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Effect of Cyclopentolate Hydrochloride 1% on the Corneal Curvature of Different Refractive Status

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ABSTRACT

The most significant refractive structure of the eye is the cornea, contributing about two-third of the eye refractive power. This study was carried out to determine the effect of 1% cyclopentolate hydrochloride on the corneal curvature of myopes, hyperopes and emmetropes. Retinoscopy and Subjective refraction were performed on the subjects who satisfied the inclusion criteria to determine their refractive status. The subjects were grouped into three groups of different refractive status: emmetropes, myopes and hyperopes. The corneal anterior curvature was measured monocularly using the Javal-Schiotz keratometer. One drop of 1% cyclopentolate hydrochloride was instilled on the subjects' eye twice in 10 minutes interval and the anterior corneal curvature reading was repeated after 30, 60 and 90 minutes of instillation from the last drop. A total 124 subjects between 18 and 30 years were used for this study. Forty-two were emmetropes, 54 were myopes and 28 were hyperopes. Results showed that the mean radius of curvature among emmetropes was 8.22 before instillation, and became 8.22, 8.25 and 8.26 after 30, 60 and 90 minutes respectively. The mean corneal radius of curvature measurements among myopes was 7.90 before instillation, and became 7.91, 7.92 and 7.90 after 30, 60 and 90 minutes respectively. The mean corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride among hyperopes was 8.38 before instillation, and became 8.40, 8.40 and 8.38 after 30, 60 and 90 minutes respectively. The changes in the mean corneal curvature values were not statistically significant (P>0.05) among the emmetropes, myopes and hyperopes. Further research on age variationswith topical cycloplegics on corneal biometrics were recommended.

Keywords: Emmetropes, Hyperopes, Myopes, Cornea Curvature, Cyclopentolate hydrochloride

INTRODUCTION

Refraction is the change in direction of light as it passes from one medium to another. This change in direction is brought about by change in speed of the light as it passes obliquely from one medium to another having different refractive index. [1] The refractive status of the human eye depends on the balance overall change of the eye size and refractive components. Refractive errors in the human eye are as a result of uncoordinated contributions of ocular components to the overall eye structures. [2] This could be due to the failure of the lens and cornea to compensate for the axial length of the eye, causing axial length elongation (Myopia) or shortening (Hyperopia). [3] Vision in humans depend on the quality of the eye's refractive components, majorly the cornea and the lens. [4] The most significant refractive structure of the eye is the cornea, contributing about two-third of the eye refractive power. [5] The cornea acts as both a protective transparent cover that encases the inner parts of the eye and as a refractive structure that focuses light back to the retina. [4] Cornea parameter measurement in their entirety is essential for both therapeutic and diagnostic purposes. [6] Sharp images produced on the retina depend on cornea transparency and appropriate refractive power. The refractive power of the cornea depends on its curvature and the large difference between its refractive index and that of air. [2] Because of its refractive power, even comparatively minor deviations in cornea shape introduce optical aberrations that prevent the formation of a focused image on the retina, thereby reducing visual acuity. [4]

Cyclopentolate hydrochloride is a muscarinic antagonist. It is commonly used as an eye drop during eye examinations to dilate the eye and prevent the eye from accommodating. [7] Cyclopentolate can also be administered to reverse muscarinic and central nervous system effects of indirect cholinomimetic drugs. [7] Cyclopentolate is an anticholinergic drug that blocks the responses of the sphincter muscle of the iris and the accommodative muscle of the ciliary body to stimulation by acetylcholine. This results in dilation of the pupil (mydriasis) and paralysis of accommodation (cycloplegia). [8] Its onset of action is rapid, taking about 60 to 90 minutes for cycloplegia and 270 minutes for mydriasis. [8] Complete recovery of accommodation usually takes 6 to 24 hours. Complete recovery from mydriasis in some persons may take up to several days. [8] During this time, patients may notice close objects and possibly distant objects to be blurred, depending on the patient's visual system. [7] The side effects of cyclopentolate are similar to the side effects of other anticholinergic medications. Because of that, extra caution should be taken when prescribing cyclopentolate to patients who are already taking other anticholinergic drugs. A possible ocular side effect is increase in pressure inside the eye, which is of particular concern when there is a predisposition toward or a presence of glaucoma. [9] Other ocular side effects can include burning sensations, discomfort, photophobia, blurred vision, irritation, inflammation of the ocular mucous membranes and inflammation of the cornea. [10] Non-ocular side effects can include neuropsychiatric symptoms like subtle concentration and memory problems, subtle decision-making problems, drowsiness, and more pronounced disorientation to time and place, confusion, disturbances of speech and movement, hyperactivity, restlessness, and seizures. [11] This study was carried out to determine the effect of cyclopentolate hydrochloride 1% on the corneal curvature of myopes, hyperopes and emmetropes.

MATERIALS AND METHODS

This study was a prospective clinical study carried out at the Department of Optometry Teaching Clinic, Federal University of Technology, Owerri, Imo state, Nigeria. The systematic sampling technique was adopted to choose subjects for the study. An informed consent was gotten from all the subjects who were part of the study. Preliminary clinical tests carried out on the subjects include case history, visual acuity, external eye examination and ophthalmoscopy. Subjects who met the inclusion criteria where chosen to be part of the study. Retinoscopy and Subjective refraction were performed on the subjects to determine their refractive status. Subjects were grouped into three groups of different refractive status: emmetropes, myopes and hyperopes. The corneal anterior curvature was measured monocularly using Javal-Schiotz keratometer. The mean keratometric reading was taken as sum of the horizontal and vertical keratometric readings for the eye divided by two. One drop of 1% cyclopentolate hydrochloride was instilled on the subjects' eye twice in 10 minutes interval and the anterior corneal curvature reading was repeated after 30, 60 and 90 minutes of instillation from the last drop. 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 124 subjects were used for this study. Forty-two were emmetropes, 54 were myopes and 28 were hyperopes. All the subjects were between 18 and 30 years. Table 1 showed the corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on emmetropes. It showed that before instillation, the minimum, maximum and mean radius of curvature values were7.55, 8.79 and 8.22 respectively. After 30 minutes, the values became 7.58, 8.33 and 8.22 respectively. After 60 minutes, the values were 7.60, 8.87 and 8.25 respectively. After 90 minutes, the values were 7.62, 8.87 and 8.26 respectively. The changes in the mean values were not statistically significant [P(0.98)>0.05]. Table 2 showed the corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on myopes. It showed that before instillation, the minimum, maximum and mean radius of curvature values were7.56, 8.33 and 7.90 respectively. After 30 minutes, the values became 7.59, 8.30 and 7.91 respectively. After 60 minutes, the values were 7.60, 8.30 and 7.92 respectively. After 90 minutes, the values were 7.57, 8.30 and 7.90 respectively. The changes in the mean values were not statistically significant [P(0.99)>0.05]. Table 3 showed the corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on hyperopes. It showed that before instillation, the minimum, maximum and mean radius of curvature values were7.69, 8.80 and 8.38 respectively. After 30 minutes, the values became 7.70, 8.83 and 8.40 respectively. After 60 minutes, the values were 7.67, 8.85 and 8.40 respectively. After 90 minutes, the values were 7.69, 8.83 and 8.38 respectively. The changes in the mean values were also not statistically significant [P(0.99)>0.05].

Table 1: Corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on emmetropes

Time of Measurement	Min.	Max.	Mean	S.D
Before Instillation	7.55	8.79	8.22	0.38
After 30 minutes	7.58	8.83	8.22	0.39
After 60 minutes	7.60	8.87	8.25	0.40
After 90 minutes	7.62	8.87	8.26	0.38
P = 0.98				

Min = minimum, Max = maximum. S.D. = standard deviation.

Table 2: Corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on myopes

Time of Measurement	Min.	Max.	Mean	S.D
Before Instillation	7.56	8.33	7.90	0.20
After 30 minutes	7.59	8.30	7.91	0.20
After 60 minutes	7.60	8.30	7.92	0.20
After 90 minutes	7.57	8.30	7.90	0.19
P = 0.99				

Min = minimum, Max = maximum. S.D. = standard deviation.

Table 3: Corneal radius of curvature measurements before and after instillation of 1% cyclopentolate hydrochloride on hyperopes

Time of Measurement	Min.	Max.	Mean	S.D
Before Instillation	7.69	8.80	8.38	0.29
After 30 minutes	7.70	8.83	8.40	0.30
After 60 minutes	7.67	8.85	8.40	0.31
After 90 minutes	7.69	8.83	8.38	0.30
P = 0.99				

DISCUSSION

This study revealed that the curvature of the cornea did not change significantly after topical instillation of cyclopentolate hydrochloride1%.This was found to be the case in a study by Bagheri et al. [12] Most of the people that came to the clinic within the ages of 18 and 30 years were found to be myopes. This could be as a result of increased near work associated with university students as this made up majority of the study population. Near work, most especially reading has been shown by Abraham and Megbelayin [13] as one of the environmental factors that may lead to myopia. Also, a study conducted on 5060 Chinese university students by Sun et al. [14] showed that 95.5% of the students were myopes. Gong et al., [15] in his study, found that female oestrogens have a certain influence on corneal thickness which correlated positively to myopic power. Also, Czepita and Filipiak [16] showed in their study that myopia was more in female than males. A study by Zhang et al [17] found that longer corneal curvature is significantly associated with male sex than females.

The corneal curvature of emmetropes was flatter after cycloplegia, but these changes were clinically negligible and statistically insignificant. Some emmetropes do not show any changes at all even after 90 minutes. This scenario was also noticed in myopic and hyperopic subjects and was supported by Bagheri et al. [12] in their study comprising of 201 myopes and 11 hyperopes. Bagheri found no significant changes in the anterior radius of corneal curvatures of myopes and hyperopes and reported no unidirectional movement of cycloplegic effects on subjects. This was also supported by Arici et al [18] who found no significant difference in the keratometry measurements of the subjects involved in their study following cycloplegia. Also, in a related study, Hamed et al [19] found no significant changes in anterior corneal curvature of normal people following cycloplegia. However, this is contrary to the results gotten from Saitoh et al [20] who independently reported a significant change in corneal curvature following cycloplegia. This differences in result could be due to different accuracy of the instrument used in taking the readings of the corneal curvatures as there were no uniformity of instruments used in the research and also could be due to lower mean age values reported on those studies leading to different probable corneal hysteresis and endothelial cell counts between children and adults. This could also be as a result of high myopia and the use of Atropine as a more potent cycloplegic agent in those studies. Though the changes in the anterior curvatures of the subjects of emmetropes, myopes and hyperopes were not significantly affected after cycloplegia, measurement of corneal power, or corneal curvature taken in a cycloplegic state for calculating intraocular lens power should be discouraged. The likely inaccuracies of biometric values of the corneal and anterior segment measured in a cycloplegic state should be considered especially before planning cataract and refractive surgeries. This research does not take into record the changes in anterior chamber depth due to its consistent changes in previous research.

In conclusion, topical cyclopentolate hydrochloride 1% had no significant effect on the corneal curvature of emmetropes, myopes and hyperopes. Further research on age variations with topical cycloplegics on corneal biometrics was recommended.

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