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Original Research Article

Comparison of conjunctival autograft and amniotic membrane graft in reducing pterygium-induced corneal astigmatism

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ABSTRACT

Background: Pterygium is a common ocular surface disorder that not only affects cosmesis but also induces corneal astigmatism, leading to visual impairment. This study aimed to compare the effectiveness of CAG and AMG in reducing pterygium-induced corneal astigmatism and to evaluate postoperative complications associated with each technique.
Methods: A prospective, comparative study was conducted on 60 patients with primary pterygium at the Upgraded Department of Ophthalmology, GMC, Jammu, from Oct.2016 to April 2017. Patients were randomly assigned to undergo pterygium excision followed by either CAG/AMG. Preoperative and postoperative assessments were conducted at multiple intervals up to six months.
Results: Preoperatively, the mean pterygium size was similar in both groups. Postoperatively, corneal astigmatism showed a progressive decline in both groups. By the first postoperative day, astigmatism significantly decreased ($p<0.001$), with further reductions at one week ($p<0.0001$). At one month, the conjunctival autograft group demonstrated a slightly greater reduction (0.60±0.61 D) compared to the amniotic membrane group (0.84±0.68 D). By three months, astigmatism remained stable at 0.62±0.62 D and 0.98±0.72 D, respectively. However, the intergroup difference was not statistically significant at any time point ($p>0.05$), indicating comparable efficacy in postoperative corneal curvature improvement. Postoperative complications were more frequent in the conjunctival autograft group, with significantly higher conjunctival hyperemia (63% vs. 26%, $p=0.003$), while other complications were comparable between groups.
Conclusions: Both conjunctival autograft and amniotic membrane graft effectively reduced corneal astigmatism following pterygium excision.

Keywords: Amniotic membrane graft, Conjunctival autograft, Corneal astigmatism, Pterygium, Recurrence, Surgical excision, Visual outcomes

INTRODUCTION

Pterygium is a wing-shaped fibrovascular overgrowth of conjunctival tissue extending onto the cornea, often associated with chronic ultraviolet (UV) light exposure, dry climates, and environmental irritants.1 It is a common ocular surface disorder, with a higher prevalence in tropical and subtropical regions, particularly among outdoor workers and populations with prolonged sun exposure. The global prevalence of pterygium varies widely, ranging from 3% to 29%, with higher incidence rates observed in regions closer to the equator.2 In India, the reported prevalence ranges between 9.5% and 13%.3 Surgical excision is the primary treatment for pterygium, especially in cases where it causes visual impairment, chronic irritation, or cosmetic concerns. However, recurrence remains a major challenge, with rates varying depending on the surgical technique used. Among the commonly employed methods to reduce recurrence are

conjunctival autograft (CAG) and amniotic membrane graft (AMG), both of which serve as adjunctive therapies by covering the bare scleral area after excision.[4] Conjunctival autografting involves transplanting the patient's own conjunctival tissue to the excision site, offering benefits like reduced recurrence rates. However, it may not be feasible in cases with extensive conjunctival involvement or in patients requiring future glaucoma surgeries.[5] Alternatively, amniotic membrane grafting utilizes preserved human amniotic membrane, providing anti-inflammatory and anti-fibrotic properties, and serving as a suitable option when conjunctival tissue is insufficient.[6] Previous studies have compared these techniques, focusing on recurrence rates and surgical outcomes. For instance, a randomized controlled trial reported recurrence rates of 12.3% for CAG and 25.0% for AMG in primary pterygium cases, indicating a higher recurrence with AMG.[7] Another study found recurrence rates of 5.4% for CAG and 13.8% for AMG, though this difference was not statistically significant.[8] However, data regarding their effects on corneal astigmatism and postoperative complications remain limited. This study aims to evaluate the impact of AMG on corneal astigmatism following pterygium excision compared to CAG. Additionally, it seeks to assess postoperative complications associated with AMG over a six-month period relative to CAG. The findings will provide valuable insights into the efficacy and safety of these surgical techniques, aiding in optimal management strategies for pterygium excision.

METHODS

This prospective, randomized controlled study was conducted at the Upgraded Department of Ophthalmology, Government Medical College, Jammu, over a period of one year. Ethical approval was obtained from the Institutional Ethics Committee of Government Medical College, Jammu, and informed consent was secured from all patients before their enrolment. The study included a total of 60 patients with primary nasal pterygium requiring surgical excision, who were randomly assigned to one of two groups.

Group I comprised 30 eyes that underwent pterygium excision followed by conjunctival autograft transplantation using 9-0 silk sutures, while Group II consisted of 30 eyes that underwent pterygium excision followed by amniotic membrane transplantation with 9-0 silk sutures. Patients aged between 15 and 80 years, with primary nasal pterygium extending at least 2 mm over the cornea, were included in the study. However, patients with recurrent pterygium, a history of previous ocular surgery, glaucoma, cicatricial ocular surface disease, pseudopterygium, clinical signs of malignancy, or pterygium extending into the pupillary area were excluded. Preoperative assessments included a detailed ophthalmic and medical history, uncorrected and best-corrected visual acuity (BCVA) measurement using Snellen's chart, slit lamp biomicroscopy to evaluate the type, size, and extent of pterygium, fundoscopic examination to assess the posterior segment, and keratometry using a Bausch & Lomb keratometer to measure corneal curvature. Patients underwent routine hematological investigations, including hemoglobin levels, bleeding time, and clotting time. Preoperative topical antibiotic and anti-inflammatory eye drops were administered four times daily, starting one day before surgery. Peribulbar anesthesia was administered using a 50:50 mixture of 2% lignocaine and 0.5% bupivacaine with 150 units/ml of hyaluronidase. Standard aseptic precautions were followed, and the eye was draped accordingly before surgery.

During the surgical procedure, a universal eye speculum was used to stabilize the eye, and an incision was made in the conjunctiva medial to the pterygium head. The conjunctiva was dissected using Westcott scissors, and the pterygium was excised by avulsion from the cornea. Only thickened conjunctival tissue and adjacent Tenon's capsule were removed, while spontaneous hemostasis was allowed. The size of the scleral defect was measured using calipers. In Group I, a conjunctival autograft was harvested from the superotemporal bulbar conjunctiva, ensuring that it exceeded the defect size by 1 mm horizontally and vertically. Lidocaine-epinephrine was injected to separate the conjunctiva from Tenon's capsule. The excised graft was placed on the bare sclera while maintaining its original limbal orientation. The edges of the graft were secured with episcleral bites, and the limbal side was sutured to the limbal area using simple interrupted 9-0 silk sutures. In Group II, a commercially available dry amniotic membrane was used. The required graft size was determined using calipers, and the membrane was placed basement membrane side up over the bare scleral area. It was then sutured to the episcleral tissue and conjunctival edges with 4-5 interrupted 9-0 silk sutures.

Postoperatively, all patients were prescribed a combination of gatifloxacin and prednisolone eye drops every two hours for one week, followed by gradual tapering over four weeks. Artificial tears were administered every six hours, and sutures were removed after one week. Patients were followed up at 24 hours, one week, two weeks, three months, and six months postoperatively. During follow-up visits, subjective symptoms such as pain, foreign body sensation, watering, and discomfort were recorded, while slit lamp biomicroscopy was performed to assess graft integrity and detect complications such as corneal epithelial defects, symblepharon, graft hemorrhage, or granuloma formation. Snellen's visual acuity and keratometry were reassessed at each visit.

For statistical analysis, data were analyzed using SPSS version 16 for Windows. Continuous variables were assessed using the Student's t-test, while categorical variables were analyzed using the Chi-square test. A p value of less than 0.05 was considered statistically significant. The primary objective of the study was to evaluate and compare the effect of amniotic membrane

graft as an adjunctive therapy following pterygium excision on corneal astigmatism, as well as to assess postoperative complications over a six-month follow-up period, comparing these outcomes with those of conjunctival autograft.

RESULTS

The demographic analysis showed a mean age of 34.11±9.41 years in the conjunctival autograft group and 37±10.28 years in the amniotic membrane graft group, with an overall mean of 35 ± 9.91 years (range: 17–55 years). Most patients were aged 26–35 years (50.0% and 26.7%, respectively), followed by those aged 36–45 years. No patients were older than 55 years. Males comprised 53.3% of the conjunctival autograft group and 56.7% of the amniotic membrane graft group, with an overall male-to-female ratio of 55:45. The majority of patients were from rural areas (80.0% and 83.3%, respectively), with an overall rural population of 81%, while urban residents accounted for 19%.

The distribution of the affected eye was nearly equal in both groups, with the right eye being involved in 53.3% of cases in the conjunctival autograft group and 50.0% in the amniotic membrane graft group. Similarly, the left eye was affected in 46.7% and 50.0% of cases, respectively. The mean pterygium size was comparable between the two groups (2.77±0.73 mm in the conjunctival autograft group and 2.73±0.74 mm in the amniotic membrane graft group). The most common pterygium size was 2 mm, seen in 40.0% and 43.3% of cases in the respective groups, followed by 3 mm (43.3% vs. 40.0%) and 4 mm (16.7% in both groups). Preoperative astigmatism was slightly higher in the amniotic membrane graft group (2.73±1.48 D) compared to the conjunctival autograft group (2.49±1.39 D). Astigmatism increased with pterygium size, showing a statistically significant difference (p=0.017). Postoperative astigmatism showed a progressive decline over time in both groups. On Day 1, the mean astigmatism was 1.33±0.92 D (conjunctival autograft) and 1.44±0.94 D (amniotic membrane graft). By Week 1, astigmatism further reduced to 0.87±0.72 D and 1.03±0.79 D, respectively.At Month 1, astigmatism was significantly lower in both groups, with the conjunctival autograft group showing a greater reduction (0.60±0.61 D) compared to the amniotic membrane group (0.84±0.68 D). By Month 3, astigmatism remained stable at 0.62±0.62 D (conjunctival autograft) and 0.94±0.72 D (amniotic membrane graft), indicating a sustained improvement in both groups.

A significant reduction in corneal astigmatism was observed in both the conjunctival autograft and amniotic membrane graft groups at all postoperative time points. On the first postoperative day, astigmatism decreased from 2.49±1.39 D to 1.33±0.92 D in the conjunctival autograft group and from 2.73±1.48 D to 1.44±0.94 D in the amniotic membrane graft group ($p<0.001$ for both). By the end of the first postoperative week, astigmatism was further reduced to 0.60±0.61 D in the conjunctival autograft group and 0.84±0.68 D in the amniotic membrane graft group ($p<0.0001$), with similar values maintained at one month postoperatively. At the three-month follow-up, astigmatism remained stable at 0.62±0.62 D in the conjunctival autograft group and 0.98±0.72 D in the amniotic membrane graft group. Although both surgical techniques effectively reduced astigmatism over time, the intergroup comparison revealed no statistically significant difference in the degree of astigmatism reduction at any time point ($p>0.05$), indicating comparable efficacy of both procedures in improving postoperative corneal curvature. Postoperative complications were observed in both study groups, with conjunctival hyperemia being significantly more frequent in the conjunctival autograft group (63%) compared to the amniotic membrane graft group (26%) ($p=0.003$). Other complications, such as conjunctival granuloma (3% vs. 10%, $p = 0.45$), recurrence (3% vs. 7%, $p=0.50$), graft edema (17% vs. 10%, $p=0.40$), hemorrhage (7% vs. 0%, $p=0.37$), and graft loss (7% vs. 13%, $p=0.32$), did not show statistically significant differences between the groups. Corneal epithelial defects and symblepharon were not observed in either group.

Table 1: Demographic characteristics of patients undergoing conjunctival autograft and amniotic.

Variable	Conjunctival autograft (n=30)	Amniotic membrane graft (n=30)	Total (n=60)
Age (in years)			
15–25	4 (13.3%)	6 (20.0%)	10 (16%)
26–35	15 (50.0%)	8 (26.7%)	23 (38%)
36–45	6 (20.0%)	8 (26.7%)	14 (23%)
46–55	5 (16.7%)	8 (26.7%)	13 (21%)
>55	0	0	0
Mean age (in years)	34.11±9.41	37±10.28	35±9.91
Age range (in years)	17–53	18–55	17–55
Sex distribution			
Male	16 (53.3%)	17 (56.7%)	33 (55%)
Female	14 (46.7%)	13 (43.3%)	27 (45%)
Residence			
Rural	24 (80.0%)	25 (83.3%)	49 (81%)
Urban	6 (20.0%)	5 (16.7%)	11 (19%)

Table 2: Preoperative clinical characteristics of patients.

Variable	Conjunctival autograft (n=30)	Amniotic membrane graft (n=30)
Affected eye		
Right	16 (53.3%)	15 (50.0%)
Left	14 (46.7%)	15 (50.0%)
Pterygium size (mm)		
2	12 (40.0%)	13 (43.3%)
3	13 (43.3%)	12 (40.0%)
4	5 (16.7%)	5 (16.7%)
Mean size (mm)	2.77±0.73	2.73±0.74
Preoperative astigmatism		
Horizontal curvature (K1) (D)	41.50±1.42	41.73±1.23
Vertical curvature (K2) (D)	43.91±1.18	44.46±1.13
Astigmatism (D)	2.49±1.39	2.73±1.48
Preoperative astigmatism by horizontal pterygium size		
2 mm	25 cases	1.38±0.25 D
3 mm	25 cases	3.21±0.12 D
4 mm	10 cases	4.2±0.20 D
P value	0.017	

Table 3: Postoperative astigmatism changes over time.

Variable	Conjunctival autograft (n=30)	Amniotic membrane graft (n=30)
Postoperative astigmatism	**(Mean±SD)**	**(Mean±SD)**
Day 1		
Horizontal curvature (K1) (D)	42.88±1.00	43.29±0.81
Vertical curvature (K2) (D)	44.19±1.27	44.73±1.07
Astigmatism (D)	1.31±0.92	1.44±0.94
Week 1		
Horizontal curvature (K1) (D)	43.33±0.94	43.68±0.84
Vertical curvature (K2) (D)	44.21±1.22	44.71±1.02
Astigmatism (D)	0.87±0.72	1.03±0.79
Month 1		
Horizontal curvature (K1) (D)	43.58±0.97	43.88±0.77
Vertical curvature (K2) (D)	44.18±1.21	44.70±1.02
Astigmatism (D)	0.60±0.61	0.84±0.68
Month 3		
Horizontal curvature (K1) (D)	43.58±0.94	43.92±0.77
Vertical curvature (K2) (D)	44.18±1.17	44.70±1.12
Astigmatism (D)	0.62±0.62	0.94±0.72

Table 4: Postoperative changes in corneal astigmatism in both study groups.

Time point	Group	Preoperative astigmatism (D)	Postoperative astigmatism (D)	Change in astigmatism (D)	P value
Day 1	Conjunctival autograft	2.49±1.39	1.33±0.92	1.16±0.75	0.0003
	Amniotic membrane graft	2.73±1.48	1.44±0.94	1.29±0.68	0.0002
	Comparison between changes in astigmatism			0.649	-
Week 1	Conjunctival autograft	2.49±1.39	0.60±0.61	1.89±1.00	<0.0001
	Amniotic membrane graft	2.73±1.48	0.84±0.68	1.70±0.79	<0.0001
	Comparison between changes in astigmatism			0.156	

Continued.

Time point	Group	Preoperative astigmatism (D)	Postoperative astigmatism (D)	Change in astigmatism (D)	P value
Month 1	Conjunctival autograft	2.49±1.39	0.60±0.61	1.89±1.00	<0.0001
	Amniotic membrane graft	2.73±1.48	0.84±0.68	1.70±0.79	<0.0001
	Comparison between changes in astigmatism			0.156	
Month 3	Conjunctival autograft	2.49±1.39	0.62±0.62	1.85±1.00	<0.0001
	Amniotic membrane graft	2.73±1.48	0.98±0.72	1.75±0.90	<0.0001
	Comparison between changes in astigmatism			0.054	

DISCUSSION

In the present study, patients were categorized into five age groups: 15–25 years, 26–35 years, 36–45 years, 46–55 years, and >55 years. The highest proportion of cases (38%) was observed in the 26–35-year age group, followed by 19% in the 36–45-year age group. Gerundo et al reported that pterygium typically occurs between 30 and 56 years of age, while Goldman et al documented that actively growing pterygia are more common in the younger age group of 25–40 years.[9,10] The findings of the present study align with these observations, suggesting that pterygium predominantly affects individuals in early to middle adulthood. In this study, the incidence of pterygium was higher in males (55%) compared to females (45%). This male predominance can be attributed to greater occupational exposure to ultraviolet (UV) radiation, dust, and dry environmental conditions. Similar observations have been reported by Gerundo et al and Kamel et al who documented a higher incidence of pterygium among males.[9,11] Additionally Townsend et al concluded that men are more frequently affected than women.[12,13]

However, the significant proportion of affected females (45%) in the present study may be explained by prolonged exposure to irritative atmospheric conditions, such as smoke from traditional chulhas in rural households. A notable majority (81%) of the cases in this study were from rural areas, while only 19% were from urban regions. This further supports the role of environmental factors, particularly dry, dusty, and hot climates, in the development of pterygium. These findings are consistent with previous studies by Dmitry et al, Rajiv et al who identified dust, wind exposure, arid conditions, and UV radiation as key etiological factors in pterygium formation.[14,15] Regarding laterality, the right eye was more frequently involved than the left eye. However, no conclusive evidence exists in the literature to support a predisposition of pterygium toward a specific eye. Therefore, this finding may be incidental.

The present study also examined the relationship between preoperative astigmatism and the horizontal size of the pterygium, measured from the limbus to its head. A significant increase in preoperative astigmatism was observed with larger pterygia. Specifically, the mean astigmatism associated with a 4 mm pterygium (4.2±0.20 D) was significantly higher (p=0.017) than that caused by a 3 mm pterygium (3.21±0.12 D), while the latter induced significantly more astigmatism than a 2 mm pterygium (1.38±0.25 D).

These findings are in agreement with the study by Seitz et al who evaluated the impact of pterygium's head-limbus distance and limbal base length on anterior corneal curvature and visual acuity, concluding that a greater horizontal extension leads to increased corneal astigmatism.[16] Maheshwari et al similarly found a direct correlation between pterygium size and induced astigmatism.[17] Furthermore Salih et al investigated the relationship between pterygium extension, width, and total area with corneal astigmatism, identifying horizontal extension as the most significant contributor to astigmatism.[18] The findings of the present study are in concordance with these observations, further reinforcing the association between pterygium size and corneal curvature distortion.

In the postoperative period, corneal astigmatism progressively decreased over the first month, after which no significant changes were observed. Furthermore, the type of graft used did not significantly influence the reduction in corneal astigmatism. Yaycioglu et al reported that postoperative astigmatism was directly correlated with preoperative astigmatism, with the degree of change being primarily dependent on the preoperative size of the pterygium rather than the type of graft used.[19] Similarly, Makkar et al observed a decrease of 0.18 D in astigmatism in the amniotic membrane group and a corresponding increase of 0.18 D in the conjunctival autograft group; however, this difference was not statistically significant.[20]

Patel et al compared wet amniotic membrane graft, conjunctival autograft, and topical mitomycin C in terms of their effectiveness in reducing corneal astigmatism after pterygium excision.[21] While they found a statistically significant reduction in mean corneal astigmatism across all three surgical methods, the changes in astigmatic values did not correlate with the type of surgical technique used. The findings of the present study are consistent with these

previous studies, further reinforcing that graft type does not significantly impact postoperative astigmatic outcomes. In the present study, the recurrence rate following conjunctival autograft was 3%, while the recurrence rate following amniotic membrane graft was 7%. This difference was not statistically significant. Luanratanakorn et al reported a higher recurrence rate with amniotic membrane graft (25%) compared to conjunctival autograft (12.3%).[7] Similarly, Tananuvat et al and Martin et al found a recurrence rate of 40% in the amniotic membrane group, whereas the conjunctival autograft group had a significantly lower recurrence rate of 4%.[22] Conversely, more recent studies by Patil et al, Melmane et al reported an equal recurrence rate of 4% in both groups.[23]

The findings of the present study indicate a slightly higher recurrence rate with the amniotic membrane graft than with the conjunctival autograft; however, this difference was not statistically significant, and the results align with certain previous studies. Regarding postoperative complications, conjunctival hyperemia was observed in 63% of cases in the conjunctival autograft group compared to 26% in the amniotic membrane group, a statistically significant difference (p=0.003). Conjunctival granuloma was found in 3% of cases in the conjunctival autograft group and 10% in the amniotic membrane group, though this difference was not statistically significant (p=0.45).

Additionally, graft edema, subconjunctival hemorrhage, and graft loss were observed in 17%, 7%, and 7% of cases, respectively, in the conjunctival autograft group, compared to 10%, 0%, and 13% in the amniotic membrane group, with none of these differences reaching statistical significance. Patil et al and Melmane et al reported subconjunctival hemorrhage in 20% of cases in the conjunctival autograft group and 12% of cases in the amniotic membrane group, while graft edema was observed in 16% of cases in the conjunctival autograft group but was absent in the amniotic membrane group.[23] No additional complications were reported in their study. Similarly, Kurna et al examined 75 cases of primary pterygium and found no significant difference in postoperative complications between the conjunctival autograft and amniotic membrane groups.[24] The results of the present study regarding postoperative complications are comparable to these previous studies, further supporting the safety profile of both surgical approaches.

CONCLUSION

The present study demonstrated that both conjunctival autograft and amniotic membrane graft are effective in significantly reducing pterygium-induced corneal astigmatism following pterygium excision. The reduction in corneal astigmatism was observed progressively over the first postoperative month, after which no further significant changes were noted. However, the type of graft used did not significantly influence the degree of astigmatic reduction. In terms of postoperative complications, conjunctival hyperemia was significantly more common in the conjunctival autograft group, while other complications, including graft edema, subconjunctival hemorrhage, and graft loss, did not show significant differences between the two groups. These findings are largely consistent with existing literature. Overall, both surgical techniques proved to be viable options for pterygium management, with similar efficacy in reducing astigmatism. The choice of graft may depend on factors such as surgeon preference, availability of graft material, and patient-specific considerations. Further research with larger sample sizes and longer follow-up periods may provide additional insights into the long-term outcomes of these surgical approaches.

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