Original Article

A study on changes in keratometry readings and astigmatism induced by pterygium before and after pterygium excision surgery

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ABSTRACT

Background: Pterygium is a wing shaped fibrovascular growth of subconjunctival tissue encroaching upon the cornea from the either side within the interpalpebral fissure area inducing significant astigmatism. Surgical intervention for excision of pterygium leads to reduction in astigmatism which significantly improves vision.

Aim: To study changes in corneal astigmatism before and after pterygium excision surgery.

Material and Methods: The study was carried out on 100 eyes of 95 patients who had primary pterygium and were admitted in Department of Ophthalmology, P. D. U. Govt. Medical College, Rajkot and underwent pterygium surgery during period of October 2012 to April 2013. All patients underwent preoperative assessment for visual acuity, anterior segment examination, posterior segment examination, auto refraction and auto keratometry. After pterygium surgery, patients were assessed for visual acuity, auto refraction and auto keratometry on 1st, 7th and 45th post operative day and the results were analysed.

Results: Mean astigmatism preoperatively was found to be 6.20 ± 3.58 Diopters (D) which subsequently decreased to 1.20 ± 1.27 D on 45th post operative day-showing 5.09 ± 3.32 D of change in astigmatism which was statistically significant(paired t-test, $p<0.05$).

Conclusion: Pterygium causes significant corneal astigmatism, which hampers vision of the patient. Excision of pterygium leads to statistically significant reduction in astigmatism, which improves vision significantly.

Keywords: Pterygium, astigmatism, keratometry, pterygium excision, vision.

INTRODUCTION

Pterygium is a wing shaped fibrovascular growth of subconjunctival tissue encroaching upon the cornea from the either side within the interpalpebral fissure area inducing significant astigmatism which may be either 'with-the-rule'(WTR) or 'against-the-rule'(ATR).

The mechanisms explaining the astigmatism are: the tractional force of contractile elements within the pterygium lead to mechanical distortion and flattening of the cornea in its horizontal meridian leading to hypermetropic WTR astigmatism. Pterygium induced with-the-rule corneal astigmatism is hemimeridonal on the side of the pterygium resulting in a localized flattening of the cornea central to the leading apex. The localised pooling of tears at the advancing edge-head of the pterygium is also responsible for corneal flattening [1, 2].

Pterygium results in high corneal astigmatism, which decreases following an excision [3]. Early surgical intervention can therefore reduce effects of corneal morbidity due to pterygium induced corneal distortion and visual disturbance arising from the encroachment of the pterygium into the visual axis. Early or late surgical intervention for excision of pterygium surgery

leads to reduction in astigmatism which leads to significant improvement in vision [4, 5].

The objectives with which this study was carried out were to study change in corneal astigmatism before and after pterygium excision surgery; to study relationship of pre operative size of pterygium with the astigmatism induced and change in it after surgery; to compare change in astigmatism in bare sclera technique and conjunctival autograft technique; to study effect of change in astigmatism on vision.

MATERIAL AND METHODS

Sample size: A prospective interventional study was carried out on 100 eyes of 95 patients at G. T. Sheth Ophthalmic Hospital, Department of Ophthalmology, P. D. U. Govt. Medical College, Rajkot. All the patients were in age group from 25-79 years, selected by non probability convenient sampling method, of which 44 were males and 56 females. The study period extended from October 2012 to April 2013.

Inclusion & exclusion criteria: Patients who had primary pterygium, admitted in G. T. Sheth Ophthalmic Hospital, Department of Ophthalmology, P. D. U. Govt. Medical College, Rajkot and underwent pterygium excision surgery were included in the study. A patient with recurrent pterygium i.e. having past history of pterygium excision, patient with history of any other corneal infection or scarring in the past or past history of corneal surgery and those with any other ocular pathology were excluded from the study.

Methods: All patients underwent preoperative (preop) assessment for visual acuity, anterior segment examination with emphasis on pterygium type morphologically, on the basis of vascularization and progression, posterior segment examination, auto refraction and auto keratometry. Patient's visual acuity and best corrected visual acuity were recorded for each eye separately, using well illuminated Snellen's visual acuity chart with patient sitting at distance of 6 meters. Preoperative horizontal length (size) of pterygium was measured by focussing the slit on the pterygium and using the ruler of the slit incorporated in the slit-lamp from limbus to the advancing edge of pterygium. Based on this size, pterygium is classified into 3 types as:
Type 1 - Pterygium encroaching 0-2 mm area on the cornea, i.e. crossing limbal margin but not reaching pupillary margin; Type 2 - Pterygium encroaching 2-4 mm area on the cornea, i.e. reaching upto pupillary margin but not crossing it; Type 3 - Pterygium encroaching > 4 mm area on the cornea, i.e. crossing pupillary margin and coming in visual axis.

Keratometry values were obtained using an automated refractokeratometer. Written and informed consent was taken from all the patients along with explained prognosis about recurrence of the pterygium and changes in astigmatism.
All the surgeries were performed under peribulbar block - containing 4 ml of 2% lignocaine and 4 ml of 0.5% bupivacaine, followed by application of super pinky's ball for 10 minutes. With the help of 15 number knife blade, a delineation mark is done on cornea 1 mm ahead of the head of pterygium and pterygium excision is started. Head of the pterygium is excised with gentle dissection and traction avulsion from the corneal surface, neck and body of pterygium are dissected and pterygium tissue is excised after delineating and separating it from overlying conjunctiva and underlying sclera. In the bare sclera technique, episclera and tenon's layer are removed with minimum bipolar wet field cautery and bare sclera area was left behind. In conjunctival autograft technique, bare sclera area is measured with callipers and conjunctival autograft of size 1 mm more than bare sclera in both dimensions is harvested form superior or superotemporal quadrant.

In case of free graft, limbal side of the graft is oriented to the limbal side of the graft and the defect is closed by suturing autograft with adjacent conjunctiva by nylon 10-0 sutures. In case of pedicle graft, one pedicle flap is attached and graft is rotated from harvesting side to the bare sclera site so that limbal side of graft is oriented to the non limbal side of the host conjunctiva, and the defect is closed by suturing autograft with adjacent conjunctiva by nylon 10-0 sutures. Topical antibiotic eye ointment application with pad and bandage was done to the eye for 24 hours. Conjunctival suture removal was done on 7^{th} post operative day or 1 week follow up in case of conjunctival autograft technique.
During follow up, patient were examined for Visual acuity; best corrected visual acuity; Autorefraction and Autokeratometry readings were recorded using above instruments as mentioned above in pre operative assessment. These measurements were done on 1^{st} post operative (postop) day, 7^{th} post operative day (1 week follow up) and 45^{th} post operative day (1.5 month follow up).

Ethical clearance: This study was done after getting ethical clearance from ethical committee.

RESULTS

In the present study, 100 eyes of 95 patients were studied during study period of 6 months. Basic characteristics of them are shown **in Table 1.** Age distribution shows that highest incidence of pterygium was found in age group of 50-60 years (35%) and least incidence was found in age group of 70-80 years (7%) and < 30 years (9%). Gender distribution shows that 44% patients in this study were males and 56% were females. 47% patients in our study were operated for left eye and 53% were operated for right eye. Morphologically, depending on the size of pterygium, maximum patients in this study had Type 2 pterygium (67%) followed by Type 1 pterygium (17%) and least had Type 3 pterygium (16%). 10% patients underwent pterygium surgery with bare sclera technique and 90% patients underwent pterygium excision surgery with conjunctival autograft.

Table 1: Baseline characteristics of patients operated for pterygium excision surgery

Characteristic	Number (n=100)
Age group (in yrs)	
<30	9
31-40	21
41-50	17
51-60	35
61-70	11
71-80	7
>80	0
Gender	
Male	44
Female	56
Operated Eye	
Right eye	53
Left eye	47
Morphological type of Pterygium	
Type 1 (0-2 mm)	17
Type 2 (2-4 mm)	67
Type 3 (> 4 mm)	16
Type of pterygium surgery	
Bare sclera	10
Conjunctival autograft	90

Table 2: Comparison of pre-operative and post-operative astigmatism according to morphological type of pterygium and type of pterygium surgery

Variable	Pre-op astigmatism	1st post op day astigmatism	7th post op day astigmatism	45th post op day astigmatism
MORPHOLOGICAL TYPE				
Type 1 (0-2 mm)	4 D	2.20 D	2.20 D	0.54 D
Type 2 (2-4 mm)	6.1 D	2.03 D	2.03 D	1.23 D
Type 3 (>4 mm)	8.9 D	5.03 D	2.89 D	1.78 D
TYPE OF PTERYGIM SURGERY				
Bare Sclera	6.17 D	3.94 D	3.22 D	2.85 D
Conjunctival autograft	6.21 D	3.03 D	1.96 D	1 D

Table 3: Comparison of pre-operative and post-operative range of best corrected visual acuity (BCVA) according to morphological type of pterygium and type of pterygium surgery

Variable	No. of patients with BCVA 3/60-5/60		No. of patients with BCVA 6/60-6/24		No. of patients with BCVA 6/18-6/6	
MORPHOLOGICAL TYPE	Pre-Op	Post-Op	Pre-Op	Post-Op	Pre-Op	Post-Op
Type 1 (0-2 mm)	1	0	10	0	6	17
Type 2 (2-4 mm)	9	0	53	2	5	65
Type 3 (> 4 mm)	6	0	10	1	0	15
TYPE OF PTERYGIM SURGERY	Pre-Op	Post-Op	Pre-Op	Post-Op	Pre-Op	Post-Op
Bare Sclera	3	0	6	1	1	9
Conjunctival autograft	13	0	67	2	10	88

Table 2 shows that as the size of pterygium increases, amount of corneal astigmatism induced by it also increases in direct proportion. Plus, postoperative decrease in astigmatism also showed a positive correlation i.e. as size increases, amount of pterygium induced is more and postoperative decrease is also more in those patients. Also, it shows that patients that underwent bare sclera surgery had pre existing astigmatism of 6.17 D and those that underwent conjunctival autograft surgery had pre existing astigmatism of 6.21 D. Plus,

decrease in astigmatism following bare sclera surgery (6.17 D to 2.85 D) is much less as compared to those with conjunctival autograft surgery (6.21 D to 1.0 D). In the bare sclera method, though the removal of the pterygium may decrease the inherent astigmatism, it has a potential to induce further astigmatism due to formation of granulation tissue during the healing process. In the conjunctival autograft method, the induced astigmatism is less due to reduced inflammation and better healing.

Table 3 shows comparison of pre-operative and post-operative range of best corrected visual acuity (BCVA) according to morphological type of pterygium and type of pterygium surgery.

Table 4: Comparison of change in mean astigmatism preoperatively, on 1st, 7th, and 45th post operative day

Day	Mean astigmatism
Pre operatively	6.20 D
1st post op day	3.11 D
7th post op day	2.09 D
45th post op day	1.20 D

It shows that pre operatively, 16 patients had BCVA between 3/60-5/60, 73 patients had BCVA between 6/60-6/24 and 11 patients had BCVA between 6/18-6/6; whereas post operatively, no patient had BCVA between 3/60-5/60, only 3 patients had BCVA between 6/60-6/24 and 97 patients had BCVA between 6/18-6/6. This shift towards improved vision shows that pterygium excision improves vision. This improvement in vision is due to reduction in astigmatism following pterygium surgery. This is shown in **Table 4**. Mean astigmatism preoperatively was found to be 6.20 ± 3.58 D which subsequently decreased to 1.20 ± 1.27 D on 45th post operative day-showing 5.09 ± 3.32 D of change in astigmatism which was statistically significant (paired t-test, $p<0.05$).

DISCUSSION

Pterygium may cause flattening of the cornea to the leading apex. An induced astigmatism was explained by several mechanisms: Pooling of the tear film at the leading edge of the pterygium, and mechanical traction exerted by the pterygium on the cornea.

In present study, we found that the degree of astigmatism decreased significantly following excision, and this decrease was related to the size of the pterygium. The size was affecting the change in astigmatism as well as postoperative degree of astigmatism. Lin and Stern found a significant correlation between the size of pterygium and corneal astigmatism [1]. Maheshwari S. has also found decrease in astigmatism following pterygium excision [2]. We also found that the change in astigmatic degree was directly related with the change in visual acuity. The refractive components were demonstrated to stabilize at 1.5 months following pterygium surgery in our study which is consistent with study done by Tomidokoro A *et al* in which the refractive components were demonstrated to stabilize at 1.5 months following pterygium surgery [3]. An increase in visual acuity is expected following pterygium excision [4, 5]. It was also suggested that pterygium extending more than 45% of corneal diameter results in increasing degrees of astigmatism [6]. Alison L and George AS also co-related the size of pterygium, extension of pterygium over cornea and degree of astigmatism induced by it [7]. Mohammad Salih and co-workers studied the pterygium extension, width, and total area and investigated their relationship with corneal astigmatism. Among the 3, an extension had the strongest and the most significant correlation with the astigmatism ($\rho = 0.462$, $P < 0.001$, *Pearson correlation analysis*). The authors reported that pterygium with larger than 2.2 mm extension might contribute to corneal astigmatism >2 D. It was reported that significant astigmatism increases with an increasing size of the pterygium [8]. Avisar A *et al* reported that when primary pterygium reaches more than 1.0 mm in size from the limbus it induces with-the-rule significant astigmatism (> or = 1.0 diopter). This significant astigmatism tends to increase with the increasing size of the lesion [9]. Kampitak concluded that the amountof induced corneal astigmatism and timing for pterygium excision are related to the pterygium size, and reported that 2.25 mm pterygium resulted in astigmatism of 2 D, and should be considered in the limits of surgery [10]. Rana Altan-Yaycioglu *et al.* concluded that with the increase in the size of pterygium, the preoperative astigmatism increases [11]. In present study, we compared the size of the pterygium with the change in astigmatism and found a significant correlation ($P < 0.001$). Main difference in change of astigmatism was between the sizes of 2 mm and 5 and 6 mm. Thus, we agree with previous reports that it is better to remove the pterygium when it measures nearly 2 mm in horizontal length. Also, in the present study, we found a significant correlation between the pre and postoperative astigmatic values (paired t test, $P <$

0.05). Mean astigmatism preoperatively was found to be 6.20 ± 3.58 D which subsequently decreased to 1.20 ± 1.27 D on 45th post operative day-showing 5.09 ± 3.32 D of change in astigmatism which was statistically significant (paired t-test, p<0.05). Excision of pterygium leads to statistically significant reduction in astigmatism, which improves vision significantly. Soriano JM *et al* also confirms that pterygium excision induces a reversal of pterygium-related corneal flattening. A significant decrease in astigmatism and improvement in visual acuity is observed post-operatively [12]. Cinal *et al* used corneal topography to measure astigmatism in patients of pterygium. They found that corneal topographical changes caused by the pterygium are almost reversible after surgical treatment, and postoperatively the cornea becomes steeper [13]. In the study done by Maheshwari S., corneal astigmatism reduced from 4.40±3.64 diopter (D) to 1.55±1.63D (*P* value <0.001) following surgery, which is comparable to our study. The regularity of corneal surface improved and asymmetry of the cornea reduced one month after surgery. Pterygium leads to significant changes in corneal refractive status, which increase with the increase in the grade of pterygia and improve following pterygium excision [14]. Surgical removal of pterygium can improve the changes; however, in eyes with advanced pterygium, corneal distortion does not normalize completely and irregular changes may persist if the lesion has reached the paracentral cornea [15]. So, result of this study is in contradiction to our study. Some other factors, like changes in corneal stroma and Bowman's layer, are suggested to be responsible for these persistent refractive changes in eyes after pterygium surgery [16]. Yilmaz *et al.* compared the astigmatic changes following different types of surgeries including conjunctival autografting, limbal conjunctival autograft, bare sclera and bare sclera with mitomycin. The authors found a statistical difference between groups for mean topographical astigmatism and surgically reduced astigmatism (*P* = 0.033 and 0.030, respectively). In that study, the mean difference was between the bare sclera and graft techniques where postoperative astigmatism was smaller in the former [17]. In present study, we found opposite difference in postoperative astigmatic changes between different surgical techniques. The main difference between the 2 studies (ours and Yilmaz *et al.'*s) is the measurement of astigmatism in present study via keratometry. In conclusion, pterygium results in high corneal astigmatism, which increases with the increase in horizontal length, and decreases to an acceptable level following excision. We found a significant correlation between the preoperative and postoperative astigmatic values as well as the changes in astigmatism with surgery.

CONCLUSION

Pterygium leads to significant high corneal astigmatism, which hampers vision of the patient.

As the size of pterygium encroaching on cornea increases, amount of induced astigmatism increases. The type of pterygium excision surgery plays a major role in modifying the induced astigmatism in patients with pterygium.

Excision of pterygium leads to statistically significant reduction in astigmatism, which improves vision significantly.

REFERENCES

1. Lin A, Stern GA. Correlation between pterygium size and induced corneal astigmatism. Cornea 1998;17:28-30.
2. Maheshwari S. Effect of pterygium excision on pterygium induced astigmatism. Indian J Ophthalmol 2003;51:187-8.
3. Tomidokoro A, Miyata K, Sakaguchi Y, Samajima T, Tokunaga T, Oshika T. Effects of pterygium on corneal spherical power and astigmatism. Ophthalmology 2000;107:1568-71.
4. Bahar I, Loya N, Weinberger D, Avisar R. Effect of pterygium surgery on corneal topography: A prospective study. Cornea 2004;23:113-7.
5. Stern GA, Lin A. Effects of pterygium excision on induced corneal topographic abnormalities. Cornea 1998;17:23-7.
6. Wu PL, Kuo CN, Hsu HL, Lai CH. Effect of pterygium surgery on refractive spherocylinder power and corneal topography. Ophthalmic Surg Lasers Imaging 2009;40:32-7
7. Alison L, George AS. Correlation between pterygium size and induced corneal astigmatism. Cornea 1998;17:28-30.
8. Mohamad-Salih PA, Sharif AF. Analysis of pterygium size and induced corneal astigmatism. Cornea 2008;27:434-8.
9. Avisar A, Loya N, Yassur Y, Weinberger D. Pterygium induced corneal astigmatism. Isr Med Assoc J 2000;2:14-5.
10. Kampitak K. The effect of pterygium on corneal astigmatism. J Med Assoc Thai 2003;86:16-23.
11. Rana Altan-Yaycioglu, Cem Kucukerdonmez, Aylin Karalezli, Fatma Corak, Yonca A Akova. Astigmatic changes following pterygium removal: Comparison of 5 different methods. Indian J Ophthalmol 2013;61:104-8.

12. Soriano JM, Janknecht P, Witschel H. Effect of pterygium operation on preoperative astigmatism. Prospective Study. Ophthalmologe 1993;90:688-90.
13. Cinal A, Yasar T, Demirok A, Topaz H. The effect of pterygium surgery on corneal topography. Ophthalmic Surg Lasers 2001;32:35-40.
14. Maheshwari S. Pterygium‐induced corneal refractive changes. Indian J Ophthalmol 2007;55:383-6.
15. Tomidokoro A, Oshika T, Amano S, Eguchi K, Eguchi S. Quantitative analysis of regular and irregular astigmatism induced by pterygium. Cornea 1999;18:412-5.
16. Cameron ME. Histology of pterygium: en electron microscopic study. Br J Ophthalmol 1983;67:604-8.
17. Yilmaz S, Yuksel T, Maden A. Corneal topographic changes after four types of pterygium. J Refract Surg 2008;24:160-5.

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