

ALTERATION IN CORNEAL ASTIGMATISM FOLLOWING PTERYGIUM EXCISION: A PROSPECTIVE INTERVENTIONAL STUDY

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Abstract

Introduction: Pterygium is a prevalent ocular surface disorder characterized by the degeneration of subconjunctival tissue, which proliferates into vascularized granulation tissue, invading the cornea and damaging its superficial layers, all covered by conjunctival epithelium. we assess the changes in corneal astigmatism following Pterygium excision at a tertiary care hospital. **Methodology:** All Patients aged 18 and above, who visited the outpatient department of Ophthalmology with primary Pterygium at our tertiary care hospital between June 2023 and December 2023, were enrolled in their study. Preoperatively evaluations were done and all the patients then underwent Pterygium excision surgery with amniotic membrane grafting under local Anaesthesia, Vicryl 8-0 sutures were applied to secure the graft. All the patients were evaluated on the first day, 1 month, and 3 months During follow up vision, keratometry, and refraction were noted. **Result:** A total of 70 patients were selected for the study, out of these 41 were male (58%) and 29 were female (42%). Most of these patients belonged to the age group ≥ 40 - 60 years (54%). It was also seen in this study that the amount of astigmatism increases as the grade of Pterygium increases in Grade 1 (2.22 ± 0.24 D), Grade 2 (2.65 ± 0.6 D) Grade 3 (3.56 ± 0.62 D), and Grade 4 (8.45 ± 0.85 D). Following Pterygium excision with amniotic membrane grafting there is the significant reduction in mean post-op astigmatism in all the grades. On comparing the pre-operative and post-operative mean corneal curvature at 3-month intervals, there was a slight increase in the vertical meridian (K1) from Pre-op 44.20 ± 1.30 to post-operative 44.05 ± 1.2 and a marked increase in the horizontal meridian (K2) from pre-operative 41.15 ± 1.42 to post-op 42.25 ± 1.65 .

Keywords: Astigmatism, Pterygium, Cornea, Excision, Grading.

INTRODUCTION

Pterygium is a prevalent ocular surface disorder characterized by the degeneration of subconjunctival tissue, which proliferates into vascularized granulation tissue, invading the cornea and damaging its superficial layers, all covered by conjunctival epithelium. It typically occurs most commonly on the nasal side of the interpalpebral fissure. The exact cause of this condition remains unclear, although various factors are believed to play significant roles, including ocular inflammation, disturbances in the tear film, exposure to UV rays, and damage to limbal stem cells. Limbal stem cells are crucial in preventing conjunctivalization and vascularization of the cornea, and their destruction can lead to the formation of Pterygium¹. Therefore, many authors also define Pterygium as a stem cell disorder with pre-malignant features.^{2,3,4,5}

Pterygium formation leads to various changes on the corneal surface, including the destruction of Bowman's layer, fibrovascular ingrowth accompanied by mild inflammatory changes⁶, and alterations in the epithelium, which may remain normal, become thick or thin, and occasionally show signs of dysplasia⁷. As a Pterygium progresses, it can lead to the development of a pigmented iron line known as Stocker's line on the corneal surface⁸. The astigmatism induced by Pterygium, particularly with

the rule astigmatism, causes visual disturbances and a decrease in contrast sensitivity⁹. The causes of astigmatism include mechanical traction exerted by the Pterygium on the cornea resulting in flattening of the cornea in the horizontal meridian, pulling of the tear film at the edges, and the size of the Pterygium itself. Many surgeons have reported a decrease in induced astigmatism following the excision of Pterygium^{9,10,11,12}. Therefore, we assess the changes in corneal astigmatism following Pterygium excision at a tertiary care hospital.

METHODS

All Patients aged 18 and above, who visited the outpatient department of Ophthalmology with primary Pterygium at our tertiary care hospital between June 2023 and December 2023, were enrolled in the study. Approval from the Institutional Ethical Committee (ICE) was obtained before the commencement of the research. Patients with conditions other than primary Pterygium, such as recurrent Pterygium, a history of refractive surgeries, or any other corneal disease, were excluded from the study. Following an explanation of the prognosis regarding Pterygium recurrence and changes in astigmatism, written informed consent was obtained from patients who expressed willingness to participate in the study.

Grading of the Pterygium

It was done based on size and encroachment over the cornea,

1. Grade I denotes encroachment extending to the limbus;
2. Grade II signifies extension reaching the midpoint between the limbus and the pupil;
3. Grade III denotes extension up to the margin of the pupil; and
4. Grade IV indicates extension crossing over the margin of the pupil to the opposite side.

Preoperatively

A comprehensive medical history was meticulously obtained from all patients presenting with Pterygium. A complete ocular examination including visual acuity on Snellen's chart, Slit Lamp examination was done to evaluate the anterior segment, and 90D was done for fundus examination. With an auto refractometer, refractive error was measured and subjective correction was given accordingly corneal curvature was measured with an auto keratometer to evaluate the amount and type of astigmatism.

Postoperatively

All the patients then underwent Pterygium excision surgery with amniotic membrane grafting under local anaesthesia, Vicryl 8-0 sutures were applied to secure the graft. All the patients were evaluated on the first day, 1 month, and 3 months During follow up vision, keratometry, and refraction were noted.

STATISTICAL ANALYSIS

Statistical data were entered into an Excel sheet and analysed using SPSS version 22. Descriptive measures were calculated using percentages or mean (SD). Pre-operative and post-operative differences in values of astigmatism were assessed using tests of significance

RESULT

A total of 70 patients were selected for the study, Out of these 41 were male (58%) and 29 were female (42%) (Table 1) Most of these patients belonged to the age group ≥ 40 - 60 years (54%) (Table 2).

Table 1: Distribution of study subjects according to gender

S.no	Gender	N (%)
1	Female	29(42)
2	Male	41(58)
	Total	70(100)

Table 2: Distribution of study subjects according to Age

S.no	Age group	N (%)
1	< 20	1(2)
2	≥ 20 -40	13(18)
3	≥ 40 -60	38(54)
4	≥ 60	18(26)
	Total	70(100)

The majority of patients were found to have grade II Pterygium, accounting for approximately 42% of the total sample. On the other hand, the least common occurrence was observed in grade IV Pterygium, which only represented about 6% of the total sample. (Table 3)

Table 3: Distribution of case according to Pterygium Grading

S.no	Grade of Pterygium	N (%)
1	Grade 1	08(12)
2	Grade 2	29(42)
3	Grade 3	28(40)
4	Grade 4	04(6)
	Total	70(100)

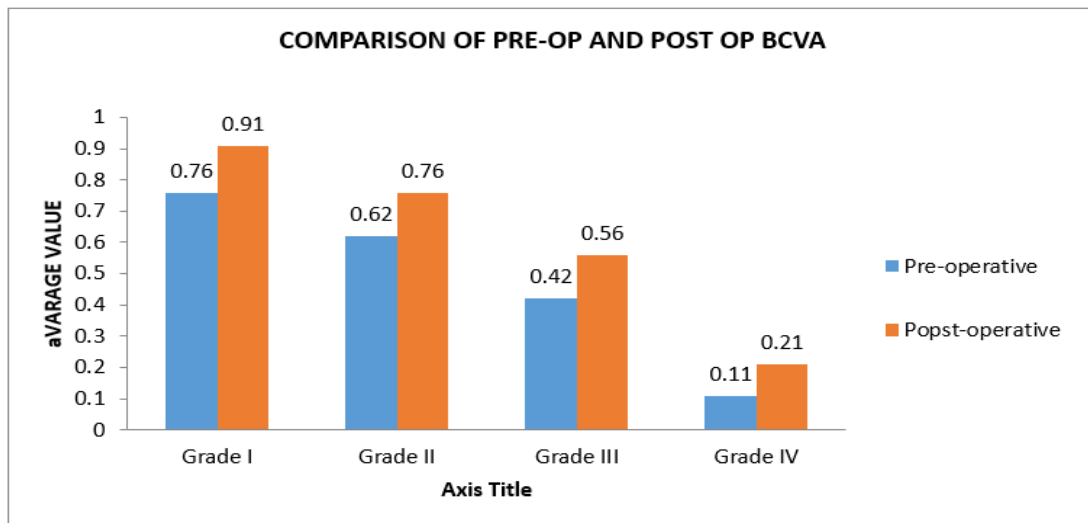
The pre and post-operative Best Corrected Visual Acuity were compared after 3 months following Pterygium excision. The pre-operative mean visual acuity of 0.52 ± 0.25 ($P < 0.0014$) was significantly improved to 0.65 ± 0.22 ($P < 0.0014$) (Table no. 4). The visual acuity also showed significant improvement in all the grades of Pterygium postoperatively (fig 1)

Table 4: Mean BCVA following Pterygium excision

Pre-operative Mean \pm SD	Post-operative Mean \pm SD	P- Value
0.52 ± 0.25	0.65 ± 0.22	0.0014

BCVA - Best corrected visual acuity

Fig 1: Comparison of pre and post-operative BCVA

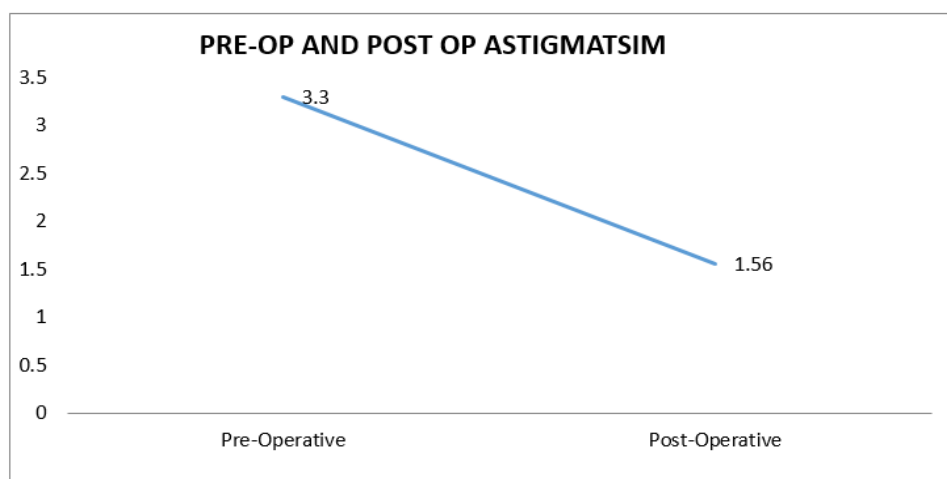


It was also seen in this study that the amount of astigmatism increases as the grade of Pterygium increases in Grade 1 (2.22 ± 0.24 D), Grade 2 (2.65 ± 0.6 D) Grade 3 (3.56 ± 0.62 D), and Grade 4 (8.45 ± 0.85 D). Following Pterygium excision with amniotic membrane grafting there is the significant reduction in mean post-op astigmatism in all the grades: Grade I (1.04 ± 0.28 D), Grade II (1.18 ± 0.4 D), Grade III (1.57 ± 0.06 D), Grade IV (4.6 ± 0.7 D) (Table no. 5) The pre-operative mean corneal astigmatism of 3.3 ± 1.52 D ($P < 0.0001$) was reduced to 1.56 ± 0.98 D ($P < 0.0001$) after 3 months (Fig 2).

Table 5: Grade-wise association of Pre and Post-operative Astigmatism in diopter

S.no	Grade of Pterygium	Pre-operative Mean \pm SD	Post-operative Mean \pm SD	P- Value
1	Grade I	2.22 ± 0.24	1.04 ± 0.285	<0.0001
2	Grade II	2.65 ± 0.6	1.18 ± 0.44	<0.0001
3	Grade III	3.56 ± 0.62	1.57 ± 0.67	<0.0001
4	Grade IV	8.45 ± 0.85	4.62 ± 0.76	<0.0001

Fig 2: Comparison of mean Pre and Post-operative astigmatism in Diopter



On comparing the pre-operative and post-operative mean corneal curvature at 3-month intervals, there was a slight increase in the vertical meridian (K1) from Pre-op 44.20 ± 1.30 to post-op 44.05 ± 1.2 and a marked increase in the horizontal meridian (K2) from pre-op 41.15 ± 1.42 to post-op 42.25 ± 1.65 (table-6).

Table 6: Association of Pre and post-operative mean cornea curvature

Corneal curvature	Pre-operative Mean ± SD	Post-operative Mean ± SD	P- Value
K1 (Vertical meridian)	44.20 ± 1.30	44.05 ± 1.2	<0.0001
K2 (Horizontal Meridian)	41.15 ± 1.42	42.25 ± 1.65	<0.0001
Mean K	42.60 ± 1.12	43.58 ± 1.26	<0.0001

DISCUSSION

Pterygium is a degenerative condition that not only causes cosmetic disfigurement but also causes visual impairment due to corneal distortion leading to a significant amount of astigmatism.^{13,14,15}

The exact mechanism of changes in the corneal curvature leading to horizontal flattening of the cornea is still unclear but many postulates suggest that it is either due to mechanical traction on the cornea¹⁶ or formation of tear meniscus at the apex of Pterygium^{17,18} resulting in with the rule astigmatism.

Lin and Stern¹⁹ found a significant correlation between the Pterygium size and corneal astigmatism. Surgery is the prime treatment of Pterygium.

Visual acuity can be successfully improved with Pterygium excision as it decreases the induced astigmatism. In our study, we found that there was a significant improvement in visual acuity from 0.52 ± 0.25 (P < 0.0014) to 0.65 ± 0.22 (P < 0.0014) after Pterygium excision which was similar to the study done by Maheshwari et al²⁰ who found that the mean visual acuity preoperatively was 0.53 ± 0.35 D which improved to 0.68 ± 0.34 D (P = 0.001) postoperatively.

Numerous studies have substantiated that after Pterygium excision there is a significant reduction in mean corneal astigmatism.

According to Garg et al⁹ they found that the preoperative mean astigmatism of 3.47 ± 1.74 D was significantly (P < 0.0001) reduced to 1.10 ± 0.78 D postoperatively.

Similarly, a study done by Mohite et al²¹ also noted the reduction in astigmatism from 3.046 ± 1.20 D to 1.486 ± 0.63D (P < 0.0001). All these results are also comparable to our study in which we found The pre-operative mean corneal astigmatism of 3.3 ± 1.52 D (P < 0.0001) was reduced to 1.56 ± 0.98 D (P < 0.0001) after 3 months

The size and grade of Pterygium also play an important role in determining the amount of induced astigmatism. Lin and Stern¹⁹ identified a noteworthy association between the size of the Pterygium and corneal astigmatism. Their findings indicated that Pterygiums induce substantial levels of astigmatism when their size exceeds 45% of the corneal radius.

Seitz et al²² concluded that as the Pterygium size extends beyond 2.5mm, there is a corresponding increase in astigmatism.

Tomidokoro et al¹³ noted that larger pterygia unfavourably influenced corneal astigmatism, as well as precipitating asymmetry and irregularity in the corneal topography

A significant correlation between the size of the Pterygium and induced corneal astigmatism was also found in a study done by Gumus et al²³

In the study done by Garg et al⁹, they found that the mean astigmatism was higher in higher grades of Pterygium the Preoperative mean astigmatism in their study was 2.19 ± 0.50 D in grade II Pterygium and 6.50 ± 0.61 D in grade IV Pterygium.

In our study we also found that the amount of astigmatism increases with the grade of Pterygium, the mean pre-operative astigmatism in Grade II was 2.65 ± 0.6 , Grade III was 3.56 ± 0.62 and Grade IV was 8.4 ± 0.85 .

Likewise, a reduction in postoperative astigmatism was also observed among the patients after the surgical intervention.

CONCLUSION

In our study, we found that with the increase in the grading of Pterygium the corneal curvature changes horizontally leading to the rule astigmatism, which causes significant visual impairment to the patients. There is a direct relation between the size of Pterygium and with change in the curvature of the cornea leading to induced astigmatism. In our research, we also discovered that employing the proper technique for Pterygium excision combined with amniotic membrane transplantation not only lowers the likelihood of recurrence but also reduces the morbidity associated with corneal astigmatism. While there may not be a substantial improvement in visual acuity, patients with Pterygium experience a significant enhancement in the quality of their vision. A more robust conclusion could be drawn with a larger sample size.

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Conflict Of Interest- Nil

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