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A PROSPECTIVE ANALYSIS OF VISUAL ACUITY AND ASTIGMATIC CHANGES AFTER PTERYGIUM EXCISION WITH LIMBAL STEM CELL GRAFTING

Ophthalmology

Dr. Kumari Preeti M.B.B.S, M.S. (Ophthal.), Assistant Professor, Upgraded Department Of Ophthalmology, Darbhanga Medical College And Hospital, Laheriasarai, Bihar.

Dr. Nitu Kumari* M.B.B.S, M.S. (Ophthal.), Senior Resident, Upgraded Department Of Ophthalmology, Darbhanga Medical College And Hospital, Laheriasarai, Bihar. *Corresponding Author

Dr. [Prof.] Alka Jha M.B.B.S, D.O.M.S., M.S. (Ophthal.), Professor And Head Of Department, Upgraded Department Of Ophthalmology, Darbhanga Medical College And Hospital, Laheriasarai, Bihar.

Dr. Debarshi Jana Young Scientist (DST), Institute Of Post-Graduate Medical Education And Research, A.J.C. Bose Road, Kolkata-700020, West Bengal, India.

ABSTRACT

Objectives: The aim of this study was to assess if there is any significant reduction in astigmatism and thus improvement in visual acuity after pterygium excision with limbal stem cell grafting.
Methods: In this prospective study, patients with primary pterygium were included. Preoperative and postoperative corneal astigmatism, refractive astigmatism and visual acuity were analyzed. All patients underwent pterygium excision with limbal stem cell grafting.
Results: Mean improvement in visual acuity of 0.09 log MAR units was observed ($p < 0.0001$, statistically significant).Mean corneal astigmatism for grade I, II and III was found to be 1.03 ± 0.68D, 1.69 ± 0.80D and 2.90 ± 1.06D respectively. Mean corneal astigmatism decreased by 1.29 D ($p < 0.0001$, statistically significant).A decrease of 0.77D in cylindrical power required was found after surgery ($p < 0.0001$, statistically significant).
Conclusions: there is a significant reduction in pterygium induced astigmatism and improvement in visual acuity on surgical removal of the pterygium.

KEYWORDS

Pterygium, corneal astigmatism, limbal stem cell grafting

INTRODUCTION

The term pterygium is derived from Greek word 'pteron' meaning wing. Pterygium is a triangular shaped growth onto cornea, usually nasally, of fibrovascular tissue that is continuous with conjunctiva. It occurs in interpalpebral fissure area, more often nasally than temporally. When present on both the sides it is called as double pterygium. It is a degenerative lesion and is associated with ultraviolet light exposure. Incidence is more in tropical areas near equator. Pterygium is made up of cap (avascular halo like subepithelial gray zone at advancing edge), head, neck and body. Pterygium can be classified into type one, two and three depending upon extent of cornea involvement. Type 1 extends less than 2mm from limbus onto cornea. Type 2 involves up to 4mm of cornea from limbus. Type 3 involves more than 4mm of cornea from limbus and may involve visual axis. Histology shows elastotic degeneration in vascularized subepithelial stromal collagen. It occurs at highest prevalence and most severely in tropical areas near the equator. Pterygia warrant treatment when they encroach upon the visual axis, induce significant regular or irregular astigmatism, or become cosmetically bothersome. Aggressive or recurrent pterygia may also cause restrictive strabismus and distortion of the eyelids.

The exact mechanism of flattening in horizontal meridian is not clear. It is thought to be caused by formation of tear meniscus between the corneal apex and the elevated pterygium, causing an apparent flattening of the normal corneal curvature or tractional flattening of horizontal meridian. Treatment of pterygium is mainly surgical. Post-operative refractive error gets stabilized usually after one month. A variety of surgical techniques has been developed. Currently, the most widely used techniques are conjunctival autografting, mitomycin C application and human amniotic membrane grafts.

Recently extensive work has been done on limbal stem cell dysfunction in pterygium and barrier role that limbal stem cells play against conjunctival overgrowth on cornea. Their deficiency at limbus allows conjunctivalization of corneal epithelium with fibrovascular tissue overgrowth. Limbal stem cell grafting prevents recurrences.

MATERIALS AND METHODS

A hospital based prospective and interventional study was conducted at Upgraded Department of Ophthalmology, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from January 2020 to September 2020 and 100 newly diagnosed patients having primary pterygium were included in the study. The tenets of Helsinki were followed. The size of the pterygium was recorded in mm by projecting a horizontal slit-lamp beam from the limbus to the apex. Grade I included pterygium extending up to 2mm on the cornea from limbus. Grade II included pterygium extending more than 2mm but less then 4mm from limbus. Grade III included pterygium encroaching onto cornea more than 4mm. Grade III primary pterygium crossing center of the pupil were not included in the study. Patients with recurrent or atrophic pterygium and patients with history of any ocular surface disorder or trauma were excluded out of the study. Assessment of preoperative astigmatism was done by standard method of refraction and keratometry. All patients underwent Pterygium surgery with limbal stem cell grafting under peribulbar anaesthesia (Lignocaine 2% with adrenaline mixed with Bupivacaine in 1:1 ratio). After proper anaesthesia, 0.5cc of lignocaine was injected under the pterygium to elevate it. Corneal epithelium 2mm ahead of head of pterygium was scraped off by a no. 15 blade. A superficial delineating keratectomy was done at leading edge of pterygium. Careful superficial lamellar dissection, from leading apex of pterygium towards limbus was done. This freed apex of pterygium from cornea. Now body of pterygium was separated from underlying sclera. This exposes bare sclera. Size of graft needed was measured using calipers. A conjunctival graft at superotemporal limbus, measuring 1mm more than bare sclera was harvested. While dissecting limbal part of graft dissection was continued upto 0.5mm into clear cornea to harvest limbal stem cells into the graft. Graft was placed over bare sclera so that limbal side of graft is placed on limbal side of bare sclera. Graft was then sutured using 10-0 monofilament nylon suture. Aantibiotic eye ointment and dressing was done. Patients were followed up at one week, two week and one month after surgery.

Comparison of preoperative and postoperative astigmatism was done after one month of pterygium surgery. Visual acuity assessment, keratometry and refractions were done on the day of admission and on 30th postoperative day. Data was analyzed by using Graph pad quick calcs software. Paired t test was used to compare preoperative and postoperative results. A p value (one tailed) of < 0.05 was defined as statistically significant.

RESULTS

Figure 1. Grade 3 pterygium

The average age of the patient was 47.19 ± 9.77 years. Age ranged from 21 years to 80 years. 50% of patients were between 40 and 54 years of age. Out of hundred patients analyzed 52 (52%) were males and 48 (48%) were females. It was found that 34% (34 in number) patients were from urban background and 66% (66 in numbers) patients were from rural background. Of the 100 cases of pterygium examined 17% were in grade I, 52% were grade and remaining 31% were graded as III. No case of temporal pterygium or double pterygium was found in the duration of this study.

Preoperative visual acuity ranged from 0.00 to 1.48 (log MAR units). Mean preoperative visual acuity was 0.52 ± 0.32. Postoperative visual acuity at one month ranged from 0.00 to 1.08. Mean postoperative visual acuity was 0.43±0.29. Improvement in visual acuity was mainly attributed to stabilization of corneal astigmatism. Mean improvement in visual acuity of 0.09 log MAR units was observed (p <0.0001, statistically significant) (Table 1).

Table – 1 : Preoperative and postoperative visual acuities as log Mar values (Mean±SD)

	Grade I	Grade II	Grade III	Total
Pre-operative	0.26±0.15	0.39±0.17	0.89±0.27	0.52±0.32
Post-operative	0.22±0.14	0.31±0.17	0.76±0.23	0.43±0.29

p<0.0001 (df=99)

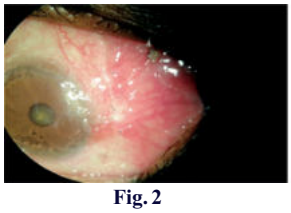

Fig. 2

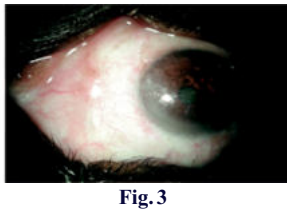

Fig. 3

Figure 2. Postoperative photograph at 1 week after surgery
Figure 3. Postoperative photograph at 1 month after surgery

Corneal astigmatism was measured by manual keratometry (Reichert type Bausch and Lomb keratometer). Mean preoperative corneal astigmatism was 1.96 ± 1.1 Diopters (D). Fifty percent of cases had corneal astigmatism from 1.25D to 2.25D. Mean corneal astigmatism for grade I, II and III was found to be 1.03 ± 0.68D, 1.69 ± 0.80D and 2.90 ± 1.06D. Mean corneal astigmatism increased with increasing grade of pterygium. Mean postoperative corneal astigmatism was 0.67D ± 0.57D. Mean corneal astigmatism for grade I, II and III was found to be 0.44D ± 0.38D, 0.54D± 0.49D and 0.98D ± 0.69D respectively. Mean corneal astigmatism decreased by 1.29 D (p <0.0001, statistically significant).In one case WTR astigmatism changed to 'against the rule' (ATR) astigmatism (Table 2).

Table – 2 : Preoperative and postoperative Corneal astigmatism in diopters (D)

	Mean±SD (Pre-op)	Mean±SD (Post-op)
Grade I	1.03±0.38 D	0.44±0.38 D
Grade II	1.69±0.8 D	0.54±0.49 D
Grade III	2.90±1.06 D	0.98±0.69 D
Total	1.96±1.1 D	0.67±0.57 D

p value< 0.0001 (df 99)

Mean preoperative refractive cylinder was 1.54 ± 0.86D. Cylindrical power determined by refraction ranged from 0.25D to 4.25D. 75% of patients had refractive cylinder of more than 0.75. Mean astigmatism for grade I, II and III was 0.97D ± 0.56D, 01.30D ± 0.69D and 2.26D ± 0.83D respectively. Mean postoperative refractive cylinder was 0.77 ± 0.55D. Fifty percent of cases had postoperative cylindrical power between 0.5D to 1.0D. Mean refractive cylindrical power for grade I, II and III was 0.51 ± 0.41D, 0.67 ± 0.50D and 01.04 ± 0.59D respectively. Single case of WTR astigmatism changed to ATR astigmatism. A decrease of 0.77D in cylindrical power required was found after surgery (p <0.0001, statistically significant) (Table 3).

Table – 3 : Preoperative and postoperative refractive cylinder in diopters (D)

	Mean±SD (Pre-op)	Mean±SD (Post-op)
Grade I	0.97±0.56 D	0.51±0.41 D
Grade II	1.30±0.69 D	0.67±0.50 D
Grade III	2.26±0.83 D	1.04±0.59 D
Total	1.54±0.86 D	0.77±0.55 D

Improvement in visual acuity and astigmatism is more in grade III than grade II and in grade II than I. This is due to worsening of visual acuity and more induced astigmatism as pterygium increases in size Preoperative astigmatism by keratometry was found to be more than astigmatism by refraction. Two cases (2%) showed recurrence during the one year period of the study.

DISCUSSION

The pterygium has been reported to have highest incidence in fourth decade. In a study conducted by Marmamula S et al. in Andra Pradesh, mean age of patients was very similar to present study (47.5±13 years). A study by Salagar KM in Karnataka showed 73% of cases were above age of 40. Another study conducted by Rao SK et al. showed that 56.98% of cases were above the age of 40 years. In present study 78% of patients were above 40 years of age.

While most studies demonstrated an increased risk of pterygium among men compared with women, this study found only slight difference in sex distribution of pterygium (51%males, 48% females). Studies in India, including the study by Salagar KM et al and Asokan R et al found a similar prevalence in both the sexes. Similar to other studies; we found a significantly higher prevalence of pterygium in the rural population (66%).

Pterygium induces refractive changes leading to visual impairment. There was poor correlation between the magnitude of refractive astigmatism and keratometric astigmatism. This can be due to the hemi-astigmatic nature of the induced changes. During manifest refraction patient deals with two images, one from the more spherical temporal cornea and one from the flatter nasal cornea. The patient preferentially views the more spherical image and therefore the corneal changes are incompletely reflected in the refraction. Similar discrepancy has been shown by various other studies.

Keratometry measures only the central cornea and peripheral cornea is ignored and hence astigmatism calculated by keratometry is less than other that measured by other topographical methods. The exact mechanism of flattening in horizontal meridian is not clear. It is thought to be caused by the formation of tear meniscus between the corneal apex and the elevated pterygium, causing an apparent flattening of the normal corneal curvature or tractional flattening of horizontal meridian.

Various studies have shown increasing size of pterygium causing increasing astigmatism. Lin and Stern found pterygium to induce significant degrees of astigmatism once it exceeded >45% of the radius. Tomidokoro et al. evaluated the percentage extension of pterygium on cornea and found larger pterygia to adversely affect astigmatism. Avisar et al in 2000 found that pterygia more than 1.1mm from limbus produce increasing astigmatism of 1D or more. Lindsay RG et al found pterygium causes with-the-rule astigmatism and found a significant correlation between the extension of the pterygium onto the cornea and the amount of induced astigmatism. In our study mean astigmatism increased with increasing size of pterygium. Corneal astigmatism recorded in grade I, II and III was 1.03 ± 0.68D, 1.69 ± 0.80D and 2.90 ± 1.06D respectively.

Mean corneal astigmatism in the present study, decreased from 1.96D to 0.67D after excision of pterygium, a difference of 1.29 D (p<0.0001). Several previous studies by different researchers

including Cinal A et al, Maheshwari S4., Stern and Lin, Tomidokoro et al. and Yagmur et al have also reported a significant decrease in corneal astigmatism following surgical removal of pterygium. Khan FA et al recently did a study based on automated keratometry. In the study median pre-operative astigmatism of 2.25D reduced significantly to median postoperative astigmatism of 1.30D.

In the present study mean refractive cylindrical power for grade I, II and III was 0.97D ± 0.56D, 01.30D ± 0.69D and 2.26D ± 0.83D respectively. This showed worsening of refractive cylindrical power with increasing encroachment of cornea by pterygium. According to the study by Maheshwari S the refractive cylinder reduced from 1.94±2.24D to 0.78±1.07D. Another study by Maheshwari S. reported the preoperative refractive cylinder improved from 4.60 ± 2 D to 2.20 ± 2.04 D postoperatively. In our study a reduction of 0.77D ($p<0.0001$) in refractive cylinder was found.

In the present study, mean visual acuity had an improvement of 0.09 log MAR units ($p<0.0001$). Similar improvement in visual acuity has been shown by other studies. Study by Maheshwari S. showed a mean visual acuity pre-operatively of 0.53 ± 0.35 D which improved to 0.68 ± 0.34 D ($p = 0.001$) postoperatively (snellen's fraction). Yagmur M et al in 2005 evaluated visual acuities and observed significant improvement in mean uncorrected visual acuity postoperatively.

Hence, it was found that induced astigmatism increases with increasing encroachment of pterygium onto cornea. This can be corrected effectively by pterygium surgery with limbal stem cell grafting.

Pterygium is more common in rural population and males, due to more exposure to sunlight (ultraviolet radiation). Mean age at presentation is 47.19 years. Magnitude of induced astigmatism increases and hence visual acuity decreases with increasing encroachment of pterygium on the cornea. There is a significant reduction in the induced astigmatism on pterygium excision with limbal stem cell autografting.

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