clinic, Federal University of Technology, Owerri, Imo state, Nigeria. Clinical tests performed on the subjects include case history, visual acuity, external eye examination, ophthalmoscopy, static retinoscopy and subjective refraction. The subjects with myopia were grouped into three according to the degree of myopia. Their intraocular pressure was measured using the indentation tonometry. A total of 50 subjects were used for this study. Twenty-five (50.00%) of the subjects had low myopia; 21 (42.00%) had medium myopia and 4 (8.00%) had high myopia. Results showed that for subjects with low myopia, those with IOP of 10 - 15 were 10 (20.00%); 16 -20, 13 (26.00%); 21 – 25, 2 (4.00%); 26 – 30, 0 (0.00%). For subjects with medium myopia, those with IOP of 10 - 15 were 11 (22.00%); 16 -20, 10 (20.00%); none of the subjects had IOP above 20mmHg. For subjects with high myopia, none had IOP of 10 – 15 and above 20 mmHg; 4 (8.00%) had IOP between 16 and 20 mmHg. The mean IOP values were 17.13±3.97, 16.63±3.09 and 20.15±1.29 mmHg for low, medium and high myopes respectively. SPSS data analysis using the one-way ANOVA at 0.05 level of significance showed that there was a significant difference (P<0.05) in the IOP values between the different degrees of myopia. Eye care practitioners were advised to closely monitor the IOP of their myopic patients.

Keywords: Myopia, Intraocular pressure, Low myopia, Medium myopia, High Myopia

INTRODUCTION

Myopia or short-sightedness is a type of refractive error in which with accommodation at rest, parallel rays of light coming from infinity are focused in front of the retina. [1] It is a refractive condition of the eye in which the images of distant objects are focused in front of the retina when accommodation is relaxed. [2] Myopia has two distinct forms; physiological myopia and pathological, malignant, degenerative or high myopia. Physiological myopia is caused by an increase in the axial length of the eye over and above the normal length of the eye or by an increase in the surface curvature of the cornea or crystalline lens. [3] Pathological myopia occurs as a result of structural defects in the posterior chamber of the eye leading to an abnormal lengthening of the eyeball with associated scleral wall thinning. [2,4] Myopia may also occur in association with some systemic diseases such as Cornelia de Lange syndrome, Down's syndrome, Ehlers-Danlos syndrome, Weil-Marchesani syndrome etc. [4] Ocular diseases associated with myopia include retinopathy of prematurity, gyrate atrophy, homocystinuria, Wagner's syndrome etc. [2] The most common symptom is blurred distance vision. [5] Signs of myopia include squinting to see distant objects, dilated pupils, tendency to move reading materials closer to the eye or approaching the target being viewed to see the target well. The anterior chamber may also be slightly deeper than normal. [5]Symptoms include eye fatigue, photophobia, blurry vision when looking at distant objects, headaches caused by eyestrain etc. Myopia can be classified according to age of onset, clinical variety, etiology, and degree. According to the degree, myopia can be classified as low myopia (-0.25D to -2.75D); medium myopia (-3.00D to -6.00D) and high myopia (Above -6.00D). [1]

The prevalence of myopia varies with age and other contributory factors. It is high in premature infants. [6] Myopia of about -0.50D has a lower prevalence among the 5-year olds than in any other age group. It increases in school- aged children and young adults and declines in older adults aged 45 years and above. The prevalence of myopia is slightly higher in females than in males, among people whose occupations require a lot of near work and increases with income levels and educational attainment. [7] Risk factors for myopia include a family history of myopia, against-the-rule astigmatism, great amounts of near work done frequently, steep corneal curvature, high axial length to corneal radius ratio, esophoria, temporary conditions that obscure the retina during infancy, presence of myopia and decreased accommodative function. [8] Myopia can be corrected with optical corrections, use of pharmaceutical agents, visual training, orthokeratology and refractive surgery. [8]

Intraocular pressure (IOP) is the pressure within the eyeball occurring as a result of continuous production and drainage of the aqueous humour. [2] This aqueous humour is produced by the capillaries of the non-pigmented layer of the ciliary processes to supply oxygen to the avascular lens and cornea. Aqueous humour is composed of ascorbic acid, amino acids, bicarbobate, sodium, chloride, glucose, phosphate, potassium, pyruvate and lactate. Aqueous production is mediated by three mechanisms; ultrafiltration, active transport or active secretion and diffusion. [9] Aqueous humour is drained away by the trabecular outflow system and the uveoscleral outflow system. The trabecular outflow system consists of collector channels and the Schlemm's canal while the uveoscleral outflow system consists of the aqueous veins and the episcleral veins. [10] Normal intraocular pressure is often taken to be between 11mmHg and 21mmHg [2] with mean IOP as 16±2.5mmHg. [1] Measurement of intraocular pressure can be done by using a tonometer. Measurements with an ideal tonometer should be accurate, reproducible and repeatable. An ideal tonometer should be easy to use, portable, standardized. [11] Types of tonometry include applanation tonometry, indentation tonometry, rebound tonometry, contour matching, intraocular implantation of pressure sensors and transpalpebral phosphene induction. [9] This study was carried out to investigate the intraocular pressure changes in the different degrees of myopia.

MATERIALS AND METHODS

This study was a clinical study carried out at the Department of Optometry Teaching Clinic, Federal University of Technology, Owerri, Imo state, Nigeria. An informed consent was gotten from all the subjects who were part of the study. Clinical tests performed on the subjects include case history, visual acuity, external eye examination, ophthalmoscopy, static retinoscopy and subjective refraction. The subjects with myopia were grouped into three according to the degree of myopia. Their intraocular pressure was measured using the indentation tonometry. Data was collected and uploaded into the Statistical Package for Social Sciences (SPSS) version 21 and the one-way ANOVA was used to test the null hypotheses at 0.05% level of significance and 95% confidence interval.

RESULTS

A total of 50 subjects were used for this study. Table 1 showed the distribution of the subjects according to the degree of myopia. The table showed that 25 (50.00%) of the subjects had low myopia; 21 (42.00%) had medium myopia and 4 (8.00%) had high myopia. Table 2 showed the distribution of intraocular pressure values of subjects with low myopia. The table showed that subjects with IOP of 10 - 15 were 10 (20.00%); 16 -20, 13 (26.00%); 21 – 25, 2 (4.00%); 26 – 30, 0 (0.00%). Table 3 showed the distribution of intraocular pressure values of subjects with medium myopia. The table showed that subjects with IOP of 10 - 15 were 11 (22.00%); 16 -20, 10 (20.00%); none of the subjects had IOP above 20mmHg. Table 4 showed the distribution of intraocular pressure values of subjects with high myopia. The table showed that none of the subjects had IOP of 10 – 15 and above 20 mmHg; 4 (8.00%) had IOP between 16 and 20 mmHg. Table 5 showed the comparison of IOP values in the different degrees of myopia. The table showed that the minimum, maximum and mean IOP values for low myopes were 10.20, 30.40 and 17.13 mmHg respectively. For medium myopes, the minimum, maximum and mean IOP values were 10.90, 21.90 and 16.63 mmHg respectively. For high myopes, the minimum, maximum and mean IOP values were 18.50, 21.90 and 20.15 mmHg respectively. SPSS data analysis using the one-way ANOVA at 0.05 level of significance showed that there was a significant difference [$P(0.036) < 0.05$] in the IOP values between the different degrees of myopia.

Table 1: Distribution of subjects among the different degrees of myopia

Degree of Myopia	n	%
Low	25	50.00
Medium	21	42.00
High	4	8.00
Total	50	100

Table 2: Intraocular pressure distribution of subjects with low myopia

IOP (mmHg)	n	%
10 – 15	10	20.00
16 – 20	13	26.00
21 – 25	2	4.00
26 – 30	0	0.00
TOTAL	25	50

Table 3: Intraocular pressure distribution of subjects with medium myopia

IOP (mmHg)	n	%
10 – 15	11	22.00
16 – 20	10	20.00
21 – 25	0	0.00
26 – 30	0	0.00
TOTAL	21	42

Table 4: Intraocular pressure distribution of subjects with high myopia

IOP (mmHg)	n	%
10 – 15	0	0.00
16 – 20	4	8.00
21 – 25	0	0.00
26 – 30	0	0.00
TOTAL	4	8

Table 5: Comparison of intraocular pressure values in the degrees of myopia

Degree	n	Min	Max	Mean	S.D
Low	25	10.20	30.40	17.13	3.97
Medium	21	10.90	21.90	16.63	3.09
High	4	18.50	21.90	20.15	1.29

n = Number, Min = Minimum, Max = Maximum. S.D. = Standard Deviation

DISCUSSION

Myopia occurs mostly as a result of either an axial elongation of the eyeball or curvature increase of the cornea or lens. It is listed as one of the important risk factors in the development of lacquer cracks, subretinal neovascularization, primary open angle glaucoma, retinal detachment and dense cataract. [7,12] Intraocular pressure plays a critical role in the pathogenesis of glaucoma and myopia. Elevated intraocular pressure causes an increase in the axial length. [13] Edgar and Rudnicka [14] found that low myopia was associated with a doubling of the risk of glaucoma at any age and a three-fold increase with medium and high myopia compared to those with emmetropia. The mean IOP values for the different degrees of myopia in this study were similar to related studies [15,16] that also found a statistically significant change in intraocular pressure with different degrees of myopia. Manny et al. [17] worked on the associations among intraocular pressure, ethnicity and refractive error and found that intraocular pressure differed among refractive error. Higher intraocular pressure was found more in children with low and medium myopia than in those with high hyperopia.

Sowjanya et al. [18] found a positive correlation between intraocular changes with refractive errors. Tham et al. [19] found a significant interaction between IOP and myopia in primary open angle glaucoma in a study on the joint effects of intraocular pressure and myopia on the risk of open-angle glaucoma in a multi-ethnic Asian population. There are other works which do not agree with the results of this study. Chinawa et al. [20] reported a lack of correlation between myopia and intraocular pressure and intraocular pressure and axial length. They however, reported a linear correlation between myopia and axial length. They also found that increased intraocular pressure causes scleral stress and creep resulting in elongation of the axial length and scleral stretch. A study by Lee et al. [15] on intraocular pressure associations with refractive error and axial length in children did not support an association between IOP and refractive error or axial length. This change in intraocular pressure with the different degrees of myopia could also be attributed to reduced choroidal circulation and consequent oxidative stress. Perfusion of the retina, choroid and optic nerve head is critical to maintaining normal vision. [21]

Samra et al. [22] investigated the change in subfoveal choroidal blood flow in patients with glaucoma and assessed the effect of myopia as one of the vascular risk factors for glaucoma on this flow. They concluded that subfoveal choroidal laser Doppler flowmetry parameters were reduced in patients with myopia and primary open-angle glaucoma than in non-myopic glaucomatous patients with age-matched comparison. They suggested impaired choroidal circulation caused by myopia as an additional risk factor involved in glaucomatous damaging process. Sugiyama et al. [12] evaluated the blood circulation in the retina, peripapillary choroid and optic disc in normal -tension glaucoma and correlated them with visual field measurement, retinal vessel width, optic disc pallor and blood pressure. They found a possible association of a decrease in retinal, choroidal and optic disc blood flow in the inferior and nasal quadrant as well as vessel width in the superior quadrant and showed an increasing blood flow for enlargement of the pallor. A decrease in blood pressure was found to be related to blood flow choroid and optic disc impairment. Changes in intraocular pressure with the different degrees of myopia have been attributed to reduced ocular perfusion. Zhi et al. [23] found a reduction of retinal blood flow and optic nerve head perfusion with increasing intraocular pressure in rats. A study by Wang et al. [24] to evaluate the peripapillary and parafoveal perfusion of young healthy myopic subjects with spectral domain optical coherence tomography angiography found significant differences in the retinal flow index and vessel density in the peripapillary area but not parafoveal area among low and medium myopes. The high myopes had the lowest peripapillary retinal flow index and vessel density.

In conclusion, there was a significant difference in the IOP of different degrees of myopia. Eye care practitioners are advised to closely monitor the IOP of their myopic patients. For young children, as the myopia progresses, the IOP should also be monitored.

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