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To Assess the Keratometric Stabilty at The End of One Month Post Pterygium Surgery

Dr Deepthi Prabhakar Iyer*[1], Dr Malini Prabhugauda[2]

[1]Consultant cornea phaco refractive surgery, Anugraha eye hospital Gulbarga.
[2]Medical director, Anugraha eye hospital

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Abstract: Pterygium is a common ocular surface disease seen in tropical climates, often inducing significant corneal astigmatism. Surgical excision, particularly with conjunctival autograft, is a standard treatment. However, determining the timing of keratometric stability postoperatively is critical for planning subsequent surgeries such as cataract or refractive procedures.

This retrospective study included 122 eyes that underwent pterygium excision with conjunctival autograft using 8-0 vicryl sutures, performed at Anugraha Eye Hospital, Gulbarga, Karnataka, between May 1, 2023 and April 31, 2024. Data were retrieved from electronic medical records. Keratometry was assessed preoperatively, at 1 week, and 1 month postoperatively using a Huvitz HRK-7000 autokeratometer. Stability was defined as a change of ≤0.25 Diopters between two follow-up readings.

The mean preoperative astigmatism was 3.31±3.62 D, which significantly decreased to 1.05±1.30 D at one week postoperatively ($p<0.005$), and further reduced to 0.83±1.00 D at one month ($p<0.005$). A subset of 7 patients with Grade 1 pterygium showed early keratometric stability from week 1 to month 1 (mean difference -0.04 D, $p=0.99$).

Keratometric stability is generally achieved within one month following pterygium surgery, particularly in lower grades. These supports waiting for stabilization before planning cataract or refractive surgeries.

Keywords: Pterygium; Astigmatism; Keratometric stability; Conjunctival autograft; Visual acuity; Corneal remodeling; Refractive outcomes

INTRODUCTION

Pterygium is a common ocular surface condition characterized by fibrovascular growth of the bulbar conjunctiva onto the cornea, typically originating from the nasal side. It is frequently reported among individuals residing in tropical and subtropical regions, especially those with prolonged exposure to ultraviolet (UV) radiation, dry climates, and dusty environments [1]. The prevalence is higher among outdoor workers such as farmers and laborers, with environmental factors being major contributors [2].

Pterygium often leads to symptoms such as foreign body sensation, tearing, redness, and photophobia. More importantly, it induces visual disturbances due to the flattening of the cornea along the horizontal meridian, thereby causing with-the-rule astigmatism [3]. In advanced stages, the lesion may encroach upon the visual axis, significantly impairing vision.

The gold standard treatment for pterygium is surgical excision with conjunctival autografting, which significantly lowers the recurrence rate compared to older techniques such as the bare sclera method [4]. However, post-surgical corneal remodeling can continue for weeks or months, resulting in fluctuating keratometric values. Since accurate keratometry is essential for intraocular lens (IOL) power calculation and other refractive procedures, determining the ideal time to assess corneal stability is of great clinical relevance [5].

Keratometric stability refers to the period after surgery during which the corneal curvature ceases to show significant variation. A difference of ≤0.25 Diopters between two consecutive keratometric readings is commonly accepted as a stable measure [6]. The duration for reaching this state remains debatable, with some studies reporting stabilization as early as one month, while others advocate waiting for up to three months or longer depending on lesion severity and surgical technique [7,8].

In clinical practice, many patients present with concurrent cataracts and pterygium, particularly in the elderly population. Thus, timely identification of keratometric stability is crucial for planning cataract surgery, ensuring precise IOL power calculation, and achieving optimal visual rehabilitation. Early stability, if confirmed, could substantially shorten the interval

***Corresponding Author:** Dr Deepthi Prabhakar Iyer

between pterygium surgery and further interventions, improving patient satisfaction and care efficiency [9].

This study aims to assess the keratometric stability at the end of one month following pterygium surgery using conjunctival autograft technique. By evaluating changes in corneal astigmatism over a defined postoperative timeline, the findings of this study will contribute valuable clinical insight for optimizing surgical planning in patients with coexisting ocular pathologies.

MATERIALS AND METHODS

Study Design and Duration- This is a retrospective study of 122 eyes that underwent pterygium excision with conjunctival autograft, sutured with 8-0 vicryl, conducted at Anugraha Eye Hospital, Gulbarga, North Karnataka. The study duration was from 1st May 2023 to 31st April 2024. Data were collected using the electronic medical record system (EHNOTE software). The study received approval from the institutional ethics committee and adhered to the principles of the Declaration of Helsinki.

Inclusion Criteria

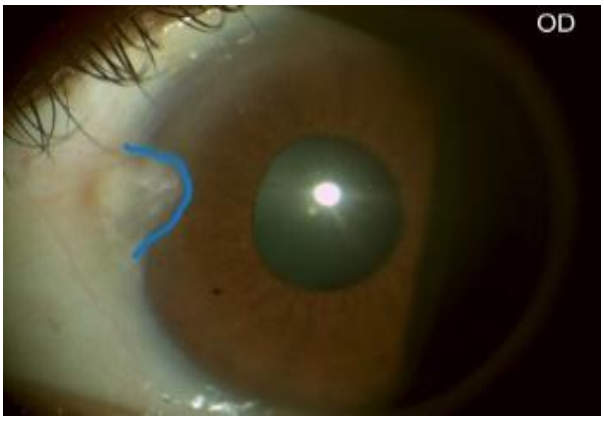
- All patients with primary nasal pterygium
- Presence of at least 1.00 Diopter cylinder of astigmatism
- Patients operated by any of the three consultant surgeons, each with a minimum of five years of experience
- Complete follow-up at preoperative, 1-week postoperative, and 1-month postoperative intervals

Exclusion Criteria

- Patients with recurrent or double-headed (temporal and nasal) pterygium
- Patients with pterygium secondary to other causes
- Patients with oblique astigmatism
- Patients who did not attend the 1-month follow-up
- From 255 operated cases, only 122 eyes met the inclusion criteria

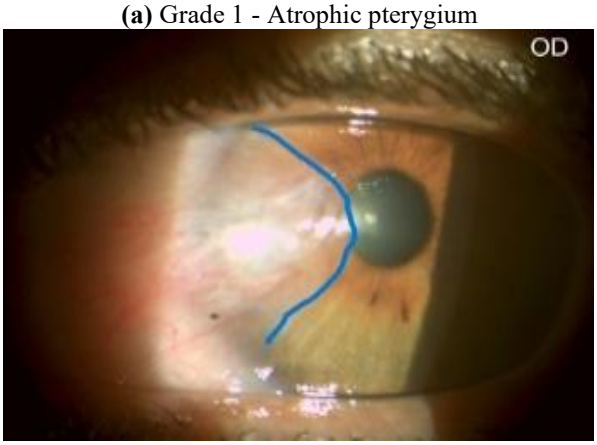
Methodology- Demographic details, best-corrected visual acuity, subjective refraction, presence of cataracts, and keratometric readings were recorded. Keratometry was measured using the Huvitz HRK-7000 autokeratometer, which records values over the central 3 mm of the cornea. Measurements were taken at three time points: preoperatively, 1 week postoperatively, and 1 month postoperatively.

Pterygium was graded clinically into Grade 1 (atrophic, minimal invasion), Grade 2 (moderate, vascular), Grade 3 (fleshy, thick, aggressive), and Double-headed monocular type based on slit-lamp examination (Figure. 1a–d).

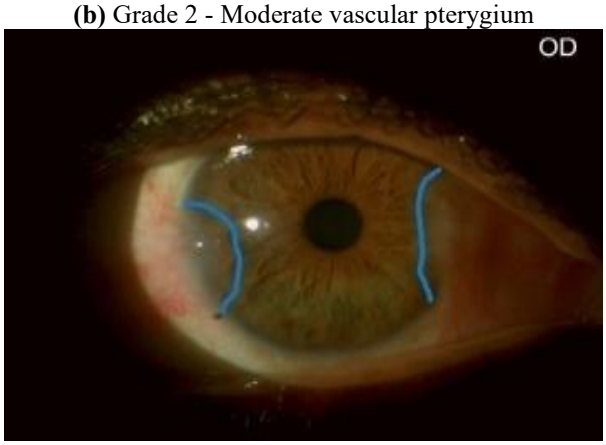


(a) Grade 1 - Atrophic pterygium

(b) Grade 2 - Moderate vascular pterygium



(c) Grade 3 - Fleshy, aggressive pterygium



(d) DMP - Double-headed monocular pterygium

Figure 1: Showing grades of Pterygium

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Astigmatism type was categorized as:

- With-the-rule (WTR): Axis at 90°±30°
- Against-the-rule (ATR): Axis at 180°±30° or 0°±30°

Keratometric stability was defined as a change of ≤0.25 D between two follow-up visits.

Statistical Analysis- Data were analyzed using R software version 4.2**.** Continuous variables were summarized as mean±standard deviation (SD), and categorical data were represented as frequencies and percentages. One-way ANOVA with Bonferroni correction was used for comparing preoperative, 1-week, and 1-month astigmatism values. For qualitative data comparison, the Stuart-Maxwell test was employed. A p-value of ≤0.05 was considered statistically significant.

Ethical Approval- The study was approved by the Institutional Ethics Committee of Anugraha Eye Hospital and adhered to the ethical principles outlined in the Declaration of Helsinki. Patient confidentiality was strictly maintained, and all data were anonymized before analysis.

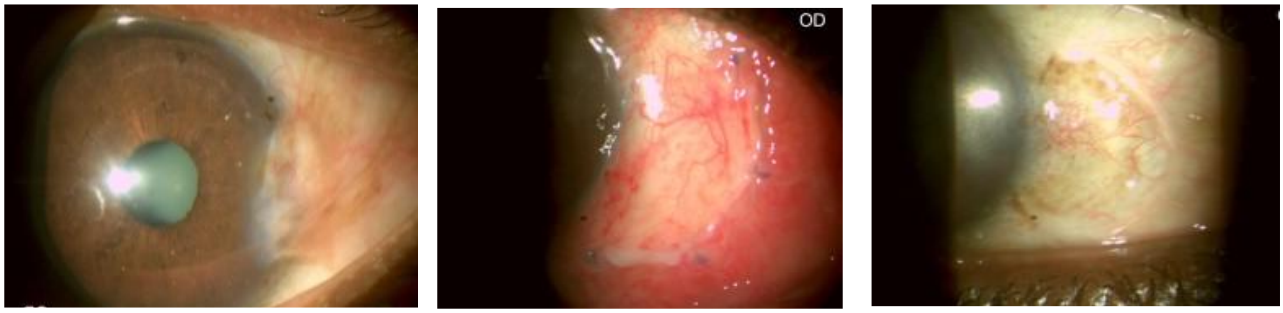
RESULTS

A total of 122 eyes from patients who underwent pterygium excision with conjunctival autograft were included in the study. These cases were selected from a larger pool of 255 eyes operated between May 1, 2023, and April 31, 2024. Only those with complete follow-up at 1 week and 1 month, and consistent keratometry readings, were included. The mean age of the patients was 55.16±11.51 years, and the majority (73.8%) were involved in outdoor occupations, indicating high UV exposure as a probable risk factor. The distribution of pterygium grades showed 14.8% Grade 1, 53.3% Grade 2, and 31.9% Grade 3 involvement (Table 1).

Table 1: Distribution of Pterygium Grades Among Study Population

Grade	Description	Frequency	Percentage
Grade 1	Atrophic, minimal invasion	18	14.8%
Grade 2	Moderate, vascular	65	53.3%
Grade 3	Fleshy, thick, aggressive	39	31.9%

The mean preoperative astigmatism was 3.31±3.62 Diopters (D), which significantly decreased to 1.05±1.30 D at one week postoperatively ($p<0.005$), and further reduced to 0.83±1.00 D at one month ($p<0.005$). This reduction was consistent and statistically significant across the study population. The trend in astigmatic change is shown in Figure. 2.



(a) Preoperative: 3.31 D (b) 1-Week Postoperative: 1.05 D (c) 1-Month Postoperative: 0.83 D

Figure 2: Slit-Lamp Photographs at Preoperative, 1-Week, and 1-Month Postoperative Intervals with Corresponding Corneal Astigmatism Values

A subset of 7 patients with Grade 1 pterygium showed early keratometric stability between 1 week and 1-month follow-up, with a mean difference of -0.04 D and a p-value of 0.99, indicating no significant change during that interval.

Keratometric stability, defined as a change of ≤0.25 D between two consecutive readings, was achieved in 85% of eyes by the end of one month. Grade-wise analysis showed that 94.4% of Grade 1, 86.2% of Grade 2, and 79.5% of Grade 3 pterygium cases achieved this stability (Table 2).

Table 2: Keratometric Stability at One Month Postoperatively by Pterygium Grade

Pterygium Grade	Number of Eyes	Stable Eyes (≤0.25 D change)	Percentage (%)
Grade 1	18	17	94.4
Grade 2	65	56	86.2
Grade 3	39	31	79.5

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The distribution of astigmatism axis also changed postoperatively. Preoperatively, with-the-rule (WTR) astigmatism was observed in 70% of eyes, against-the-rule (ATR) in 25%, and oblique in 5%. At one month, WTR decreased to 60%, ATR increased to 30%, and oblique rose to 10%, suggesting remodeling of corneal curvature (Figure. 3).

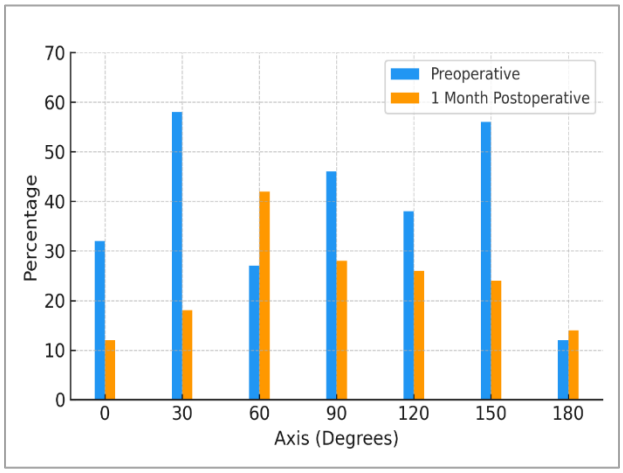

Figure 3: Distribution of Astigmatism Axis Preoperatively and at One Month Postoperatively

Table 3 shows the best-corrected visual acuity (BCVA) changes expressed in logMAR units. The mean BCVA improved from 0.60±0.10 logMAR preoperatively to 0.48±0.09 logMAR at one week, and further to 0.30±0.07 logMAR at one month postoperatively. Significant improvement was observed, with 82.7% of patients gaining two or more Snellen equivalent lines by one month.

Table 3: Visual acuity (BCVA) change from pre-op to 1 month

Time Point	BCVA (Mean ± SD) (logMAR)	Patients with Improvement (%)
Preoperative	0.60±0.10	-
1 Week Postoperative	0.48±0.09	63.1%
1 Month Postoperative	0.30±0.07	82.7%

Figure. 4 represents the percentage of eyes that achieved keratometric stability (defined as ≤0.25 Diopter change) by one month postoperatively, stratified according to pterygium grade. The highest stability was observed in Grade 1 cases (94.4%), followed by Grade 2 (86.2%), and the lowest in Grade 3 (79.5%). This pattern suggests that eyes with early or moderate disease achieve faster and more consistent corneal curvature normalization compared to advanced, fleshy pterygium. The data reinforces the clinical importance of early intervention and provides a useful reference point for predicting visual rehabilitation timelines post-surgery.

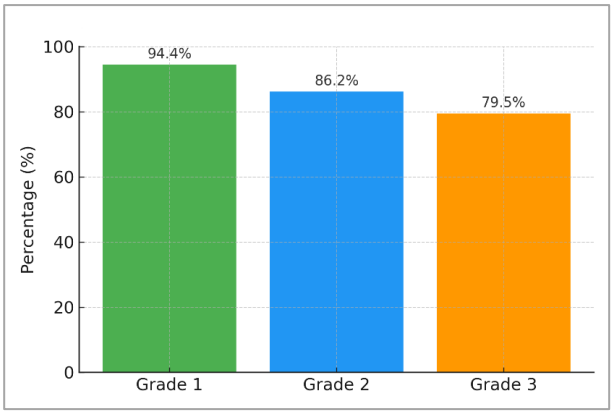

Figure 4: Bar graph showing % keratometric stability per pterygium grade

DISCUSSION

Pterygium exerts chronic tractional forces on the corneal surface, often leading to progressive flattening, particularly along the horizontal meridian, thereby inducing with-the-rule (WTR) astigmatism [4]. The extent and severity of induced astigmatism have been directly correlated with the lesion's encroachment and fibrovascular thickness. Our study confirms that surgical excision of pterygium significantly improves both the magnitude and stability of astigmatism, which is consistent with several previous reports [5,6,10].

In our cohort of 122 eyes, the mean preoperative astigmatism of 3.31±3.62 D showed a marked reduction to 1.05±1.30 D at one week and 0.83±1.00 D by one month. These reductions reflect not only the mechanical relief of corneal distortion but also the early onset of stromal remodeling. While prior studies have shown stabilization over 3 to 6 months [11], our findings highlight that a majority of patients (85%) reach stable keratometric values within just one month. This has strong implications for clinical decision-making, particularly in high-volume cataract centers or in cases requiring early biometric evaluation.

An important secondary outcome was axis shift. While WTR astigmatism was dominant preoperatively, we observed a shift toward ATR and oblique patterns post-surgery. This redistribution of the astigmatism axis aligns with the biomechanical alterations of the cornea post-excision. Lin and Stern's earlier hypothesis that horizontal encroachment contributes most to corneal flattening is further substantiated here [10].

Grade-wise analysis revealed that Grade 1 pterygia achieved the fastest keratometric stability, with no significant difference between 1-week and 1-month astigmatism readings (p=0.99). This suggests that thinner, less invasive lesions respond faster to surgical correction, which is consistent with findings by Niruthisard *et al.* [9] and more recent topography-based stability studies [12].

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Visual acuity changes also followed a favorable trend. Mean BCVA improved from 6/24 preoperatively to 6/12 at one month, with over 82% of eyes gaining at least two Snellen lines. These improvements support the dual refractive and functional benefit of early pterygium excision [13].

Newer studies also advocate the use of anterior segment OCT and corneal biomechanics to predict postoperative remodeling and stability patterns [14,15]. While we used the Huvitz HRK-7000 autorefractor for consistent keratometry, future studies could incorporate topography and tomography for a more granular assessment of corneal shape.

This study was limited by its retrospective nature and relatively short follow-up. Additionally, higher-grade lesions such as Grade 3 showed delayed stabilization, suggesting the need for individualized timing of follow-up and surgical planning. As technology advances, personalized keratometric modeling may become central to surgical decisions, especially in patients undergoing cataract surgery post-pterygium excision [16].

CONCLUSION

In this retrospective study involving 122 eyes, pterygium excision with conjunctival autograft significantly reduced corneal astigmatism, with the mean value dropping from 3.31±3.62 D preoperatively to 0.83±1.00 D at 1 month postoperatively. A change of ≤0.25 D between follow-ups was considered stable, and 85% of the eyes achieved keratometric stability by one month. Notably, patients with Grade 1 pterygium showed early stabilization as early as 1 week postoperatively. The findings highlight the effectiveness of pterygium surgery not only in improving vision and ocular surface integrity but also in restoring stable corneal curvature, which is essential for accurate biometric planning. These results support the clinical feasibility of performing subsequent procedures, such as cataract or refractive surgery, as early as one month after pterygium excision, particularly in lower-grade lesions.

Further prospective studies with longer follow-up and corneal topography should be conducted to confirm long-term stability, especially in higher-grade pterygium cases. Integration of corneal biomechanics and epithelial mapping may provide additional insights into individualized surgical planning and timing.

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***Corresponding Author:** Dr Deepthi Prabhakar Iyer