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Original Article

Topographic Changes Before and After Pterygium Surgery

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ABSTRACT

Background: Pterygium characterized by a centripetal growth of fibrovascular tissue associated with inflammation and vascularization. Corneal astigmatism in an eye with pterygium may reflect the cumulative effect of a naturally occurring astigmatism and that induced by the pterygium. Pterygium surgery usually affects topographic changes associated with pterygium.

The aim of the work: This study aimed to detect the topographic changes that occur before and after pterygium surgery using the bare sclera technique.

Patients and Methods: This study is prospective, interventional, and non-randomized. It was held at Al-Zahraa University Hospital. It included 20 eyes of 17 patients with primary nasal pterygium. Their age ranged between 23 and 72 years. Pterygium was graded according to its size, extent of corneal involvement and visibility of the underlying episcleral blood vessels. All cases were operated with the bare sclera technique. Follow-up was done after one day, one week, one month, and three months postoperatively.

Results: There was a significant improvement of uncorrected and best correct visual acuity at one and three months after surgery. After excision of smaller sized pterygium, the UCVA and BCVA are more improved as compared to excision of larger sized pterygium. The astigmatic value significantly decreased during the first week and third months postoperatively. Sim K2 was significantly increased during the first week and first month after pterygium surgery. Recurrence was reported in 7 out of 20 eyes. Two eyes experienced pyogenic granuloma on the first month of follow-up, while dryness was encountered in 8 eyes.

Conclusion: Pterygium excision with bare sclera technique is associated with improvement in UCVA and BCVA, decrease in astigmatic values, and improvement in corneal aberrations. It is associated with a 35% recurrence rate. It is preferable to excise pterygium before reaching 3 mm to avoid visual impairment in late cases.

Keywords: Pterygium; Keratometric Readings; Astigmatism; Corneal Topography; Visual Acuity

INTRODUCTION

Pterygium is a wing-shaped fibrovascular overgrowth of the bulbar conjunctiva onto the cornea. It consists of a head [the part which rests on the cornea], a neck, and a body. It can occur on either side of the cornea, but the nasal limbus is frequently involved [1, 2].

Ultraviolet light is a predisposing factor for increased incidence of pterygium. So, it occurs more frequently in people who are exposed more frequently to UV light, in a hot, dry, windy, and dusty environment. Pterygia are reported to occur in males twice as frequently as in females [1]. It is uncommon for patients to present with pterygia before 20 years. Patients aged 20-40 years have the highest incidence of pterygia [3]. Pterygium has a variety of complaints ranging from no symptoms to

significant redness, inflammation, foreign body sensation, tearing, dry and itchy eyes [4]. In advanced cases, the pterygium can affect ocular motility and vision. Visual disturbances are due to corneal curvature abnormalities leading to astigmatism [5].

Several surgical techniques have been tried including, bare sclera resection**,** pterygium excision plus conjunctival autograft or amniotic membrane grafts, and the use of topical chemotherapeutic agents such as intra-operative or postoperative mitomycin-C application [6]. According to Stern and Lin [7]**,** indications of pterygium surgery include: pterygium either invading or threatening the visual axis, visual impairment due to astigmatism, irritative symptoms and inflammation, restricted movement, and cosmetic indications.

THE AIM OF THE WORK

This study aimed to evaluate the topographic changes before and after pterygium surgery using the bare sclera technique.

PATIENTS AND METHODS

This study is a prospective, interventional and non-randomized study. It was held at Al-Zahraa University Hospital over 14 months. It included 20 eyes of 17 patients [a convenient sample] with primary nasal pterygium. Three patients had bilateral pterygia. Eight patients were males [47.1%], and nine patients were females [52.9%]. Their mean age + SD was 46.2 + 13.2 years [Range: 23 - 72 years].

Inclusion Criteria: patients with primary nasal pterygium invading or threatening the visual axis and associated with visual impairment or irritative symptoms.

Exclusion Criteria include patients with recurrent pterygium, patients with any other ocular pathology, patients with collagen diseases, and patients with pseudo-pterygium.

All patients were subjected to entire history taking, uncorrected visual acuity [UCVA] [it was converted into decimal visual acuity], autorefractometry, best-corrected visual acuity [BCVA], evaluation of extra-ocular muscles by examination of eye movements in the six cardinal directions monocularly and binocularly, slit-lamp biomicroscopy [for the anterior segment and grading of pterygium according to the extension of corneal invasion, body translucency], applanation tonometry. Tear film evaluation was done by detecting the break-up time [BUT] and Schirmer tests.

Pterygium was graded according size of pterygium into [Grade 1, 0<2 mm from the limbus; Grade 2, 2-4 mm from the limbus; and Grade 3, >4 mm from the limbus].

Operative technique: All cases were operated upon for pterygium excision with the bare sclera technique using the surgical microscope under aseptic conditions. Topical anesthesia was done by installing 0.4% boxinate hydrochloride three times with a 3 minutes interval, followed by subconjunctival 2% of Lidocaine hydrochloride [Xylocaine] injection using a 25- gauge needle. Cleaning the eye with Povidone-iodine [betadine®] diluted 1:10. A lid speculum was then applied to provide maximal exposure. Marking of the pterygium body by a violet marker. Infiltration of pterygium body using 2% lignocaine. Cutting the pterygium base using the Wescott scissors, followed by blunt dissection of the pterygium body. Cutting off the edges by Wescott scissors. Avulsion of the pterygium head from the cornea leaves a bare sclera area [about 3-4mm]. Superficial keratotomy was performed using a no. 15 Bard Parker blade to remove any possible remnants of residual pterygium tissues attached to the cornea after pterygium excision. Bleeding vessels were cauterized by minimal cautery. A rectangular area of the bare sclera of about 4 x 6 mm was formed. Local antibiotic eye drops and ointment. Patching of the operated eye using a sterile pad for 24 hours.

Postoperative treatment: Postoperative topical combined antibiotics steroid eye drops [0.3% tobramycin and 0.1 dexamethasone] five times daily for 15 days, topical combined eye ointment [0.3% tobramycin and 0.1 dexamethasone] once at bed-time for five days,

together with 0.2% sodium hyaluronate eye drops three times daily for three weeks.

Follow-up: Follow-up was done after one day, one week, one month, and three months postoperatively. On each follow-up visit, patients were subjected to test the UCVA and best BCVA [converted into Decimal visual acuity], autorefractometry, examination of extra-ocular muscles, slit-lamp biomicroscopy [to detect healing of cornea and the sclera bed, to detect early recurrences or any complications of pterygium surgery as granuloma], applanation tonometry, tear film break-up time [BUT] and Schirmer tests. Using OPTIKION 2000 CORNEAL TOPOGRAPHER, Corneal topography was done one week, one month, and three months postoperatively.

Data Collection and Analysis

Data were collected and statistically described mean + SD, median, range, frequencies [number of cases], and percentages when appropriate. The study groups' numerical variables were compared using the Kruskal Wallis test. Within-group comparison of numerical variables was made using Freidman's test with post-hoc multiple 2-group comparisons. For comparing categorical data, Chi-square [x2] test was performed. An exact test was used instead when the expected frequency was less than 5. Correlation between various variables was done using the Spearman rank correlation equation. P-value less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS [Statistical Package for the social science; SPSS Inc., Chicago. IL. USA] version 15 for Microsoft Windows.

Ethical considerations: Patients were informed about the nature of the procedure, and each patient signed informed consent.

Figure [1]: Applying the lid speculum

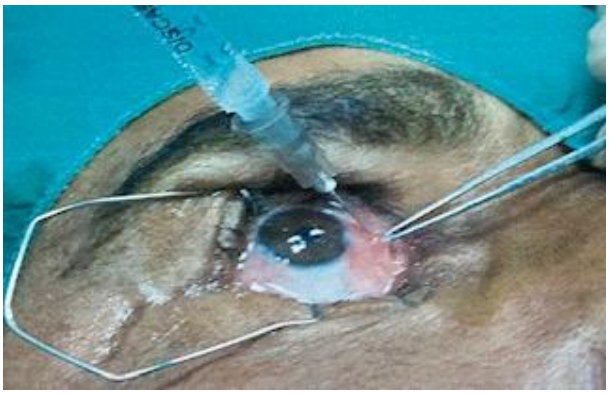


Figure [2]: Local infiltration anesthesia

Figure [3]: Cutting the base of pterygium

Figure [4]: Cutting the edges of pterygium

Figure [5]: Avulsion of the head of the pterygium

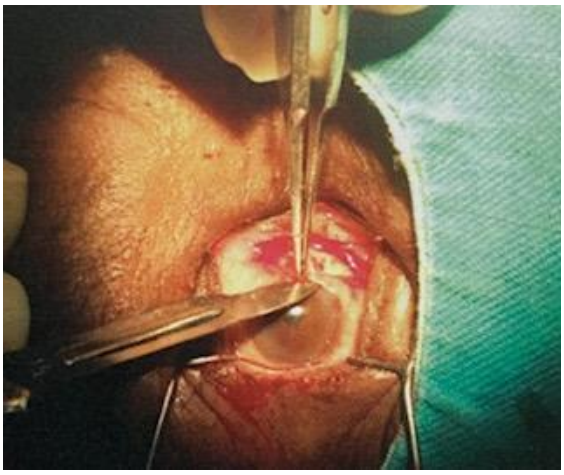


Figure [6]: Superficial keratectomy

Figure [7]: Cautery of bleeding vessels and formation of 4x6 mm bare sclera

RESULTS

This study aims to evaluate the effect of pterygium surgery on corneal topography, which includes sim K1, Sim K2, Bfs, Bfc, Qs, Qf, TI, and RMS done on an absolute scale, and also to investigate the effect of different grades of pterygium on ocular aberrations along with corneal topography. The study included 20 eyes with primary nasal pterygium in 17 patients. Three patients had bilateral pterygia. Left eye pterygium was reported in 13 cases, while the right eye was reported 7 cases. Three were 8 males [47.1%] and 9 females [52.9%]. Their mean age $\pm$ SD was 46.2±13.2 years [Range 23-72 years]. Using the slit-lamp, pterygia were graded depending on their extent of corneal involvement into 3 grades. Five pterygia were Grade I [25%], 12 pterygia were Grade II [60%], and 3 pterygia were Grade III [15%]. According to the visibility of the underlying episcleral blood vessels, there were 6 pterygia [T1, "atrophic," 30%], 7 pterygia [T2 "intermediate," 35%], and 7 pterygia [T3 "fleshy, opaque," 35%]. According to pterygium size, 45% of cases were between 2 and 2.9 mm, 40% between 3 and 3.9 mm, and 15% between 4 and 4.9 mm. The best corrected and uncorrected visual acuity was significantly improved at one and three months after surgery when compared to values before surgery. There were statistically non-significant differences between the UCVA as well as the BCVA and the pterygium sizes; Group 1 included 2-2.9 mm of pterygium size, Group2 included 3-3.9 mm of pterygium size, and Group 3 included 4 - 4.9 mm of pterygium size, as being clarified in the table below. However, it can be noticed that after excision of smaller sized pterygium, the UCVA and BCVA are more improved than the excision of larger sized ones.

The auto-refractometer obtained Kerato-metric readings. Mean k_1 pre-operatively was 42.3$\pm$2.42 with a statistically significant increase during the first week postoperatively

[mean value 43.1D±1.88], where the p-value is 0.01. There were non-significance statistical differences between k_2 and ACP [average corneal power] pre-and postoperatively.

The mean astigmatic value per-operatively was -3.4±2.4. There was a statistically significant decrease in the astigmatic value during the first week and third month postoperatively with mean values -2.3±2.3 and -2.2±2.1 respectively [p values = 0.05 and 0.00 respectively].

Statistically, the above table showed nonsignificant statistical differences in K_1 pre and postoperatively among the three groups, where the P-value was more than 0.05. However, there was a statistically significant difference in K_2 during the third month of follow-up, where P value was 0.03.

It was clear that the astigmatic power increases with the increase in the pterygium size. Additionally, in groups 1 and 3, the mean values of the astigmatic powers pre-operatively were -2.42D ± 1.99 and -6.58D ± 2.93 respectively, and during the third month of follow up, the mean values were -1.56 D ± 1.08 and -5.42D ±3.66 respectively, showing no significant statistical difference. Whereas, in Group 2 that included 3-3.9 mm of pterygium sizes, the mean values of the astigmatic powers were -3.38D ± 1.97 pre-operatively and -1.72 D ± 1.50 during the third month post-operatively, showing decrease in the astigmatic power of 1.4ID after pterygium excision during the third month of the follow-up.

Topographic data includes Sim K1 Sim K2 Bfs, Bfc, Qs, Qf, TI, and RMS [root mean square; which would consist of coma and spherical aberrations, which in turn are types of high order aberrations [HOA]. There was a statistically nonsignificant difference in Sim Ki. On the other hand, there was a statistically significant increase in Sim K2 during the first week and the first month being higher in the first week [P-value =0.00] [P-value at one month = 0.001]. There was no significant difference during the third month.

Similarly, the mean value of the Bfs pre-operatively was 44.8D ± 3.1. There was a statistically significant difference during the first week and first month postoperatively, higher in the first week [P-value = 0.00 and 0.02 respectively]. Similarly, the mean value of Bfc pr-operatively was 5.7 ± 5.5, with a statistically significant difference during the first week, the first month, and the third month postoperatively [P-value = 0.00, 3.0+3.3, 3.0±3.4 and 2.7+3.2 respectively] being the lowest during the third month, as shown below.

However, there were statistically nonsignificant differences in the Qs and Qf pre and postoperatively, where P values are more than 0.05, as shown below.

Comparison of topographic data was also made according to different sizes of pterygia showing only statistically significant differences in Sim K_1 in the first week postoperatively with P-value = 0.02.

The mean values of Bfc pre-operatively were 3.17D ± 3.06, 5.27D ± 3.09, and 14.82D ± 7.90 in Groups 1, 2, and 3. Postoperatively, mean values during the third month were 1.93D ± 1.44, 1.83D ±1.38, and 7.53D ± 6.61 in Groups 1, 2, and 3, respectively. It has been noticed a decrease in the mean value of the Bfc by 1.24D, 3.44D, and 7.29D in Groups 1, 2, and 3 respectively during the third month of follow up, being the highest in group 3, as shown below.

There were non-significant differences in the RMS mean values among the three groups of different pterygium sizes [P > 0.05] pre and postoperatively. However, it is noticeable that the RMS mean values showed a significant decrease during the 3rd month post-operatively in groups 1 and 2; group 1 RMS mean values were 28.42pm and 6.70pm pre-operatively and at the 3rd month postoperatively, respectively, group 2 values were 24.83pm and 4.26 pm pre-operatively and at the third month postoperatively respectively. On the other hand, in group 3, the RMS showed nearly no change compared to the pre-operative mean value. Consequently, in group 3, there were residual aberrations after pterygium excision.

Pre-operatively, 18 pterygia had with-the-rule astigmatism, and 2 had against-the-rule astigmatism. One week postoperatively, 13 eyes had with-the-rule astigmatism, 4 had against-the-rule astigmatism, and 3 had oblique astigmatism. One month postoperatively, 15

eyes had with-the-rule astigmatism, 3 had against-the-rule astigmatism, and 2 had oblique astigmatism. On the third month of follow-up, 16 eyes had with-the-rule astigmatism, 3 had against-the-rule astigmatism, and one eye had oblique astigmatism.

Recurrence of pterygium was reported in one eye [5%, one month postoperatively] and 6 eyes [30%, 3 months postoperatively]. In addition, 2 eyes [10%] experienced pyogenic granuloma at the first month. Dryness was also experienced in 8 eyes out of 20 [40%].

Table [1]: Comparison of visual acuity pre and postoperatively

Variables	Preoperative	Postoperative			Statistical comparison		
		1 day	1 month	3 months	P1	P2	P3
UCVA	0.36±0.25	0.43±0.25	0.44±0.23	0.46±0.24	0.09	0.03*	0.01*
BCVA	0.53±0.32	0.59±0.31	0.66±0.28	0.65±0.24	0.17	<0.001*	<0.001*
K1	42.3±2.42	43.1±1.88	41.2±7.84	42.7±1.8	0.014	0.03	0.127
K2	45.7±3.42	45.4±3.1	45.4±3.1	45.3±3.04	0.78	0.54	0.38
ACP [average corneal power	43.8±2.6	44.2±2.4	43.9±2.1	43.7±2.2	0.73	0.68	0.84
Astigmatism	-3.4±2.4	-2.3±2.3	-2.5±2.5	-2.2±2.1	0.05	0.51	<0.001*
Sim K1	47.7±5.0	48.8±4.4	47.9±5.0	46.3±4.1	0.95	0.50	0.22
Sim K2	44.4±11.0	46.1±4.4	44.8±3.7	43.6±2.4	0.06	0.10	0.14
Bfs [best-fit sphere]	44.8±3.1	47.3±3.8	46.4±4.0	45.0±2.9	<0.001*	0.02*	0.25
Bfc [best fit cylinder]	5.7±2.5	3.0±3.3	3.0±3.4	2.7±1.2	<0.001*	<0.001*	<0.001*
Qs	-0.1±0.6	0.07±0.61	1.6±1.1	-0.2±0.4	0.95	0.29	0.26
Qf	0.74±1.4	0.37±1.0	0.27±0.60	0.31- 0.78	0.50	0.58	0.22
TI [Topography irregularity]	2.1±2.4	1.83±1.6	1.0±0.94	0.93±0.72	0.58	0.01*	<0.001*
RMS [root/mean/1 square]	24.2±33.2	22.8±31.5	23.2±34.1	6.4±6.1	0.52	0.14	<0.001*

Table [2]: Comparison of visual acuities pre and postoperatively

Variables	Pterygium size	UCVA				P value			
		Pre	Post			Pre	1w	1m	**3m**
			1w	1m	3m				
UCVA	2 - 2.9 mm	0.45±0.24	0.45±0.19	0.52±0.23	0.49±0.20	0.06	0.3	0.07	**0.15**
	3 - 3.9 mm	0.34±0.26	0.47±0.36	0.45±0.22	0.52±0.29				
	4-4.9 mm	0.10±0.06	0.24±0.06	0.22±0.04	0.24±0.06				
BCVA	2 - 2.9 mm	0.67±0.28	0.66±0.28	0.73±0.27	0.70±0.25	0.07	0.06	0.44	**0.33**
	3 - 3.9 mm	0.48±0.32	0.64±0.33	0.65±0.33	068±0.31				
	4-4.9 mm	0.21±0.24	0.24±0.06	0.49±0.18	0.42±0.21				
K1	2 - 2.9 mm	41.77±1.99	43.11±1.541	39.08±11.42	42.61±1.40	0.46	0.71	0.53	**0.35**
	3 - 3.9 mm	42.50±2.39	42.75±1.76	42.56±1.77	42.21±1.69				
	4-4.9 mm	43.33±4.12	44.08±3.40	44.41±2.84	44.58±2.56				
K2	2 - 2.9 mm	44.19±1.35	44.63±1.94	44.66±1.48	44.16±1.41	0.06	0.11	0.06	**0.03**
	3 - 3.9 mm	45.87±3.52	44.93±2.45	44.43±2.34	43.84±2.33				
	4-4.9 mm	49.91±4.87	49.50±5.19	49.83±4.91	50.00±4.78				
Astigmatism [D]	2 - 2.9 mm	-2.42±1,99	-1.52±1.30	-2.25±2.37	-1.56±1.08	0.08	0.13	0.22	**0.19**
	3 - 3.9 mm	-3.38±1.97	-2.18± 1.98	-1.87±1.85	-1.72±1.50				
	4-4.9 mm	-6.58±2.93	-5.41±3.81	-5.41 ±3.66	-5.42±3.66				
Sim K	2 - 2.9 mm	46.71±2.33	46.74±3.92	46.80±2.73	45.57±2.20	0.15	0.02	0.27	**0.09**
	3 - 3.9 mm	46.03±3.36	48.88±3.31	46.87±4.05	44.82±2.85				
	4-4.9 mm	55.23±8.98	55.10±3.39	54.39±8.80	52.95±6.14				
K2	2 - 2.9 mm	43.54±3.67	44.40±1.65	44.66±2.35	43.69±1.39	0.20	0.41	0.98	**0.64**
	3 - 3.9 mm	40.76±2.00	46.86±3.81	44.72±3.66	42.98±2.51				
	4-4.9 mm	57.07±28.05	49.73±9.45	45.99±8.04	45.42±4.48				
BFS	2 - 2.9 mm	45.13±2.67	45.51±2.70	45.73±2.45	44.60±1.69	0.09	0.05	0.41	**0.14**
	3 - 3.9 mm	43.39±2.29	47.87±3.47	45.79±3.76	43.90±2.59				
	4-4.9 mm	47.82±5.06	51.4I±5.14	50.19±7.76	49.18±4.24				
BFC	2 - 2.9 mm	3.17±3.06	2.44±2.75	2.15±1.44	1.93±1.44	<0.001*	0.07	0.14	**0.11**
	3 - 3.9 mm	5.27±3.09	2.01±1.68	2.15±1.75	1.83±1.38				
	4-4.9 mm	14.82±7.90	7.37±5.58	8.40±6.57	7.53±6.61				
RMS	2 - 2.9 mm	28.42±40.94	8.48±8.51	28.09+41.21	6.70+5.31	0.48	0.12	0.82	**0.60**
	3 - 3.9 mm	24.83+31.32	33.91+41.29	9.28+4.84	4.26+1.78				
	4-4.9 mm	**9.94+1.64**	**36.31±38.74**	**46.26+50.00**	**12.09+13.18**				

Table [3]: Distribution of topographic astigmatic axes before and after pterygium surgery

	Pre-operative	Third month postoperative
With-the-rule	18 eyes [90%]	16 eyes [80%]
Against-the-rule	2 eyes [10%]	3 eyes [15%]
Oblique	Zero eyes [0%]	1 eye [5%]

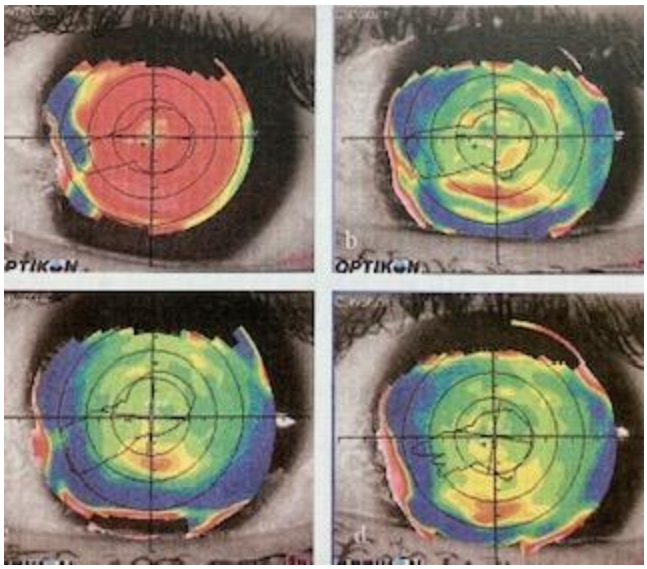


Figure [1]: Eye no. 1 [Topographic map], A: Pre-operative, B: One week postoperatively; C: One month postoperatively; D: Three months postoperatively

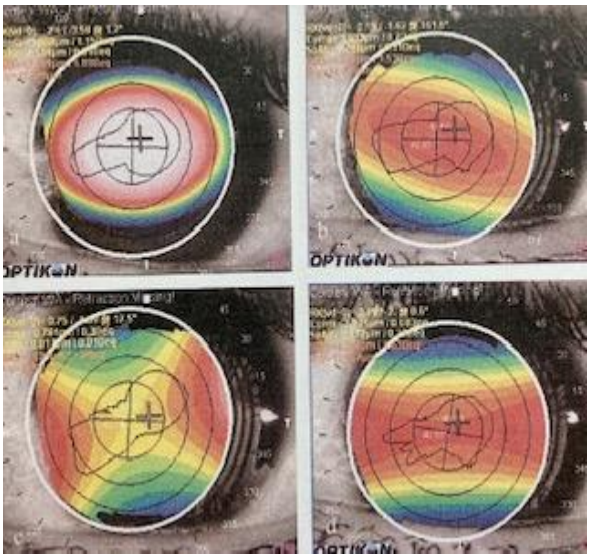
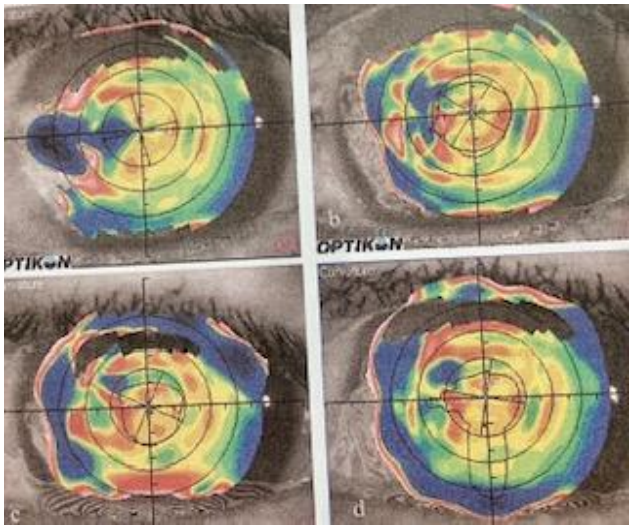
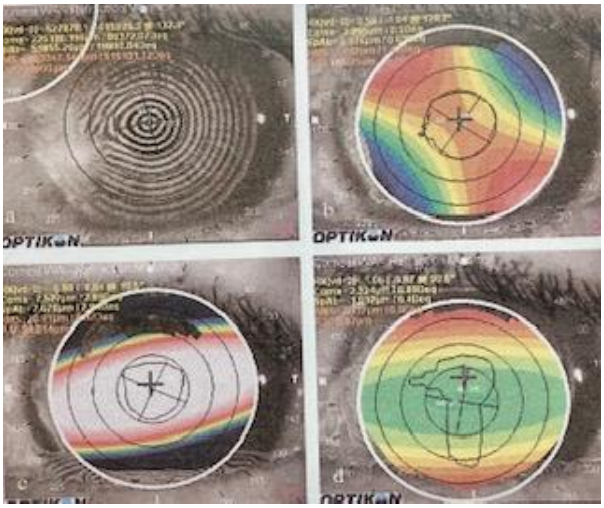


Figure [2] Eye no. 1 [Wavefront map]; A: Pre-operative; B: One week postoperatively; C: One month postoperatively; D: Three months post-operatively



[Figure 3] Eye no. 10 [Topographic map], A: Pre-operative, B: One week postoperatively, C: One month postoperatively, D: Three months postoperatively



[Figure 4] Eye no. 11 [Wavefront map]: A: Pre-operative, B: One week postoperatively, C: One month postoperatively, D: Three months post-operatively

DISCUSSION

Pterygium is an ocular surface disease characterized by the centripetal growth of fibrovascular tissue with inflammation and vascularization. It can reach and invade the corneal surface reducing visual acuity [3, 8]. Epidemiological studies have shown that pterygium is strongly related to sun exposure [1]. Prevalence increases geographically in people exposed to outdoor environments. In addition, there are associations with rural areas, increasing age, and male gender [9]. The mean age in our study was 46.2 ± 13.2 years [23-72 years], proving that pterygium may occur at any age. In our study, 9 patients [52.9%] were outdoor workers. **Salih and Sharif** [10] found that male predominance could be due to increased environmental insults because the outdoor workers were more likely to be men.

In our study, 47.1 % of patients were females, and 52.9% were males. However, some studies showed no difference between men and women. A higher incidence among women was reported in a hospital-based study. It was explained that females are more concerned about the disease and its cosmetic effect [11, 12].

Salih and Sharif [10] reported that symptoms of burning sensation, irritation, lacrimation, and foreign body sensation might accompany the growth of pterygium onto the cornea and an unfavorable cosmetic effect. Significant

astigmatism may be induced either with or against the rule. They also reported that most of the population had complained of lacrimation, which was noticed to decrease with eyes of larger pterygia, mostly > 3mm.

In our study, eyes experienced dry eye had low values of Schirmer test in accordance with **Elwan** [13]. In our study, pterygium recurrence after excising with the bare sclera technique was 30%, which is close to another study reported by **Hille *et al.*** [14], who states that the bare-sclera approach was associated with a recurrence rate of 35.5%. On the other hand, **Hirst** [15] noted that simple excision with bare sclera is associated with a high recurrence rate, as high as 80%. **Tan** [16] reported that due to excessive inflammation and localized irritation occurring at the site of exposed Tenon's tissue, granuloma might occur. He added that Tenon's granuloma/ pyogenic granuloma might happen a week after the pterygium surgery due to proliferative and inflammatory reactions. They also reported that the incidence of its formation was 19%. However, in our study, granuloma formation was reported in 10% of the eyes [2 eyes out of 20] one month postoperatively.

Corneal astigmatism in an eye with pterygium may reflect the cumulative effect of a naturally occurring astigmatism and that induced by the pterygium. The possible mechanisms of pterygium-induced astigmatism are as follows: first, the frictional force of contractile elements within the pterygium that mechanically distort and flatten the cornea. Second, the localized pooling of tears at the pterygium apex leads to the observation of corneal flattening in keratometry [17]. **Yasar *et al.*** [18] observed that a pterygium causes corneal astigmatism, 4.3 D, which was reduced to 2. I D following dried pooling of tears at the pterygium apex. In our study, the mean keratometric astigmatic value was 3.4 D pre-operatively and 2.2 D at the third month postoperatively. **Oh and Wee** [19] proved that the mean Sim K astigmatism values decreased significantly after pterygium surgery in patients with pre-operative Sim K astigmatism >2 D. However, the Sim K astigmatism tended to increase after surgery in patients with pre-operative Sim K astigmatism <2 D, although the increase was statistically not significant. The surgery itself might induce corneal topographic changes, which becomes more evident in cases with minor corneal astigmatism before surgery.

Yagmur *et al.* [20] studied the effect of pterygium excision on 30 eyes. They found that topographic astigmatism was reduced from 4.6 D ± 3.02 D pre-operatively to 2.33 D ± 2.26 D, which is nearly close to the mean values we found in our study. In our study, the mean value of topographic astigmatism was -3.4 ± 2.4 pre-operatively and -2.2±2.1 D three months postoperatively. **Stern and Lin** [7] reported corneal astigmatism to reduce from 5.93 D ± 1.68 to 1.92D ± 1.68 D, which agrees more with our findings. **Salih and Sharif** [10] mentioned that pterygium generally causes with-the-rule astigmatism that is hemi-meridional on the side of the pterygium due to localized flattening of the cornea central to the leading apex. They reported that with-the-rule astigmatism was the primary type, followed by against-the-rule and oblique astigmatism, which is agreed with our study, where 90% of eyes had with-the-rule, 10% had against-the-rule astigmatism, and none had oblique astigmatism. On the other hand, **Oh and Wee** [19] found 58% of the eyes with pterygium had with-the-rule astigmatism, 25% had oblique astigmatism, and 17% had against-the-rule astigmatism. They noted that the corneal axis of astigmatism changed from with-the-rule to against-the-rule astigmatism one month after surgery. They explained this phenomenon by flattening the cornea horizontally in the nasal quadrant, where the pterygium was located. This flattening effect dissipated after pterygium removal. In our study, we found that 2 eyes had with-the-rule astigmatism. They turned into against-the-rule astigmatism after one month postoperatively.

Ozdemir and Cinal [21] reported that astigmatic axes change to return to with-the-rule at the postoperative about the third month post-operatively. The axes change from with-the-rule to against-the-rule, and oblique occurs early at the second week postoperatively. Our study found that three eyes that had with-the-rule astigmatism changed their axes to against-the-rule one week postoperatively, and 3 eyes that had with-the-rule astigmatism pre-operatively changed into oblique astigmatism one week postoperatively. Additionally, three months

postoperatively, eyes that had with-the-rule astigmatism pre-operatively changed either to against-the-rule or oblique astigmatism between the first week and first month postoperatively had turned into with-the-rule astigmatism. It was noticed that one eye had with-the-rule astigmatism pre-operatively turned into against-the-rule astigmatism postoperatively and did not return to with-the-rule astigmatism. Also, 2 eyes had against-the-rule astigmatism. One of them, its axes, did not change throughout the follow-up period, while the other had turned to with-the-rule astigmatism at the third month post-operatively. This finding indicated that 10% of astigmatism-induced by pterygium could be against-the-rule, which in turn can lead to the fact that nasal pterygium might cause steepness other than flatness on the nasal Hemi-meridian and could also be due to the naturally occurring astigmatism.

Yagmur *et al*. [20] reported that surgical intervention of pterygium resulted in an increase in the mean refractive power at one month after pterygium surgery, which indicated a steepening of the flattened cornea. **Ozdemir and Cinal** [21] also reported that the mean corneal refractive power was 42.51±1.99 D at the pre-operative period, 43.95±1.58D at the early postoperative period, and 43.89±1.8D at the late postoperative period. **Fan *et al*.** [22] reported that after pterygium surgery, Sim Ki increased from 44.94±1.41 D pre-operatively to 45.23±0.78D postoperatively in the vertical meridian, while Sim K2 increased from 43.71±1.12 D pre-operatively to 44.40±0.83 D in the horizontal meridian postoperatively.

Our study also showed a statistically significant increase in the BFS, Simi, and Sim K2 values after pterygium excision, particularly after the first week and first month post-operatively. Sim Ki was 47.7±5.0 pre-operatively, 48.8±4.4 one week post-operatively and 47.9±5.0 one month post-operatively, and returned to 46.3 ± 4.1 on the third month of follow up after the use of lubricants. Sim K2 was 44.4±11.0D pre-operatively, 46.1 ± 4.4D one week post-operatively and 44.8 ± 3.7 one month post-operatively decreasing to 43.6 ± 2.4 on the third month of the follow up after the use of lubricants, giving the cornea its symmetric and uniform configuration. **Salih and Sharif** [10] reported that many studies showed a significant correlation between the degree of pterygium extension onto the cornea and the amount of induced astigmatism. This indicates that the size of pterygium is an important predictor for the amount of induced corneal astigmatism. **Stern and Lin** [7] reported that pterygium extending to >45% of the corneal radius or within 3.2 mm of the visual axis produced increasing degrees of induced astigmatism, significantly improved by successful surgery.

Our study showed a decrease in the astigmatic power [BFC] in the three groups; Group 1, which included 2-2.9 mm of pterygia, showed a mean reduction from 3.17D pre-operatively to 1.9D three months post-operatively. Group 2 that included 3-3.9 mm of pterygia, showed a mean decrease from 5.27D pre-operatively to 1.83D in the third month. Group 3, which included 4 - 4.9 mm of pterygia, showed a mean reduction from 14.82D to 7.53D in the third month.

In our study we used the bare sclera technique for treatment of pterygia. **Ozer *et al.*** [23] reported a study to compare the long-term follow-up results of the bare sclera technique, limbal-conjunctival autograft technique and amniotic membrane graft technique in primary pterygium excisions. They found that the limbal-conjunctival autograft technique is a significantly more effective procedure than the bare sclera technique and the amniotic membrane graft technique, with decreased recurrence rates after pterygium excision. They concluded that limbal-conjunctival autograft is useful treatment in pterygium surgery due to higher success rates and lower recurrence rates. Amniotic membrane grafts may be an alternative surgical technique for pterygium treatment for patients with or without glaucoma who might need glaucoma surgery in the future.

Conclusion: Pterygium excision with bare sclera technique is associated with improvement in UCVA, BCVA, decrease in astigmatic values, and improvement in corneal aberrations. Results of a small pterygium excision are better than of a large one, to avoid visual impairment in late cases. Pterygium excision with bare sclera technique is associated with a 35% recurrence rate.

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