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Original Research Article

Study of morphometric changes of cornea in cases of pterygium

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ABSTRACT

Background: Pterygium is a benign, wing-shaped, fibrovascular growth that originates on the bulbar conjunctiva and can spread to the limbus and beyond, causing morphometric changes in the cornea and affecting visual status. Aim of study was to study the morphometric changes in the cornea in patients with pterygium.
Methods: Prospective hospital-based analytical study conducted on 100 consecutive patients with unilateral pterygium for two years. Each patient underwent a complete ophthalmic examination, including evaluation of visual acuity refraction, corneal curvature, corneal endothelial cell density (CECD), central corneal thickness (CCT), coefficient of variation (CV) and hexagonality. Necessary demographic data and variables like age, smoking status and occupation were also determined. The healthy eye was considered as a control.
Results: Majority of the study population, i.e. 43%, belonging to the 21-40 years of age group; socioeconomically, maximum cases (61%) were found in class IV with a male preponderance of 53%. 56% of patients hailed from rural areas, and regarding occupation, it was found that 37% of patients were farmers. This study found that the majority of patients (60% of cases) had multiple ocular complaints. There was a significant association between pterygium grade and keratometric astigmatism. Our study found a significant difference between ECD, hexagonality and CV in the normal and diseased eye. CCT was found more in diseased eyes but was significant only in grade IV pterygium.
Conclusions: Pterygium leads to deterioration of visual performance by causing refractive and keratometric changes.

Keywords: Endothelial cell density, Keratometry, Pterygium

INTRODUCTION

A pterygium is a benign growth that begins on the bulbar conjunctiva and can extend to the limbus and beyond, with a higher incidence at the nasal limbus than the temporal (less than 1%). Its prevalence is high in equatorial regions (up to 22%) but less than 2% in latitudes above 40 degrees.[1] Pterygium occurs more frequently in men and those between 20 and 40 years of age.[2] The primary causative factor is believed to be exposure to ultraviolet (UV) light, particularly UV-B radiation, which can lead to mutations in the p53 tumour suppressor gene, resulting in abnormal limbal epithelial cell proliferation.[3]

Pterygium can be classified into four subtypes based on clinical presentation, with increasing severity from grade I to grade IV.[4] It induces corneal astigmatism by flattening the area between the central cornea and the advancing end of the pterygium, resulting in the rule astigmatism. However, there is a poor correlation between pterygium-induced corneal astigmatism measured topographically and that measured by manifest refraction.[5] Previous studies have linked pterygium encroachment onto the cornea with corneal endothelial cell density (CECD) loss and the development of corneal astigmatism. However, few studies have investigated the relationship between pterygium morphology and changes in keratometry, CECD, hexagonality, CV. Specular

microscopy is a non-invasive approach to qualitatively, quantitatively, and morphometrically evaluate corneal endothelial functions. It can assess corneal thickness, cell density (CD), pleomorphism (cell shape variation in the endothelium), and polymegathism (variation in individual cell area). The hexagonal cell ratio is used to evaluate pleomorphism, while the coefficient of variation (determined by the ratio of standard deviation to the mean cell area) defines polymegathism. This study aims to explore all these morphometric changes in patients with pterygium in a tertiary care hospital.

METHODS

This study is an analytical, prospective study conducted between September 2020 and August 2022 at SP Medical College PBM and AGH, Bikaner Rajasthan. A sample size of 100 patients was calculated using prevalence of pterygium as 22%.[5] With Q=1-P, Confidence Interval - 95%, so z=1.96, d=error i.e. 10%, $N=Z2pq/d^2$, N=70 and assuming 20% attrition and rounding off to minimum a sample size was calculated to be 100.

Before participating in the study, the patients provided informed written consent and received approval from the Ethical Committee. A predesigned proforma was used to collect data, which included a comprehensive ophthalmic and clinical examination, visual acuity assessment using a log MAR chart, and corneal curvature assessment using an auto refractometer. Corneal endothelial cell density (CECD), central corneal thickness (CCT), coefficient of variation (CV), and hexagonality were evaluated using a non-contact specular microscope. Demographic data and essential variables such as age, smoking status, and occupation were also collected. The severity of pterygium was determined based on its morphology using slit-lamp examination, and the patient's healthy eye was considered the control. The data were analyzed using SPSS-22, with chi-square tests used for categorical variables and independent samples t-tests used for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Inclusion criteria

Patients with unilateral pterygium, patients with primary pterygium, patients giving informed consent and willing to participate in the study were included.

Exclusion criteria

Patients with history of recurrent pterygium, patients with pterygium due to secondary causes like chemical injury, patients having associated glaucoma and any other corneal pathology, patients having ocular surface diseases and corneal opacity, and patients not willing to participate in the study were excluded.

RESULTS

Majority of study population i.e. 43% belonged to 21-40 years of age group with mean age of 40.83±13.73 years and age range of 18 to 75 years (Table 1).

Table 1: Sociodemographic.

	Frequency	Percentage
Age (years)		
≤20	5	5
21-40	43	43
41-60	42	42
61-80	10	10
Gender		
Male	53	53
Female	47	47
Residence		
Rural	56	56.00
Urban	44	44.00

The study population had male to female ratio of 1.12:1, with the male preponderance of 53%. 56% of patients hailed from rural areas, and regarding occupation, it was found that 37% of patients were farmers, 25% patients were housewives, 15% patients were students, 3% patients were shopkeepers, 2% each were daily wage workers, tailors, mechanics, carpenter and only 1% each were plumber and soldier.

Socioeconomically, the maximum cases (61%) were found in class IV; 33% of patients were in class V. 14% were smokers, and 14% were tobacco chewer.7% were alcoholics. The majority of patients (65% of cases) do not have any significant personal history.

Table 2: According to chief complaints and their duration.

Chief complaints	Frequency	Percentage
Multiple ocular complaints	60	60
Cosmetic	13	13
Diminution of vision	10	10
Watering	10	10
Foreign body sensation	5	5
Ocular pain	2	2
Duration (years)		
0-1	13	13
1-2	24	24
2-3	15	15
3-4	17	17
4-5	10	10
6-10	13	13
>10	8	8

This study found that the majority of patients (60% of cases) had multiple ocular complaints. Most of the patients (38% of cases) had grade II pterygium. 33% of

patients had grade III, 20% of patients had grade I, and only 9% of cases had grade IV pterygium (Table 2).

From the findings of visual acuity, it was observed that the mean values of visual acuity were less in the diseased eye than in normal eye in all grades, but the difference was found significant in grade II (0.225±0.23 and 0.34±0.28; p value 0.045), grade III (0.30±0.24 and 0.56±0.29; p value 0.0001), and grade IV (0.37±0.23 and 0.72±0.29; p value 0.012 in the diseased eye and normal eye respectively) of pterygium.

In this study, it was observed that the mean difference of K2-K1 was less in the normal eye compared to the diseased eye, but the difference was statistically significant only in grade III (5.51±2.82 and 1.049±0.81; p value 0.0001) and grade IV (6.39±2.82 and 1.39±0.89; p value 0.0001). So, we found a significant association between pterygium grade and keratometric astigmatism.

Table 3: Comparison of visual acuity, keratometry and corneal morphometric changes in diseased eye vs. normal eye.

Visual acuity	Diseased eye	Normal eye	P value
Grade I (20)	0.07±0.23	0.13±0.29	0.473
Grade II (38)	0.225±0.23	0.34±0.28	0.045*
Grade III (33)	0.30±0.24	0.56±0.29	0.0001*
Grade IV (9)	0.37±0.23	0.72±0.29	0.012*
K2-K1			
Grade I (20)	1.07±2.72	0.61±0.79	0.472
Grade II (38)	1.465±2.76	0.76±0.77	0.136
Grade III (33)	5.51±2.82	1.049±0.81	0.0001*
Grade IV (9)	6.39±2.82	1.39±0.89	0.0001*
Endothelial cell density			
Grade I (20)	2706.2±380.49	2732.8±255.35	0.801
Grade II (38)	2556.92±371.76	2586.07±251.57	0.681
Grade III (33)	2243.72±321.32	2492.52±253.76	0.031
Grade IV (9)	2158.42±314.75	2449.71±251.70	0.021
Central corneal thickness			
Grade I (20)	508.3±38.62	508.3±30.38	1.000
Grade II (38)	511.82±39.54	508.35±29.7	0.710
Grade III (33)	510.30±38.66	502.13±29.40	0.348
Grade IV (9)	551.14±39.61	513.42±29.41	0.035*
Hexagonality			
Grade I (20)	50.5±6.96	49.8±5.92	0.570
Grade II (38)	45.71±6.77	48.14±5.76	0.093
Grade III (33)	40.15±5.82	45.95±6.87	0.005
Grade IV (9)	38.00±5.55	47.42±6.0	0.007
Coefficient of variation			
Grade I (20)	33.4±5.64	33.2±4.66	0.902
Grade II (38)	35.89±5.47	34.64±4.54	0.192
Grade III (33)	38.26±5.95	35.60±4.90	0.052
Grade IV (9)	40.28±5.27	37.28±4.63	0.293

This study demonstrated that the mean Endothelial Cell Density (ECD) was more in the normal eye than the diseased eye in grades I, II, III and IV, but statistical significance was seen in grades III and IV only. In this study, the mean value of central corneal thickness was more in the diseased eyes than in normal eyes in all grades of pterygium, but the difference was found to be significant in only grade IV pterygium (551.14±39.61 and 513.42±29.41; p value 0.035).

In this study, the mean value of hexagonality was less in the diseased eye than in normal eye in all grades, and the difference was found to be significant in grades III and IV of pterygium. These findings were in accord with ECD. Also, the mean value of the coefficient of variation was higher in diseased eyes than in normal eyes in all grades, but the difference was significant in grades III and IV of pterygium (Table 3).

DISCUSSION

Pterygium is one of the most common ocular surface diseases in the elderly. Its prevalence has been noted to be higher in specific populations, such as outdoor workers who have significant sun exposure. Still, its exact pathogenesis and underlying causes have yet to be entirely understood.

In the present study, the majority of the study population, i.e. 43%, belonged to the 21-40 years of age group with a mean age of 40.83±13.73 years and an age range of 18 to 75 years, which was comparable to the mean age of 43.80±24.37 years in the study performed by Zaidi et al.[6] which showed that patients older than 40 years have the highest prevalence of pterygium, while patients aged 20-40 years are reported to have the highest incidence of pterygium.

Our study population had male to female ratio of 1.12:1, with a male preponderance of 53%. This can be attributed to the fact that males are involved more in outdoor work in India. Also, females in rural areas seek healthcare facilities less often due to socioeconomic constraints. Similarly, male preponderance was seen by Zaidi et al with a male-to-female ratio of 1.6:1.[6]

In our study, 56% of patients hailed from rural areas. Regarding occupation, it was found that 37% of patients were farmers, 25% of patients were housewives, 15% of patients were students, 3% of patients were shopkeepers, 2% each were daily wage workers, tailors, mechanics, and carpenters, and only 1% were plumber and soldier. Socioeconomically maximum cases (61%) were found in class IV, 33% of patients were in class V, and 3% of patients belonged to both class II and class III. Similarly, Zaidi et al found that the most common occupation was labour/construction work (n=31), followed by farming (n=27).[6] A statistically significant association was found between outdoor work and pterygium formation, which may be related to higher exposure to sunlight and dust in outdoor workers.[7] Efforts may be made to educate outdoor workers to wear proper equipment to protect their eyes against excessive sunlight. People with a low level of education in rural areas often work in outdoor occupations. Although lower economic status carried a higher risk of pterygium, that odds ratio does not decrease with statistical significance with an increase in household income.

According to personal history, 14% of patients were smokers, and 14% of patients were tobacco chewer. 7% of patients were alcoholics. The majority of patients (65% of cases) do not have any significant personal history. The Barbados Eye Study found a protective effect of smoking against the prospective development of pterygium. Such effects may be explained by vasoconstriction or suppression of inflammatory cytokines induced by nicotine and alterations in the tear film, such as increased levels of secreted antibodies.[8]

In the present study, the majority of patients (60% of cases) had multiple ocular complaints.13% of patients had cosmetic issues, 10% of patients had complaints of diminution of vision,10% of patients had watering, 5% of patients had foreign body sensations, and 2% of patients had ocular pain.

Also, most patients (38% of cases) had grade II pterygium. 33% of patients had grade III pterygium, 20% of patients had grade I pterygium, and only 9% of cases had grade IV pterygium. Songur et al, in their case-control study, observed that there were 33 type 1 pterygium, 31 type 2 pterygium, 30 type 3 pterygium patients and 30 had healthy controls.[9]

A pterygium reduces vision by distorting corneal optics, disrupting tear film, encroaching on the central cornea, and inducing astigmatism. In our study, the mean values of visual acuity were less in diseased eyes than in normal eyes in all grades, but the difference was found to be significant in grade II, grade III and grade IV of pterygium. Vanathi et al found mean Log Mar uncorrected visual acuity in diseased eyes and control eyes was 0.21±0.20 and 0.12±0.15, respectively (p=0.0 16) and concluded that pterygium leads to deterioration of visual performance, not only by causing refractive and topographic changes but also by causing a significant increase in the corneal wavefront aberrations.[10]

In our study, we observed that the mean difference of K2-K1 was less in normal eyes compared to diseased eyes, but the difference was statistically significant only in grade III and grade IV. So, we found a significant association between pterygium grade and keratometric astigmatism. A similar association was also found by Souley et al.[11] Hence pterygium causes corneal distortion and induces a significant amount of astigmatism. This astigmatism may occur either due to traction generated by the pterygium, pulling on and distorting the cornea, or by tears pooling near the apex of the pterygium or both.[12]

Our study found that the mean value of central corneal thickness was higher in diseased eyes than normal eyes in all grades of pterygium, but the difference was only statistically significant in grade IV pterygium. Pterygium is caused by three main factors, namely mitogenicity, the formation of a new vascular network, and remodelling of the extracellular matrix, which promote aggressive growth on top of the cornea, creating new vascular and fibrotic tissue. However, other studies conducted by Songur et al and Sousa et al did not find a significant difference in central corneal thickness.[9,13]

Although a pterygium lesion typically affects the surface layers of the cornea, it can disrupt the connections between cells due to the activation of an enzyme called matrix metalloproteinase. This has led researchers to investigate whether the lesion also affects deeper layers of the cornea, such as the endothelium and Descemet's membrane. A study done by Mootha et al reported that in

long-term nasal pterygium, the underlying Bowman layer of the pterygium could dissolve due to fibroblast infiltration of the anterior stroma and, subsequently, descents membrane and endothelial damage may occur in the cornea.[14] Our study found that the density of endothelial cells was higher in normal eyes compared to eyes with pterygium, across all grades of severity. However, this difference was statistically significant as the grade progressed. Similar changes were noticed for hexagonality and coefficient of variation. This suggested that as the pterygium progress, it significantly affects the corneal parameters. This was consistent with the other similar studies.[9,15] Hence it is suggested that a pterygium should be operated as soon as diagnosed to prevent its detrimental effects on corneal morphology. Also, as we observed a significant decrease in CECD in grade 3 and 4 pterygium, these patients should be taken for specular microscopy before planning for intraocular surgery like cataract extraction. There were several limitations in our study, such as the less number of patients and difficulties in performing specular microscopy, especially in patients with grade IV pterygium. We also need more long-term follow-ups of patients. Hence, the effect of pterygium in the long run on the cornea's ECD, CV, CCT, and hexagonality cannot be concluded. Studies should be conducted on a large sample size with long-term follow-up to confirm the association.

CONCLUSION

Pterygium leads to the deterioration of visual performance not only by causing refractive and keratometric changes but also by causing significant morphometric changes. Further, longitudinal studies need to be conducted on a large scale to confirm this association between these variables as this poses a serious risk for postoperative oedema and decreased vision, especially among patients that require cataract surgery.

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REFERENCES

1. Mackenzie FAD, Hirst LW, Battistutta D, Green A. Risk analysis in the development of pterygia. Opthalmol. 1992;99(7):1056.
2. Bradley PG, William MT. Pterygium. In: Kaufman (ed). 2nd ed. The Cornea Butterworth-Hienmann Boston; 1998:497-521.
3. Chui J, Di Girolamo N, Wakefield D, Coroneo MT. The pathogenesis of pterygium: current concepts and their therapeutic implications. Ocul Surf. 2008;6(1):24-43.
4. Johnston SC, Williams PB, Sheppard JD. A comprehensive system for pterygium classification. Invest Ophthalmol Vis Sci. 2004;45(13):2940.
5. Han SB, Jeon HS, Kim M, Lee SJ, Yang HK, Hwang JM, et al. Quantification of astigmatism induced by pterygium using automated image analysis. Cornea. 2016;35(3):370-6.
6. Zaidi SBH, Khan WA. Is pterygium morphology related to loss of corneal endothelial cells? a cross-sectional study. Clin Ophthalmol. 2021;15:1259-66.
7. Khoo J, Saw SM, Banerjee K, Chia SE, Tan D. Outdoor work and the risk of pterygia: a case-control study. Int Ophthalmol. 1998;22(5):293-8.
8. Nemesure B, Wu SY, Hennis A, Leske MC, Barbados Eye Studies Group. Nine-year incidence and risk factors for pterygium in the barbados eye studies. Ophthalmology 2008;115(12):2153–8.
9. Songur MS, Erkan E, Bayhan SA, Bayhan HA. Evaluation of changes in corneal endothelial morphology during the progression of pterygium by specular microscopy. J Surg Med. 2021;5(7):679-82.
10. Vanathi M, Goel S, Ganger A, Agarwal T, Dada T, Khokhar S. Corneal tomography and biomechanics in primary pterygium. Int Ophthalmol. 2018;38(2):663-71.
11. Souley AS, Sambou KF, Adam ND, Joanelle EL, Abdou A. Case series about physiological astigmatism and the impact of pterygium surgery. Ann Med Surg (Lond). 2022;81:104488.
12. Tseng SC. Concept and application of limbal stem cells. Eye. 1989;3(2):141-57.
13. Sousa HCC, Silva LNP, Tzelikis PF. Corneal endothelial cell density and pterygium: a cross-sectional study. Arq Bras Oftalmol. 2017;80(5):317-20.
14. Mootha VV, Pingree M, Jaramillo J. Pterygia with deep corneal changes. Cornea. 2004;23(6):635-8.
15. Hu Y, Atik A, Qi W, Yuan L. The association between primary pterygium and corneal endothelial cell density. Clin Exp Optom. 2020;103:778-81.

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