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Original Research Article

Histopathological Characteristics of Surgically Excised Pterygium

Dammala Anuradha[1], Nibedita Moharana[2]

[1]Assistant Professor, Department of Ophthalmology, Saheed Laxman Nayak Medical College and Hospital, Koraput, Odisha, India

[2]Assistant Professor, Department of Ophthalmology, Saheed Rendo Majhi Medical College and Hospital, Bhawanipatna, Odisha, India

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Corresponding Author: Dammala Anuradha

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Abstract:

Background: Pterygium is a common degenerative ocular surface disorder with variable clinical behaviour and risk of recurrence. Histopathological evaluation helps in understanding disease activity, progression, and factors associated with recurrence. This study aimed to analyse histopathological changes in excised pterygium specimens and their association with clinical features.

Methods: A prospective study was conducted on 85 patients who underwent pterygium excision with conjunctival autograft, including fixation using autologous serum. Excised tissues were processed for routine histopathology and stained with H&E, Masson's trichrome, Gomori's reticulin, and PAS. Inflammation, vascularisation, and fibrinoid degeneration were graded semi-quantitatively. Clinical and histopathological data were statistically analysed using SPSS software.

Results: Mild to moderate inflammation was most common, with Grade 1 changes seen in 34.1% of cases. Moderate to marked vascularisation and fibrinoid degeneration (Grades 2 and 3) were observed in over 60% of specimens, indicating active fibrovascular pathology. Higher grades of inflammation, vascularisation, and fibrinoid change were significantly more frequent in patients with Fuchs' spots. Recurrent pterygia also demonstrated a greater proportion of moderate to severe histopathological changes.

Conclusion: Histopathological severity correlates with clinical progression and recurrence of pterygium, emphasizing the importance of thorough excision and careful postoperative follow-up.

Keywords: Pterygium; Histopathology; Vascularisation; Fuchs' spots; Recurrence.

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Introduction

Pterygium is a degenerative condition of the bulbar conjunctiva, characterized by a triangular fibrovascular growth that extends onto the cornea [1]. Histopathologically, it is associated with proliferating limbal stem cells, epithelial metaplasia, inflammation, active fibrovascular tissue, and disruption of Bowman's layer at the advancing edge [2]. The lesion commonly develops in populations residing within the so-called "pterygium belt," located between 30° north and 30° south of the equator [3].

The prevalence of pterygium varies widely, ranging from 1% to over 30% depending on geographic location and population characteristics [2]. A 2015 meta-analysis encompassing 20 studies estimated its global prevalence to be approximately 10% [4]. Ultraviolet (UV) radiation is strongly implicated as a major etiological factor, as UV-induced damage to corneal and conjunctival tissues promotes abnormal cellular proliferation [5]. Additional risk factors include advancing age, male sex, dry eye disease, and genetic susceptibility [6,7]. Molecular studies have shown that p53 overexpression correlates with lesion severity, while increased Ki-67 expression is associated with longer disease duration [8].

Clinically, pterygium may cause symptoms ranging from ocular irritation and dryness to reduced visual acuity due to induced astigmatism when it encroaches on the visual axis [9]. Surgical excision remains the mainstay of management; however, several conjunctival lesions can closely mimic pterygium. Notably, conjunctival epithelial neoplasia often lacks distinguishing clinical features, making histopathological examination essential for accurate diagnosis [9–11]. Ocular surface squamous neoplasia (OSSN) represents a spectrum of epithelial lesions from dysplasia to invasive squamous cell carcinoma and is classified as benign, preinvasive, or malignant [12,13]. This study aimed to assess the prevalence of premalignant and malignant lesions in histopathological specimens from patients clinically

diagnosed with pterygium who underwent excision between 2024 and 2025, with diagnoses and surgeries performed by first-year residents under preceptor supervision.

Materials and Methods

Study Population and Follow-up: This study included 85 patients clinically diagnosed with pterygium who underwent pterygium excision with conjunctival autograft, including fixation using autologous serum, between March 2024 and October 2025 at the Department of Ophthalmology, Saheed Laxman Nayak Medical College and Hospital, Koraput, Odisha. All patients were followed postoperatively for a period of one year to monitor recurrence. The excised pterygium specimens were fixed in 10% buffered formalin and routinely processed for paraffin embedding.

Histopathological Processing and Staining: Paraffin sections measuring 3–5 µm in thickness were prepared to assess the structural and topohistological features of the pterygium tissue. Standard histochemical stains were employed, including hematoxylin and eosin (H&E), Masson's trichrome, Gomori's reticulin stain, and periodic acid–Schiff (PAS), to evaluate tissue composition and pathological alterations.

Semi-quantitative Histopathological Evaluation: Histopathological changes were assessed semi-quantitatively and classified into five grades. Inflammatory intensity ranged from absence of infiltrate (grade 0) to diffuse chronic inflammation (grade 4), based on the distribution and predominant inflammatory cells. Vascularisation was graded from normal conjunctival-like vascularity (grade 0) to marked subepithelial and advanced-region arteriolar proliferation (grade 4). Fibrinoid degeneration was similarly graded from absence (grade 0) to extensive focal and diffuse subepithelial involvement, particularly in progressive areas (grade 4).

Statistical Analysis: Clinical and histopathological findings were comparatively analysed. Statistical evaluation was performed using SPSS software (version 11). Descriptive statistics included mean values, while inferential analysis employed Student's t-test for parametric data and the Mann–Whitney U test for non-parametric comparisons, depending on the variables analysed.

Results

The distribution of histopathological changes among the 85 pterygium specimens is shown, with inflammation intensity most frequently demonstrating mild to moderate involvement. Grade 1 inflammation was observed in 34.1% of cases, followed by Grade 3 in 23.5%. Vascularisation predominantly showed moderate to marked changes, with Grades 2 and 3 together accounting for more than 60% of specimens, indicating active fibrovascular proliferation. Fibrinoid change was also more commonly observed at higher grades, with Grades 2 and 3 comprising 64.7% of cases, reflecting progressive degenerative alterations within the pterygium tissue (Table 1).

Table 1: Distribution of Histopathological Changes in 85 Patients with Pterygium

Intensity Grade (0–4)	Inflammation Intensity n (%)	Degree of Vascularisation n (%)	Fibrinoid Change n (%)
Grade 0	15 (17.6)	17 (20.0)	14 (16.5)
Grade 1	29 (34.1)	5 (5.9)	4 (4.7)
Grade 2	5 (5.9)	29 (34.1)	26 (30.6)
Grade 3	20 (23.5)	24 (28.2)	29 (34.1)
Grade 4	16 (18.9)	10 (11.8)	12 (14.1)
Total	**85 (100)**	**85 (100)**	**85 (100)**

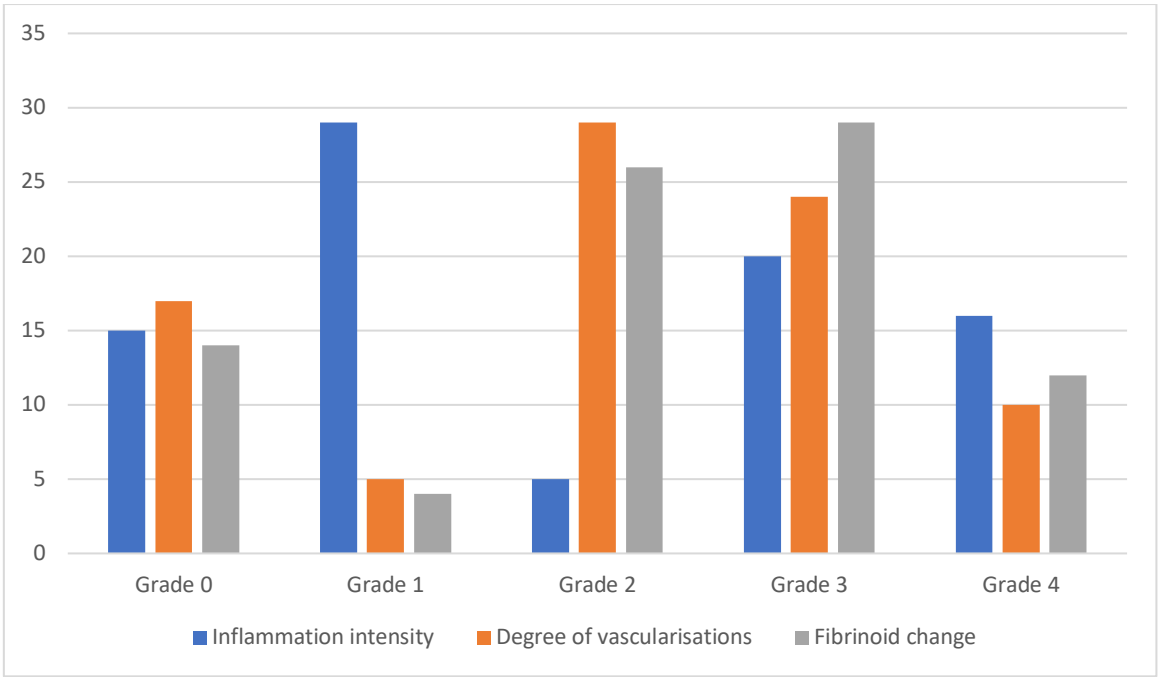

Figure 1: Distribution of Histopathological Changes in 85 Patients with Pterygium.

A clear association was observed between the presence of Fuchs' spots, recurrence, and the severity of histopathological changes. More than three-quarters of cases with Fuchs' spots demonstrated Grade ≥2 inflammation, vascularisation, and fibrinoid degeneration. Similarly, recurrent pterygia showed a higher proportion of moderate to severe pathological changes compared to non-recurrent cases, particularly with respect to inflammation and vascularisation, suggesting that increased tissue activity is associated with clinical recurrence (Table 2).

Table 2: Association of Fuchs' Spots and Recurrence with Histopathological Changes (n = 85)

Variable	Inflammation Intensity ≥ Grade 2 n (%)	Vascularisation ≥ Grade 2 n (%)	Fibrinoid Change ≥ Grade 2 n (%)
Presence of Fuchs' spots (n = 24)	19 (79.2)	20 (83.3)	18 (75.0)
Absence of Fuchs' spots (n = 61)	32 (52.5)	35 (57.4)	34 (55.7)
Recurrence (n = 21)	17 (81.0)	18 (85.7)	16 (76.2)
No recurrence (n = 64)	34 (53.1)	37 (57.8)	36 (56.3)

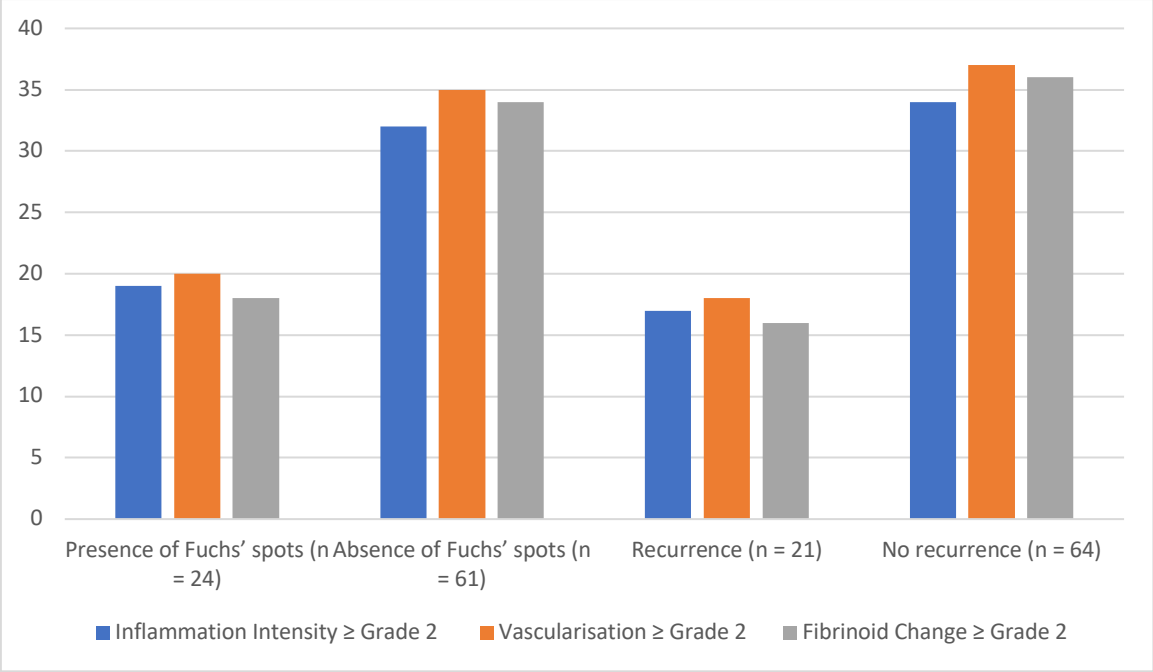

Figure 2: Association of Fuchs' Spots and Recurrence with Histopathological Changes.

Discussion

The overall histomorphological features observed in the present cohort of 85 patients were consistent with the classical descriptions of pterygium reported by Fuchs, Cilova, and Seifert [14–16]. All excised lesions represented fibrovascular proliferations predominantly covered by conjunctival epithelium, without a clear and consistent topographic division into cap, head, neck, and body, as also noted in earlier studies [15,16]. Similar to previous reports, variability in epithelial morphology was evident, particularly at the advancing head of the pterygium, where features resembling modified stratified squamous corneal epithelium were identified. In our series, epithelial alterations showed greater heterogeneity, including cellular and nuclear polymorphism, especially in surface layers. These epithelial changes were frequently associated with dominant fibrinoid degeneration in the underlying lamina propria, supporting the clinical appearance of Fuchs' patches as markers of active progression [14–16].

Connective tissue changes formed the major bulk of the pterygium, reflecting its progressive nature. In the present study, moderate to severe fibrinoid degeneration and vascularisation were common, particularly in lesions exhibiting clinical progression or recurrence. Newly formed subepithelial connective tissue, rich in fibroblasts and blood vessels, extended from the pinguecular region toward the cornea, disrupting Bowman's layer and altering extracellular matrix composition [17,18]. These matrix changes likely contribute to loss of mechanical stability and surface bulging of the lesion. Consistent with earlier observations, progressive pterygia demonstrated immature, loosely arranged connective tissue, whereas stationary lesions showed denser, more compact stroma with features resembling corneal connective tissue [15]. The need for wide surgical excision, including tissue beneath and around the lesion margins, is supported by these findings to reduce the risk of recurrence caused by residual pathologically altered tissue.

Vascular and inflammatory components showed marked variability but were clearly associated with disease activity. In our cohort of 85 patients, the presence of Fuchs' patches and recurrence was associated with higher grades of inflammation, vascularisation, and fibrinoid change, reflecting periods of rapid pterygium growth. Previous studies have demonstrated increased expression of angiogenic markers such as VEGF and vWF in pterygium tissue, supporting the role of angiogenesis in its pathogenesis [19]. Similar to earlier reports, lesions with progression zones showed significantly greater vascularization, emphasizing the requirement for increased blood supply to support connective tissue expansion [15,17]. Although recurrence was associated with higher inflammatory and vascular indices in our study, statistical significance may have been limited by sample size. Nevertheless, the consistent association of Fuchs' patches with increased vascularisation and fibrinoid degeneration reinforces their value as reliable clinical indicators of pterygium activity and potential recurrence risk [17].

Conclusion

The present study demonstrates that pterygium is characterized by a wide spectrum of histopathological changes, with a predominance of moderate to severe inflammation, vascularisation, and fibrinoid degeneration among the 85 cases analysed. The strong association between higher-grade histopathological alterations and the presence of Fuchs' spots, as well as postoperative recurrence, underscores the role of active fibrovascular proliferation and chronic inflammation in disease progression. These findings highlight the importance of careful clinical assessment of progression markers and thorough surgical excision of pathologically altered tissue to minimize recurrence. Routine histopathological evaluation of excised pterygium specimens remains essential for understanding disease activity and guiding optimal management strategies.

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