

A STUDY ON CORNEAL ASTIGMATISM IN PTERYGIUM CASES BEFORE AND AFTER SURGERY

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ABSTRACT

BACKGROUND

Pterygium is a common degenerative condition seen in the Indian subcontinent. One of the indications for pterygium excision is visual impairment due to astigmatism. Several mechanisms have been suggested to explain the induced astigmatism – a) pooling of the tear film at the leading edge of the pterygium, b) mechanical traction exerted by the pterygium on cornea. Hence this study was done retrospectively to assess the effect of pterygium excision on the induced astigmatism.

MATERIALS AND METHODS

Records of patients operated for primary ocular pterygium by pterygium excision with primary conjunctival closure/ conjunctival autograft in the age group 18 - 70 years over a 1-year period were analysed retrospectively. Pre-operative and post-operative follow up records of day 1 and 1st month were analysed for changes in corneal curvature and astigmatism using the recorded Automated Refractometry and Keratometry readings.

RESULTS

Out of the 44 cases analysed retrospectively as 2 groups – pterygium excision with primary conjunctival closure and pterygium excision with conjunctival autograft, majority of them were found to be females (70%), and between 40 - 50 years (90%). Most of the pterygium cases were found to be nasal, and commonly in the right eye and also that the amount of astigmatism increased with the grading of pterygium ($p < .000$). The most common type of astigmatism noted was "with the rule" astigmatism (75%). The percentage of "against the rule" and oblique astigmatism were 9% & 15% respectively.

The decrease in the mean astigmatism after surgery was found to be statistically significant. The difference in t value between the preoperative and one-month postoperative corneal astigmatism was 2.5 D ($p < .018$). Steepening of both horizontal and vertical meridian was found in conjunctival autograft cases, but in simple closure cases steepening was found only in the vertical meridian.

CONCLUSION

To conclude, pterygium leads to a considerable effect on corneal refractive status. The common type of astigmatism seen in patients with pterygium is "with-the rule". There was a positive correlation between the grading of Pterygium and the induced astigmatism. Pterygium surgery effectively decreases this cylindrical error and reverts corneal curvatures towards normality, thus improving subjective visual acuity.

KEYWORDS

Pterygium Excision, Conjunctival Autograft, Simple Closure, Astigmatism, Corneal Curvature.

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BACKGROUND

Pterygium is from the Greek word 'Pterygos' meaning wing. It is a triangular, wing-shaped, degenerative, fibrovascular, hyperplastic proliferative tissue actively growing from the conjunctival limbal area onto the cornea.¹ Pterygia typically develop in the interpalpebral space with a significantly greater number occurring nasally than temporally.²

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The typical pterygium is triangular and made up of cap, head, neck and body.

Higher prevalence rates of pterygium have been reported in high UV-exposure countries. Pterygium has been endemic in the Indian subcontinent. Prevalence of pterygium in the South Indian population is 9.5%.³

Advancing age and male gender have been identified as risk factors for the development of pterygia.⁴ Ultraviolet exposure appears to be an important environmental influence as it causes mutation in P53 tumor suppressor gene in the parental limbal cells and leads to pterygium formation.⁵ Risk of pterygium increased in subjects who worked outdoors.⁶

Pathogenesis - chronic irritation produces chronic inflammatory infiltrate with resultant inflammatory oedema and cell induced angiogenesis. These processes together



with actinic damage are responsible for fibrovascular reaction which characterizes a growing pterygium.⁷

Pterygia developing on the nasal limbus is attributed to reflected sun light focused at this point.⁸

Pterygium induced astigmatism can be the cause of subjective visual complaints like decreased visual acuity, glare etc., It usually causes asymmetric "with the rule astigmatism". Causes may be traction generated by the pterygium mechanically pulling and distorting the cornea, pooling of tears in front of the pterygium or by both.

Astigmatism of ≥ 1 D is often seen when a pterygium encroaches 3.5 mm onto the cornea and visually significant changes occur when pterygium extends into the cornea beyond 45% of the nasal corneal radius or within 3.2 mm of the visual axis.

Indications for Treatment of Pterygium

1. Threatening the visual axis
2. Visual disturbance from astigmatism
3. Eye movement restriction
4. Atypical appearance such as possible dysplasia
5. Reported growth by the patient and progression observed by an ophthalmologist
6. Symptoms of irritation
7. Cosmetic concern

A number of surgical techniques are available. All methods begin with excision and removal of the pterygium from the globe. These techniques then vary in their handling of the conjunctival defect and in the adjunctive measures taken in an attempt to achieve a safe, cosmetically acceptable, and recurrence free procedure. After pterygium excision, simple closure is generally done for smaller conjunctival defects. Free conjunctival autograft is a better technique to prevent recurrence after pterygium surgery. This technique is free from sight threatening complications. Thus, in this study we retrospectively analyse the changes in corneal curvature and astigmatism after pterygium surgery by comparing with pre-operative values.

Aims and Objectives

This study was done retrospectively to find out type of corneal astigmatism produced by pterygium, to find out changes in corneal astigmatism after surgery and to determine the difference in mean corneal curvatures before and after pterygium surgery.

Inclusion Criteria

- Patients with a primary ocular pterygium.
- Age group of 18-70 years.

Exclusion Criteria

- Recurrent pterygium.
- Inflamed pterygium.
- Previous history of corneal disease.
- Previous history of intraocular surgery.
- Eye trauma.
- Contact lens wear.

- Pseudo pterygium.
- Systemic diseases like collagen vascular disorders.

MATERIALS AND METHODS

Records of patients operated for primary ocular pterygium by a single surgeon by the method of pterygium excision with primary conjunctival closure/ conjunctival autograft over a 1-year period were analysed retrospectively. Pre-operative and post-operative follow up records of day 1 and 1st month were analysed for changes in corneal curvature and astigmatism using the recorded Automated Refractometry and Keratometry readings.

The recorded pre-operative parameters were analysed for inclusion and exclusion. Pterygium grading that has been found on slit lamp examination was noted.

Grading of pterygium⁹

- Grade - I = crossing the limbus but not reaching the pupil margin. (<2 mm).
- Grade - II = crossing the limbus and reaching up to the pupil margin (2 – 4 mm).
- Grade - III = reaching beyond the pupil margin (involving the visual axis) (> 4 mm).

Pre-operative corneal astigmatism evaluation was noted. Corneal curvature measurements done preoperatively using automated keratometer were recorded separately for horizontal and vertical meridians.

Then pterygium surgery details regarding whether pterygium excision with primary conjunctival closure or conjunctival auto grafting was done was recorded. The cases operated by a single surgeon were selected to rule out the confounding effect of surgeon factor.

Age, sex, laterality, location of pterygium, pterygium grading, induced astigmatism, astigmatism according to grading, mean k1, k2 values (pre-op and post – op day 1, day 30) documented in the case records were analysed for all cases.

Postop followup records of day 1 and 1 month were analysed for changes in corneal curvature and astigmatism using the Automated Refractometry and Keratometry values.

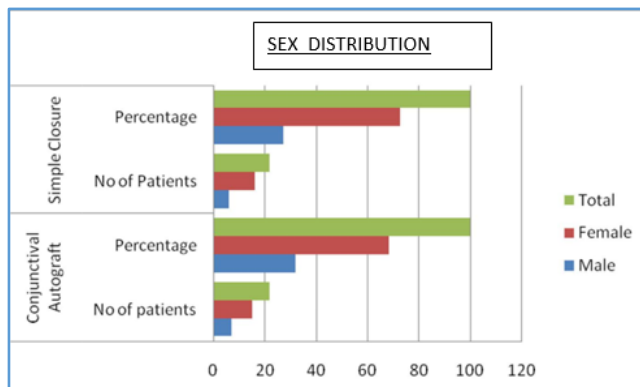
RESULTS

Sex Distribution-

In conjunctival autograft group, out of 22 patients, 68.18% were females. In simple closure group, out of 22 patients, 72.72% were females.

Gender	Conjunctival Autograft		Simple Closure	
	No. of patients	%	No. of Patients	%
Male	7	31.8	6	27.2
Female	15	68.18	16	72.72
Total	22	100	22	100

Table 1. Sex Distribution

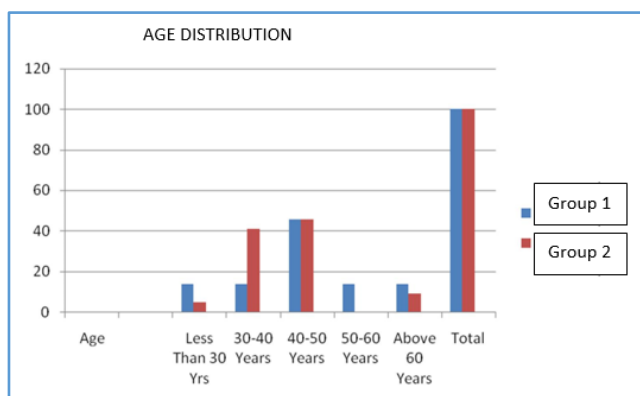


Graph 1. Sex Distribution

Age Distribution- From the patient records, it was observed that among both patient groups who had undergone pterygium excision with conjunctival autograft or simple closure, 45.5% of patients were in the age group of 40-50 years.⁴

Age	Conjunctival Autograft		Simple Closure	
	No. of Patients	%	No. of Patients	%
Less Than 30 Years	3	13.6	1	4.5
30-40 Years	3	13.6	9	40.9
40-50 Years	10	45.5	10	45.5
50-60 Years	3	13.6	0	0
Above 60 Years	3	13.6	2	9.09
Total	22	100	22	100

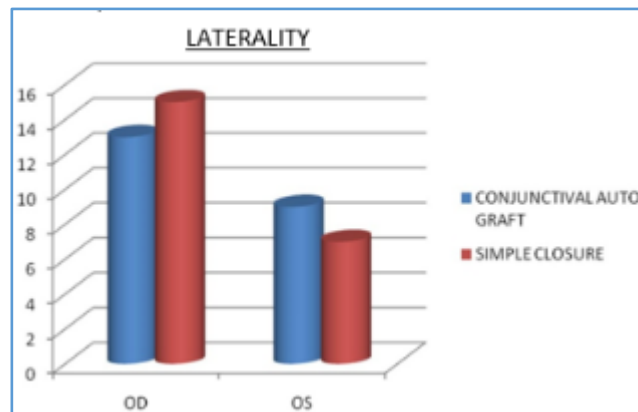
Table 2. Age Distribution



Graph 2. Age Distribution

Laterality	OD	OS
Conjunctival auto graft	13	9
Simple closure	15	7

Table 3. Laterality



Graph 3. Laterality

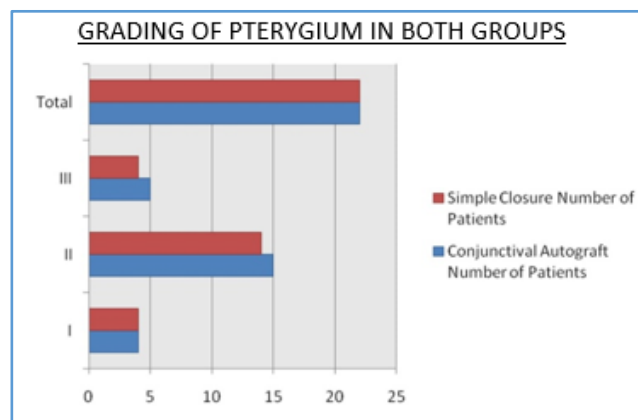
Location	Nasal	Temporal
Conjunctival auto graft	20	2
Simple closure	22	-

Table 4. Location of Pterygium

Above data shows that the predominant site of pterygium was nasal in both the groups (2).

Grading of pterygium	Conjunctival Autograft	Simple Closure
	Number of Patients	Number of Patients
I	2	4
II	15	14
III	5	4
Total	22	22

Table 5. Grading of Pterygium

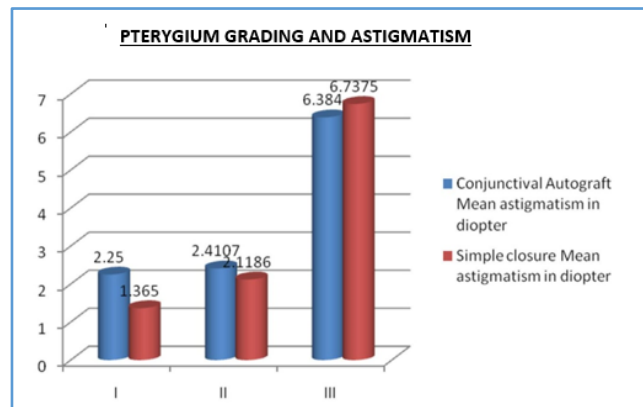


Graph 4. Grading of Pterygium

Above table shows that 2 out of 22 patients in conjunctival autograft group and 4 out of 22 patients in simple closure group belonged to grade I. 15 out of 22 patients in conjunctival autograft group and 14 out of 22 patients in simple closure group belonged to grade II. Remaining 5 patients in conjunctival autograft group and 4 patients in simple closure group belonged to grade III.

Grading of pterygium	Conjunctival Autograft	± SD	Simple Closure	± SD
	Mean Astigmatism in Diopter		Mean Astigmatism in Dioptre	
I	2.250	2.4	1.3650	.422
II	2.4107	1.9	2.1186	.5006
III	6.3840	.881	6.7375	1.639

Table 6. Grading and Astigmatism



Graph 5. Grading and Astigmatism

The above table shows that among the patients who underwent conjunctival autograft, the amount of mean astigmatism pre-operatively in grade I was 2.25 + 2.4 D, grade II was 2.4+ 1.9 D, grade III was 6.38+ .881 D. Among those who underwent simple closure, the amount of mean astigmatism pre-operatively in grade I was 1.36 + .422 D, grade II was 2.11 + .50 D, grade III was 6.73 + .1.6 D. This infers that the amount of astigmatism increased with grading of pterygium in each group (p<.000).⁹

Type of Induced Astigmatism

Type of astigmatism in percentage	Conjunctival Autograft		Simple Closure	
	No. of Patients	Percentage	No. of Patients	Percentage
with the rule	18	81.8 %	15	68.18%
against the rule	3	13.6%	1	4.6%
oblique astigmatism	1	4.6%	6	27.27%
Total	22	100	22	100

Table 7. Type of Astigmatism in Patients Before Undergoing Surgery

In conjunctival autograft group, 81.8% patients had 'with the rule astigmatism', 13.6 % patients had against the rule and 4.6% belonged to oblique astigmatism.

In simple closure group, 68.18% patients had 'with the rule astigmatism', 27.27% patients had oblique astigmatism and 4.5% patients had against the rule astigmatism.

Keratometry Values

Mean K1 and K2 values ± SD - difference in horizontal and vertical meridians between pre-operative and post-operative values within each group.

Keratometry Values	Pre-op	Postop Day 1	Postop 1 month
mean k1 value ± SD (conjunctival autograft)	42.158 ± 1.94	44.098 ± 1.6	44.416 ± 1.41
mean k1 value ± SD (simple closure)	44.867 ± 2.74	44.602 ± 2.05	44.55 ± 2.07
mean k2 value ± SD (conjunctival autograft)	45.554 ± 1.62	46.328 ± 1.82	46.43 ± 1.089
mean k2 value ± SD (simple closure)	47.149 ± 2.91	46.32 ± 1.52	46.05 ± 2.40

Table 8. Keratometry Values

Conjunctival Autograft

K1 Reading - The t value between preoperative K1 D to first postoperative day K1 D was 4.320 (p< 000). The t value between preoperative K1 D to postoperative 1-month K1D was 5.065 (p<.000). The t value between first postoperative K1 D to postoperative 1-month K1D was 1.216 (p=.237).

This shows that there was statistically significant steepening of horizontal meridian after conjunctival autograft.

K2 reading - The t value between preoperative K2 D to first postoperative day K2 D was .2.65 (p<.015). The t value between preoperative K2 D to postoperative 1-month K2 D was 2.52 (p<.019). There was very minimal change between first postoperative K2 D to postoperative 1-month K2 D.

This states that there was statistically significant steepening of vertical curvature after conjunctival autograft.

Simple Closure

K1 reading - The t value between preoperative K1 D to first postoperative day K1D was .437 (p = .637). The t value between preoperative K1 D to postoperative 1-month K1D was .590 (p= .562). The t value between first postoperative day K1 D to postoperative 1-month K1D was .117 (p=.908).

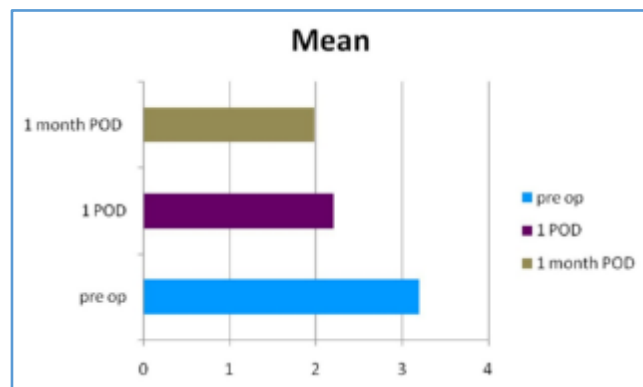
This shows that there was no statistically significant change in horizontal meridian in this group.

K2 reading- The t value between preoperative K2 D to first postoperative day K2 D was 1.51 (p= .144), the t value between preoperative K2 D to postoperative 1-month K2 D was 2.22 (p= .034). The t value between 1st postoperative day K2 D to postoperative 1-month K2 D was 1.317 (p=.202).

This infers that there was statistically significant flattening of vertical curvature, after pterygium excision.

Astigmatism	Number of Patients	Mean	± SD
Pre-op	22	3.2	2.44
1 POD	22	2.2	1.29
1-month POD	22	1.98	1.006

Table 9. Astigmatism in Conjunctival Autograft Group

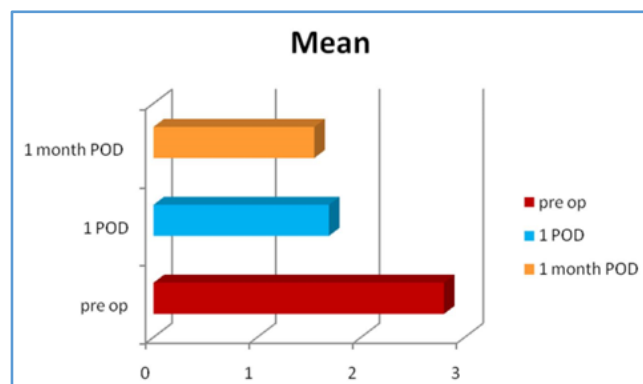


Graph 6. Mean Astigmatism after Conjunctival Autograft

The t value between preoperative corneal astigmatism and corneal astigmatism on first postoperative day was 2.07(p<.051). The t value between preoperative corneal astigmatism and corneal astigmatism on 1-month postoperative day was 2.5 (p <.018). The t value between corneal astigmatism on first postoperative day and corneal astigmatism on 1-month postoperative day was .901 (p=.378). This showed that there was statistically significant decrease of astigmatism post-operatively in this group.

Astigmatism	No. of patients	Mean	± SD
Pre-op	22	2.8	2.05
1 POD	22	1.69	1.34
1-month POD	22	1.55	1.006

Table 10. Astigmatism In Simple Closure Group



Graph 7. Astigmatism after Pterygium Excision and Simple Conjunctival Closure

The t value between preoperative corneal astigmatism and corneal astigmatism on first postoperative day was 2.82 (p<.010). The t value between preoperative corneal astigmatism and corneal astigmatism on 1-month postoperative day was 3.4 (p<.002). The t value between corneal astigmatism on first postoperative day and 1-month postoperative day was .529(p <.602).

This showed that there was statistically significant decrease of astigmatism post operatively in this group also.

DISCUSSION

Pterygium-induced refractive change often leads to visual impairment. A significant degree of corneal astigmatism can be induced by the encroachment of a pterygium onto the cornea. In this study, 44 patients with pterygium who were subjected to two types of surgical procedures were evaluated for corneal astigmatism, corneal curvature changes pre-op and post-operatively.

In this study, we found that out of 22 patients in each study group, 68.18% of study population in the conjunctival auto graft group and 72.72% of patients in the simple closure group were females. With regard to age distribution, 45.5% of patients belonging to both conjunctival auto graft group and the simple closure group were 40-50 years of age. This has positive correlation with previous studies.

Pre-operatively, 81.8% of patients in conjunctival auto graft group and 68% of patients in pterygium excision with simple closure group had 'with the rule astigmatism'.

Results of this study support previous reports that pterygium commonly causes 'with the rule astigmatism. This has positive correlation with the following studies:

Sejal Maheswari study,¹⁰ Hetal Kumar Yagnik et al study,¹¹ Richard G Lindsay and Laurence Sullivand et al study.¹²

This verifies the statement that pterygia press against, flattens the cornea, and thus increases the horizontal diameter of the corneal curvature. The amount of astigmatism increases with the grading of pterygium, in this study (p<.000) which also has a positive correlation with following studies in which same findings were observed.

Muhammad Imran Saleem et al study,¹³ Payman A et al study,¹⁴ Sulman Jaffar et al study,¹⁵ Mohd Yousuf study,¹⁶ Koray Gumus et al study.¹⁷

Corneal Astigmatism

The amount of astigmatic changes from preoperative value to postoperative value is significant in conjunctival auto graft (p<.018) and also in simple closure group (p<.010). It has positive correlation with the following studies.

Mean Astigmatism ± SD	Conjunctival Autograft	Simple Closure	Hetal Kumar Yagnik et al Study	Sejal Maheswari Study 2003	Sejal Maheswari Study 2007	Mohd Yousuf Study
Preop	3.2 ± 2.4D	2.8 ± 2.0	4.22 ± 3.4D	4.6 ± 2.2D	4.40 ± 3.64D	4.32 ± 1.88D
Postop	1.98 ± 1D	1.5 ± 1D	1.08 ± 1.0D	2.2 ± 2.4D	1.55 ± 1.63D	2.11 ± 1.96 D

Table 11. Corneal Astigmatism

This infers that pterygium surgery brings about significant change in astigmatism

Corneal Curvature Changes

There was significant steepening of horizontal curvature post operatively in conjunctival auto graft group (p<.000). There was significant steepening of vertical curvature post operatively in conjunctival auto graft group (p <.015). There was no steepening of horizontal curvature post operatively in simple closure group (p = .908) but there was significant flattening of vertical curvature post operatively in simple closure group (p = .202). This also has positive correlation with previous studies.

Thus, this infers that pterygium surgery brings about significant changes in corneal curvature.

CONCLUSION

To conclude, pterygium leads to a considerable effect on corneal refractive status. Astigmatism seen in patients with pterygium is mostly induced by the pterygium itself and most of the time it is with-the rule astigmatism. Pterygium surgery effectively decreases this cylindrical error and reverts corneal curvatures towards normality, thus improving subjective visual acuity. These findings were noted in both conjunctival autograft group and simple closure groups. This study also showed that the size of pterygium and the amount of astigmatism were directly proportional, and pterygium surgery decreased this astigmatism as well.

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