

Estimation of Prevalence of Dry Eye Disease in Patients with Pterygium at a Tertiary Care Centre

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ABSTRACT:

Background: Dry eye disease (DED) is a multifactorial disorder characterized by tear film instability, inflammation, and ocular surface damage, leading to discomfort and visual disturbance. Pterygium, a common degenerative ocular condition linked to ultraviolet exposure, shares overlapping mechanisms with DED, including chronic inflammation and tear film dysfunction. However, data on DED prevalence among pterygium patients in the Indian population remain limited. This study was conducted to estimate the prevalence of DED in patients with pterygium and evaluate its association with clinical and environmental risk factors. **Methods:** This hospital-based cross-sectional study was conducted at a tertiary care centre in Karnataka over a period of 18 months after receiving ethical clearance. A total of 100 clinically diagnosed pterygium patients underwent detailed ocular evaluation. DED assessment included the Ocular Surface Disease Index (OSDI), Schirmer's test, Tear Break-Up Time (TBUT), Tear Meniscus Height (TMH), and ocular surface staining. Demographic details, occupational exposure, and environmental risk factors were recorded. Associations between DED and clinical parameters were analyzed. **Results:** Dry eye disease (DED) was observed in 62% of patients (RE: 54%, LE: 45%). Mean Schirmer's values (~11–13 mm) and TBUT (~9.7–10.0 sec) indicated borderline tear function, with significantly lower values in DED cases ($p < 0.001$). TMH (~0.22 mm) was also significantly reduced in DED ($p < 0.001$). DED prevalence was 62%, with a significant association with pterygium grade ($p < 0.001$), corneal encroachment ($p = 0.040$), and reduced tear film parameters including Schirmer's test, TBUT, and TMH ($p < 0.001$). DED showed a significant association with corneal encroachment and pterygium severity ($p \leq 0.04$; ANOVA $p < 0.001$) and with reduced best-corrected visual acuity (BCVA) ($p < 0.001$). Outdoor occupations had a higher DED risk ($p < 0.05$), while age, sex, residence, symptom duration, vascularity, and UV protection were not significant ($p > 0.05$). **Conclusion:** DED is highly prevalent in patients with pterygium and is closely associated with disease severity and environmental exposure. Routine screening and early management of DED are essential to improve patient comfort, enhance visual outcomes, and reduce postoperative complications.

Keywords: Dry eye disease, Pterygium, Tear film instability, Ocular surface disease, Prevalence, Tertiary care centre.

INTRODUCTION:

Pterygium is a benign fibrovascular growth of the conjunctiva extending onto the cornea, associated with ultraviolet exposure, environmental irritants, and genetic predisposition. It can disrupt corneal contour and tear distribution, contributing to tear film instability and

ocular surface inflammation. Recent evidence suggests a significant association between pterygium and dry eye disease, with shared mechanisms such as inflammation, tear hyperosmolarity, and altered corneal sensitivity [1, 2]. The interaction between pterygium and dry eye disease represents a complex interplay of mechanical and

inflammatory factors, where each condition may exacerbate the other. Tear film instability and inflammatory mediators are elevated in both conditions, highlighting overlapping pathogenic pathways. Assessment of dry eye in patients with pterygium requires both subjective and objective evaluation, including symptom questionnaires and clinical tests such as TBUT and Schirmer's test [2–5].

Epidemiological studies indicate a higher prevalence of dry eye disease in patients with pterygium, emphasizing the importance of early diagnosis and management [6–8]. Chronic inflammation and environmental factors further strengthen the bidirectional relationship between these conditions, contributing to disease progression. Understanding this association is essential for optimizing clinical management and improving patient outcomes.

Management strategies for patients with coexisting pterygium and dry eye disease require an integrated approach. Conservative measures, including preservative-free artificial tears, topical anti-inflammatory agents, punctal plugs, and lifestyle modifications, aim to restore tear film stability and reduce ocular surface inflammation. Surgical intervention for pterygium, indicated for progressive lesions, visual axis encroachment, or cosmetic concerns, must be planned with consideration of underlying dry eye. Postoperative care focuses on maintaining ocular surface homeostasis, minimizing inflammation, and preventing recurrence. Advances such as conjunctival auto-grafting and amniotic membrane transplantation show improved outcomes when combined with dry eye management. Tailored strategies help optimize symptomatic relief and surgical success [9, 10]. This study was conducted to estimate the prevalence of dry eye disease in patients with pterygium at a tertiary care centre.

MATERIALS AND METHODS:

This hospital-based observational cross-sectional study was conducted in the Outpatient Department (OPD) of the Department of Ophthalmology at the Adichunchanagiri Institute of Medical Sciences (AIMS), B.G. Nagara, Mandya District, Karnataka, over a period of 18 months (July 2024 to January 2026). A consecutive sampling method was employed, and 100 participants were selected for the study fulfilling the inclusion criteria. Ethical clearance was received from the Institutional Ethics Committee before starting the study.

Inclusion Criteria:

- All patients diagnosed with pterygium, regardless of grade, presenting with symptoms and/or signs suggestive of dry eye disease.
- Patients with either unilateral or bilateral pterygium.
- Patients who provided written informed consent to participate in the study.

- Sample size was calculated using the formula $n = Z^2PQ/d^2$ considering the prevalence of dry eye disease among pterygium patients reported in previous studies. The minimum calculated sample size was approximately 95; therefore, 100 patients were included.

Exclusion Criteria:

- Patients with a history of systemic diseases known to cause dry eye, such as Sjögren's syndrome, rheumatoid arthritis, or systemic lupus erythematosus (SLE).
- Those on systemic medications leading to ocular drying (e.g., diuretics, antihistamines, psychotropic drugs).
- Contact lens users.
- Patients with other ocular adnexal diseases (e.g., blepharitis, entropion, ectropion) or anterior/posterior segment diseases.
- Individuals having a history of any ocular surgery within the preceding 6 months (e.g., cataract surgery, refractive surgery).
- Those using topical antiglaucoma medications known to cause ocular surface drying.
- Patients with recurrent pterygium.
- Individuals unwilling to provide consent.

Ethical clearance:

Ethical clearance was received from the Institutional Ethics Committee before starting the study.

After obtaining ethical clearance and written informed consent, all participants underwent a comprehensive and systematic ophthalmological evaluation. Initially, patient identification details and a detailed clinical history, including demographic data and ocular symptoms, were recorded. Visual acuity was assessed for both eyes using a Snellen chart, followed by a preliminary external ocular examination with a torchlight to evaluate the anterior segment and pupillary reactions. Keratometry was performed to measure corneal curvature, and intraocular pressure was recorded using a rebound tonometer. A detailed slit-lamp biomicroscopic examination of the eyelids, conjunctiva, cornea, iris, pupil, and lens was then conducted. The pterygium was carefully examined and graded based on its extent of corneal involvement. Subsequently, tear film function tests were carried out in a specific sequence to avoid inter-test interference. Tear Break-Up Time (TBUT) was measured after fluorescein instillation, followed by Tear Meniscus Height (TMH) assessment using a slit-lamp reticule. Schirmer's Test I was performed without anesthesia to assess total tear secretion, and Schirmer's Test II (basal secretion test) was conducted after the instillation of topical anesthetic to

eliminate reflex tearing. Finally, a fundus examination was performed using direct and indirect ophthalmoscopy after pupillary dilation to rule out posterior segment pathology. All findings were systematically recorded in a structured proforma for analysis.

The collected data were entered into a Microsoft Excel 2016 spreadsheet. Statistical analysis was performed using SPSS software (Statistical Package for the Social Sciences), version 20.0. Descriptive statistics were used to summarize the data; quantitative variables were

expressed as mean and standard deviation, while qualitative variables were expressed as proportions and percentages. Inferential statistical tests, including the Chi-square test for categorical data and other relevant non-parametric tests (e.g., Mann-Whitney U test, Kruskal-Wallis test), were used to test for associations between variables such as pterygium grade and dry eye parameters. A p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS:

Table 1: Combined Demographic and Exposure Profile of Study Participants (N = 100)

Variable	Category	Frequency (n)	Percentage (%)
Age Group (Years)	20–30	15	15%
	31–40	26	26%
	41–50	32	32%
	51–60	22	22%
	61–70	5	5%
Gender	Male	54	54%
	Female	46	46%
Residence	Rural	63	63%
	Urban	37	37%

The study population demonstrated a predominance of middle-aged individuals, with the highest proportion in the 41–50 years age group (32%), followed by 31–40 years (26%) and 51–60 years (22%), indicating that pterygium was more common in the active working-age population. Males (54%) slightly outnumbered females (46%), suggesting a modest male predominance. A majority of participants were from rural areas (63%), highlighting a higher burden of disease in rural populations. Occupation wise, outdoor and semi-outdoor professions such as vendors (14%), security personnel (13%), drivers and farmers (11% each), and students

(12%) formed a substantial proportion, indicating increased environmental exposure. Consistently, 58% of participants reported outdoor work, reinforcing the role of environmental factors. The use of ultraviolet (UV) protection was low, with 57% of participants not using any protective measures, while only a minority used sunglasses (22%), hats (16%), or both (5%). This suggests inadequate preventive practices and highlights UV exposure as a potential contributing factor in the development of pterygium and associated ocular surface disorders.

Table 2: Clinical Profile of Patients with Pterygium (N = 100)

Variable	Category / Statistic	Frequency (n)	Percentage (%)
Duration of Symptoms	Mean ± SD	10.03 ± 7.97 months	—
Laterality	Unilateral	70	70%
	Bilateral	30	30%
Anatomical Position	Nasal	78	78%
	Temporal	13	13%
	Both	9	9%
Pterygium Grade	Grade I	57	57%
	Grade II	29	29%
	Grade III	14	14%
Corneal Encroachment	Mean ± SD	1.52 ± 0.91 mm	—
Vascularity	Mild	44	44%
	Moderate	36	36%
	Severe	20	20%

The mean duration of symptoms was 10.03 ± 7.97 months (range: 1–45 months). Unilateral pterygium was more common (70%, n = 70) than bilateral (30%, n = 30). Nasal location predominated (78%, n = 78), followed by temporal (13%, n = 13) and both (9%, n = 9). Most cases were Grade I (57%, n = 57), followed by Grade II (29%,

n = 29) and Grade III (14%, n = 14). Mean corneal encroachment was 1.52 ± 0.91 mm (range: 0.5–3.91 mm). Mild vascularity was most common (44%, n = 44), followed by moderate (36%, n = 36) and severe (20%, n = 20).

Table 3: Overall Prevalence of Dry Eye Disease among Study Participants (N = 100)

Dry Eye Patient	Frequency
Yes	62
No	38
Grand Total	100

Overall analysis showed that 62% (n = 62) of the study participants were diagnosed with dry eye disease, while 38% (n = 38) did not have dry eye. Dry eye disease was thus present in nearly two-thirds of the study population.

Table 4: Association of Dry Eye Disease with Clinical Parameters

Parameter	P value
Schirmer I	<0.001
Schirmer II	<0.001
TBUT	<0.001
TMH	<0.001
Corneal Encroachment	0.040
BCVA	<0.001

One-way ANOVA analysis demonstrated a statistically significant association between dry eye disease and corneal encroachment, Schirmer I and II values, TBUT, TMH, and BCVA in both eyes (p < 0.001). Symptom duration and intraocular pressure in both eyes did not show a significant association with dry eye disease (p > 0.05). Statistically significant post-hoc comparisons demonstrated a progressive decline in tear secretion (Schirmer I & II), tear film stability (TBUT), and tear volume (TMH) with increasing pterygium grade (p < 0.05

for most comparisons). Grade III pterygium consistently showed the greatest impairment, with highly significant differences when compared to both Grade I and II. For visual acuity (BCVA), a significant reduction was primarily observed in Grade III, while differences between Grade I and II were largely non-significant (RE), indicating that visual deterioration occurs mainly in advanced disease. Overall, these findings confirm a strong, graded association between pterygium severity and worsening dry eye parameters, supporting a dose–response relationship.

Table:5 Association between DED and Pterygium Grade

Grade	DED Present	DED Absent
Grade I	21	36
Grade II	27	2
Grade III	14	0

P<0.001

Overall dry eye disease was observed in 21 patients with Grade I, 27 with Grade II, and 14 with Grade III pterygium, whereas the absence of dry eye was mainly seen in Grade I (n = 36). The association between dry eye

status and pterygium grade was statistically significant (Pearson Chi-square = 35.801, p < 0.001). Dry eye disease was more prevalent among rural residents (68.3%) compared to urban (51.4%), though the

association was not statistically significant ($p = 0.093$). Across occupations, higher proportions of dry eye were observed in outdoor and high-exposure groups such as farmers (72.7%), security guards (69.2%), and vendors (64.3%). Similarly, individuals engaged in outdoor work

(63.8%) showed a higher prevalence of dry eye compared to non-outdoor workers (59.5%), suggesting a possible environmental influence, although statistical significance was not established.

Table: 6 Logistic Regression Analysis

Variable	P value
Construction Worker	0.014
Security Guard	0.031
Corneal Encroachment	0.040

Multivariate analysis revealed that sex ($p = 0.386$) and residence ($p = 0.63$) were not significant predictors of dry eye, indicating that gender and rural–urban differences did not independently influence disease occurrence. Among occupational groups, construction workers ($p = 0.014$) and security guards ($p = 0.031$) demonstrated significantly higher odds of dry eye compared to vendors, while other occupations showed no significant association, suggesting that increased exposure to outdoor environmental factors such as dust, sunlight, and wind may elevate dry eye risk. Duration of symptoms ($p = 0.151$) was also not significantly associated with dry eye status.

Regarding disease characteristics, pterygium grade did not emerge as an independent predictor (Grade I vs III: $p = 0.998$; Grade II vs III: $p = 0.998$), indicating that severity grading alone does not determine dry eye when adjusted for other variables. However, corneal encroachment ($p = 0.040$) was a significant factor, demonstrating that a greater extension of pterygium onto the cornea increases the likelihood of dry eye. Additionally, UV protection practices (partial: $p = 0.373$; always: $p = 0.177$) and vascularity (moderate: $p = 0.709$; severe: $p = 0.520$) were not significantly associated with dry eye in the adjusted model. Overall, these findings suggest that environmental exposure (via occupation) and anatomical progression (corneal encroachment) play a more critical role in dry eye development than demographic factors, symptom duration, or clinical grading alone.

DISCUSSION:

The aim of this study was to estimate the prevalence of Dry Eye Disease (DED) among patients with pterygium at a tertiary care centre and to evaluate its association with demographic factors, environmental exposures (outdoor work, UV protection), and pterygium-related clinical characteristics. It further assessed the relationship between DED and objective severity markers such as corneal encroachment, as well as ocular surface parameters including Schirmer's tests, TBUT, TMH,

visual acuity, and IOP. The study is clinically significant as it highlights the frequent coexistence of DED in pterygium, demonstrating its association with tear film dysfunction and disease severity. These findings support the need for routine dry eye screening and integrated ocular surface management in pterygium patients, while also emphasizing the role of modifiable environmental exposures in prevention.

The majority of patients in this study belonged to the 41–50 years age group (32%), supporting the role of cumulative environmental exposure in pterygium development. Similar age-related trends have been reported by Fotouhi et al. [11] and Viso et al. [12].

A slight male predominance (54%) was observed, consistent with Rim et al. [13] and Liu et al. [14], likely reflecting higher outdoor exposure. The higher proportion of rural participants (63%) aligns with Rim et al. [13], highlighting rural exposure as a risk factor; however, no significant association with dry eye ($p = 0.093$) was observed.

Occupational and outdoor exposure (58%) patterns were consistent with established evidence linking sunlight, dust, and wind to pterygium and ocular surface disease [12, 14, 15], although occupation itself was not significantly associated with dry eye. The high proportion of no UV protection (57%) reflects a modifiable risk factor, supported by studies demonstrating the protective effects of sunglasses and hats [13, 15, 16].

The mean symptom duration in this study was 10.03 ± 7.97 months, with no significant association with dry eye ($p = 0.995$), indicating that symptom chronicity does not reliably reflect ocular surface dysfunction. This aligns with studies by Fotouhi et al. [11] and Viso et al. [12], which emphasize age and environmental exposure rather than symptom duration as key determinants.

Unilateral pterygium (70%) predominated, consistent with Liu et al. [14] and Bikbov et al. [17], though a substantial bilateral proportion (30%) was observed, similar to global data. A strong nasal predominance (78%) was noted, which can be explained by exposure-related mechanisms described by Rezvan et al. [15] and

Viso et al. [12], linking sunlight and ocular surface damage to lesion development.

Most patients had Grade I pterygium (57%), with fewer Grade II (29%) and Grade III (14%), indicating early-stage predominance. This is consistent with Lu et al. [16], who demonstrated worsening visual function with increasing grade, and Rim et al. [13], who linked severe subtypes to prolonged sun exposure.

The mean corneal encroachment (1.52 ± 0.91 mm) showed a strong association with dry eye ($p < 0.001$), highlighting it as a key anatomical determinant of tear film dysfunction. This is supported by exposure-driven progression models described by Rezvan et al. [15] and oxidative stress mechanisms demonstrated by Balci et al. [18].

Vascularity was predominantly mild to moderate, with 20% severe cases, reflecting varying inflammatory activity. Evidence from Rim et al. [13] and Balci et al. [18] supports the role of sun exposure and oxidative stress in promoting more vascular, active lesions, while ocular surface damage associations reported by Viso et al. [12] and Adriano et al. [19] further link vascularity with surface pathology.

Schirmer's test in this study showed borderline mean tear production (Schirmer-1: ~ 12.6 – 12.9 mm; Schirmer-2: ~ 11.2 – 11.3 mm), but with low minimum values (~ 3 – 4 mm) indicating a deficient subgroup. A strong association with dry eye ($p < 0.001$) confirms aqueous deficiency as a contributing factor. This is consistent with Lu et al. [16], who identified Schirmer ≤ 5 mm as an independent risk factor (OR 2.4), and Ramakrishnan and John [20], who reported predominantly mild–moderate tear deficiency in pterygium.

TBUT values (~ 9.7 – 10.0 seconds) were near the instability threshold, with a significant association with dry eye ($p < 0.001$), indicating tear film instability as a key mechanism. This aligns with Lu et al. [16] (TBUT ≤ 10 sec; OR 2.3) and clinical findings by Ramakrishnan and John [20].

TMH (~ 0.22 mm) was largely preserved but significantly associated with dry eye ($p < 0.001$), indicating reduced tear volume in a subset. This complements findings by Ramakrishnan and John [20] and supports the tear dysfunction model described by Lu et al. [16].

BCVA was generally preserved but significantly reduced in dry eye cases ($p < 0.001$), with worsening vision in higher grades. This is consistent with Lu et al. [16], who demonstrated an inverse association between visual acuity and pterygium grade, and is further supported by ocular surface damage studies by Viso et al. [12].

Dry eye disease (DED) was highly prevalent in this cohort, affecting 54% of right eyes, 45% of left eyes, and 62% overall, indicating that nearly two-thirds of pterygium patients had coexisting ocular surface dysfunction. This supports the concept that pterygium is

frequently part of a broader tear film disorder rather than an isolated lesion. Similar associations have been reported by Lu et al. [16], who identified reduced tear production (Schirmer ≤ 5 mm; OR 2.4) and reduced TBUT (≤ 10 sec; OR 2.3) as independent correlates.

DED showed a strong, significant association with pterygium grade ($p < 0.001$), with prevalence increasing from Grade I to Grade III, indicating a clear severity–dry eye relationship. This aligns with Lu et al. [16] and exposure-based severity findings by Rim et al. [13]. ANOVA further confirmed that DED was significantly associated with corneal encroachment, Schirmer values, TBUT, TMH, and BCVA (all $p < 0.001$), reinforcing that dry eye is driven by objective tear film dysfunction and anatomical severity rather than symptom duration. Supporting evidence includes ocular surface damage correlations by Viso et al. [12] and Adriano et al. [19].

Multivariate analysis identified outdoor-related occupations (construction workers, security guards) and corneal encroachment as significant predictors, consistent with exposure-driven risk models described by Liu et al. [14] and Rezvan et al. [15]. Residence and occupation categories alone were not significant, suggesting that actual environmental exposure is more relevant than demographic grouping. Outdoor work showed a significant association with DED, further supporting this pathway.

Post-hoc analysis demonstrated progressive worsening of tear parameters (Schirmer, TBUT, TMH) and visual acuity with increasing grade, indicating a severity-linked decline in ocular surface function. This is biologically supported by oxidative stress mechanisms described by Balci et al. [18].

The findings of the present study are comparable with previous reports demonstrating a strong association between pterygium severity and tear film dysfunction. The high prevalence of DED observed in this study underscores the importance of routine ocular surface evaluation in all patients with pterygium.

Strengths and Limitations:

This study's key strength lies in its well-structured clinic-based design with a defined sample of 100 patients, enabling reliable prevalence estimation and detailed clinical profiling. It comprehensively evaluates demographic, environmental, and clinical factors alongside objective bilateral tear function tests (Schirmer I/II, TBUT, TMH), enhancing diagnostic accuracy. The use of multi-level statistical analysis (chi-square, ANOVA, and multivariate regression) and post-hoc comparisons strengthens the validity of associations, particularly linking dry eye with pterygium severity, corneal encroachment, and visual acuity. However, limitations include its hospital-based and cross-sectional design, which may overestimate prevalence and preclude

causal inference. The modest sample size limits subgroup power, while self-reported exposure data introduce recall bias. Lack of a control group, potential variability in tear tests, unmeasured confounders (e.g., systemic factors, screen use), and a single centre setting further restrict generalizability.

In addition, the absence of a healthy control group limited direct comparison of tear film parameters with the general population.

CONCLUSION:

In conclusion, the study establishes that DED is highly prevalent among pterygium patients, is strongly linked to pterygium severity and corneal involvement, and is reflected in measurable deterioration of tear film parameters and visual acuity in advanced grades. These findings support routine, objective dry eye screening and ocular surface optimization as an integral component of pterygium evaluation and management, particularly among patients with greater encroachment and higher clinical grades. Early identification and treatment of dry eye disease in pterygium patients may improve quality of life, optimize surgical outcomes, and reduce long-term ocular surface morbidity.

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Conflict of Interest:

The authors declare no conflict of interest.

Author Contributions:

Dr. Yemmani Sravani collected data, performed statistical analysis, and drafted the manuscript.

Dr. D.N. Prakash supervised the study, interpreted the findings, critically revised the manuscript, and approved the final version.

Data Availability Statement:

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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