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RESEARCH ARTICLE

EVALUATION OF MYOPIA AND ITS CORRELATION WITH CORNEAL CURVATURE AND AXIAL LENGTH OF EYEBALL IN TERTIARY CENTER

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Abstract

Introduction: Refractive errors are a common cause of visual disorders, of which myopia is the second most common. Myopia is also known as shortsightedness. It is a condition occurring as a result of increased global axial length or increased refractive power of anterior segment, with the former being more important.

Aim: To evaluate the myopia and its correlation with axial length and corneal curvature .

Methods: A cross-sectional study conducted from July 2022 to December 2023 on 100 Cases of Myopia attending OPD in Department of Opthalmology, JNU Medical College, Jaipur. Refraction was measured as the spherical equivalent (SE).

Results: In present study, the patients were divided into three groups: mild myopia (≤−0.50D and >−3.00D), moderate myopia (≤−3.00D and >−6.00D), and high myopia (≤−6.00D), according to Spherical Equivalent (SE).In present study AL showed statistically significant differences among the three groups and AL increases with increase in myopia grade. In present study corneal curvature showed no statistically significant differences among the three groups i.e. corneal curvature is not statistically significantly associated with grades of myopia. In present study AL/CR showed statistically significant differences among the three groups and AL/CR increases with increase in myopia grade.

Conclusions: The present study concluded that that AL and AL/CR were significantly negatively correlated with SE in myopia patients, and the correlation between AL/CR and SE is higher than that between AL and SE. AL and AL/CR can be used as an alternative refractive status evaluation method for refraction.

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Introduction:-

Refractive errors are a common cause of visual disorders, of which myopia is the second most common. Myopia is also known as shortsightedness. It is a condition occurring as a result of increased global axial length or increased refractive power of anterior segment, with the former being more important. Its importance arises from the fact that it can affect almost all age groups, ethnic groups either sex and can even cause blindness.[1]

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Myopia is the refractive anomaly of the eye in which the conjugate focus of the retina is at some finite point in front of the eye, when the eye is not accommodating. It can also be described as the refractive condition in which parallel light rays from an object at optical infinity are focused by the eye in front of the retina, with accommodation relaxed.[2]

Myopia is a major threat for vision health across the world. It is responsible for around 75% of the refractive-error-related complications, with serious social and economical consequences. Patients with severe forms of myopia or high myopia are more susceptible to other ocular abnormalities such as lacquer cracks, retinal detachment, chorioretinal atrophy and glaucoma.[2]

According to a recent report of the Joint World Health Organization–Brien Hold en Vision Institute Global Scientific Meeting, myopia and high myopia were estimated to affect 27% (1893 million) and 2.8% (170 million) of the world population, respectively, in 2010. According to published studies, the prevalence of myopia is highest in east Asia, where China, Japan, the Republic of Korea and Singapore have a prevalence of approximately 50%, and lower in Australia, Europe and north and south America. Preliminary projections based on these prevalence data and the corresponding United Nations population figures and accounting for the effects of age and time, indicate that myopia and high myopia will affect 52% (4949 million) and 10.0% (925 million), respectively, of the world's population by 2050.[3]

There is a high prevalence of myopia, 80% to 90%, in young adults in East Asia; myopia has become the leading cause of blindness in this area. As the myopic population increases globally, the severity of its impact is predicted. Approximately one fifth of the myopic population has high myopia (≥−6 dioptres), which results in irreversible vision loss such as retinal detachment, choroidal neovascularization, cataracts, glaucoma, and macular atrophy. Early onset of myopia in childhood is associated with high myopia in adult life.Therefore, it is very important to stop or control myopia progression in myopic children from a young age.[4]

Myopia can be classified as axial myopia and non-axial myopia. It is classified in low myopia (0 to –3 D), moderate myopia (-3 to -6 D) and high myopia (<-6 D); syndromic myopia and non-syndromic myopia. There are 4 ocular structures contributing to the refractive status of a given human eye, including the cornea and lens. The cornea and lens fail to compensate for axial length (AL) elongation(myopia) or shortening (hyperopia).[5]

The etiology of myopia is complex and the current research consensus is that both genetic and environmental factors contribute to the development of myopia.[6]

For each individual, although genetic factors usually remain unchanged, their living environment is different and can change throughout life. Therefore, the status and severity of myopia are likely to change accordingly, and the biological parameters of the eye may change in the development of myopia.[7]
The current gold standard for the diagnosis of myopia and its severity is cycloplegic refraction.[8]

Researches have confirmed that axial length (AL) is the most important ocular biological parameter affecting refractive status, while the association between corneal curvature radius (CR) and refractive state is inconsistent.[9]

Grosvenor found for the first time that there is a positive correlation between AL and CR, that is, when AL becomes longer, CR also becomes larger.[10] When AL gradually increases and leads to the focus of parallel light before the retina, the eye tends to develop myopia . At this time, the cornea plays a regulatory role, making the eye return to emmetropia as much as possible through its compensation effect of flattening (CR increases). However, myopia occurs when the axial growth of the eye exceeds a certain limit and the corneal flattening effect cannot compensate for the myopia changes. Therefore, axial length to corneal curvature radius ratio (AL/CR) can reflect the refractive state of myopia to a certain extent.[11]

Many previous studies, based on children and adolescents aged 3–18 years, have found that the limit of corneal compensation is reached when AL/CR ≥ 3, and AL/CR is associated with SE. [12] This study has been undertaken to establish a correlation between the axial length, corneal curvature of eyeball and the degree of myopia using A-scan and keratometer to rule out the severity of myopia in patients of 5-50 years of age attending the ophthalmology OPD.

Aims and Objectives:-

To evaluate the myopia and its correlation with axial length and corneal curvature .

Materials and Methods:-

A cross-sectional study conducted from July 2022 to December 2023 on 100 Cases of Myopia attending OPD in Department of Opthalmology, JNU Medical College, Jaipur.

Results:-

Table no. 1:- Age profile of myopia subjects.

Parameter	Myopia Subjects				P Value
	Mild	Moderate	High	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Age	21.71±13.35	18.21±6.05	28.00±9.60	22.52±10.52	<.001

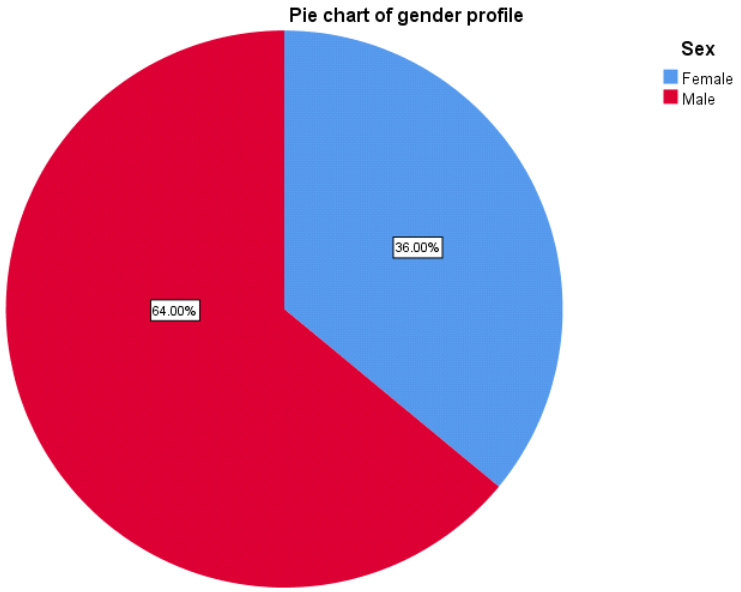
Graph No. 1:-

The mean age ± SD of age of myopia patients was 22.52±10.52 58 years. The mean age in mild myopia , moderate myopia, and high myopia group were 21.71±13.35 years, 18.21±6.05 years and 28.00±9.60 years respectively.

Table no. 2:- Sex Distribution of Myopia subjects.

Parameter		Myopia Subjects								P Value
		Mild		Moderate		High		Total		
		No.	%	No.	%	No.	%	No.	%	
Sex	Female	10	27.8%	18	50.0%	8	22.2%	36	36.0%	.109
	Male	18	28.1%	20	31.3%	26	40.6%	64	64.0%	
	Total	28	28.0%	38	38.0%	34	34.0%	100	100.0%	

Graph 2 A:-



Graph 2 B:-

In present study out of 100 patients of myopia 64 were male and 36 were female. Out of 64 males 18 male patients have mild myopia, 20 male patients have moderate myopia and 26 male patients have severe myopia. Out of 36 females 10 female patients have mild myopia, 18 female patients have moderate myopia and 8 female patients have severe myopia.

Table no. 3:- Association of axial length with grades of myopia.

Parameter	Myopia	

	Mild	Moderate	High	Total	P Value
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Right eye axial length (mm)	24.87±1.08	25.62±1.02	27.50±.40	26.31±1.36	<.001
Left eye axial length (mm)	24.89±1.07	26.21±1.13	27.13±.87	26.15±1.35	<.001

Graph no. 3 A and B:-
In present study the mean axial length of right myopic eyes was 26.31±1.36 mm . The mean AL (of right myopic eyes) in mild myopia , moderate myopia, and high myopia group were 24.87±1.08, 25.62±1.02 and 27.50±.40 mm respectively.

In present study the mean axial length of left myopic eyes was 26.15±1.35 mm . The mean AL (of left myopic eyes) in mild myopia , moderate myopia, and high myopia group were 24.89±1.07, 26.21±1.13, and 27.13±.87mm respectively

Table no. 4:- Association of corneal curvature with grades of myopia.

Parameter	Myopia				P Value
	Mild	Moderate	High	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Right eye corneal curvature radius (mm)	7.78±.07	7.77±.05	7.77±.05	7.78±.06	.901
Left eye corneal curvature radius (mm)	7.78±.06	7.77±.04	7.78±.08	7.78±.06	.957

Graph no. 4 A and B
In present study the mean corneal curvature radius of right myopic eyes was 7.78±.06 mm . The mean corneal curvature radius (of right myopic eyes) in mild myopia , moderate myopia, and high myopia group were 7.78±.07,7.77±.05, and 7.77±.05 mm respectively.

In present study the mean corneal curvature radius of left myopic eyes was 7.78±.06 mm . The mean corneal curvature radius (of left myopic eyes) in mild myopia , moderate myopia, and high myopia group were 7.78±.06, 7.77±.04, and 7.78±.08 mm respectively.

Table no. 5:- Association of AL/CR with grades of myopia.

Parameter	Myopia				P Value
	Mild	Moderate	High	Total	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	
Right Eye AL/CR	3.20±.13	3.30±.14	3.53±.07	3.38±.18	<.001
Left eye AL/CR	3.20±.13	3.37±.15	3.49±.12	3.36±.17	<.001

Graph no. 5 A and B:-
The mean AL/CR of right myopic eyes was 3.38±.18 . The mean AL/CR (of right myopic eyes) in mild myopia , moderate myopia, and high myopia group were 3.20±.13,3.30±.14, and 3.53±.07respectively.

The mean AL/CR of left myopic eyes was 3.36±.17. The mean AL/CR (of left myopic eyes) in mild myopia , moderate myopia, and high myopia group were 3.20±.13, 3.37±.15,3.49±.12 respectively

Discussion:-

Relatively few studies have been performed in past to evaluate the severity of myopia , observe the correlation between myopia, the axial length of eyeball and curvature of cornea in Rajasthan in a tertiary care center.
In present study, the patients were divided into three groups: mild myopia (≤−0.50D and >−3.00D), moderate myopia (≤−3.00D and >−6.00D), and high myopia (≤−6.00D), according to Spherical Equivalent (SE).

In present study AL showed statistically significant differences among the three groups and AL increases with increase in myopia grade. M. Jong et al.(2018) ,Chu et al.(2022) and Yanyun Fan et al. (2024) in their study on myopia subjects found that AL increases with increase in myopia grade which is consistent with results of present study. [9,13,14]

As myopia progresses, both the cornea and sclera tend to expand, causing the axial length of the eyeball to increase and the cornea became flatten . This may be due in part to the thinning of collagen fibers in the posterior pole of the sclera leading to deterioration of biomechanical properties.

In present study corneal curvature showed no statistically significant differences among the three groups i.e. corneal curvature is not statistically significantly associated with grades of myopia. Yanyun Fan et al. in their study on myopia subjects found that corneal curvature was not statistically significantly associated with grades of myopia which is consistent with results of present study. [45] However Chu et al. in their study on myopia subjects found that corneal curvature was statistically significantly associated with grades of myopia which is inconsistent with results of present study. [13]

The variation in between the two studies could be explained by differences in the average age of the sample and the grouping strategy. Unlike the majority of participants in present study were myopic adults , Chu et al. included more young myopic patients in their study. Age may have a significant influence on the distribution of ocular biological parameters. [13]

Researches have found that AL and CR in children constantly change with the gradual completion of eyeball development. But in adults as after the development of the eyeball is completed, the increase of AL can continue until the age of 30, but other refractive components did not change which is considered to be an important cause of axial myopia. Since the association between AL or CR and myopia seems to be unstable, this may have contributed to the in significant difference in CR in present study. [13]

In present study AL/CR showed statistically significant differences among the three groups and AL/CR increases with increase in myopia grade. M. Jong et al. ,Chu et al., and Yanyun Fan et al. in their study on myopia subjects found that AL/CR increases with increase in myopia grade which is consistent with results of present study. [9,13,14] Recent researches have shown that AL/CR in adolescents and children is more closely associated to myopia than AL alone, so attention should be taken to explore AL/CR in adults, as it may be a more stable indicator for evaluating the progression of myopia. Present study further verifies the possibility that AL/CR also indicates the severity of myopia. [15-16]

Conclusion:-

The present study concluded that that AL and AL/CR were significantly negatively correlated with SE in myopia patients, and the correlation between AL/CR and SE is higher than that between AL and SE. AL and AL/CR can be used as an alternative refractive status evaluation method for refraction and has good specificity and sensitivity for the diagnosis of high myopia in patients. In the future, large sample size and multicenter studies are needed to further confirm these findings and guide the clinical application of AL and AL/CR.

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