Original Article

Decision making in pterygium surgery: Our experience noting the length of pterygium

ABSTRACT

Background: This is a prospective study which aims: To compare the preoperative and postoperative corneal astigmatism in patients undergoing pterygium excision by conjunctival autograft technique using autologous blood. To determine the correlation of pterygium length with preoperative and postoperative corneal astigmatism and thus ascertain an early indication for pterygium surgery. **Materials and methods:** 75 patients with primary pterygia were evaluated after dividing them into three groups based on length, Grade A - < 2mm, Grade B - 2 – 4mm and Grade C - > 4mm. Preoperative and postoperative corneal astigmatism were compared between the three groups using autorefraction and keratometer readings. Postoperative astigmatism was recorded on three visits – day 7, day 28 and third month. **Statistical analysis:** Statistical Package for Social Sciences (SPSS) version 19.0 for windows was used. Spearman's rank order (ρ) was calculated to observe correlation of pterygium length with the preoperative and postoperative corneal astigmatism. A p-value < 0.05 was considered statistically significant. **Results:** The mean length of the pterygium was 2.77 ± 0.12mm. Majority had with – the – rule astigmatism (64%). Postoperatively mean uncorrected visual acuity (UCVA) increased significantly from 0.533 ± 0.03 to 0.78 ± 0.03 ($P < 0.0001$). Preoperative mean keratometric astigmatism of 2.55 ± 0.36D significantly decreased to 1.213 ± 0.20D postoperatively ($r = 0.89$, $P < 0.0001$). A positive correlation between the length of pterygium and both preoperative ($\rho = 0.68$, $P < 0.001$) and postoperative ($\rho = 0.53$, $P < 0.001$) corneal astigmatism was observed. **Conclusion:** The increase in the length of pterygium significantly correlated with the degree of preoperative corneal astigmatism. The evidence of significant improvement in visual acuity and decrease in pterygium induced corneal astigmatism was observed three months postoperatively by conjunctival autograft technique with autologous blood. Hence, pterygium induced corneal astigmatism of length > 2mm is an early indication for surgical intervention.

Keywords: Conjunctival autograft, corneal astigmatism, keratometry, pterygium

INTRODUCTION

Pterygium is a degenerative and hyperplastic process in which bulbar conjunctiva actively invades the cornea.[1] Clinically pterygium appears as a wing-shaped, vascular, and fleshy growth of conjunctiva encroaching onto the cornea on either side within the palpebral fissure.

Epidemiological studies worldwide have shown that the prevalence rates of pterygium range from 0.3%–37.46%. Pterygium is a very common degenerative condition seen in the Indian subcontinent with a prevalence of 5.2%. Pterygia cause corneal distortion and induce a significant amount of astigmatism which has been previously measured in various studies by refraction and keratometry.[2,3] This astigmatism may occur either due to pooling of tears ahead of the pterygium or by traction generated by the pterygium mechanically pulling on and distorting the cornea in the horizontal meridian.[4] The induced astigmatism (with-the-rule astigmatism) may become significant to cause visual distortion or dimness, even when

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the pterygium remains distant from the visual axis. Pterygia are more commonly seen in tropical climates and most of them develop on the nasal limbus thus implicating direct sunlight and ultraviolet radiation as aggravating factors.[5-7]

Pterygium excision surgeries using amniotic membrane graft and conjunctival autograft are better surgical techniques than bare sclera as far as reducing astigmatism is concerned.[8] Although its effect on corneal curvature and visual acuity has been recognized and many surgical techniques described for the same, not much attention has been given to the relief of astigmatism by early surgical treatment. Although many studies have correlated the size of pterygium with preoperative astigmatism, only few have attempted to determine the influence of the pterygium length on postoperative corneal astigmatism with conjunctival autograft technique without suture and glue.

In the present study, an attempt is made to determine the correlation between length of the pterygium on preoperative as well as postoperative astigmatism with conjunctival autograft technique, and to know whether corneal astigmatism is an early indication for surgical intervention. Kampitak suggests that a pterygium exceeding 2.25 mm of length should be considered within the limits of surgery.[9] On the contrary, Oner *et al*. recommended that pterygia whose length exceeds 3 mm should be considered within the limits of surgery.[10]

Aims and objectives

1. To compare the preoperative and postoperative corneal astigmatism in patients undergoing pterygium excision
2. To determine the correlation between length of pterygium on preoperative and postoperative astigmatism
3. To know whether corneal astigmatism is an early indication for surgical intervention.

MATERIALS AND METHODS

This cross-sectional study was conducted at the Ophthalmology Department of a tertiary care hospital. Seventy-five eyes of 75 patients with primary pterygium were included in this study. The duration of study was 1 year. This study was approved by the institutional review board.

Inclusion criteria

Patients aged 25–65 years with primary nasal pterygium:

1. Consenting for surgery
2. With constant irritation
3. For cosmetic reasons
4. Encroaching the visual axis inducing visually significant astigmatism.

Exclusion criteria

1. Pseudopterygium, recurrent pterygium
2. Postoperative graft dislocation
3. Cataract
4. Glaucoma
5. Corneal opacity
6. Macular degeneration
7. History of trauma to the eye
8. Previous surgical intervention to the eye.

Sample size

The prevalence of pterygium in India is estimated to be 5.2% considering 95% confidence interval and 5% permissible error, sample size was calculated to be 75 cases.

A written informed consent was obtained from all patients. After obtaining ocular and systemic history, ocular examination was done which included Snellen's uncorrected visual acuity (UCVA) (in decimal), objective refraction, keratometry, and slit-lamp examination. The length of the pterygium was measured using the Haag-Streit slit-lamp biomicroscope by projecting a horizontal slit beam from the limbus to the apex of the pterygium and recording the length in millimeters, and the cases were divided into three groups:[11]

- Group A – <2 mm
- Group B – 2–4 mm and
- Group C – above 4.0 mm.

Manual keratometry (Bausch and Lomb) and objective refraction with Canon Auto-refractokeratometer were done in all patients.

All surgeries were performed by the same surgeon and a free conjunctival autograft was placed with no glue and no suture technique in all cases. Under local anesthesia, the pterygium head was dissected from its corneal edge till the limbus, separated with blunt dissection from the underlying sclera and overlying bulbar conjunctiva till the insertion of the medial rectus muscle. Then, the pterygium was excised along with its accompanying tenon's fascia. The bare sclera defect was measured with calipers and a free limbal conjunctival graft was harvested from the superotemporal conjunctiva of the same eye and placed on the bare sclera with no sutures or glue. Adherence of the graft was achieved through natural hemostasis. Ciprofloxacin with dexamethasone ointment was applied and the eye was padded.

The eye pad was removed on the first postoperative day and the graft was checked for its adherence. Ciprofloxacin with dexamethasone eye drops four times daily was prescribed for 4 weeks and tapered weekly. All the patients were

followed – up on day 7, 1st month–3rd month. Keratometric data, refraction, and UCVA (in decimal) were obtained on all the follow-ups.

Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS) version 19.0 for windows (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp. IBM Corp. Released 2011). Descriptive statistics were used to describe the clinic-demographic data. Preoperative and 3rd month postoperative astigmatism by keratometry were compared using the paired *t*-test. Alpins astigmatism analysis was used to calculate target-induced astigmatism (TIA) and difference vectors (DVs).[12] Spearman's rank order (ρ) was calculated to observe correlation of pterygium size with the preoperative and postoperative corneal astigmatism. A $P < 0.05$ was considered statistically significant.

RESULTS

The 75 eyes of 75 patients selected were divided into three groups based on the length of pterygium. Most of the patients (27%) belonged to the age group of 46–65 years with a mean age of 47 ± 12 years. Females constituted 75% of cases while 25% of cases were males. The prevalence of pterygium was found to be more among the agriculturists (54%), followed by laborer's (29%); both belong to the outdoor occupation group.

The length of the pterygium varied between 1.25 mm and 6 mm and the mean length was 2.76 ± 0.12 mm. All eyes had nasal primary pterygia of which Group A had 12 eyes (13%), Group B had 52 eyes (71%), and Group C – 11 eyes (16%), respectively.

It was observed that Group A had an improvement in UCVA of one line after surgery ($P < 0.05$). In Group B, the preoperative mean UCVA of 0.52 ± 0.06 improved to 0.798 ± 0.06 ($P < 0.0001$) postoperatively, which corresponds to 1–2 lines of Snellen's visual acuity. Group C showed a preoperative UCVA of 0.33 ± 0.14 which significantly improved to 0.57 ± 0.18 ($P < 0.0001$) postoperatively (3rd month), indicating 2–3 lines improvement in Snellen's visual acuity [Table 1]. Preoperative analysis of pterygium showed that 64% (48 cases) had with-the-rule astigmatism, 20% (15 cases) had oblique astigmatism, and 16% (12 cases) had against-the-rule astigmatism.

The mean preoperative corneal astigmatism of the study group using keratometry was 2.55 ± 0.364 D which significantly

Table 1: Comparison of Pre and Postoperative Uncorrected visual acuity (in Decimal) in relation to pterygium size

Group	Length of Pterygium (mm)	Uncorrected Visual Acuity (UCVA) (mean±SD)		Improvement in Snellen's	*P*
		Preoperative	Postoperative (3rd month)		
A	<2 mm	0.7666±0.080	0.875±0.0445	1 line	<0.05
B	2-4 mm	0.5221±0.0300	0.7980±0.0280	1 to 2 lines	<0.0001
C	> 4 mm	0.3318±0.0626	0.572±0.0810	2 to 3 lines	<0.0001

Table 2: Comparison of Pre and Post - operative Corneal Astigmatism (in Diopter) with the Grade of Pterygium

Group	Preoperative Keratometric astigmatism	Postoperative Keratometric astigmatism	Reduction (mean±SD)	Paired *t* - test	Pearson's correlation (*r*)	*P*
A	1±0.213 D	0.4791±0.0782D	0.4791±0.1582D	3.17	0.74	<0.05
B	2.197±0.353D	0.9182±0.128D	1.283±0.2504D	5.1	0.86	<0.0001
C	5.909±1.483D	3.409±1.0608D	2.5±0.579D	4.31	0.95	<0.001

Table 3: Refractive astigmatism as measured by autorefractometer

Group	Preoperative astigmatism (mean±SD)	Postoperative astigmatism (mean±SD)	Reduction (mean±SD)	Paired *t* - test	Pearson's correlation (*r*)	*P*
A	1.0416±0.197	0.5±0.075	0.542±0.159	3.398	0.64	<0.05
B	2.381±0.3350	0.903±0.1292	1.490±0.265	5.540	0.67	<0.0001
C	6.204±0.9455	2.272±0.6100	3.931±0.617	6.362	0.77	<0.0001

Table 4: Correlation between pterygium length and preoperative and postoperative corneal astigmatism (*n*=75)

Pterygium length (mm)	Preoperative corneal astigmatism	Postoperative corneal astigmatism (3 months)	Spearman's rank order (ρ) - Preoperative	Spearman's rank order (ρ) - Postoperative	*P*
2.76±0.12	2.55±0.364	1.21±0.2044	0.680	0.53	0

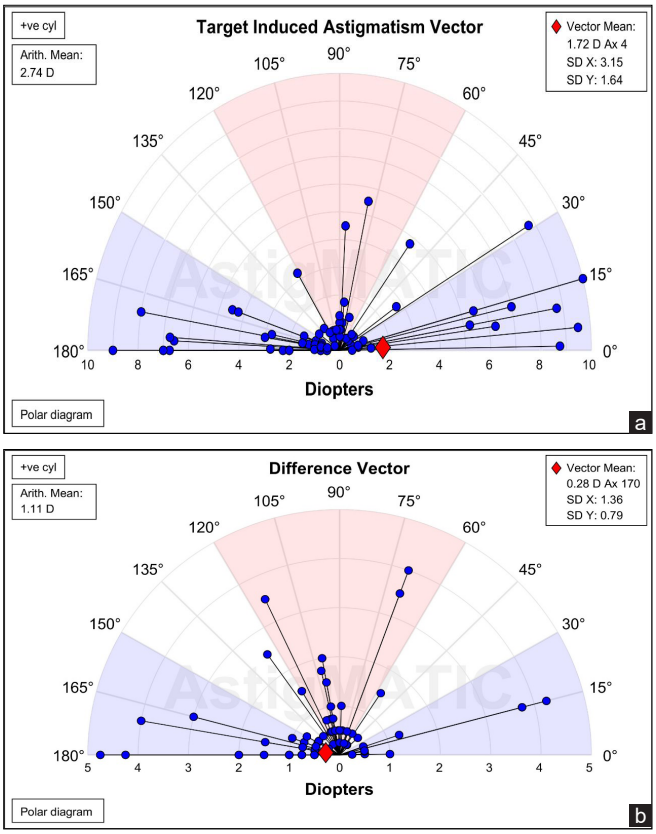

Figure 1: Alpins single-angle plots for the total study population (n=75 eyes). Target-induced astigmatism (TIA, a) and difference vector (DV, b) arithmetic and vector means are shown. Images generated by AstigMATIC Software

reduced to 1.21 ± 0.204 D ($P < 0.0001$) 3 months after surgery. The mean preoperative astigmatism was 1 ± 0.213 D, 2.197 ± 0.353 D, and 5.9 ± 1.483 D in Groups A, B, and C, respectively which indicates the amount of corneal astigmatism induced by pterygium increases with the increase in length of pterygium. The mean postoperative astigmatism at 3rd month in Groups A, B, and C were 0.479 ± 0.078 D ($P < 0.05$), 0.918 ± 0.128 D ($P < 0.0001$), and 3.41 ± 1.060 D ($P < 0.001$), respectively. Thus, a significant reduction in corneal astigmatism was seen 3 months after surgery more significantly in Groups B and C [Table 2]. It was observed that the mean preoperative refractive cylinder of 2.76 ± 0.33D as measured by autorefractometry reduced to 1.093 ± 0.12 D ($P < 0.0001$) postoperatively, which was statistically significant as in Table 3. TIA and DV between preoperative and 3 months postoperatively refractive astigmatism was calculated using Alpins single – Angle plots with AstigMATIC software (AstigMATIC is programmed in MATLAB R2018a (Mathworks Inc., Natick, MA, USA)) [Figure 1].

A statistically significant positive correlation was seen between the length of the pterygium and both preoperative ($\rho = 0.680, P < 0.0001$) and postoperative ($\rho = 0.53, P < 0.0001$) corneal astigmatism [Table 4].

DISCUSSION

Pterygium is a degenerative condition of the subconjunctival tissues which proliferates as vascularized granulation tissue to invade the cornea, destroying the superficial layers of the stroma and Bowman's membrane. It is more common in dry sunny climates, ultraviolet light being an etiological factor. The working hypothesis is that Ultraviolet (UV) radiation causes mutations in the p53 tumor suppressor gene, thus facilitating the abnormal proliferation of limbal epithelium.[7,13] As the disease progresses, the lesion increases in size and becomes more apparent to the naked eye and cosmetically unpleasant for the patient. Further growth may cause diminished vision due to induced astigmatism or direct encroachment onto the visual axis.

In our study, pterygia were more common in the age group of 46–65 years (27%). Females (75%) outnumbered males (25%) probably because they seek surgical intervention for cosmetic reasons. More cases were reported among the farmers and laborers which are in accordance with other studies and shows association with ultraviolet light exposure, low humidity, and dust.[5]

Avisar *et al*. observed 94 eyes with unilateral primary pterygium of different sizes. They found significant astigmatism in 16.6% with pterygium of 0.2–1 mm size, 45.45% in 1.1–3 mm size, and 100% in 5.1–6.7 mm in size. They suggested early surgical intervention in lesions >1 mm size from the limbus.[14] In our study, all eyes had nasal primary pterygia with a mean size of 2.7 ± 0.12 mm, of which Group A (<2 mm) had 12 eyes (13%), Group B (2–4 mm) had 52 eyes (71%), and Group C (>4 mm) had 11 eyes (16%), respectively.

Pterygia cause corneal distortion which results in with-the-rule astigmatism more often due to flattening of horizontal meridian.[15] However, against-the-rule and oblique astigmatism have also been recorded in patients with pterygia.[16] In our study, preoperatively 48 cases (64%) had with-the-rule astigmatism which confirms the finding as in previous studies.

The mean preoperative UCVA of 0.52 ± 0.06D and 0.33 ± 0.14D in Groups B and C significantly improved at 3rd month postoperatively by 0.798 ± 0.06D and 0.57 ± 0.18D ($P < 0.0001$). The UCVA remained the same in Group A with $\rho = 0.023$ which indicates less correlation between astigmatism induced by Grade I pterygia and UCVA. It is also observed that as the length of the pterygium increases, the mean UCVA decreases. These observations were comparable with the studies carried out by Maheshwari and Dr. Anwar hussain *et al*.[2,15]

A study by Lin and Stern showed a significant correlation between the pterygium length and corneal astigmatism, they reported significant degrees of induced corneal astigmatism seen in pterygium once it exceeded >45% of the radius of cornea or within 3.2 mm of the visual axis.[16] As Keratometry measures, only the central cornea and peripheral cornea is ignored, more erroneous results are seen in eyes with pterygium. Hence, computerized videokeratography remains the best tool for evaluating corneal astigmatism which was a limitation in our study.[17]

Hanson and Norn reported that pterygium >3.0 mm induced 1.97D of astigmatism versus 1.11D in <3 mm.[18] Kampitak reported a 2 D or more of astigmatism with length >2.25 mm.[9] Recently, Jaffar *et al*. found a strong correlation with a mean length of 2.84 ± 0.557 mm and inducing a 3.46 ± 1.441 D ($P = 0.01$) of astigmatism.[19] Similar observation was made in this study, where Groups B and C had preoperative astigmatism of 2.197 ± 0.71 D, and 5.9 ± 3.305 D, respectively compared to Group A which had 1 ± 0.469 D of corneal astigmatism. This proves that pterygia of length <2 mm induces less astigmatism compared to those of 2 mm–>4 mm.

Pterygium surgery significantly reduces corneal astigmatism.[20] There was a significant reduction of corneal astigmatism 3 months postoperatively after pterygium excision with conjunctival autograft. The difference between pre and postoperative astigmatism was 0.4791 ± 0.1582D in Group A, while it was 1.283 ± 0.2504D–2.5 ± 0.579D in Groups B and C respectively, the difference being statistically significant ($P < 0.0001$).

Mohammad-Salih and Sharif reported that the pterygium length has a stronger correlation with corneal astigmatism than does width.[21] Han *et al*. multivariate analysis revealed that only the length of pterygium was a significant predictive factor of pterygium-induced astigmatism.[22] In our study, a positive correlation between the pterygium length and preoperative ($\rho = 0.68$, $P < 0.0001$) and postoperative ($\rho = 0.53$, $P < 0.0001$) corneal astigmatism 3 months after surgery was observed. Patients requiring cataract surgery with Grade I, atrophic and nonprogressive pterygium can undergo cataract surgery directly.[2] However, Grade II pterygium or larger significantly affects the refractive component of the cornea leading to erroneous intraocular lens power calculation and postcataract refractive surprise. Hence, it is preferable to undergo pterygium excision before undertaking cataract surgery in such patients. By time-course analysis, cornea has been shown to stabilize 1 month after pterygium surgery.

CONCLUSIONS

Primary pterygium of more than 2.0 mm in length from the limbus, induces with-the-rule astigmatism (>2.55 ± 0.364 diopters). This significant astigmatism increases with the increase in length of the pterygium. A positive correlation between the pterygium length and preoperative ($\rho = 0.68$, $P < 0.0001$) and postoperative ($\rho = 0.53$, $P < 0.0001$) corneal astigmatism 3 months after surgery was observed. Keratometric astigmatism shows improvement or reduction 3 months after pterygium excision by conjunctival autograft technique with autologous blood. The findings in this study suggest an early surgical pterygium removal is indicated for pterygia of length >2 mm from the limbus.

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Conflicts of interest

There are no conflicts of interest.

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