ORIGINAL ARTICLE

Corneal Curvatures, Anterior Chamber Depth and Axial Lengths in Pakistani High Myopic Cases

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Abstract:

Objectives: To determine correlations between the myopia and the Axial Length of the eye and the values of other ocular biometrics like corneal curvature and anterior chamber depth in high myopic patients of Pakistan.

Methods: Total 77 patients with refractive error of more than -5.00 D were included in this cross-sectional study. Ocular biometrics like axial length, keratometric readings and anterior chamber depth were documented. Axial lengths of eyes were measured by A-scan Ultrasonography. The mean value and ranges of ocular biometrics were calculated. Data was analyzed using SPSS version 22.

Results: Mean axial length of study participants was 26.3895±1.54274 mm, ranging from 21.56 mm to 29.21 mm. Mean keratometric values were (K1 of 44.41 D and K2 of 45.36 D). Our results showed no significant association between Axial Length (AL) and Anterior Chamber Depth **(**ACD), 2.998± 0.47680 with $p > 0.05$.

Conclusion: Myopia progression was directly associated with axial length. However, there is no statistically significant relationship of keratometric values and Anterior Chamber Depth **(**ACD) with severity of myopia. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 50-55. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

Refractive errors are the leading cause of progressive painless deterioration of vision in children and young adults[1]. Myopia is reported to be the most common refractive error in Pakistani population[2]. It is becoming an alarming pandemic and 2.5 billion people could be affected worldwide by myopia by the end of this decade[3].It is paramount to closely monitor high myopia due to its association with irreversible sight threatening complications[4].Some of the most common complications are retinal detachment, glaucoma and myopic maculopathy[5].

High myopia is generally defined as myopia of -5.00 diopters or higher[6]. The prevalence of high myopia has been increasing over the last several decades, particularly in developed countries[7]. The reason is multifactorial.

High myopia and its association with axial length(AL) and other biometric components has fascinated the clinicians from many years .Many studies on ocular components and growth of eye revealed that myopia is associated with long axial length[8]. Hassan Hashemi et al noted that strong correlation exist between corneal power and axial length in high myopic individuals[9]. Cornea have significant role in refraction of eye and corneal curvature CC has inverse association with AL[10].Determination of these parameters is helpful to ophthalmologists for management of refractive errors. Refractive state of eye thus depends on balance between eye size and its refractive components i.e., lens and cornea[11]. Axial length is major contributor of refractive error and is sum of anterior chamber depth (ACD), lens thickness and vitreous chamber depth. Higher axial length increase myopia but at the same time flatter cornea decrease refractive error[12].There is positive correlation between AL and ACD in myopic eyes[13].

Goal of our study is to measure ocular biometrics such as axial length, corneal curvature and anterior chamber depth and also study their mean and ranges in high myopic patients in Pakistani population.

Methodology:

This Observational cross-sectional study was conducted at Department of Ophthalmology, HBS medical and dental college, Islamabad from May 2017 to May 2024 after taking approval from the ethical review board of institution.77 Patients of an age with refractive error greater than -5D were included through non probability consecutive sampling technique. Patients with any pathology in eye causing induced myopia e.g., nuclear cataract were excluded**.** After inclusion in the study, patients were examined on slit lamp to rule out any other ocular disease. The patient's axial lengths of eyes were measured by A-scan Ultrasonography or by optical biometry (OA 2000 Tomy) in the hospital after taking their consent. Their keratometric values and anterior chamber depths were also noted.

Data were analyzed using IBM SPSS Statistics version 22. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to summarize ocular biometric parameters such as axial length, keratometric values (K1, K2), and anterior chamber depth (ACD).

To assess the relationship between axial length and other biometric parameters, an independent samples t-test was conducted by categorizing patients into two groups based on their autorefraction (AR) values: mild to moderate myopia (0 to -10 D) and high myopia (-10.1 to -30 D). The significance level was set at $p < 0.05$.

Pearson's correlation analysis was performed to evaluate the association between axial length and anterior chamber depth, as well as between axial length and keratometric values (K1, K2). A p-value of less than 0.05 was considered statistically significant for all tests.

Results were presented in the form of tables and figures, with confidence intervals (95%) provided for the independent t-tests to assess the precision of mean differences.

Results:

A total of 77 patients were included in this study with a mean age of 18.75 and a standard deviation of 7.635.

36.3 %(n=28) of the study population were males and 63.6 %(n=49) were females. This is shown in figure 1.

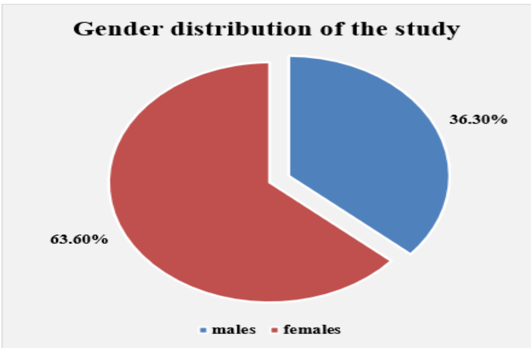

Figure 1. Gender distribution of the

Table 1. Best-corrected Vision in High Myopes

BCVA	Frequency	Percent
6/6	11	14.2%
6/9	8	10.3%
6/12	14	18.18%
6/18	12	15.58%
6/24	7	9.09%
6/36	6	7.79%
6/60	3	3.89%
CF	16	20.77%
Total	77	100%

Results:

The mean value of autorefraction (AR) was -11.1149 with a standard deviation of 3.78863. The maximum AR value recorded was -23.00, while the minimum was -6.00, resulting in a range of -17.00.

For keratometry (K) values, the mean K1 was 44.4066 with a standard deviation of 2.22596, a minimum value of 40.47, and a maximum value of 55.19. The mean K2 was 45.3631 with a standard deviation of 2.75899, ranging from 40.97 to 60.87.

The axial length measurements showed a mean value of 26.3895 with a standard deviation of 1.54274. The shortest recorded axial length was 21.56, while the longest was 29.21. The anterior chamber depth had a mean of 2.9981 with a standard deviation of 0.47680, with observed values ranging from 1.98 to 4.22.

To analyze the relationship between AR and axial length, AR values were categorized into two groups: one group included patients with AR values ranging from 0 to -10, while the second group comprised patients with AR values between -10.1 and -30. An independent samples t-test was conducted to compare axial length between these two groups, revealing a statistically significant relationship between high myopia and axial length ($p < 0.05$). This finding suggests that axial myopia is a predominant characteristic among highly myopic patients in our study population. The detailed statistical results of the t-test are presented in Table 2.

An Independent samples t-test was then applied between the two groups of AR and Anterior chamber depth. The result is shown in Table 3

Table 2. Independent Samples t-test between auto refraction (AR) and axial length

Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Axial Length	4.671	75	0.001	1.46534	0.31368	0.84046 – 2.09021

Table 3. Independent Samples t-test between AR and Anterior chamber depth

Variable	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Anterior chamber depth	1.592	75	0.116	0.17242	0.10834	0.04339 – 0.38824

Discussion:

The relationship between axial length and myopia severity has been well-documented. In our study, a significant relationship (p value 0.001) was observed between axial length and the severity of myopia, with a mean axial length of 26.3895 mm (SD = 1.54274), ranging from 21.56 mm to 29.21 mm. These results are comparable to the findings reported in the study by Zafar et al. (2023) where the mean axial length in myopic patients was found to be 25.68 mm (SD = 1.63) for individuals with moderate myopia, increasing to 27.14 mm (SD = 1.57) for those with high myopia[14]. Arora et al (2019) and Herb EN (2019) study similarly documented the relationship between axial length and refractive error, noting an increase in axial length with higher myopia, supporting the premise that axial length is a critical biomarker for assessing and managing myopia severity[15,16].

The mean keratometric values (K1 of 44.41 D and K2 of 45.36 D) in our study were within the typical range for myopic patients. However, unlike axial length, keratometric readings did not show a statistically significant relationship with the severity of myopia. According to Zhang et al, (2023), myopes typically exhibit steeper corneal curvatures compared to emmetropic and hyperopic individuals. The study reported that myopic patients had a significantly larger average corneal curvature with a mean difference of 0.253 D (95% CI, 0.089 to 0.417 D; $p < 0.001$)[17]. Interestingly, Sun et al. (2023) found that while corneal curvature plays a significant role in the management of myopia, the amount of corneal refractive change did not directly correlate with the degree of myopia18. Their study emphasized that axial length, rather than keratometry, was a more reliable indicator for assessing the efficacy of myopia control. In terms of anterior chamber depth, our results showed no significant association between AR and ACD 2.9981 (SD =0.47680 $p > 0.05$). A study by Aziz JH (2020) on the correlation between axial length and anterior chamber depth, which evaluated a diverse range of subjects, found a statistically significant inverse relationship between ACD and axial length across various subgroups[19]. Specifically, the study showed that as axial length increased, ACD decreased significantly, suggesting a consistent pattern in myopic eyes ($p < 0.001$). This finding contrasts significantly with the results from Dogan et al. (2019), who reported a mean ACD of 3.94 ± 0.22 mm for myopic population[20]. This could be attributed to differences in population demographics, genetic predisposition, and environmental factors that affect anterior segment parameters. Similarly, in the study titled "Distribution of White-to-White Corneal Diameter and Anterior Chamber Depth in Chinese Myopic Patients," the mean ACD was significantly higher than in our findings[21]. This study reported a mean ACD of 3.64 ± 0.25 mm, showing a stronger relationship between ACD and myopia in their cohort. The study also highlighted that a deeper anterior chamber may contribute to the development of myopia, although this trend was not evident in our results.

The study has many limitations first it is cross sectional and comprised only myopic subjects, and ocular biometrics may differ from those of hyperopic and emmetropic subjects. Second, only the subjects of a single center were included in the study, and all of the participants were Pakistanis, this may limit the generalizability of our results. Regardless of these limitations, our results clearly provide information about axial length, anterior chamber depth, corneal curvature and their intercorrelations and the results are of great value for ophthalmologists and may provide insight into the mechanism underlying ocular biometrics in high myopic patients.

Conclusion:

In line with both regional and global research, our study concluded that axial length is a crucial factor in determining the severity of myopia. Although our cohort's anterior chamber depth and keratometric values did not significantly correlate with Autorefraction, more studies in bigger populations are necessary to fully comprehend the significance of anterior segment parameters in the progression of myopia.

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