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ORIGINAL RESEARCH

To assess the association between corneal astigmatism and the morphology of pterygium

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ABSTRACT
Aim: The study aims to evaluate the relationship between corneal astigmatism and the morphology of pterygium using Anterior Segment Optical Coherence Tomography (AS-OCT). **Methods:** The pterygium was measured manually for its horizontal width and vertical length. The area and how much it extends onto the cornea (% extension) were also calculated. Anterior corneal astigmatism, and the principal meridians (K1 and K2) were measured. The pterygium's morphology was examined with ASOCT, identifying two patterns based on how far the pterygium extends under the corneal surface: continuous and nodular. The study analyzed how anterior corneal astigmatism relates to the size, percentage extension, and shape of the pterygium. **Results:** The study involved 80 patients (50 males and 30 females) with an average age of 55.01 years. Of these, 60% were from rural areas and 40% from urban areas. pterygium morphology and found that 47.5% had a continuous growth pattern, while 52.5% had a nodular pattern. The average best-corrected visual acuity (BCVA) was 0.4411. The mean horizontal width of the pterygium was 0.3450 mm, and the vertical length was 0.3163 mm, with an average percentage extension of 24.1%. The mean anterior corneal astigmatism was 2.2926, in continuous(2.8995) in nodular group(2.4076),and (p=0.02). **Conclusion:** Although not statistically significant, it highlights that continuous pterygium growth is associated with greater anterior corneal astigmatism compared to the nodular type, emphasizing the importance of pterygium morphology.
Keywords: corneal astigmatism, morphology, pterygium

INTRODUCTION

Pterygium is a wing-shaped growth of fibrovascular tissue that starts on the bulbar conjunctiva and extends towards the cornea. Its prevalence varies between 1.1% and 23.4%, depending on the population studied. Pterygium can cause cosmetic issues, recurring inflammation, and significant visual disturbances. It can alter corneal refractive status even before it affects the optical zone, often leading to with-the-rule astigmatism due to the flattening of the cornea beneath the pterygium.

Studies have shown that larger pterygia are more strongly associated with corneal astigmatism. However, there is limited research on the morphological patterns of pterygium and their impact on corneal astigmatism. Anterior segment optical coherence tomography (AS-OCT) provides detailed imaging of the ocular surface and helps to understand the relationship between pterygium and the cornea. Previous research using AS-OCT has described the pterygium's structure and its effect on visual acuity and astigmatism. This study aims to use AS-OCT to explore how the size and morphology of pterygium influence corneal astigmatism.

METHODS AND MATERIALS

The study was performed with the prior approval of National Institute of Medical Science and Research and followed the tenets of the declaration of Helsinki. Written informed consent was obtained from each subject.

This study was conducted at the National Institute of Medical Science and Research in Jaipur from July 1,2022 to December 31,2023. It was an observational cohort study that explored the relationship between corneal astigmatism and pterygium morphology

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among patients from both outpatient and inpatient ophthalmology departments. Patients aged 18 and older with primary ocular pterygium were included, while those with recurrent or inflamed pterygium, prior corneal diseases, eye trauma, contact lens users, or systemic conditions like collagen vascular disorders were excluded to maintain a uniform study group.

Data collection involved gathering demographic information, measuring refraction as spherical equivalent, assessing visual acuity with a Snellen chart, conducting slit-lamp microscopy for eye examination, and performing keratometry with a keratometry machine. Pterygium morphology was evaluated using NIDEK anterior segment optical coherence tomography (AS-OCT), which provided high-resolution images to classify pterygium patterns as continuous or nodular based on the extent of the apex below the corneal epithelium. Measurements of pterygium size included vertical length and horizontal width, with percentage extension onto the cornea calculated relative to corneal diameter. Data were analysed using SPSS Software (Version 28), with results reported as means and standard deviations for quantitative data and proportions for qualitative data. Statistical significance was determined using paired t-tests, Pearson correlation, chi-square tests, and Mann-Whitney U tests, with p-values less than 0.05 considered significant.

RESULT

1. Demographic Details

The study included 80 patients, comprising 50 males (62.5%) and 30 females (37.5%), with a mean age of 55.01 ± 13.353 years. In terms of the area of population, 48 patients (60.0%) were from rural areas, while 32 patients (40.0%) were from urban areas (Table 1).

Table 1: Demographic Details of the subjects enrolled in the study.

Variables	
Sample Size, n (%)	80 (100)
Age, Mean ± SD	55.01 ± 13.353
Gender, n (%)	
Male	50 (62.5)
Female	30 (37.5)
Area of Population, n (%)	
Rural	48(60.0)
Urban	32(40.0)

2. Clinical Parameters

2.1 Morphological characteristics

The study analyzed the morphology of the pterygium growth. It was observed that 38 patients (47.5%) had continuous growth patterns, while 42 patients (52.5%) exhibited nodular morphology. These findings shed light on the diverse distribution and distinct characteristics of pterygium within the patient cohort, emphasizing the variability in diagnosis and growth patterns across different eyes and individuals (Table 2).

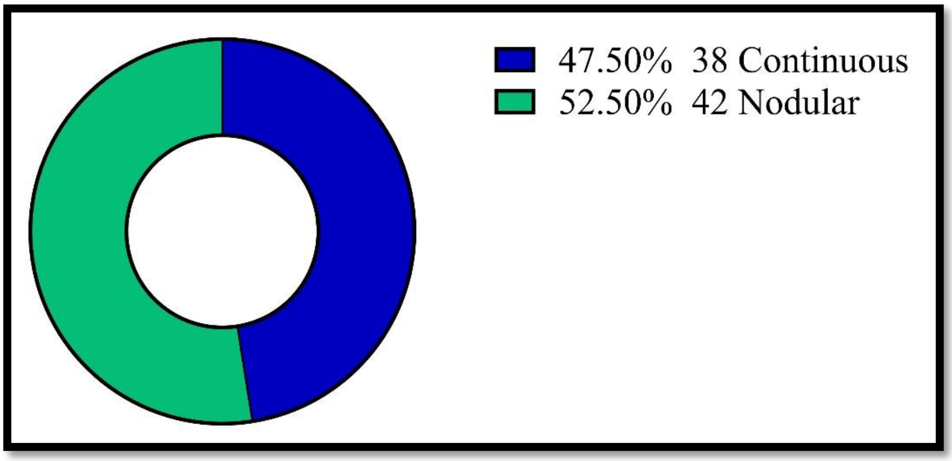

Table 2: Morphological characteristics of the patients enrolled in the study.

Variables	Frequency	Percent
Morphology		
Continuous	38	47.5
Nodular	42	52.5

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2.2 Clinical and Keratometry Parameters

The mean best-corrected visual acuity (BCVA) was 0.4411 ± 0.37939. The mean horizontal pterygium width (HORIZONTAL_WIDTH) was 0.3450 ± 0.20494 mm. The vertical length (VERTICAL_LENGTH) was 0.3163 ± 0.19386 mm. The percentage extension of the pterygium (PERCENTAGE_EXTENSION) was 24.1 ± 10.6%.

The mean anterior corneal astigmatism values were measured. The mean K1 was 42.622 ± 1.857 D, and the mean K2 was 45.049 ± 1.928 D. The mean corneal diameter was 1.2225 ± 0.117 mm.

The mean anterior corneal astigmatism was 43.2075 ± 1.71283 D (K1) and 44.2379 ± 2.47274 D (K2). The corneal diameter was 1.2225 ± 0.11690mm. The study analyzed data from 80 patients, categorized into two groups based on the morphology of pterygium: continuous (n=38) and nodular (n=42). The mean and standard deviation (SD) for various variables were calculated in each group, and p-values indicated the statistical significance of differences between the groups

Table 3: Clinical and keratometry parameters of patients

Variable	Mean ± SD (Continuous)	Mean ± SD (Nodular)	p-value
BCVA	0.3991 ± 0.42631	0.4790 ± 0.33200	0.35
HORIZONTAL WIDTH	0.3184 ± 0.24479	0.3690 ± 0.16001	0.273
VERTICAL_LENGTH	0.2947 ± 0.17698	0.3357 ± 0.20815	0.348
PERCENTAGE_EXTENSION	0.2516 ± 0.18297	0.3060 ± 0.13601	0.133
K1	42.6658 ± 1.87791	42.5838 ± 1.86107	0.845
K2	45.1653 ± 2.09295	44.9914 ± 1.78723	0.69
ASTIGMATISM	2.8995 + 0.77794	2.4076 + 0.70739	0.02
The data is significant at p-value<0.05.			

For best-corrected visual acuity (BCVA), the continuous group had a mean of 0.3991 ± 0.42631, while the nodular group had a mean of 0.4790 ± 0.33200 (p=0.35). In terms of Horizontal width, the continuous group had a mean of 0.3184 ± 0.24479 compared to 0.3690 ± 0.16001 in the nodular group (p=0.273). Similarly, vertical length was 0.2947 ± 0.17698 in the continuous group and 0.3357 ± 0.20815 in the nodular group (p=0.348). The percentage extension was 0.2516 ± 0.18297 in the continuous group and 0.3060 ± 0.13601 in the nodular group (p=0.133).

Regarding keratometry (K) values, the mean K1 was 42.6658 ± 1.87791 in the continuous group and 42.5838 ± 1.86107 in the nodular group (p=0.845). The mean K2 was 45.1653 ± 2.09295 in the continuous group and K2 was 44.9914 ± 1.78723 in the nodular group (p=0.69).

For astigmatism, values were 2.8995 ± 0.77794 in the continuous group and 2.4076 ± 0.70739 in the nodular group (p=0.02).

Overall, these results highlight differences in keratometry and astigmatism between the continuous and nodular morphology groups, showing astigmatism more in continuous group than in nodular group with a significant difference, suggesting potential implications for treatment and management strategies.

2.3 Corneal Astigmatism

Tracking Changes in Astigmatism

Corneal astigmatism ranged from 0.06 D to 9.62 D, with a mean of 2.2926 D and a standard deviation of 2.24533 D, indicating diverse patient conditions. (Table 4)

Table 4: Corneal Astigmatism among patients enrolled in the study.

Variables	N	Minimum	Maximum	Mean	SD
CORNEAL ASTIGMATISM	80	.06	9.62	2.2926	2.24533

3. Correlation between corneal astigmatism and other variables

The scatter plots provide a detailed interpretation of the relationship between corneal astigmatism and various morphological features of pterygium.

3.1 Correlation between corneal astigmatism and horizontal length

In the first graph (A), which examines the correlation between corneal astigmatism (D) and horizontal length (mm), the data points show a positive relationship with a p-value of 0.054 and an r-value of 0.842. This indicates a strong positive correlation, although the p-value suggests that the result is not statistically significant at the conventional 0.05 level.

3.2 Correlation between corneal astigmatism and vertical width

The second graph (B) shows the relationship between corneal astigmatism (D) and vertical width (mm), revealing a moderate positive correlation with a p-value of 0.084 and an r-value of 0.442. This suggests a statistically non-significant but positive relationship.

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3.3 Correlation between corneal astigmatism and percentage extension of pterygium

The third graph (C) presents the correlation between corneal astigmatism (D) and the percentage extension (%) of pterygium. This graph shows a very strong positive correlation with a p-value of 0.156 and an r-value of 0.942, indicating a strong relationship, although the p-value indicates that this result is not statistically significant.

Overall, these plots suggest that increases in horizontal width, vertical length, and percentage extension of pterygium are associated with increases in corneal astigmatism, with varying degrees of statistical significance (Figure 3).

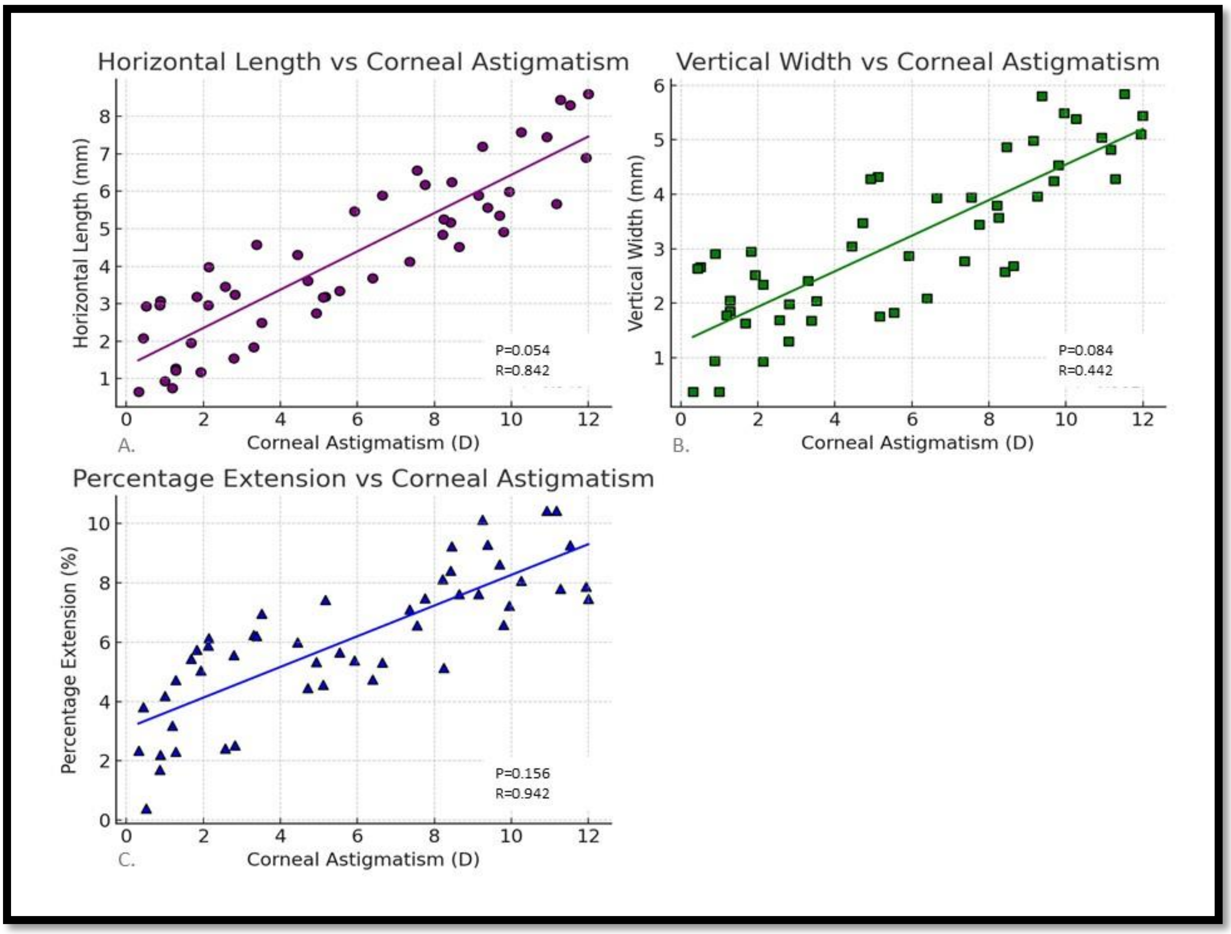

Figure 3: The scatter plots indicate a correlation between corneal astigmatism and A. Horizontal Length; B. Vertical Width; C. Percentage Extension

DISCUSSION

This study examined the relationship between pterygium size, its morphology, and the resulting anterior corneal astigmatism. Our findings show that larger pterygia are linked to higher levels of corneal astigmatism, but the specific morphology of the pterygium does not have a significant impact.

Pterygium induces central corneal flattening through mechanical pressure or tear pooling at its apex. Previous studies have established a strong connection between the size of the pterygium (including its width, length, and area) and corneal astigmatism. For example, Han and colleagues found that the horizontal length of the pterygium correlates more strongly with astigmatism than its width or total area. Similarly, Mohammad-Salih and colleagues reported that pterygium extension had the strongest correlation with corneal astigmatism, followed by its total area. Our study also found significant correlations with percentage extension, pterygium area, and horizontal length.

AS-OCT is a valuable tool for in vivo imaging of the anterior segment, allowing detailed visualization of the cornea and pterygium. Although AS-OCT has been used to identify various pterygium patterns, there is no systematic classification of how pterygium interacts with the cornea. Soliman and colleagues described primary pterygium as a wedge-shaped mass that extends beneath the corneal epithelium, sometimes causing scarring or satellite masses. Gasser and colleagues further categorized pterygium morphology based on the corneoscleral transition zone, linking flat or nodular appearances to higher astigmatism and increased corneal scarring.

In our study, we identified two pterygium patterns based on the extent to which the apex extends below

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the corneal epithelium. Continuous morphology, suggesting more advanced pterygium stages, was associated with higher anterior corneal astigmatism compared to nodular types. However, this difference was not statistically significant, possibly due to variations in mechanical traction and scarring effects.

Limitations

The study's limitations include a small sample size.

CONCLUSION

Our study highlights that larger pterygia are associated with greater anterior corneal astigmatism. Although continuous pterygia showed higher astigmatism than nodular ones, this difference was not statistically significant. AS-OCT is useful for assessing pterygium morphology and its effects on corneal astigmatism, but more extensive studies are needed to fully understand these relationships.

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