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IMPACT OF DIFFERENT GRADES OF PTERYGIUM ON CORNEAL ASTIGMATISM AND VISUAL FUNCTION

Observational Analytical Study

Aafaq Ahmad Khan[1]*, Ummara Shafiq[2], Shehzad Ahmad[3], Abaid Ur Rehman[1], Hafiz Zohaib Hassan[1], Zara Arif[1]
[1]Superior University, Lahore, Pakistan.
[2]Assistant Professor, Superior University, Lahore, Pakistan.
[3]Lecturer, Superior University, Lahore, Pakistan.
Corresponding Author: Aafaq Ahmad Khan, Superior University, Lahore, Pakistan, aafaqkhan212@gmail.com
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ABSTRACT

Background: Pterygium is a progressive ocular surface disorder characterized by a fibrovascular growth that extends from the conjunctiva onto the cornea. Its presence disrupts corneal curvature, inducing astigmatism and compromising visual function. Ultraviolet (UV) radiation exposure remains the most prominent risk factor, particularly in individuals with outdoor occupations. Understanding the correlation between pterygium severity and its impact on visual outcomes is critical to guide early intervention, prevent progression, and reduce the associated visual morbidity in affected populations.

Objective: The objective of this study was to evaluate the impact of different grades of pterygium on corneal astigmatism and visual function in patients aged 20–60 years.

Methods: An observational analytical study was conducted at the Layton Rahmatulla Benevolent Trust (LRBT) Eye Hospital over six months. A total of 60 participants were recruited using convenience sampling. Inclusion criteria consisted of clinically diagnosed pterygium, while patients with other ocular or systemic diseases were excluded. Visual acuity was measured using the Snellen chart, pterygium grading was performed with slit-lamp biomicroscopy, and corneal astigmatism was assessed using an auto-refractometer. Best-corrected visual acuity (BCVA) was determined through subjective refraction. Statistical analysis was performed using SPSS v25, with Chi-square and Pearson correlation applied to assess associations.

Results: The mean age of participants was 40.22 ± 12.6 years, with 53.3% males and 46.7% females. Outdoor workers represented 70% of the sample. Grade 1, 3, and 4 pterygium were equally prevalent (30% each), while Grade 2 accounted for 10%. Corneal astigmatism increased significantly with advancing pterygium grade ($p<0.001$), with 43.3% of participants showing astigmatism ≥1.75 D. Visual acuity improved from 25% achieving 6/6 before correction to 35% after correction, while 63.3% attained 6/9. Visual disturbances were frequent in 51.7% of patients, with eye irritation (28.3%), foreign body sensation (21.7%), and photophobia (20%) reported as the most common symptoms. A significant correlation was observed between pterygium grade and both spherical refractive error ($p<0.001$) and BCVA ($r=0.536$, $p<0.001$).

Conclusion: This study found that increasing pterygium grade was significantly associated with higher corneal astigmatism, spherical refractive errors, and visual disturbances. These findings highlight the importance of early diagnosis, preventive measures, and timely intervention to minimize functional impairment and improve quality of life in affected individuals.

Keywords: Astigmatism; Best Corrected Visual Acuity; Corneal diseases; Pterygium; Refractive errors; Slit-Lamp Biomicroscopy; Visual function.

INTRODUCTION

Pterygium is a common ocular disorder characterized by a fibrovascular overgrowth of conjunctival tissue extending onto the corneal surface, which can distort corneal architecture and compromise visual acuity (1–3). Its impact extends beyond cosmetic disfigurement, as progressive lesions are often associated with irregular astigmatism, reduced vision, and ocular surface discomfort. The condition is most prevalent in populations exposed to high levels of ultraviolet (UV) radiation, particularly outdoor workers and residents of equatorial or sunny regions, highlighting the significant role of environmental exposure in its etiology (4–6). The pathogenesis of pterygium involves complex interactions between environmental triggers and tissue responses. Chronic UV exposure induces oxidative stress, fibroblast activation, and aberrant epithelial and stromal cell proliferation, leading to connective tissue remodeling and vascularization (7–9). These structural changes can not only affect corneal regularity but also alter tear film stability, contributing to dry eye symptoms and further visual impairment. Importantly, the severity of pterygium is not determined solely by its size; studies indicate that contrast sensitivity, an essential parameter of functional vision, is disproportionately affected in larger lesions, underscoring the broader spectrum of its visual consequences. Management of pterygium primarily involves surgical excision, with conjunctival autografting regarded as the gold standard due to its lower recurrence rates compared with other techniques (10–12). However, recurrence remains a major clinical challenge, often linked to persistent inflammation, inadequate ocular surface rehabilitation, and continued UV exposure. Adjunctive strategies, such as the use of artificial tears to restore tear film function and anti-inflammatory measures to suppress conjunctival hyperactivity, are recommended to reduce postoperative recurrence. Preventive measures, including protective eyewear and hats, are essential for high-risk individuals, particularly those with occupational or geographical susceptibility (13–15). Despite advancements in surgical and preventive approaches, significant gaps remain in understanding the correlation between pterygium morphology, functional vision outcomes, and recurrence patterns. This study seeks to address these gaps by exploring the association between pterygium characteristics, their visual impact, and the effectiveness of surgical and preventive measures, with the ultimate objective of informing strategies that optimize patient care and reduce recurrence risk.

METHODS

The study was conducted using an observational analytical design at the Layton Rahmatulla Benevolent Trust (LRBT) Eye Hospital over a period of six months, following formal approval of the study synopsis by the institutional ethical review board. A sample size of 60 participants was determined using Cochran's formula, based on estimates from previous research (3,4). Convenience non-probability sampling was employed to recruit eligible participants, acknowledging the limitation of potential selection bias inherent in this approach. Participants included male and female patients aged 20–60 years with a confirmed diagnosis of pterygium. Exclusion criteria comprised individuals with other ocular comorbidities such as glaucoma, cataracts, corneal degenerations, or dystrophies, as well as systemic diseases that could affect ocular health. Pregnant and lactating women were excluded to avoid potential confounding effects of hormonal changes on ocular parameters. These criteria were designed to ensure a homogeneous sample, minimizing confounders that could influence corneal topography and visual function. Ethical principles were strictly adhered to throughout the study. Written informed consent was obtained from all participants after explaining the purpose, procedures, and voluntary nature of participation. Confidentiality and anonymity of the subjects were maintained, and data were used solely for research purposes. Approval was granted by the institutional review board of the relevant institute.

Data collection employed standardized ophthalmic instruments and validated tools. Visual acuity was assessed using the Snellen chart under standardized illumination, followed by refraction with an auto-refractometer and subjective refinement to determine best-corrected visual acuity (BCVA). Corneal topography and astigmatism were evaluated using Scheimpflug imaging (Pentacam), which provided objective indices of corneal curvature and irregularity. The grade of pterygium was determined by slit-lamp biomicroscopy using established grading criteria, ensuring reproducibility. A structured questionnaire was administered to collect demographic and clinical information relevant to the study objectives. Data analysis was performed using IBM SPSS Statistics version 25. Descriptive statistics, including means and standard deviations for continuous variables and frequencies for categorical variables, were generated to summarize baseline characteristics. Associations between categorical variables were examined using the Chi-square test, with statistical significance set at $p < 0.05$. Results were presented through bar charts and pie charts to provide visual clarity of key findings.

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RESULTS

The study analyzed data from 60 participants, with an average age of 40.22 years (SD ± 12.59). The median age was 39 years, while the most frequently occurring age was 28, indicating a relatively balanced age distribution across young and middle-aged groups. The sample consisted of 53.3% males (n=32) and 46.7% females (n=28), showing a slightly higher proportion of male participants. Occupational analysis revealed that the majority, 70% (n=42), were engaged in outdoor work, while 15% (n=9) worked indoors and 15% (n=9) reported mixed occupational exposure. Corrective eyewear use was common, with 58.3% (n=35) using glasses and 16.7% (n=10) using contact lenses, whereas 25% (n=15) did not use any corrective measures. Laterality analysis indicated that the right eye was affected in 53.3% (n=32) and the left eye in 46.7% (n=28), reflecting an almost equal distribution between both eyes. Regarding duration, 41.7% (n=25) had pterygium for more than 6 years, 21.7% (n=13) for 1–3 years, 20% (n=12) for less than 1 year, and 16.7% (n=10) for 4–6 years. A large majority, 70% (n=42), reported having received prior treatment for pterygium, while 30% (n=18) had not undergone treatment. Distribution by clinical grade showed that Grade 1, Grade 3, and Grade 4 were equally prevalent at 30% each (n=18), whereas Grade 2 was least common at 10% (n=6). Symptom analysis revealed that eye irritation was the most reported symptom (28.3%, n=17), followed by foreign body sensation (21.7%, n=13), photophobia (20%, n=12), double vision (18.3%, n=11), and blurred vision (11.7%, n=7). Visual disturbances were frequently reported, with 51.7% (n=31) experiencing them often, 28.3% (n=17) occasionally, and 20% (n=12) rarely. Prior to correction, 25% (n=15) of participants had visual acuity of 6/6, 26.7% (n=16) had 6/9, 33.3% (n=20) had 6/12, and 15% (n=9) had worse than 6/12 vision. After correction, 35% (n=21) achieved 6/6 vision, while 63.3% (n=38) achieved 6/9, indicating significant improvement. Only one participant's corrected visual acuity was missing.

Astigmatism was widely distributed, with 33.3% (n=20) falling within 0.75–1.5 D, 28.3% (n=17) between 1.75–2.5 D, 23.3% (n=14) below 0.75 D, and 15% (n=9) exceeding 2.5 D. In terms of spherical power, 40% (n=24) fell within 0.75–2.5 D, 25% (n=15) below 0.75 D, 20% (n=12) between 2.5–5 D, and 15% (n=9) above 5 D. The astigmatic axis was most frequently at 90° in 65% (n=39), followed by 180° in 20% (n=12), and oblique in 15% (n=9). Correlation analysis revealed that pterygium grade had a strong positive relationship with duration ($r=0.332$, $p=0.010$), visual disturbances ($r=0.665$, $p<0.001$), best-corrected visual acuity ($r=0.536$, $p<0.001$), astigmatism range ($r=0.632$, $p<0.001$), spherical power range ($r=0.615$, $p<0.001$), and astigmatic axis ($r=0.431$, $p=0.001$). Visual disturbances strongly correlated with astigmatism range ($r=0.838$, $p<0.001$) and best-corrected visual acuity ($r=0.783$, $p<0.001$). The strongest observed correlation was between spherical power range and astigmatic axis ($r=0.916$, $p<0.001$). Gender did not show significant correlations with the clinical variables. A direct measure of contrast sensitivity was not collected in this cohort; therefore, contrast-sensitivity outcomes could not be quantified. As functional proxies relevant to contrast processing, more advanced pterygium grade was accompanied by more frequent visual disturbances ($r=0.665$, $p<0.001$), greater astigmatism magnitude ($r=0.632$, $p<0.001$), worse best-corrected visual acuity (BCVA) ($r=0.536$, $p<0.001$), longer disease duration ($r=0.332$, $p=0.010$), and higher spherical power range ($r=0.615$, $p<0.001$). At the symptom level, over half of participants reported frequent visual disturbances (31/60, 51.7%), while 43.3% (26/60) demonstrated astigmatism ≥1.75 D and 64.4% (38/59) had BCVA worse than 6/6 among those with available refraction. Visual disturbances also correlated strongly with astigmatism range ($r=0.838$, $p<0.001$) and BCVA ($r=0.783$, $p<0.001$). Collectively, these proxy findings indicated a substantial functional burden consistent with reduced contrast handling, despite the absence of direct contrast-sensitivity testing.

Table 1: Demographic Characteristics of Study Participants

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Age	N Valid	60	–	–	–
	Missing	0	–	–	–
	Mean	40.22	–	–	–
	Median	39.00	–	–	–
	Mode	28a	–	–	–
	Std. Deviation	12.596	–	–	–
Gender	Male	32	53.3	53.3	53.3
	Female	28	46.7	46.7	100.0
	Total	60	100.0	100.0	–
Occupation	Indoor	9	15.0	15.0	15.0

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Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
	Outdoor	42	70.0	70.0	85.0
	Mixed	9	15.0	15.0	100.0
	Total	60	100.0	100.0	–

Table 2: Clinical Characteristics of Study Participants

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Corrective Eyewear	Glasses	35	58.3	58.3	58.3
	Contact Lenses	10	16.7	16.7	75.0
	None	15	25.0	25.0	100.0
	Total	60	100.0	100.0	–
Affected Eye	Right	32	53.3	53.3	53.3
	Left	28	46.7	46.7	100.0
	Total	60	100.0	100.0	–
Duration of Pterygium	<1 year	12	20.0	20.0	20.0
	1–3 years	13	21.7	21.7	41.7
	4–6 years	10	16.7	16.7	58.3
	>6 years	25	41.7	41.7	100.0
	Total	60	100.0	100.0	–

Table 3: Clinical History, Pterygium Grade, and Reported Symptoms of Study Participants

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Treated Before	Yes	42	70.0	70.0	70.0
	No	18	30.0	30.0	100.0
	Total	60	100.0	100.0	–
Pterygium Grade	Grade 1	18	30.0	30.0	30.0
	Grade 2	6	10.0	10.0	40.0
	Grade 3	18	30.0	30.0	70.0
	Grade 4	18	30.0	30.0	100.0
	Total	60	100.0	100.0	–
Symptoms	Blurred Vision	7	11.7	11.7	11.7
	Double Vision	11	18.3	18.3	30.0
	Eye Irritation	17	28.3	28.3	58.3
	Foreign Body Sensation	13	21.7	21.7	80.0
	Photophobia	12	20.0	20.0	100.0
	Total	60	100.0	100.0	–

Table 4: Visual Disturbances and Visual Acuity of Study Participants

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Visual Disturbances	Rarely	12	20.0	20.0	20.0
	Occasionally	17	28.3	28.3	48.3
	Frequently	31	51.7	51.7	100.0
	Total	60	100.0	100.0	–
Visual Acuity Before Correction	6/6	15	25.0	25.0	25.0
	6/9	16	26.7	26.7	51.7
	6/12	20	33.3	33.3	85.0
	Worse than 6/12	9	15.0	15.0	100.0
	Total	60	100.0	100.0	–

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Best Corrected Visual Acuity	6/6	21	35.0	35.6	35.6
	6/9	38	63.3	64.4	100.0
	Total (Valid)	59	98.3	100.0	–
	Missing (System)	1	1.7	–	–
	Grand Total	60	100.0	–	–

Table 5: Refractive Characteristics of Study Participants

Variable	Category	Frequency	Percent	Valid Percent	Cumulative Percent
Astigmatism Range	<0.75 D	14	23.3	23.3	23.3
	0.75–1.5 D	20	33.3	33.3	56.7
	1.75–2.5 D	17	28.3	28.3	85.0
	>2.5 D	9	15.0	15.0	100.0
	Total	60	100.0	100.0	–
Spherical Power Range	<0.75 D	15	25.0	25.0	25.0
	0.75–2.5 D	24	40.0	40.0	65.0
	2.5–5 D	12	20.0	20.0	85.0
	>5 D	9	15.0	15.0	100.0
	Total	60	100.0	100.0	–
Astigmatic Axis	90°	39	65.0	65.0	65.0
	180°	12	20.0	20.0	85.0
	Oblique	9	15.0	15.0	100.0
	Total	60	100.0	100.0	–

Table 6: Correlation between all variables

Correlations		**Pterygium Grade**	**Gender**	**Occupation**	**Duration of Pterygium**	**Visual Disturbances**	**Best Corrected Visual Acuity**	**Astigmatism Range**	**Spherical Power Range**	**Astigmatic Axis**
Pterygium Grade	Pearson Correlation	1	-.078	.304*	.332**	.665**	.536**	.632**	.615**	.431**
	Sig. (2-tailed)		.554	.018	.010	.000	.000	.000	.000	.001
	N	60	60	60	60	60	59	60	60	60
Gender	Pearson Correlation	-.078	1	-.244	-.181	-.122	.043	-.027	-.067	.000
	Sig. (2-tailed)	.554		.060	.166	.353	.744	.839	.610	1.000
	N	60	60	60	60	60	59	60	60	60
Occupation	Pearson Correlation	.304*	-.244	1	.541**	.504**	.449**	.336**	.184	.000
	Sig. (2-tailed)	.018	.060		.000	.000	.000	.009	.160	1.000

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Correlations

		Pterygium Grade	**Gender**	**Occupation**	**Duration of Pterygium**	**Visual Disturbances**	**Best Corrected Visual Acuity**	**Astigmatism Range**	**Spherical Power Range**	**Astigmatic Axis**
	N	60	60	60	60	60	59	60	60	60
Duration of Pterygium	Pearson Correlation	.332**	-.181	.541**	1	.572**	.711**	.626**	.739**	.647**
	Sig. (2-tailed)	.010	.166	.000		.000	.000	.000	.000	.000
	N	60	60	60	60	60	59	60	60	60
Visual Disturbances	Pearson Correlation	.665**	-.122	.504**	.572**	1	.783**	.838**	.689**	.444**
	Sig. (2-tailed)	.000	.353	.000	.000		.000	.000	.000	.000
	N	60	60	60	60	60	59	60	60	60
Best Corrected Visual Acuity	Pearson Correlation	.536**	.043	.449**	.711**	.783**	1	.746**	.684**	.507**
	Sig. (2-tailed)	.000	.744	.000	.000	.000		.000	.000	.000
	N	59	59	59	59	59	59	59	59	59
Astigmatism Range	Pearson Correlation	.632**	-.027	.336**	.626**	.838**	.746**	1	.837**	.687**
	Sig. (2-tailed)	.000	.839	.009	.000	.000	.000		.000	.000
	N	60	60	60	60	60	59	60	60	60
Spherical Power Range	Pearson Correlation	.615**	-.067	.184	.739**	.689**	.684**	.837**	1	.916**
	Sig. (2-tailed)	.000	.610	.160	.000	.000	.000	.000		.000
	N	60	60	60	60	60	59	60	60	60
Astigmatic Axis	Pearson Correlation	.431**	.000	.000	.647**	.444**	.507**	.687**	.916**	1
	Sig. (2-tailed)	.001	1.000	1.000	.000	.000	.000	.000	.000	
	N	60	60	60	60	60	59	60	60	60

Table 7: Contrast Sensitivity—Proxy Indicators Summary

Proxy indicator	Definition / level	n/N (%)	Correlation with pterygium grade r (p)	Correlation with visual disturbances r (p)
Visual disturbances (frequent)	"Frequently" reported	31/60 (51.7%)	0.665 (<0.001)	—
Astigmatism magnitude	≥1.75 D (1.75–2.5 D or >2.5 D)	26/60 (43.3%)	0.632 (<0.001)	0.838 (<0.001)
Best-corrected visual acuity	Worse than 6/6 (valid cases)	38/59 (64.4%)	0.536 (<0.001)	0.783 (<0.001)
Disease duration	>6 years	25/60 (41.7%)	0.332 (0.010)	0.572 (<0.001)
Spherical power range	>2.5 D	9/60 (15.0%)	0.615 (<0.001)	0.689 (<0.001)

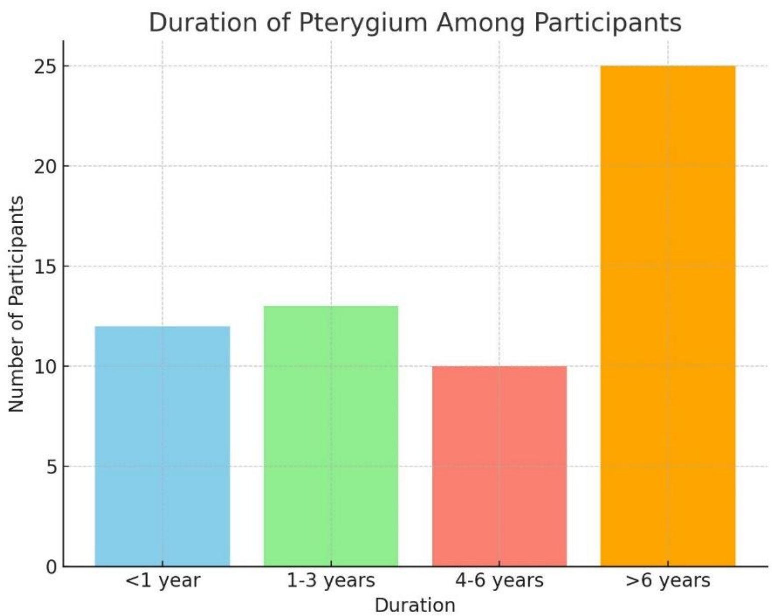

Figure 2 Duration of Pterygium Among Participants

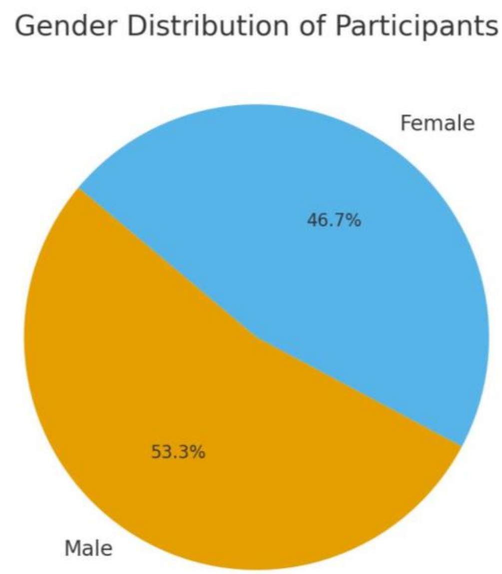

Figure 2 Gender Distribution of Participants

DISCUSSION

The present study provides valuable insights into the demographic, occupational, clinical, and refractive characteristics of patients with pterygium, while also reinforcing the strong associations between disease severity and visual function. The mean age of the participants was 40.22 years with a wide range, reflecting the tendency of pterygium to manifest predominantly in middle-aged individuals. The nearly equal gender distribution, with a slight male predominance, is consistent with most regional and international studies which report that pterygium does not demonstrate a clear gender bias, although environmental and occupational factors such as outdoor exposure often explain a higher proportion of male cases (10). The predominance of outdoor workers in this study (70%) highlights the critical role of ultraviolet radiation as a modifiable risk factor in the development and progression of pterygium. This finding corroborates earlier reports that individuals engaged in occupations with greater sun exposure are more susceptible to recurrence and advanced disease (11,12). Such evidence underscores the importance of occupational health interventions, including protective eyewear and sun-safety

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measures, as cost-effective preventive strategies in populations at risk. The relatively high prevalence of corrective eyewear use, with 58.3% of participants wearing glasses, suggests the substantial impact of pterygium-induced refractive errors, particularly astigmatism. This is consistent with previous evidence indicating that the fibrovascular growth associated with pterygium induces corneal distortion, thereby necessitating corrective measures (13,14). The findings also reflect the burden of corneal irregularities among pterygium patients and highlight the importance of refractive evaluation as part of routine clinical assessment. Disease chronicity was notable, as 41.7% of participants reported a history of pterygium lasting more than six years. The distribution of pterygium grades revealed a balanced occurrence of early- and late-stage disease, reinforcing the view that both newly developing and long-standing lesions are common in clinical practice. Prior literature has consistently shown that higher grades correlate with recurrence and more pronounced visual impairment, supporting the observations of this study (15,16). These findings emphasize the necessity for timely intervention to prevent disease progression and its functional consequences.

Symptomatology analysis revealed that eye irritation, foreign body sensation, and photophobia were the most frequent complaints, reflecting the ocular surface disturbance and tear film instability commonly caused by pterygium (17). More than half of the participants reported frequent visual disturbances, a finding consistent with prior work demonstrating that advancing lesions markedly reduce visual quality and overall functional vision (18). These symptoms highlight the dual impact of pterygium as both a cosmetic and a functional ocular condition. Visual acuity outcomes indicated that most patients achieved significant improvement following correction, with 35% attaining 6/6 vision and over 60% achieving 6/9. This aligns with established evidence that surgical excision with conjunctival autografting restores corneal regularity and improves vision in affected individuals (19,20). However, the persistence of suboptimal acuity in some cases suggests that advanced corneal distortion or residual irregular astigmatism may limit the degree of visual recovery. Astigmatism distribution further supported the role of pterygium in refractive alterations, with a large proportion of participants demonstrating moderate-to-high astigmatic values. This mirrors earlier reports that pterygium size and extent are strongly associated with induced astigmatism (21,22). The spherical power changes observed in this cohort also indicate that refractive shifts extend beyond astigmatism, further impairing visual performance. The astigmatic axis was predominantly aligned at 90°, consistent with previous findings that pterygium-induced flattening is often vertical in orientation.

The correlation analysis highlighted significant associations between pterygium grade, disease duration, astigmatism, and visual disturbances. The strong correlation between visual disturbances and astigmatism emphasizes the clinical importance of refractive management in these patients. The positive correlation with best-corrected visual acuity further confirms that disease severity directly compromises vision and functional outcomes (23,24). These findings collectively affirm the multifactorial impact of pterygium on ocular health and underscore the need for comprehensive evaluation encompassing both structural and functional parameters. A notable limitation of this study is the absence of contrast sensitivity assessment, which was identified in the introduction as a key functional outcome. Although proxy indicators such as visual acuity, astigmatism, and visual disturbances suggest impairment in contrast handling, the lack of direct measurement restricts the ability to fully evaluate this important aspect of visual function. The use of convenience sampling also limits generalizability, as it may not represent the broader population. Furthermore, the relatively small sample size reduces the statistical power to detect subtle associations. Despite these limitations, the study’s strengths include the use of standardized ophthalmic tools, comprehensive evaluation of both demographic and clinical variables, and correlation analysis that provides robust evidence of the relationships between disease features and visual outcomes. Future research should incorporate direct contrast sensitivity testing, larger and more diverse samples, and longitudinal designs to assess progression and treatment outcomes over time. In addition, evaluation of preventive strategies, including the role of protective eyewear in outdoor workers, would provide practical insights for reducing disease burden. Overall, this study contributes meaningful evidence regarding the interplay between pterygium severity, refractive error, and visual function, while also identifying areas requiring further investigation to improve patient care.

CONCLUSION

This study concludes that pterygium is a multifactorial ocular condition with significant implications for visual function, most notably through its association with astigmatism, disease duration, and visual disturbances. The findings underscore the importance of timely diagnosis and appropriate management, including surgical intervention, to mitigate its impact on vision and quality of life. By reaffirming the close link between disease severity and functional outcomes, the study highlights the necessity of preventive strategies, such as reducing ultraviolet exposure, alongside clinical treatment. Ultimately, these insights contribute to strengthening clinical practice and emphasize the need for continued research to refine therapeutic strategies and improve long-term patient outcomes.

AUTHOR CONTRIBUTION

Author	Contribution
Aafaq Ahmad Khan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Ummara Shafiq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Shehzad Ahmad	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Abaid Ur Rehman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hafiz Zohaib Hassan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Zara Arif	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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