ANALYSIS OF CORNEAL ASTIGMATISM BEFORE AND AFTER PTERYGIUM SURGERY- A PROSPECTIVE STUDY IN PATIENTS ATTENDING KIMS, HUBLI

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ABSTRACT

BACKGROUND

Pterygium is a very common degenerative condition seen in Indian subcontinent. It is a wing-shaped fibrovascular encroaching up on the cornea from either sides. The prevalence rate is 5.2%. Pterygium is known to affect refractive astigmatism. The induced astigmatism may become significant to cause visual distortion, even though the pterygium remains distant from visual axis induced astigmatism maybe either "with-the-rule" or "against-the-rule."

The aim of the study is to-

1. Compare preoperative with postoperative astigmatism in case of pterygium.
2. Assess the amount of astigmatism in case of pterygia of different lengths measured from the limbus over the cornea.

MATERIALS AND METHODS

The study included 70 eyes of 70 patients with primary pterygium. Preoperative evaluation included pterygium size, visual acuity, keratometry and refraction with subjective correction. Patients included in the study were divided into three groups based on length of pterygium encroaching on cornea (1 to 2 mm, 2 to 3 mm, >3 mm). Each eye underwent bare sclera pterygium excision. Postoperative visual acuity, keratometry and refraction were evaluated on 1st day, at the end of 1st week, 4th week and 9th week. The pre and postoperative results were compared and analysed.

RESULTS

An average of all 70 cases with mean pterygium length 3.2 mm had a mean keratometry astigmatism of 1.84 ± 0.89D preoperatively and 0.514 ± 0.52D postoperatively indicating a reduction of pterygium-induced corneal astigmatism by 1.45 ± 0.77D (p value <0.0001), which was statistically significant.

CONCLUSION

Pterygium-induced corneal astigmatism is directly proportional to the size of the pterygium. Thus, early surgical excision reduces the corneal astigmatism, and hence, improves the visual acuity.

KEYWORDS

Pterygium, Astigmatism, Refractive Error, Asthenopia, Keratometry.

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BACKGROUND

Pterygium is a wing-shaped fibrovascular structure encroaching upon the cornea from either sides. The prevalence rate is 5.2%. It is a very common subconjunctival degenerative condition. The induced astigmatism may become significant to cause visual distortion, even though the pterygium remains distant from visual axis induced astigmatism maybe either "with-the-rule" or "against-the-rule."

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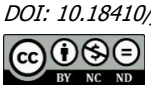

Pterygium induced with-the-rule astigmatism is hemimeridonal on the side of pterygium resulting in a localised flattening of cornea central to leading apex. Early surgical intervention can therefore reduce the effects of corneal morbidity due to pterygium-induced corneal and visual disturbance arising from the encroachment of the pterygium into visual axis[1] surgical intervention leads to reduction of astigmatism with significant improvement in vision.

Aims and Objectives

1. To compare preoperative with postoperative astigmatism in case of pterygium.
2. To assess the amount of astigmatism in case of pterygia of different lengths measured from the limbus over the cornea.

MATERIALS AND METHODS

1. The study included 70 eyes of 70 patients with primary pterygium. Preoperative evaluation included pterygium size, visual acuity, keratometry and refraction with subjective correction.
2. Patients included in the study were divided into three groups based on length of pterygium encroaching on cornea (1 to 2 mm, 2 to 3 mm, >3 mm). Each eye underwent bare sclera pterygium excision.
3. Postoperative visual acuity, keratometry and refraction were evaluated on 1st day, at the end of 1st week, 4th week and 9th week. The pre and postoperative results were compared and analysed.

Setting of the Study- It is a prospective study conducted in the Department of Ophthalmology at Karnataka Institute of Medical Sciences, Hubli.

Sample Size- The study included 70 eyes of primary pterygium.

Inclusion Criteria

Patients attending the Outpatient Department of Ophthalmology at KIMS, Hubli, who were diagnosed having pterygium with one or more of the following indications and willing to undergo surgery were included.

- Visual loss from proximity to visual axis.
- Threatening the visual axis.
- Visual loss from astigmatism.
- Eye movement restriction.
- Atypical appearance such as possible dysplasia.
- Symptoms of irritation.
- Cosmetic concerns.

Exclusion Criteria

Patients with-

- Pseudopterygium.
- Cataract.
- Glaucoma.
- Corneal opacity.
- Macular degeneration.
- History of trauma to eye.
- Previous surgical intervention to eye.

Preoperative Evaluation

General Examination

Local Examination-

1. Visual acuity using Snellen's chart. Distant vision, pinhole improvement and near vision were recorded.
2. Anterior and posterior segment examination was done to rule out any other pathology accounting for visual loss.
3. Specific examination of the pterygium was done including side (right eye/left eye), position (nasal/temporal/double headed) and nature of growth (progressive/non-progressive).
4. Length of pterygium encroaching on cornea beyond limbus was measured and divided into three groups.
5. The amount of corneal curvature was measured by keratometry and astigmatism by refraction with subjective correction.

Postoperative Treatment- Antibiotic steroid combination eye drops and lubricating eye drops were advised 4 times each, daily for 2 weeks and then tapered over the next 10 days.

Follow up- All the patients were examined on the first postoperative day, at the end of 1 week, 4 weeks and 9 weeks.

During each follow up, uncorrected visual acuity was recorded using Snellen's chart, corneal curvature was measured by keratometer and astigmatism noted by refraction with subjective correction.

Analysis- The data and results were tabulated and statistically analysed. Comparison between preoperative astigmatism and 9th week postoperative astigmatism was done by paired t-test.

RESULTS

Sl. No.	Age Groups (Years)	Number of Cases	Percentage
1.	<30	17	24.3
2.	30-39	21	30.0
3.	40-49	19	27.1
4.	50-59	7	10.0
5.	>60	6	8.6
	Total	**70**	**100**

Table 1. Age Incidence

Majority of the patients (81%) belonged to 20-50 years age group. In the table above, we find that incidence declines gradually after 50 years of age.

Sl. No.	Sex	Number of Cases	Percentage
1.	Male	38	54.29
2.	Female	32	45.71
	Total	**70**	**100**

Table 2. Sex Incidence

As we can see in the table above, there is a male preponderance; the percentage being, males- 54.29% and females- 45.71%.

Sl. No.	Living Surroundings	Number of Cases	Percentage
1.	Rural	52	74.29%
2.	Urban	18	25.71%
	Total	**70**	**100**

Table 3. Effect of Living Surroundings

The prevalence of pterygium was found to be more in patients from rural areas than in urban areas.

It is clear from the above table that the prevalence of pterygium was maximum amongst the farmers (44.29%),

followed by labourers (31.43%). The overall incidence was found to be more in patients with outdoor occupation.

Sl. No.	Occupation	No. of Cases	%
1.	**Outdoor**		
	Farmer	31	44.29
	Labourers	22	31.43
	Others	5	7.14
2.	**Indoor**		
	Housewives	5	7.14
	Office staff	4	5.71
	Students	3	4.29
	Total	**70**	**100**

Table 4. Effect of Occupation

Sl. No.	Nature of Pterygium	No. of Cases	%
1.	Progressive	50	71.43
2.	Non-progressive/atrophic	20	28.57
	Total	**70**	**100**

Table 5. Incidence of Nature of Pterygium

The table above shows that 71.43% of patients had progressive pterygium, while 28.57% of patients had atrophic pterygium.

Group	Length of Pterygium Over Cornea (mm)	Number of Cases	Percentage
I	1.1-2	14	20
II	2.1-3	18	25.71
III	>3	38	54.29
	Total	**70**	**100**

Table 6. Number of Cases in Different Groups According to Length of Pterygium

The pterygium length varied between 1.5 mm and 5.0 mm. The mean pterygium size was 3.19 ± 0.87 mm. Most of the patients (54.29%) belonged to Group III. Group I consisted of 20% patients, while Group II had 25.71% patients.

Group	Length of Pterygium (mm)	Uncorrected Visual Acuity		Improvement in Snellen's Visual Acuity	p value
		Preoperative	Postoperative		
I	1.1 to 2.0 Mean- 1.8 mm	0.483 ± 0.19	0.79 ± 0.19	1 to 2 lines	<0.0001
II	2.1 to 3.0 mm Mean- 2.8 mm	0.46 ± 0.18	0.74 ± 0.22	1 to 2 lines	<0.0001
III	>3.0 mm Mean- 3.9 mm	0.37 ± 0.209	0.70 ± 0.26	2 to 3 lines	<0.0001

Table 7. Uncorrected Visual Acuity in Relation to Size

The amount of diminution of vision varied with-the-length of the pterygium. An average of 3 groups (70 cases) has mean pterygium length of 3.19 mm, which had preoperative uncorrected visual acuity of 0.414 and postoperatively 0.72 indicating an improvement of 1 to 2 lines of Snellen's visual acuity after the excision.

Group	Length Group (mm)	Preoperative Keratometry	Postoperative Keratometry	Reduction	Paired t-test	p-value
I	1.1-2.0 mean-1.8 mm	1.16 ± 0.27D	0.53 ± 0.35D	1.14 ± 0.68D	10.26	<0.0001
II	2.1-3.0 mean-2.8 mm	1.28 ± 0.49D	0.28 ± 0.22D	1.15 ± 0.67D	8.02	<0.0001
III	>3.0 mean-3.9 mm	2.36 ± 0.84D	0.62 ± 0.62D	1.74 ± 0.75D	15.19	<0.0001

Table 8. Astigmatism as Measured by Keratometry in Different Groups

An average of all 70 cases with mean pterygium length 3.2 mm had a mean keratometry astigmatism of 1.84 ± 0.89D preoperatively and 0.514 ± 0.52D postoperatively indicating a reduction of pterygium-induced corneal astigmatism by 1.45 ± 0.77D (p value <0.0001), which was statistically significant.

Group	Length group (mm)	Preoperative Astigmatism	Postoperative Astigmatism	Reduction	Paired t-test	p-value
I	1.1 to 2.0	0.66 ± 0.15D	0.267 ± 0.21D	0.36 ± 0.20D	6.276	<0.0001
II	2.1 to 3.0	0.944 ± 0.327D	0.486 ± 0.327D	0.56 ± 0.27D	6.007	<0.0001
III	>3.0	1.44 ± 0.74D	0.473 ± 0.43D	1.01 ± 0.51D	10.19	<0.0001

Table 9. Astigmatism as Measured by Subjective Correction

An average of all 70 cases with mean pterygium length 3.19 mm had mean preoperative astigmatism of 1.15 ± 0.67D as measured by subjective correction. Postoperatively, the astigmatism was 0.43 ± 0.38D. Thus, the reduction of pterygium-induced corneal astigmatism was 0.76 ± 0.49D (p value <0.0001), which was statistically significant.

DISCUSSION

70 eyes of 70 patients with pterygium were studied. The results of the study are discussed as under.

Age- A maximum of 21 (30%) patients were in the age group of 30-39 years, followed by 19 (27.1%) patients in the age group of 40-49 years and 17 (24.3%) patients in <30 years age group. In the present study, there were 7 (10%) patients in the age group of 50-59 years and 6 (8.6%) patients in >60 years age group. Youngson[2] reported maximum prevalence between 26-50 years. Townsend and Gardner[3] have said that pterygia arc seen more often in individuals between 20-40 years. Hilgers,[4] however, noted that in the age group of 40-49 years, there was an increased tendency to develop pterygium. In the present study, 81% of the patients were in the age group of 20-50 years.

Sex- Males were affected slightly more than the females, 38 (54.29%) patients being males and 32 (45.71%) patients being females. Townsend and Gardner[3] have said that pterygia are seen nearly twice as often in men as in women. Various other studies[2,4] have found that males and females were equally affected and there was no sex predilection. However, when a male preponderance was found, the authors felt it could be due to the predominant outdoor activity of the men as compared to women. In the present study, the slightly higher incidence in males could be explained by the outdoor activity of the men exposing them to the risk factors responsible for the development of pterygium.

Living Surroundings- 52 (74.29%) patients were from the rural areas, while 18 (25.71%) patients were from the urban areas. This could be attributed to the fact that the rural population is most often engaged in outdoor activities, exposing them to more heat, dust, wind and sunlight as compared to those residing in urban areas. Moreover, people from the rural areas do not use any protective measures to shield the eyes from environmental irritants. Both these factors added together could explain the increased incidence in rural population. These findings coincide with the findings of Forsius and Erikson in their study, which showed higher incidence of pterygium among the rural population.

Occupation- The highest incidence of 44.29% was found in farmers, followed by 31.43% in labourers. Both of these belonged to the outdoor occupation group. This further confirms that exposure to environmental irritants is the most important factor in the occurrence of pterygium. While the total incidence among patients of indoor occupation group was 17.14, the rest 82.86% came under the outdoor occupation group. It has been mentioned in Kaufman that the most exuberant pterygia are seen in farmers and construction workers. Various other studies[2,5,6] have stressed on the importance of outdoor occupations that expose individuals to ultraviolet radiation with or without other associated irritants as being important in the causation of pterygium.

Size- The pterygium size varied between 1.5 mm and 5.0 mm among the 70 patients included in the study. The mean pterygium size was 3.19 ± 0.87 mm. There were 14 cases in 1.0 to 2.0 mm, 18 cases in 2.1 to 3.0 mm and 38 cases in >3.0 mm group. Only about 45% of the patients sought help at the early stages, while 55% of the patients delayed the process of seeking treatment. This is so because, apart from cosmetic blemish, most often pterygia are asymptomatic in the early stages when the growth is small.

Astigmatism- Preoperative assessment of astigmatism by keratometry and refraction of the 70 patients included in the study showed a significant with-the-rule astigmatism. This is similar to the findings of other studies.[1,7,8,9,10,11,12,13]

The mean preoperative astigmatism measured by refraction was 1.16 ± 0.27D in Group I (1.1-2.0 mm); 1.28 ± 0.49D in Group II (2.1-3.0 mm); and 2.36 ± 0.85D in Group III (>3 mm). This difference in astigmatism in different groups is statistically significant ($p<0.0001$). The pterygium size correlated well with the refractive cylinder ($p<0.0001$).

In their study, Lin and Stem[2] found that for larger pterygium, there was a linear relationship between the pterygium size and topographic astigmatism, which was nearly perfectly correlated ($R^2 = 0.96$, $p<0.0001$), but the refractive cylinder did not correlate with the topographic cylinder. Avisar et al[12] observed significant astigmatism (>1D) in 45.45% of eyes with lesion <3 mm ($p<0.002$) and in 93.33% of eyes with lesion >3 mm ($p<0.0004$). They used computerised corneal analysis system for measuring the astigmatism. The present study does not include measurement of astigmatism by corneal topography. However, corneal topography is thought to be more reflective of the astigmatism induced in cases of pterygium.

The preoperative conical astigmatism assessed by keratometer showed a mean astigmatism of 1.16 ± 0.27D in 1.0 to 2.0 mm group; 1.28 ± 0.49D in 2.0 to 3.0 mm group and 2.36 ± 0.85D in >3.1 mm group.

The mean preoperative uncorrected visual acuity in 1.1 to 2.0 mm group was 0.483 ± 0.20; in group 2.1 to 3.0 rnm, it was 0.46 ± 0.19; and in >3 mm group, it was 0.37 ± 0.21. This drop in visual acuity in relation to pterygium length was statistically significant ($p<0.0001$). Avisar et al[12] study has shown similar finding of BCVA, the values being 0.7465 ± 0.321 in the <3 mm size group and 0.567 ± 0.229 in the >3 mm size group. These values were statistically significant.

Following surgical excision of the pterygium, the postoperative refractive cylinder reduced in all cases. The overall mean postoperative astigmatism reduction was 0.76 ± 0.49D. The difference between pre and postoperative astigmatism was 0.36 ± 0.20D in the 1.1 to 2.0 mm group, while it was 0.56 ± 0.27D in the 2.1 to 3.0 mm group and 1.01 ± 0.51D in the >3.0 mm group, the difference being statistically significant ($p<0.0001$). It is obvious from these observations that the change in refraction was less in smaller pterygium. The larger the pterygium, the greater was the postoperative change. Bedrossian,[11] however, observed refractive changes only in 42%, of the patients in his study.

This is much less than that observed in the present study. The reason for this could be due to the fact that he considered only those eyes with >0.37D change as having truly changed.

Walkow et al[13] observed in their study that the absolute astigmatism of the control group that underwent pterygium excision with bare sclera technique reduced from a mean of 1.15 ± 0.05D to 0.72 ± 0.56D. This reduction was statistically significant ($p<0.05$).

Mohammad-Salih[14] PA et al studied the relationship between pterygium size (extension, width, total area) and corneal astigmatism in 77 eyes with unilateral primary pterygium. They noted a stronger correlation between pterygium size and the difference in corneal astigmatism between pterygium-affected eyes and control eyes. They concluded that pterygium induced 2D of corneal astigmatism when its extension exceeded 2.2 mm and that surgical intervention is indicated when pterygium extension exceeded 2.2 mm.

The postoperative keratometry showed that the horizontal curvature either increased or remained the same. The vertical curvature on the other hand was found to have flattened. The increase in the horizontal curvature is more logically explained by a release of tension exerted by the pterygium on the cornea. The mean postoperative corneal astigmatism reduction was 1.32 ± 0.74D. The difference between pre and postoperative astigmatism was 1.14 ± 0.684D in 1.1 to 2.0 mm group, 1.15 ± 0.667D in the 2.1 to 3.0 mm group and 1.74 ± 0.755D in the >3.0 mm group. This difference was statistically significant ($p<0.0001$). These observations indicate that greater the preoperative astigmatism, greater is the difference between pre and postoperative astigmatism.

Bedrossian[11] found corneal curvature changes in 45% patients. Here again, those eyes with <0.37D change were considered unchanged and could be the probable reason for the comparatively lesser incidence. Most other studies have only evaluated the preoperative corneal curvature in cases of pterygium. However, one study by Avisar et al[12] evaluated the changes in keratometer readings following surgical excision of pterygium. They found that surgical excision of pterygium had no effect on the corneal keratometer readings recorded 4 months after surgery. With the limitations of the keratometer, one can expect such varied results in different studies.

Soriano et al[1] found a statistically significant reduction in astigmatism in 83% of their patients. The change was from a mean preoperative astigmatism of 2.41D in the horizontal meridian to a mean postoperative astigmatism a 1.29D ($p<0.0001$). These findings are similar to that of the present study.

To wind up, the present study suggests that pterygium induces with-the-rule astigmatism. It may be noted that the increase in astigmatism is proportionate to the size of the pterygium. However, the BCVA is inversely proportional to the size of the pterygium. Thus, patients with larger pterygia most often present with diminution of vision. The diminution of vision is the result of pterygium-induced corneal astigmatism.

Keratometry as a method of assessing the corneal astigmatism has its own limitations as it considers only the central 3 mm of the cornea for evaluating the astigmatism. Since, pterygia cause localised flattening of the peripheral cornea, astigmatism as measured by keratometry may not be truly reflective, especially in cases of small pterygia. In case of pterygium, the keratometry mires sometimes may not superimpose correctly due to uneven surface produced.

Surgical excision of pterygium results in reduction in the corneal astigmatism, which is reflected by an improvement in uncorrected visual acuity. The difference between pre and postoperative astigmatism is greater in those eyes, which have greater preoperative astigmatism. There is some residual astigmatism as corneal distortion does not normalise completely in eyes with advanced pterygia. Thus, early surgical intervention is indicated in patients with pterygium.

CONCLUSION

On complete analysis of study data, it was observed that pterygium induced significant corneal astigmatism and that the induced astigmatism increased with the increasing size of the pterygium resulting in decreased visual acuity. Following surgical excision of the pterygium, there was significant reduction in the pterygium-induced corneal astigmatism in all the groups, which resulted in improvement of visual acuity. However, it was found that the residual astigmatism in patients with advanced pterygium (Group III) was relatively greater than in patients with early pterygium (Group I and II). Hence, early surgical excision of pterygium is indicated even though it remains distant from visual axis.

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