Original Article

Comparison of the Effect of Cycloplegia on Ocular Biometric Parameters in Myopic and Hypermetropic Pakistani Children Using Lenstar

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ABSTRACT

Purpose: To evaluate the effect of cycloplegia on ocular biometric parameters in children with myopia and hypermetropia.

Study Design: Cross sectional study.

Place and Duration of Study: Institute of ophthalmology LUMHS Jamshoro from September 2024 to march2025.

Methods: This study included children aged 5 to 12 years diagnosed with myopia or hypermetropia. Cycloplegic refraction was performed using 1% cyclopentolate and an autorefractor meter (Topcon KR-800). Ocular biometry measurements were obtained before and after cycloplegia using Lenstar LS 900 (HAAG-STREIT). A total of 188 eyes from 94 children (47 myopic and 47 hyperopic) were analyzed. Parameters assessed included pupil diameter (PD), axial length (AL), central corneal thickness (CCT), anterior chamber depth (ACD), corneal curvature (CC), and central retinal thickness (CRT). Data were analyzed using SPSS version 26.

Results: In myopic children, ACD increased from 3.63 ± 0.22 mm to 3.94 ± 0.27 mm, and PD increased from 3.83 ± 0.73 mm to 4.82 ± 0.55 mm after cycloplegia, while CC, CCT, and CRT remained unchanged. In hypermetropic children, PD increased from 2.81 ± 0.29 mm to 4.59 ± 0.59 mm, and ACD increased from 2.79 ± 0.73 mm to 2.98 ± 0.19mm, with no significant changes observed in posterior segment parameters.

Conclusion: Cycloplegia significantly affects anterior segment parameters, particularly PD and ACD, in both myopic and hypermetropic children, while posterior segment measurements remain stable. These findings highlight the importance of cycloplegia in achieving accurate pediatric ocular assessments.

Keywords: Cycloplegia, Myopia, Hypermetropia, Ocular Biometry, Pediatric Ophthalmology.

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INTRODUCTION

Ocular examinations often include the application of cycloplegic drugs. To minimize the impact of accommodation and improve measurement precision, cycloplegia is regularly employed among children suffering from refractive issues and binocular vision disorders prior to refraction.[1,2] Though atropine is the gold standard drug in cycloplegia, the more commonly used drugs in clinical environments are cyclopentolate and tropicamide.[3,4] The effects of atropine, however, are delayed and prolonged (two weeks), and their side effects are frequent. One of the synthetic antimuscarinic agents is cyclopentolate. Effects of this agent occur at 25-75 minutes, and recovery takes up to 6-24 hours.[5] According to one study, topical dosage of 1% cyclopentolates had a significant effect on the anterior chamber depth and the pupil diameter in the myopic and hyperopic groups.[6]

The prevalence of myopia is rising worldwide. In 2020, over 30% of people worldwide suffered from myopia; by 2050, that percentage is predicted to increase to 50%.[7] WHO reports indicate that refractive errors are one of the leading causes of impaired vision in the world today.[8] The significance of correct diagnosis and treatment is extremely important as this rate of growth, particularly among the pediatric patients in developing nations, is very high. Pediatric eyes have a special problem related to refractive assessment because of the dynamic accommodative system. In the children, the accommodative amplitude is high and can permit true refractive errors to pass undetected where hypermetropia may not be corrected and myopia misdiagnosed.[9] Since cycloplegic refraction is a dependable way of eliminating the accommodation and offers a true baseline refractive position by paralyzing the ciliary muscle, even though temporarily, it is the gold standard of measuring this population.[10] The effects of cycloplegia on the eye are more than just for refractive examination purposes but rather they are due to the physiological effects that occur within the eye. The effects of cycloplegics have been demonstrated by many studies to be significantly important to several biometric measures of the eye.[9,10,11] Paralysis of the ciliary muscle brought about by cycloplegia leads to relaxation of the lens and its thinning, resulting in posterior movement of the lens and iris diaphragm, thus increasing the ACD. By relaxing the sphincter pupillae muscle, pupillary dilatation occurs, indicating changes in autonomic innervation of the eye.[12] Advances in optical biometric devices such as the Lenstar LS 900 have significantly improved the accuracy of measuring different parameters of the eye simultaneously without contact.[13] The technology is able to measure axial length (AL), corneal curvature (CC), Anterior chamber depth (ACD), central corneal thickness (CCT), and retinal thickness (RT) for a complete picture of ocular structure and functionality. For efficient diagnosis, refractive correction, and surgical planning, children's ocular biometric characteristics must be accurately assessed.[14] While previous studies have mostly focused on specific biometric features or individual refractive categories, cycloplegics are often employed to eliminate the influence of accommodation. Such research in different [populations and ethnicities will improve clinical decision-making in pediatrics ophthalmology. Preliminary findings in the study by Qu et al. showed that cycloplegia affected several parameters, especially pupil dynamics. However, there are still large gaps in the data gathered from some populations, particularly in Pakistan.[15] Comprehending these variations is crucial for both enhancing clinical management and clarifying the pathophysiological mechanisms that underlie the emergence of refractive defects. In this regard, it is critical to evaluate the changes in anterior segment features and refraction after cycloplegia. The results will be valuable for specific population-based clinical practice and will enhance understanding of accommodative physiology across different refractive conditions.

METHODS

This cross-sectional study was conducted at the Institute of Ophthalmology, Liaquat University of Medical Sciences, Jamshoro, Hyderabad, following approval from the Institutional Ethical Committee **(Ref. No. LUMHS/REC/-154).** Written informed consent was obtained from the parents or legal guardians of all participants. The sample size was calculated using the WHO sample size calculator based on the following parameters: $\alpha = 5\%$, power = 90%, expected mean pupil diameter after cycloplegia in myopic children of 7.68 ± 0.51 mm, and in hypermetropic children of 7.41 ± 0.57 mm. A total of 188 eyes from 94 children (47 myopic and 47 hypermetropic) were included in the study. Children aged 5–12 years, diagnosed with myopia (spherical equivalent < −0.50 D) or hypermetropia (spherical equivalent > +0.75 D), irrespective of gender, and recruited between September 2024 and March 2025, were eligible for inclusion. Children younger than 5 years or older than 12 years, those with pre-existing ocular conditions (including cataract, glaucoma, keratoconus, corneal opacity, retinal disease, or active ocular infection), a history of ocular surgery, or current contact lens use were excluded.

Eligible children underwent a detailed ocular examination, including slit-lamp bio microscopy and fundoscopy. Refraction and ocular biometric measurements were obtained before cycloplegia. Cycloplegic objective refraction was performed using an autorefractometer (Topcon KR 800). Baseline ocular biometric parameters, PD, AL, CCT, ACD, and RT were recorded using the Lenstar LS 900. Cycloplegia was induced using 1% cyclopentolate eye drops, administered as one drop every 10 minutes, with full cycloplegia confirmed after 30–45 minutes. To minimize examiner bias, all tests were conducted by qualified technicians following a standardized procedure under consistent indoor illumination. The same equipment (Lenstar LS 900) was used for all measurements, and confidentiality was maintained throughout the study.

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. The independent t-test was used to assess differences between the means of myopic and hypermetropic groups. The paired t-test was used to evaluate differences in mean values before and after cycloplegia within the same participants. Statistical significance was set at $p < 0.05$.

RESULTS

The comparison of ocular biometric parameters between myopic and hypermetropic children before cycloplegia is presented in Table 1. All measured parameters showed statistically significant differences between the two groups except CC. Hypermetropic eyes demonstrated significantly greater CCT and CRT, whereas myopic eyes exhibited higher CC, ACD, PD, and AL. Post-cycloplegia comparisons between the two groups are summarized in Table 2. Significant differences were observed for all parameters except CC, which did not differ significantly between myopic and hypermetropic eyes ($p = 0.741$). Hypermetropic eyes maintained higher CCT and CRT values, while myopic eyes showed greater ACD, PD, and AL.

Within-group comparisons for myopic children before and after cycloplegia are shown in (Table 3) Cycloplegia resulted in a statistically significant increase in ACD and PD, along with a significant decrease in AL ($p < 0.001$ for all). No significant changes were observed in CCT, CC, or CRT. Similarly, within-group comparisons for

Table 1: *Comparative Refractive Properties of Myopia and Hypermetropia Before Cycloplegia.*

Refractive Components	Myopia (N =94) Mean ± SD	Hypermetropia (N = 94) Mean ± SD	T-value	P-value
CCT (µm)	554.11 ± 30.51	576.91 ± 31.85	-5.01	<0.001
CC (D)	44.47 ± 1.14	43.52 ± 1.39	0.54	0.59
ACD (mm)	3.63 ± 0.22	2.79 ± 0.73	10.68	<0.001
PD (mm)	3.83 ± 0.73	2.81 ± 0.29	12.59	<0.001
AL (mm)	24.93 ± 0.69	21.71 ± 1.35	2.12	0.035
CRT (µm)	247.85 ± 33.67	279.55 ± 30.17	-6.80	<0.001

CCT=central corneal thickness; CC=corneal curvature; ACD=anterior chamber depth; PD=pupil diameter; AL=axial length; CRT=central retinal thickness; ± S=mean ± standard deviation; CI=confidence interval.

Table 2: *Comparative Analysis of Ocular Variables for Myopic and Hypermetric Pakistani children after Cycloplegia.*

Refractive Components	Myopia (N = 94)Mean ± SD	Hypermetropia (N = 94) Mean ± SD	T-value	P-value
CCT (µm)	550.80 ± 31.13	581.15 ± 30.34	-6.77	<0.001
CC (D)	44.00 ± 1.32	43.50 ± 1.43	0.26	0.79
ACD (mm)	3.94 ± 0.27	2.98 ± 0.19	28.19	<0.001
PD (mm)	4.82 ± 0.55	4.59 ± 0.59	2.76	0.006
AL (mm)	24.20 ± 0.47	21.70 ± 1.12	19.96	<0.001
CRT (µm)	243.20 ± 29.49	274.80 ± 25.41	-7.87	<0.001

Table 3: *Ocular Parameters in Myopic Children Before & After Cycloplegia.*

Refractive Components	Before Cycloplegia Mean ± SD	After Cycloplegia Mean ± SD	T-value	P-value
CCT (µm)	554.11 ± 30.51	550.80 ± 31.13	0.68	0.50 (ns)
CC (D)	44.47 ± 10.14	44.00 ± 10.32	0.30	0.77 (ns)
ACD (mm)	3.63 ± 0.22	3.94 ± 0.27	−7.65	<0.001
PD (mm)	3.83 ± 0.73	4.82 ± 0.55	−8.72	<0.001
AL (mm)	24.93 ± 0.69	24.20 ± 0.47	7.92	<0.001
CRT (µm)	247.85 ± 33.67	243.20 ± 29.49	1.02	0.31 (ns)

Table 4: *Comparison of Ocular Parameters Between Hypermetropic Pakistani Children Before & After Cycloplegia.*

Refractive Components	Before Cycloplegia Mean ± SD	After Cycloplegia Mean ± SD	T-value	P-value
CCT (µm)	576.91 ± 31.85	581.15 ± 30.34	−0.88	0.38
CC (D)	4.52 ± 1.39	43.50 ± 10.43	−34.8	<0.001
ACD (mm)	2.79 ± 0.73	2.98 ± 0.19	−2.69	0.008
PD (mm)	2.81 ± 0.29	4.59 ± 0.59	−25.8	<0.001
AL (mm)	21.71 ± 11.35	21.70 ± 1.12	0.01	0.99
CRT (µm)	279.55 ± 30.17	274.80 ± 25.41	1.26	0.21

hypermetropic children (Table 4) demonstrated significant increases in PD, ACD, and CC following cycloplegia ($p < 0.05$). In contrast, CCT, AL, and CRT did not show statistically significant changes.

DISCUSSION

The study gives in-depth data on the different impacts of cycloplegia on eye biometric measurements in hypermetropic and myopic Pakistani children. We provide a series of findings on variation in anterior segment movements related to the type of refractive error with major focus on the behavior of the pupil and the appearance of the anterior chamber. The most important observation of the study is the variation of the pupil diameter of the myopic children and the hypermetropic children following cycloplegia. In natural conditions, pupils of myopic children were relatively larger than that of hypermetropic children. The above result is endorsed by the previous studies.[16,17] Myopia has often been associated with large pupils. The contraction of the ciliary muscle also leads to an extension of the axial length. This could potentially be the initiating factor for myopia.[18]We noticed a change in pupil size following cycloplegia: children who were myopic showed bigger pupil diameters than children who were hypermetropic. Cyclopentolate causes pupillary dilatation and paralysis of accommodation by blocking the muscarinic receptors in the ciliary body and iris sphincter muscle. This may reveal underlying autonomic regulatory variations among refractive error type.[15]

The eyes with myopia have a much greater ACD before and after cycloplegia, indicating an irreducible anatomical difference between myopic and hypermetropic eyes.[19] The increase in ACD after cycloplegia in the two groups is well known and is due to the posterior shift of the lens-iris diaphragm after relaxation of the ciliary muscles.[20] Nevertheless, the absolute ACD in myopes persisted at this level despite cycloplegia, suggesting an anatomical rather than a dynamic physiological difference.[21],[22]

Central corneal thickness, corneal curvature, and retinal thickness are among the metrics that stay constant during cycloplegia, indicating that the accommodative processes have no effect on these parameters. This consistency validates the independence of these measurements from cycloplegic status, which is useful in a clinical practice context when repeated measurements are needed.[23]

A few limitations have been noted in this study that have to be considered. To start with, the study cannot be applied to other populations since it is based on one tertiary care center only. Secondly, application to other populations may be restricted due to age differences since only children aged between 5 and 12 years were used. Third, variables such as pupil size and anterior chamber depth could be affected by personal differences in response to the use of cycloplegia, in addition to the potential influence of diurnal variations and lightening conditions. In addition, the study focused only on the impact of cycloplegic effect using 1% cyclopentolate. On the other hand, results may differ if atropine and tropicamide are used. Lastly, despite the high precision of the Lenstar LS 900, there is no systematic evaluation of the limitations associated with optical biometry.

CONCLUSION

Children's anterior segment parameters, particularly pupil diameter and anterior chamber depth, are greatly impacted by cycloplegia. Underlying physiological differences in accommodation are shown by the different pupillary responses between myopic and hypermetropic eyes. These results highlight the need for cycloplegia for precise refractive evaluation and offer reference information for the pediatric population in Pakistan.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(LUMHS/REC/-154.)**

REFERENCES

1. **Weise KK, Khanal S.** Atropine vs Cyclopentolate for Cycloplegic Refraction in Children. JAMA Ophthalmol. 2025;**143(11):**914-915. Doi: 10.1001/jamaophthalmol.2025.3342.
2. **Ho M, Morjaria P.** Cycloplegic refraction in children. Community Eye Health. 2024;**37(122):**14-15. PMID: 38827966; PMCID: PMC11141127.
3. **Yazdani N, Sadeghi R, Momeni-Moghaddam H, Zarifmahmoudi L, Ehsaei A.** Comparison of cyclopentolate versus tropicamide cycloplegia: A systematic review and meta-analysis. J Optom. 2018;**11(3):**135-143. Doi: 10.1016/j.optom.2017.09.001.
4. **Singh RP, Amitava AK, Sharma N, Gupta Y, Raza SA, Bose A, et al.** Comparison of cycloplegia with atropine 1% versus cyclopentolate 1. Indian J Ophthalmol. 2023;**71(12):**3633-3636. Doi: 10.4103/IJO.IJO_1159_23.
5. **Pei R, Liu Z, Rong H, Zhao L, Du B, Jin N, et al.** A randomized clinical trial using cyclopentolate and tropicamide to compare cycloplegic refraction in Chinese young adults with dark irises. BMC Ophthalmol. 2021;**21(1):**256. Doi: 10.1186/s12886-021-02001-6.
6. **Al-Ghamdi WM, Al-Rasheed SH, Nair V, Alluwimi MS.** Effects of cyclopentolate hydrochloride dosage on anterior segment parameters in young adults (measured with Pentacam). Clin Ophthalmol. 2021;**15:**891–898. Doi: 10.2147/OPTH.S291991.
7. **Sankaridurg P, Tahhan N, Kandel H, Naduvilath T, Zou H, Frick KD, et al.** IMI Impact of Myopia. Invest Ophthalmol Vis Sci. 2021;**62(5):**2. Doi: 10.1167/iovs.62.5.2.
8. **Hashemi H, Fotouhi A, Yekta A, Pakzad R, Ostadimoghaddam H, Khabazkhoob M.** Global and regional estimates of prevalence of refractive errors: Systematic review and meta-analysis. J Curr Ophthalmol. 2017;**30(1):**3-22. Doi: 10.1016/j.joco.2017.08.009.
9. **Tuncer I, Zengin MÖ, Yıldız S.** The effect of cycloplegia on ocular biometry and intraocular lens power based on age. Eye (Lond). 2021;**35:**676–681. Doi: 10.1038/s41433-020-01131-3
10. **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):**440–447. Doi: 10.1097/OPX.0000000000001524.
11. **McAlinden C, Gao R, Yu A, Wang X, Yang J, Yu Y, et al.** Repeatability and agreement of ocular biometry measurements: Aladdin versus Lenstar. Br J Ophthalmol. 2017;**101(9):**1223–1229. Doi: 10.1136/bjophthalmol-2016-309365.
12. **Yulin Tao, Xiaokang Cheng, Can Ouyang, Xiaoyong Qu, Wenjiang Liao, et al.** Changes in ocular biological parameters after cycloplegia based on diopter, age and sex. Sci Rep. 2022;**12:**22470. Doi: 10.1038/s41598-022-25462-1.
13. **Langenbucher A, Szentmáry N, Wendelstein J, Cayless A, Hoffmann P, Cooke D.** Repeatability of biometric measures from the Lenstar LS900 in a cataractous population. PLoS One. 2025;**20(5):**e0321786. Doi:10.1371/journal.pone.0321786.
14. **Mazur R, Wylegala A, Wylegala E, Dobrowolski D.** Comparative analysis of measurements of the anterior segment and axial length parameters obtained with optical and ultrasound technique. Expert Rev Med Devices. 2021;**18(12):**1245–1253. Doi: 10.1080/17434440.2021.2012448
15. **Qu G, Wang B, Ding S, Liu X, Gao L, Wang X.** Effects of cycloplegic agents on ocular parameters in children with myopia and hyperopia. J Ophthalmol. 2023;**2023:**9003942. Doi: 10.1155/2023/9003942.
16. **El-Metwaly HM, Mohamed SA, Seaud SA.** Scotopic pupil size in myopia and hypermetropia. Al Azhar Int Med J. 2024;**5(11):**14–20. Doi: 10.58675/2682-339X.2745
17. **Koc H, Kaya F.** Pupil barycenter configuration in patients with myopia and hyperopia. Int Ophthalmol. 2022;**42(11):**3441-3447. Doi: 10.1007/s10792-022-02343-0
18. **Meng ZY, Yang L, Zhou P.** Ciliary muscles contraction leads to axial length extension--The possible initiating factor for myopia. PLoS One. 2024;**19(4):**e0301844. Doi: 10.1371/journal.pone.0301844.
19. **Vetrugno M, Cardascia N, Cardia L.** Anterior chamber depth measured by two methods in myopic and hyperopic phakic IOL implant. Br J Ophthalmol. 2000;**84(10):**1113–1116. Doi:10.1136/bjo.84.10.1113.
20. **Sella R, Bu JJ, Lian RR, Hu JQ, Gali HE, Walker EH, et al.** Axial length and pharmacologic pupillary dilation in highly myopic patients. Graefes Arch Clin Exp Ophthalmol. 2024;**262(5):**1531–1538. Doi:10.1007/s00417-023-06296-7.

21. **Li T, Jiang B, Zhou X.** Axial length elongation in primary school-age children: a 3-year cohort study in Shanghai. BMJ Open. 2019;**9:**e029896. Doi:10.1136/bmjopen-2019-029896.
22. **Jo E, Kim SM, Kim JM, Han SY.** Changes in ocular biometrics following cycloplegic refraction in strabismic and amblyopic children. Medicine (Baltimore). 2024;**103(20):**e38143. Doi:10.1097/MD.0000000000038143.
23. **Bahar A, Pekel G.** The effects of pharmacological accommodation and cycloplegia on axial length and choroidal thickness. Arq Bras Oftalmol. 2021;**84(2):**107-112. Doi: 10.5935/0004-2749.20210015.

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