EFFECT OF CYCLOPENTOLATE ON CORNEAL CURVATURE IN DIFFERENT REFRACTIVE STATES

AUTHORS & CONTRIBUTORS:

Aqsa Mustafa[1]
Saman Ali[2]
Hameeda Haider[3]

For Authors' affiliation & contribution see end of Article

ABSTRACT

PURPOSE: *To find the effect of cyclopentolate on corneal curvature of different refractive status*

METHOD: *This prospective clinical study included 62 subjects.This study was carried out at Mayo Hospital, Lahore. Subjects were divided into three groups, emmetropes, myopes and hyperopes. The data was collected through, non-random convenient sampling technique, self-made questionnaire after taking patients' consent. K-reading was measured before and after 45 minutes of instilling cyclopentolate eye drops. Data was entered and analysed by SPSS-21 software. Shapiro-Wilk test was applied for normality. Data was not normally distributed in any group. Wilcoxon signed rank test was applied for comparing pre- and post-cyclopentolate average K-reading. P value less than 0.05 considered as significant.*

RESULTS: *A total of 62 subjects were used for this study(male: 30; females: 32) of mean age 7.87±2.45 years of males and 7.28±2.68 years of females.The mean difference of average K-reading of emmetropes subjects before and after cyclopentolate were 0.02±0.08 mm (p=0.82). In myopes, there was difference of 0.01±0.14 mm (p=0.80) Table2 and in hyperopes, the difference was of 0.03±0.2mm (p=0.56).*

CONCLUSION: *In emmetropes, myopes and hyperopes there is no significant difference in corneal curvature before and after.*

KEY WORDS: *Emmetropes Hyperopes, Myopes, Cornea Curvature, Cyclopentolate hydrochloride.*

INTRODUCTION

Refraction is defined as the change in path of light as it passes from one medium to another medium. This change in path of light is mainly due to change in speed of light in different mediums having different refractive index (n). The human eye's refractive status depends on the balance of refractive components of eye and overall change of the eye size. Thus, the refractive error occurs due to imbalance between refractive ocular components and ocular structure. The major refractive components of eye are lens and cornea which is responsible of 1/3 and 2/3 of total refractive power, respectively and ocular axial length (AL); elongation of AL leads towards myopic shift whereas, shortening of AL causes focusing of light behind the retina (hyperopia). Crystalline lens and cornea, thus, responsible of fine visual quality of human being.[1,2] Corneal curvature and its thickness, anterior chamber depth (ACD) which is the distance from the corneal endothelium to the anterior surface of the crystalline lens, are major components for many ophthalmic procedures like cataract and refractive surgeries. Like crystalline thickness, corneal curvature also changes with age.[3]

There are many instruments designed for the purpose of measuring corneal thickness, however, ultrasound (US) pachymetry is considered as standard technique for measuring central corneal thickness (CCT). Corneal thickness increases from centre to periphery. The peripheral thickness decreases with age which causes continuous change in corneal map. The thinnest part of cornea in healthy individuals is infero-temporally and the thickest part present supro-temporally. The radius of curvature of corneal central region is 7.8 mm.Several studies enlisted the effects of accommodation on corneal refractive power.[4] The effect of accommodation on cornea is insignificant in phakic eye as compared to the effect on lens. However, the effect of pseudo-accommodation in pseudo-

phakic eye which referred to the varying of pupil size and focusing depth, may have correlation with corneal accommodation.[5,6]

For routine fundus examination and cycloplegic refraction (objective refraction) cycloplegic drops (mydriasis and cycloplegia) are used in eye clinics. Most common mydriasis drugs used in clinics to dilate pupil for eye examination are cyclopentolate and tropicamide. Cyclopentolate hydrochloride is one of a muscarinic antagonist. It is usually used for ocular dilation in the form of drops to prevent accommodation so the fundus view become wide and clear during ocular examination in eye clinics.[7,8] Its beginning of action is quick, taking around sixty minutes to an hour and a half for cycloplegia and 270 minutes for mydriasis. Complete recuperation of accommodation normally takes 6 - 24 hours. Complete recuperation from mydriasis in certain people may take as long as a few days. During this time, patients may notice close objects and possibly distant objects to be blurred, depending on the patient's visual system.[9] The side effects of cyclopentolate are like 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.[10]

With the advancement in medical science, objective refraction becomes one of the hard-line topics of discussion. As uncorrected visual acuity is one of the main causes of blindness. It is necessary to evaluate the causes of uncorrected visual acuity. Cyclopentolate eye drops are used in objective refraction (retinoscopy). However, post-cyclopentolate ocular changes are important factors effecting refraction. That is one of the questions that have had inconsistent answers.[11]

Ceyhun Arici and co-workers conducted a study to investigate the effects of topically applied 1% cyclopentolate hydrochloride on anterior segment parameters.[12,13,14]

A possible ocular side effect is increase in pressure inside the eye, which is of concern when there is a predisposition toward or a presence of glaucoma. Other ocular side effects can include burning sensations, discomfort, photophobia, blurred vision, irritation, inflammation of the ocular mucous membranes and inflammation of the cornea.[15] 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.[16]

MATERIALS AND METHODS

This prospective clinical study included 62 subjects. This study was carried out at Mayo Hospital OPD and COAVS respectively. The patients with any ocular disease were excluded from this study and data was collected by self-designated proforma after taking patients consent. K1, K2 reading was measured by using Keratometer Log MAR chart was for visual acuity of patient and analyzed by making graphs charts and tables. Data was entered by using SPSS-21. Shapiro-Wilk test was applied for normality. For comparing pre- and post-cyclopentolate K-reading, related sample Wilcoxon signed rank test was used. p-value less than 0.05 was considered as significant.

Duration of study

3 months after approval of synopsis.

Sample size

62 individuals

Study Design

Prospective cross sectional study

RESULTS

This study includes 62 subjects having mean age of males and females' subjects 7.87 ± 2.45 years and 7.28 ± 2.68 years, respectively. The mean K1, K2 and K of right eye of emmetropes before and after were 7.73 ± 0.36 mm and 7.74 ± 0.37 mm, 7.62 ± 0.21 mm and 7.64 ± 0.19 mm, 7.67 ± 0.23 mm and 7.69 ± 0.24 mm, respectively. Similarly,

the mean K1, K2 and K of left eye before and after were 7.52 ± 0.54 mm and 7.66 ± 0.22 mm, 7.69 ± 0.18 mm and 7.83 ± 0.43 mm, 7.60 ± 0.32 mm and 7.69 ± 0.18 mm, respectively. The average K-reading of emmetropes before and after cyclopentolate were 7.67 ± 0.23 mm and 7.69 ± 0.24 mm. there was difference of -0.02 ± 0.08 mm (0.389). The average K-reading of myopes before and after cyclopentolate were 7.63 ± 0.27 mm and 7.64 ± 0.26 mm. there was difference of -0.01 ± 0.14 mm (0.681). The average K-reading of hyperopes before and after cyclopentolate were 7.78 ± 0.48 mm and 7.81 ± 0.42 mm. there was difference of -0.03 ± 0.2 mm (0.70). Similarly, the average K-reading of left eye of emmetropes before and after cyclopentolate were 7.61 ± 0.31 mm and 7.69 ± 0.18 mm. there was difference of -0.091 ± 0.22 mm (0.009). The average K-reading of myopes before and after cyclopentolate were 7.56 ± 0.32 mm and 7.53 ± 0.22 mm. there was difference of 0.027 ± 0.18 mm. (0.629). The average K-reading of hyperopes before and after cyclopentolate was 7.57 ± 0.35 mm and 7.45 ± 0.21 mm. There was difference of 0.13 ± 0.29 mm (0.055)(Table 1).

Table1: Result of pre-cyclopentolate and post-cyclopentolate (n=40 in each subgroup).

Group	Sub-Group	Minimum	Maximum	Mean	Std. Deviation	p value
Emmetropic	K before cyclopentolate	6.49	8.23	7.64	0.28	0.82
	K after cyclopentolate	7.35	8.24	7.69	0.21	
Myopia	K before cyclopentolate	7.18	8.47	7.59	0.27	0.80
	K after cyclopentolate	7.19	8.3	7.59	0.24	
Hyperopia	K before cyclopentolate	7.21	8.86	7.68	0.43	0.56
	K after cyclopentolate	7.19	8.88	7.63	0.37	

DISCUSSION

In previous studies conducted by Megwas et al. the corneal curvature of emmetropes was flatter after cycloplegia, but these changes were clinically negligible and statistically insignificant.[2] 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. 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 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 found no significant changes in anterior corneal curvature of normal people following cycloplegia.[17] However, this is contrary to the results gotten from Saitoh et al who independently reported a significant change in corneal curvature following cycloplegia. The difference in results could be due to different accuracy of the instrument used in taking the readings of the corneal curvatures.[18]

There was no refractive correction needed in emmetropes after cyclopentolate. The mean spherical equivalent measured after cyclopentolate in myopes and hyperopes of right and left eye were -3.03 ± 3.22 D and -3.74 ± 4.17 D, 1.53 ± 1.15 D and 1.78 ± 1.15 D, respectively.

Cheng et al. also found the mean keratometric values decreased (p=0.005). Whereas corneal astigmatism did not change significantly.[19] Bagheri et al found anterior corneal curvature change was not statistically significant (p=0.5).[20] This study reports random based on laterality. The right eye's keratometry reading increases while in the left eye it decreased after instilling cyclopentolate except in case of emmetropes with significant change.[13]

CONCLUSION

In emmetropes, myopes and hyperopes there is no significant difference in corneal curvature before and after cyclopentolate which can be due low instrument's reliability.

RECOMMENDATION

It is recommended from this study that cyclopentolate has no significant effect on corneal radius of curvature in emmetropes, myopes and hyperopes. The results can be improved by comparing spherical equivalent pre- and post-cyclopentolate. That would give exact estimation in change of dioptric power pre- and post-cyclopentolate. This study includes only post-cyclopentolate retinoscopy reading.

AUTHORS & CONTRIBUTORS

1. **Aqsa Mustafa**
   BSc. (Optometry)
   College of ophthalmology and Allied Vision Sciences
   aqsamustafa@gmail.com
   literature search, methods, data collection

2. **Saman Ali**
   Ophthalmologist COAVS
   drsumanali@hotmail.com
   College of Ophthalmology and Allied Vision Sciences
   Data analysis, results

3. **Hameeda Haider**
   College of ophthalmology and Allied Vision Sciences
   Kiranhaider098@gmail.com
   Data collection, Data analysis

REFERENCES

1. Winkler M, Shoa G, Tran ST, Xie Y, Thomasy S, Raghunathan VK, et al. A comparative study of vertebrate corneal structure: the evolution of a refractive lens. Invest Ophthalmol Vis Sci. 2015;56(4):2764-72.

2. Megwas A, Ogbuagu F, Azuamah Y, Nwakamma G, Nwawume I, Ugwoke G. Effect of cyclopentolate hydrochloride 1% on the corneal curvature of different refractive status. Invest Ophthalmol Vis Sci. 2017;32(7):235-9.

3. Huang J, Lu W, Savini G, Chen H, Wang C, Yu X, et al. Comparison between a new optical biometry device and an anterior segment optical coherence tomographer for measuring central corneal thickness and anterior chamber depth. J Ophthalmol. 2016;45(4):312-9.

4. Bayramlar H, Sadigov F, Yildirim A. Effect of accommodation on corneal topography. Cornea. 2013;32(9):1251-4.

5. Sisó-Fuertes I, Domínguez-Vicent A, del Águila-Carrasco A, Ferrer-Blasco T, Montés-Micó R. Corneal changes with accommodation using dual Scheimpflug photography. J Cataract Refr Surg. 2015;41(5):981-9.

6. Ni Y, Liu X, Lin Y, Guo X, Wang X, Liu Y. Evaluation of corneal changes with accommodation in young and presbyopic populations using P entacam H igh R esolution S cheimpflug system. Clin Exp Ophthalmol 2013;41(3):244-50.

7. Sergienko NM, Kondratenko YN, Tutchenko NN. Depth of focus in pseudophakic eyes. Graefes Arch Clin Exp Ophthalmol. 2008;246(11):1623-7.

8. Rajappa N, Patra S, Bhalsing S, Lune AA. A case of acute psychosis induced by topical cyclopentolate eye drops in an elderly patient. Med J DY Patil Vidyapeeth. 2014;7(1):68-72.

9. Lai JS, Gangwani RA. Medication-induced acute angle closure attack. Hong Kong Med J. 2012;52(7):231-8.

10. Rosman MS, Skaat A, Chien JL, Ghassibi MP, Sarimiye TF, Ritch R, et al. Effect of cyclopentolate on in vivo Schlemm canal microarchitecture in healthy subjects. J Glaucoma. 2017;26(2):133-7.

11. Dave P, Senthil S, Rao HL, Garudadri CS. Treatment outcomes in malignant glaucoma. Ophthalmology. 2013;120(5):984-90.

12. Hashemi H, Asharlous A, Khabazkhoob M, Iribarren R, Khosravi A, Yekta A, et al. The effect of cyclopentolate on ocular biometric components. Optom Vis Sci. 2020;97(6):440-7.

13. Chang S-W, Lo AY, Su P-F. Anterior segment biometry changes with cycloplegia in myopic adults. Optom Vis Sci. 2016;93(1):12-8.

14. Arici C, Turk A, Ceylan OM, Kola M, Hurmeric V. Effects of 1% cyclopentolate hydrochloride on anterior segment parameters obtained with Pentacam in young adults. Arq Bras Oftalmol. 2014;77(4):228-32.

15. Sharif NM, Moghadam HO, Azizi E, Ghoochani E, Ehsaei A. Comparison of cyclopentolate versus tropicamide on corneal topography in emmetropic and myopic eyes. Invest Ophthalmol Vis Sci. 2020;33(5):114-7.

16. Ihekairei DE. The comparative efficacy of cyclopegic drugs–tropicamide and cyclopentolate on school children. Int J Sci Res Educ. 2012;5(2):223-46.

17. Bagheri A, Feizi M, Shafii A, Faramarzi A, Tavakoli M, Yazdani S. Effect of cycloplegia on corneal biometrics and refractive state. J Ophthalmic Vis Res. 2018;13(2):101-8.

18. Momeni-Moghaddam H, Maddah N, Wolffsohn JS, Etezad-Razavi M, Zarei-Ghanavati S, Rezayat AA, et al. The effect of cycloplegia on the ocular biometric and anterior segment parameters: a cross-sectional study. Ophthalmol Ther. 2019;8(3):387-95.

19. Cheng H-C, Hsieh Y-T. Short-term refractive change and ocular parameter changes after cycloplegia. Optom Vis Sci. 2014;91(9):1113-7.

20. Bagheri A, Feizi M, Shafie A, Faramarzi A, Yaseri M, Baradaran-Rafii G. Effect of cycloplegia with cyclopentolate 1% on corneal parameter and refractive state of the eye. Br J Ophthalmol. 2017;22(3):179-92.