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Original Article

Effect of Pterygium Surgery on Corneal Astigmatism at Tertiary Care Center: An Interventional Study

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ABSTRACT

Background: Pterygium is a common ocular surface disorder that induces corneal astigmatism and visual impairment. Surgical excision with conjunctival autografting is the standard treatment, but the optimal fixation technique remains debated.
Aim: To evaluate the effect of pterygium surgery on corneal astigmatism and compare outcomes between sutured and sutureless conjunctival autograft techniques.
Materials and Methods: This hospital-based interventional study was conducted over 2.5 years and included 75 patients with primary pterygium and corneal astigmatism ≥1 diopter. Patients were randomly assigned into two groups: sutured conjunctival autograft (n=38) and sutureless autograft using autologous blood (n=38). Keratometry and astigmatism were assessed preoperatively and postoperatively at day 1, week 1, week 2, and week 4. Data were analyzed using SPSS v27 with appropriate statistical tests.
Results: The mean age of patients was 40.37 ± 9.97 years. Both techniques resulted in a significant reduction in corneal astigmatism over 4 weeks ($p < 0.0001$). Operative time was significantly lower in the sutureless group (29.2 ± 2.1 vs 40.2 ± 2.7 minutes). The sutureless group showed better early postoperative comfort with less foreign body sensation and lacrimation ($p < 0.05$). However, subconjunctival hemorrhage and minor graft dehiscence were more frequent in the sutureless group, while graft edema was more common in the sutured group. Graft displacement rates and long-term outcomes were comparable between both groups.
Conclusion: Pterygium surgery significantly improves corneal astigmatism. Both sutured and sutureless conjunctival autograft techniques are effective; however, the sutureless technique offers advantages of shorter operative time and improved early postoperative comfort with comparable long-term outcomes.

Keywords*: Pterygium, corneal astigmatism, conjunctival autograft, sutured technique, sutureless technique, autologous blood.*

INTRODUCTION

Pterygium is a common degenerative fibrovascular disorder of the ocular surface characterized by triangular conjunctival overgrowth extending onto the cornea. It is frequently associated with chronic ultraviolet (UV) radiation exposure, dry and dusty environmental conditions, and ocular surface inflammation. The condition is particularly prevalent in tropical and subtropical regions, including India, where environmental exposure plays a major role in its pathogenesis [1].

The primary clinical concern in pterygium is its effect on visual function. As the lesion encroaches onto the cornea, it induces significant corneal astigmatism due to mechanical traction and alteration of corneal curvature. This astigmatism is often with-the-rule or irregular in nature and can lead to progressive visual impairment even before the lesion reaches the visual axis [2].

Surgical excision remains the definitive treatment for pterygium. However, simple excision is associated with high recurrence rates. Therefore, conjunctival autografting has become the gold standard surgical technique due to its lower

recurrence rate and better functional outcomes [3]. Recent advancements have introduced variations such as sutured conjunctival autograft and sutureless or glue-free techniques using autologous blood, aimed at reducing operative time, postoperative discomfort, and complication rates [4].

Corneal astigmatism has been shown to improve significantly following successful pterygium excision, although the magnitude and timeline of recovery may vary depending on surgical technique and postoperative healing response [5]. Sutures themselves may induce localized inflammation and discomfort, potentially affecting early corneal biomechanics and patient satisfaction. In contrast, sutureless techniques may reduce postoperative irritation but may carry a higher risk of early graft displacement or hemorrhage [6].

Despite multiple studies evaluating individual surgical techniques, there remains ongoing debate regarding the comparative effectiveness of sutured versus sutureless conjunctival autografting in terms of corneal astigmatism reduction, visual recovery, and postoperative complications. Therefore, the present study was conducted to evaluate the effect of pterygium surgery on corneal astigmatism and to compare outcomes between sutured and sutureless conjunctival autograft techniques in a tertiary care setting.

MATERIALS AND METHODS

Study Design

This was a hospital-based interventional study conducted at a tertiary health care centre over a duration of 2.5 years.

Study Population

The study included patients attending the Ophthalmology Outpatient Department (OPD) with pterygium requiring surgical intervention.

Sample Size

A total of 75 patients diagnosed with primary pterygium were enrolled in the study.

Sample Size Calculation

The sample size was calculated using the formula for the estimation of a proportion with a confidence interval:
[n = \frac{Z^2 \times p \times q}{E^2}]

Where:

- (Z = 1.96) for 95% confidence interval
- (p = 0.13) (prevalence of pterygium reported by Clearfield E et al., 2016)
- (q = 1-p)
- (E = 0.1) (precision level)

Using the above formula, the calculated sample size was 72.13, which was rounded to 75 subjects.

Sampling Technique

Patients were selected by a simple random sampling method.

Inclusion Criteria

- Patients aged between 20 and 60 years.
- Patients with primary pterygium associated with corneal astigmatism of at least 1 diopter cylinder (DC).
- Patients with normal fundus findings on direct ophthalmoscopy.
- Patients willing to participate in the study and provide written informed consent.

Exclusion Criteria

- Patients below 20 years or above 60 years of age.
- Patients with a history of previous ocular surgery.
- Recurrent pterygium and Grade IV pterygium involving the pupillary area.
- Patients already using spectacle correction or having other ocular surface diseases.
- Patients unwilling to participate in the study.

Outcome Variables

Primary outcome variables included:

1. Improvement in corneal astigmatism following surgery.
2. Comparison of postoperative outcomes between sutured and sutureless pterygium surgery techniques.

Ethical Considerations
The study was initiated after obtaining approval from the Institutional Ethics Committee (IEC). Subsequently, approval from Maharashtra University of Health Sciences (MUHS), Nashik, was obtained. Written informed consent was taken from all participants before enrolment. The study was conducted in accordance with the ethical principles laid down by the Institutional Ethics Committee.

Preoperative Evaluation
Baseline demographic and clinical details, including age, gender, occupation, laterality of disease, and location of pterygium (nasal, temporal, or both) were recorded. All patients underwent detailed anterior segment examination using slit lamp biomicroscopy.

Pterygium was graded according to the extent of corneal involvement as per Kanski's classification:

- Grade I: Pterygium extending midway between limbus and pupil.
- Grade II: Pterygium reaching the pupillary margin.
- Grade III: Pterygium crossing the pupillary margin.

Keratometric measurements were recorded preoperatively and postoperatively on day 1, at 1 week, 2 weeks, and 4 weeks.

Surgical Technique
All surgeries were performed under peribulbar anaesthesia using a combination of 2% lignocaine and 0.5% bupivacaine in a ratio of 3:2. After sterile preparation and draping, a lid speculum was inserted and the ocular surface was irrigated with balanced salt solution.

The head of the pterygium was avulsed from the cornea using fine-toothed forceps and curved needle holder. The subconjunctival fibrovascular tissue along with overlying conjunctiva and Tenon’s capsule was excised. Residual corneal tissue was scraped using a crescent knife to achieve a smooth corneoscleral surface. Care was taken to excise Tenon’s tissue completely to minimize recurrence.

The dimensions of the bare scleral area were measured using calipers. A conjunctival autograft was harvested from the superotemporal bulbar conjunctiva of the same eye. The graft was fashioned approximately 1 mm larger than the recipient bed and included limbal stem cells.

The harvested graft was transferred to the recipient bed with the epithelial side facing upward and limbal edge oriented toward the limbus.

Group 1: Sutured Conjunctival Autograft
In this group, the graft was secured to the scleral bed using 4–6 interrupted 10-0 nylon sutures.

Group 2: Sutureless and Glue-free Conjunctival Autograft
In this group, the graft was secured using autologous blood without sutures or fibrin glue. Natural haemostasis was allowed to occur, and gentle pressure was applied when required to stabilize the graft. Adequate graft adherence was confirmed before patching the eye.

Postoperative Management
All patients received topical moxifloxacin and dexamethasone eye drops four times daily with gradual tapering over 4 weeks, along with lubricating eye drops for 4 weeks. Patients were advised to avoid dust exposure, sunlight, heat, and eye rubbing. Protective dark glasses were prescribed.

Follow-up Evaluation
Patients were evaluated postoperatively for:

- Uncorrected and best corrected visual acuity (BCVA)
- Extraocular movements
- Patient symptoms such as foreign body sensation and lacrimation
- Graft integrity and displacement
- Graft oedema and subconjunctival haemorrhage
- Anterior chamber reaction
- Mean surgical duration
- Recurrence rate

Recurrence was defined as fibrovascular tissue growth extending at least 1 mm across the corneoscleral limbus.

Symptoms were graded as:

- Grade 0: No symptoms
- Grade 1: Very mild symptoms
- Grade 2: Mild discomfort
- Grade 3: Moderate symptoms interfering with activities
- Grade 4: Severe symptoms interfering with routine activities or sleep

Complications Assessed

Intraoperative Complications

- Buttonholing of graft
- Accidental corneal or scleral perforation
- Medial rectus muscle injury

Postoperative Complications

- Conjunctival graft edema
- Graft retraction or failure
- Subgraft haemorrhage
- Scleral thinning
- Tenon's granuloma
- Corneal or scleral dellen
- Epithelial inclusion cyst
- Corneal thinning or astigmatism
- Corneal infection
- Endophthalmitis

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5.

Continuous variables were expressed as mean ± standard deviation, while categorical variables were summarised as frequency and percentage.

The following statistical tests were used:

- Paired t-test for comparison of preoperative and postoperative continuous variables within groups.
- Unpaired t-test for comparison between independent groups.
- Chi-square test or Fisher's exact test for categorical variables.

A p-value ≤ 0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

Table 1: Distribution of Demographic Characteristics of Study Participants (n=76)

Variable	Frequency	Percentage (%)
Age Group (Years)		
21–30	**13**	**17.1**
31–40	**27**	**35.5**
41–50	**22**	**28.9**
51–60	**13**	**17.1**
>60	**1**	**1.3**
Sex		
Male	**37**	**48.7**
Female	**39**	**51.3**

The mean age of the study participants was 40.37 ± 9.97 years. Majority of patients belonged to the 31–40 years age group (35.5%). Female patients (51.3%) were slightly more than males (48.7%).

Table 2: Distribution of Clinical Characteristics

Variable	Frequency	Percentage (%)
Location of Pterygium		
Nasal	**68**	**89.5**
Temporal	**8**	**10.5**
Laterality		

Right Eye (OD)	**44**	**57.9**
Left Eye (OS)	**32**	**42.1**
Grade of Pterygium		
Grade I	**9**	**11.8**
Grade II	**49**	**64.5**
Grade III	**18**	**23.7**

Nasal pterygium was the most common presentation (89.5%). Right eye involvement was more frequent (57.9%). Grade II pterygium was the predominant grade observed in the study population (64.5%).

Table 3: Comparison of Baseline Characteristics Between Sutured and Sutureless Groups

Variable	Sutured Group (n=38)	Sutureless Group (n=38)	p-value
Female	**22 (57.9%)**	**17 (44.7%)**	**0.2511**
Male	**16 (42.1%)**	**21 (55.3%)**	
Nasal Pterygium	**34 (89.5%)**	**34 (89.5%)**	**1.0000**
Temporal Pterygium	**4 (10.5%)**	**4 (10.5%)**	
Right Eye (OD)	**22 (57.9%)**	**22 (57.9%)**	**1.0000**
Left Eye (OS)	**16 (42.1%)**	**16 (42.1%)**	
Mean Grade of Pterygium	**2.05 ± 0.32**	**2.07 ± 0.42**	**0.7633**

Both groups were comparable with respect to gender, location, laterality, and grade of pterygium. No statistically significant difference was observed between the groups.

Table 4: Mean Keratometry Changes in Sutured Group

Time Point	Mean Keratometry (D)	p-value
Pre-operative	**43.68 ± 1.24**	**—**
Day 1	**45.16 ± 1.61**	**<0.0001**
Week 1	**45.36 ± 1.32**	**<0.0001**
Week 2	**45.22 ± 1.33**	**<0.0001**
Week 4	**45.49 ± 1.39**	**<0.0001**

A statistically significant increase in postoperative keratometry values was observed in the sutured group throughout follow-up.

Table 5: Mean Keratometry Changes in Sutureless Group

Time Point	Mean Keratometry (D)	p-value
Pre-operative	**44.03 ± 1.19**	**—**
Day 1	**45.62 ± 1.72**	**<0.0001**
Week 1	**45.16 ± 1.31**	**<0.0001**
Week 2	**45.37 ± 1.25**	**<0.0001**
Week 4	**45.62 ± 1.29**	**<0.0001**

The sutureless group also demonstrated significant postoperative corneal steepening at all follow-up visits.

Table 6: Mean Cylinder Changes in Sutured Group

Time Point	Mean Cylinder (D)	p-value
Pre-operative	**3.71 ± 1.61**	**—**
Day 1	**2.21 ± 1.25**	**<0.0001**
Week 1	**2.25 ± 1.25**	**<0.0001**
Week 2	**1.90 ± 1.14**	**<0.0001**
Week 4	**1.54 ± 1.07**	**<0.0001**

A significant reduction in postoperative astigmatism was observed in the sutured group.

Table 7: Mean Cylinder Changes in Sutureless Group

Time Point	Mean Cylinder (D)	p-value
Pre-operative	**3.82 ± 1.71**	**—**
Day 1	**2.81 ± 1.33**	**<0.0001**
Week 1	**2.65 ± 1.33**	**<0.0001**
Week 2	**2.17 ± 1.20**	**<0.0001**
Week 4	**1.77 ± 1.15**	**<0.0001**

The sutureless technique also resulted in significant reduction of corneal astigmatism during follow-up.

Table 8: Comparison of Mean Axis Changes

Time Point	Sutured Group Mean Axis	p-value	Sutureless Group Mean Axis	p-value

Pre-operative	**93.89 ± 25.66**	—	**93.89 ± 25.66**	—
Day 1	**93.57 ± 27.88**	**0.9422**	**95.65 ± 29.74**	**0.6962**
Week 1	**94.26 ± 20.58**	**0.9223**	**96.39 ± 22.65**	**0.5253**
Week 2	**93.65 ± 16.22**	**0.9459**	**90.60 ± 10.83**	**0.3049**
Week 4	**85.55 ± 20.54**	**0.0285**	**89.73 ± 21.03**	**0.2764**

No significant change in axis was observed in the sutureless group. In the sutured group, a significant axis shift was noted at 4 weeks.

Table 9: Comparison of Lacrimation Between Groups

Follow-up	Significant Finding	p-value
Day 1	**Severe lacrimation is higher in the sutured group**	**0.0002**
Week 1	**No lacrimation is more common in the sutureless group**	**<0.0001**
Week 2	**Persistent symptoms are higher in the sutured group**	**<0.0001**
Month 1	**Complete relief in the sutureless group**	**0.0524**

Postoperative lacrimation was significantly less in the sutureless group throughout follow-up.

Table 10: Comparison of Foreign Body Sensation Between Groups

Follow-up	Significant Finding	p-value
Day 1	**Severe symptoms more common in sutured group**	**<0.0001**
Week 1	**Better comfort in sutureless group**	**<0.0001**
Week 2	**Symptoms persisted in sutured group**	**<0.0001**
Month 1	**Complete symptom resolution in sutureless group**	**0.0053**

Foreign body sensation was significantly lower in the sutureless group at all postoperative visits.

Table 11: Comparison of Operative Time and Early Postoperative Complications

Variable	Sutured Group	Sutureless Group	p-value
Mean Operative Time (min)	**40.2 ± 2.7**	**29.2 ± 2.1**	**<0.001**
Graft Edema	**2 (5.3%)**	**0 (0%)**	**0.04**
Subconjunctival Hemorrhage	**6 (16.2%)**	**18 (48.6%)**	**0.003**
Graft Dehiscence	**0 (0%)**	**3 (7.9%)**	**0.04**

The sutureless technique required significantly less operative time. Graft oedema was more common in the sutured group, whereas subconjunctival haemorrhage and graft dehiscence were more frequent in the sutureless group.

Table 12: Comparison of Graft Displacement and Overall Complications

Variable	Sutured Group	Sutureless Group	p-value
Graft Displacement Day 1	**1 (2.6%)**	**2 (5.3%)**	**0.45**
Graft Displacement Week 1	**1 (2.6%)**	**3 (8.1%)**	**0.44**
Significant Day 1 Complications	**Higher in the sutured group**	**Lower in the sutureless group**	**<0.0001**
Significant Week 1 Complications	**Higher in the sutured group**	**Lower in the sutureless group**	**0.0259**
Significant Week 2 Complications	**Higher in the sutured group**	**Lower in the sutureless group**	**0.0455**
Significant Month 1 Complications	**Comparable**	**Comparable**	**0.2063**

Graft displacement rates were comparable between the groups. Early postoperative complications were significantly more common in the sutured group, while long-term complications were similar in both groups.

DISCUSSION

The present interventional study evaluated the effect of pterygium surgery on corneal astigmatism and compared outcomes between sutured and sutureless conjunctival autograft techniques. Our findings demonstrate a significant reduction in corneal astigmatism following surgery in both groups, along with meaningful improvements in keratometric values over the follow-up period.

In our study, the mean age of patients was 40.37 ± 9.97 years, with a slight female preponderance. Similar demographic patterns have been reported by Gazzard et al., who observed higher prevalence in middle-aged individuals exposed to chronic UV radiation [1]. The predominance of nasal pterygium (89.5%) in our study is consistent with established literature, which attributes this distribution to the wind and sunlight exposure pattern across the nasal limbus [2].

A significant reduction in corneal astigmatism was observed in both sutured and sutureless groups, with progressive improvement over 4 weeks. This finding is consistent with previous studies by Bahar et al., who reported significant corneal flattening after pterygium excision due to release of mechanical traction forces on the cornea [5]. Similar improvements were also reported by Hacioglu et al., who demonstrated that early postoperative corneal astigmatism reduction is primarily driven by removal of fibrovascular tension [6].

In the present study, both surgical techniques were effective in reducing astigmatism; however, sutured and sutureless groups showed slightly different recovery patterns. The sutured group demonstrated more stable long-term keratometric improvement, whereas the sutureless group showed faster early symptom relief and improved patient comfort. These findings align with the study by Singh et al., which reported that sutureless techniques reduce postoperative irritation but may initially show variability in graft stability [7].

Operative time was significantly shorter in the sutureless group (29.2 ± 2.1 minutes) compared to the sutured group (40.2 ± 2.7 minutes), consistent with previous findings by Narasimhaiah et al., who highlighted the time-saving advantage of autologous blood fixation techniques [8]. Reduced surgical time may improve operating room efficiency and reduce patient exposure to anesthesia.

Postoperative complications varied between groups. Subconjunctival hemorrhage and graft dehiscence were more frequent in the sutureless group, likely due to lack of mechanical fixation. However, graft edema and postoperative discomfort were more common in the sutured group, likely due to suture-induced inflammation. These findings are consistent with Sharma et al., who reported similar complication profiles between the two techniques [9].

Foreign body sensation and lacrimation were significantly lower in the sutureless group throughout follow-up, indicating better early postoperative comfort. This is in agreement with previous studies demonstrating that absence of sutures reduces ocular surface irritation and improves patient satisfaction [10].

Importantly, graft displacement rates were comparable between groups, suggesting that careful surgical technique and appropriate case selection can minimize this risk even in sutureless procedures. Recurrence rates were also similar at short-term follow-up, although long-term follow-up would be required to confirm stability of outcomes.

Overall, our findings suggest that both sutured and sutureless conjunctival autografting are effective techniques for pterygium surgery, with significant improvement in corneal astigmatism. However, sutureless techniques offer advantages in terms of reduced operative time and improved early postoperative comfort, while sutured techniques may provide slightly better early graft stability.

CONCLUSION

Pterygium excision with conjunctival autografting is effective in significantly reducing corneal astigmatism and improving corneal curvature in affected patients. Both sutured and sutureless techniques demonstrated comparable long-term functional outcomes. However, the sutureless (autologous blood–assisted) technique offered advantages in terms of shorter operative time and better early postoperative comfort, while showing a slightly higher incidence of minor early complications such as graft dehiscence. Overall, sutureless conjunctival autografting appears to be a safe and efficient alternative to sutured repair in appropriately selected patients.

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