

Corneal Topographic Changes After Two Different Grafting Pterygium Surgery Techniques

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ABSTRACT

Background: Surgical treatment of pterygium can result in corneal topographic changes. It is not clear that those changes are universal or technique dependent.

Objectives: Evaluation of corneal topographic changes following pterygium surgery using sutured conjunctival autografting versus sutured amniotic membrane grafting.

Patients and methods: In this prospective randomized study, patients suffering from primary pterygia that extend between two and four millimeters over the cornea were included. Patients were separated into group I; underwent pterygium excision with sutured conjunctival autograft, and group II underwent pterygium excision with sutured amniotic membrane graft after a comprehensive ophthalmic examination. The following topographic parameters were noted: the axial curvature map, elevation posterior map, and corneal thickness map.

Results: Significant improvement of the mean visual acuity measured using the logMAR test was found in both groups postoperatively. The improvement included UCVA and BCVA as well as anterior keratometric and cylindrical power of the cornea without significant dissimilarity between study groups. No statistically considerable changes in the posterior corneal surface or the corneal thickness were found.

Conclusions: Pterygium excision can cause changes in the keratometric and cylindrical power of the cornea without the affection of the posterior corneal surface or the corneal thickness. The corneal topographic changes caused by the pterygium were not varied with the type of surgical technique used.

Keywords: Amniotic membrane, conjunctival autograft, pterygium, corneal topography.

INTRODUCTION

Surgical excision remains the main treatment for pterygium causing impaired vision, cosmetic deformity, restriction of ocular motility, and/or marked irritation unrelieved by medical management ⁽¹⁾.

To reduce the rate of recurrence following surgical treatment of pterygium, various techniques have been applied which include pterygium resection combined with conjunctival auto-graft, amniotic membrane graft, or with stem cell transplantation ⁽²⁾.

Refractive and topographic changes possibly occur as a result of pterygium existence or due to surgical interference for its management ⁽³⁾. Previous studies tried to correlate the degree of spherocylindrical changes to the technique of surgical removal used keratometric values only ⁽⁴⁾. Scheimpflug topographer imaging system was reported to accurately determine different corneal characteristics as curvature and topography of anterior and posterior corneal surface as well as its thickness ⁽⁵⁾.

This study intended to evaluate the different corneal topographic changes following pterygium excision using two grafting techniques and their refractive outcome.

PATIENTS AND METHODS

In this perspective, controlled, randomized study (randomization was achieved using a software computer program); voluntary patients aged 20 - 60 years old and suffering from primary pterygia that extend between two and four millimeters over the cornea were included. After

a full explanation about the nature of the procedure used written consents were taken from the patients before surgery.

History of ocular trauma, ocular surgery, recurrent pterygium, and presence of corneal abnormalities such as scarring was accepted as exclusion criteria. Included patients were allocated into two groups: group I; comprised 20 eyes that underwent pterygium excision with sutured conjunctival autograft, and group II comprised 20 eyes that underwent pterygium excision with sutured amniotic membrane graft.

After obtaining the required consent, complete medical and ocular history was taken from all patients. Then they were exposed to comprehensive ophthalmic examination including visual acuity [uncorrected (UCVA) and best-corrected (BCVA)], refraction, tonometry, as well as slit-lamp examination. Computerized video keratography (Scheimpflug topographer TMS -5, Tomey GmbH Technology, and vision, Nurnberg, Germany) was obtained before the surgery.

The following topographic parameters were noted: the axial curvature map [steep axis of curvature (Ks), the flat axis of curvature (Kf), average K and corneal astigmatism (Cyl)], elevation posterior map (Ks, Kf, average K, Cyl), corneal thickness map (apex and thinnest location).

Intraoperative:



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Twenty eyes underwent pterygium excision with conjunctival autograft, the other twenty eyes underwent pterygium excision with amniotic membrane graft. Surgical procedures were performed under local anesthesia (peribulbar anesthesia). The peeling of pterygium off the cornea followed by excision of its body was done. The area of the bare sclera was covered using superior temporal conjunctival autograft in group I; or using a lyophilized amniotic membrane (Biomembrane freeze-dried sterile human amnion membrane, National Center for Radiation Research) in group II. Either type of graft was then sutured using 8/0 vicryl suture (AssuCryl®, Assut Medical, Switzerland) and the eye was patched.

Postoperative:

For all eyes in both groups, combined steroid and antibiotic eye drops were prescribed four times daily to all patients postoperatively (Tobradex®, Alcon Laboratories, Inc., Fort Worth, Texas, USA). Follow up was started one day, one week, one month, and three months postoperatively. During each visit, patients were evaluated clinically, and corneal topography was repeated by the end of the 3rd month.

Ethical consideration:

Protocols of the study were following the tenets of the Helsinki declaration and were approved by the ethical committee and the Institutional Review Board of Aswan univeristy. Confidentiality of all data was ensured at every step of the study.

Statistical analysis:

The arithmetic mean, standard deviation, and other tests as the unpaired student's (t) test, Wilcoxon ranks test, Fisher's exact test, Yates corrected Chi-square, and Mann-Whitney test was used for statistical analysis of the result of this study when appropriate. Probability (P) value < 0.05 was reported significant. SPSS program, Version 16.0, Chicago, IL, USA was used.

RESULTS

In this present study forty eyes of 40 patients with primary pterygia underwent pterygium surgery, they were classified into 2 groups; group I: including 20 eyes who underwent excision of pterygium using sutured

conjunctival autograft (CAG), and group II: including 20 eyes who underwent pterygium excision with sutured amniotic membrane graft (AMG).

There was no difference between both study groups as regards to age, gender, or duration of pterygium (**Table 1**).

In group, I significant improvement in visual acuity (UCVA and BCVA) was recorded and was found to be associated with a marked decrease in the mean spherical equivalent postoperatively compared to preoperative figures. Also, significant changes in anterior surface topographic parameters were found with an increase in K reading particularly with steeping in the flatter meridian (Kf). This resulted in a significant decrease in the cylindrical power of the cornea. On the other hand, no significant changes were noted in the posterior surface keratometric power or thickness of the cornea (**Table 2**).

Similar results were found in group II with significant improvement in visual acuity (UCVA and BCVA) and marked decrease in the mean spherical equivalent postoperatively compared to preoperative findings. Moreover, significant changes in anterior surface keratometric readings particularly with steeping in the flatter meridian (Kf) and a significant decrease in the cylindrical power of the cornea. Also, there were no significant changes in the posterior surface keratometric power or thickness of the cornea (**Table 3**).

Comparing both studied groups as regards UCVA as well as BCVA measured with LogMAR, there were no statistically significant differences pre or postoperative (P-value 0.521 and 0.236 respectively). Also, no difference in spherical equivalent was noted between both groups postoperatively (p-value 0.098) even though a mild significant difference in the basic preoperative spherical equivalent was found between them (p-value 0.043) (**Table 4**).

Study groups revealed no differences in keratometric parameters before surgery as regards to both steep and flat posterior curvatures. The lack of significant disparity between both groups was also extended postoperatively. Moreover, no significant difference was found between group I and group II when corneal thickness (apical and thinnest point) was compared pre and postoperatively (**Table 5**).

Table (1): Demographic differences between group I (conjunctival autografting), and group II (amniotic membrane grafting).

		Group I (n=20)	Group II (n=20)	P-value
Age	Mean ±SD	42.8±9.7	42.25±11.17	0.869
Sex No (%)	Male	11(55%)	10(50%)	0.752
	Female	9(45%)	10(50%)	
Eye No (%)	Right	8(40%)	8(40%)	1.000
	Left	12(60%)	12(60%)	
Duration of pterygium (months)	Mean ±SD	22.2 ±9.76	18 ±6.156	0.173

Independent t-test, P-value significant<0.05.

Table (2): Comparison between preoperative and postoperative visual acuity, spherical equivalent, corneal keratometric power and corneal thickness in group I (conjunctival autografting)

		Preoperative Mean ± SD	Postoperative Mean ± SD	z	p-value
VA (logMAR)	UCVA	0.304±0.186	0.219±0.140	3.526	0.000
	BCVA	0.177±0.163	0.092±0.112	3.314	0.001
SE (diopter)		1.502±1.602	0.983±1.371	2.42	0.016
Keratometry Power (diopter)	Ks	45.36±2.57	45.92±2.30 D	3.248	0.001
	Kf	41.9±2.32	43.73±2.55 D	3.92	0.00009
	Kav	43.64±1.63	44.83±2.26 D	3.92	0.00009
	CYL	3.42±3.66	1.95±1.33	2.725	0.006
Posterior surface power (diopter)	Ks	-.67±0.599D	-6.64±0.668D	0.299	0.765
	Kf	-6.21±0.266	-.245±0.282D	0.897	0.37
	Kav	-6.43±0.394	-6.45±0.434	0.037	0.97
	CYL	0.538±0.593	0.408±0.532	1.048	0.295
Pachymetry (µm)	Apex	542.6±59.02	539.1±59.31	0.691	0.49
	Thinnest	522.5±43.97	518.0±80.82	0.653	0.514

VA= visual acuity, logMAR (Logarithm of Minimal Resolution angle), UCVA (Uncorrected Visual Acuity), BCVA (Best Corrected Visual Acuity), Ks = steep keratometric axis, Kf = flat keratometric axis, Kav =Keratometric average, CYL = cylinder, D =diopter, SE = spherical equivalent, µm = micrometer, P value <0.05 significant (Wilcoxon ranks test)

Table (3): Comparison between preoperative and postoperative visual acuity, spherical equivalent, corneal keratometric power, and corneal thickness in group II (amniotic membrane grafting)

		Preoperative Mean ± SD	Postoperative Mean ± SD	z	p-value
VA (logMAR)	UCVA	0.279±0.215	0.189±0.153	3.065	0.002
	BCVA	0.115±0.129	0.051±0.068	2.740	0.006
SE (diopter)		0.396 + 3.485	0.0110±3.188	2.334	0.020
Keratometry Power (diopter)	Ks	45.05±2.10	44.93 + 2.27	1.642	0.1
	Kf	42.74±2.65	43.23 + 2.41	3.174	0.002
	Kav	43.89±2.23	44.08 + 2.25	3.174	0.002
	CYL	2.31±1.72	1.54 + 1.14	2.763	0.006
Posterior surface power (diopter)	Ks	-6.59±0.52 D	-6.47±0.33 D	1.064	0.287
	Kf	-6.23±0.25 D	-6.18±0.29 D	0.645	0.519
	Kav	-6.41±0.33 D	-6.33±0.27 D	1.008	0.313
	CYL	0.368±0.468	0.324±0.415	0.205	0.837
Pachymetry (µm)	Apex	558.3±66.83	556.8±60.28	0.168	0.867
	Thinnest	532.8±49.78	531.2±63.83	0.336	0.737

VA= visual acuity, logMAR (Logarithm of Minimal Resolution angle), UCVA (Uncorrected Visual Acuity), BCVA (Best Corrected Visual Acuity), Ks = steep keratometric axis, Kf = flat keratometric axis, Kav =Keratometric average, CYL = cylinder, D =diopter, SE = spherical equivalent, µm = micrometer, P value <0.05 significant (Wilcoxon ranks test)

Table (4): Comparison between group I (conjunctival autografting) and group II (amniotic membrane grafting) as regards to visual acuity and spherical equivalent pre and postoperatively

Item	Preoperative				Postoperative				Test
	Mean ±SD		z	p-value	Mean ±SD		z	p-value	
	Group I	Group II			Group I	Group II			
UCVA (Log MAR)	0.304±0.186	0.279±0.215	0.642	0.521	0.219±0.140	0.189±0.153	0.999	0.318	Mann-Whitney test
BCVA (Log MAR)	0.177±0.163	0.115±0.129	1.186	0.236	0.092±0.112	0.051±0.068	1.204	0.229	
SE	1.502±1.602	0.396 ±3.485	2.019	0.043	0.983±1.371	0.0110±3.188	1.653	0.098	

logMAR (Logarithm of Minimal Resolution angle), UCVA (Uncorrected Visual Acuity), BCVA (Best Corrected Visual Acuity), SE = spherical equivalent, P value < 0.05 = significant

Table (5): Comparison between group I (conjunctival autografting) and group II (amniotic membrane grafting) as regards to keratometric and pachymetric parameters pre and postoperatively

Item	Preoperative				Postoperative				Test	
	Mean ±SD		z	p-value	Mean ±SD		z	P-value		
	Group I	Group II			Group I	Group II				
Anterior Keratometry	Ks	45.36±2.57	45.05±2.10	0.338	0.735	45.92+ 2.3	44.93 + 2.27	1.407	0.16	Mann-Whitney test
	Kf	41.9±2.32	42.74±2.65	1.298	0.194	43.73 + 2.55	43.23 + 2.41	0.46	0.646	
	Kav	43.64±1.63	43.89±2.23	0.433	0.665	44.83 + 2.26	44.08 + 2.25	0.839	0.402	
	CYL	3.42±3.66	2.31±1.72	1.19	0.234	1.95 + 1.33	1.54 + 1.14	1.244	0.213	
Posterior keratometry	Ks	-6.67+ 0.6	-6.59 + 0.52	0.501	0.617	-6.64+ 0.67	-6.47 + 0.33	0.771	0.441	
	Kf	-6.21 + 0.266	-6.23 + 0.25	0.176	0.860.	-6.25 + 0.28	-6.18 + 0.29	0.622	0.534	
	Kav	-6.43 + 0.39	-6.41 + 0.33	0.122	0.903	-6.45 + 0.43	-6.33 + 0.27	0.717	0.473	
	CYL	0.54 + 0.59	0.37 + 0.47	1.476	0.14	0.41 + 0.53	0.32 + 0.42	1.435	0.151	
Pachymetry	Apex	542.55+ 59.02	558.3 + 66.83	0.906	0.365	558.3 + 66.83	556.75 + 60.28	0.168	0.867	Wilcoxon signed ranks
	Thin	522.45 + 43.97	532.8 + 49.78	0.582	0.561	532.8 + 49.78	531.15 + 63.83	0.336	0.737	

VA= visual acuity, Ks = steep keratometric axis, Kf= flat keratometric axis, Kav =Keratometric average, CYL = cylinder, P value < 0.05 = significant

DISCUSSION

Correlation between degrees of corneal parameters changes to particular techniques of pterygium excision surgery was infrequently discussed by previous studies. Some of them again used keratometric values only to confirm various changes (4).

Using Scheimpflug topographer; the recent study tried to answer three questions; (1) is the change of the anterior corneal surface parameters following pterygium excision is technique dependant or not; (2) is there a change in central or apical corneal thickness related to pterygium excision; and (3) is there a change in posterior corneal parameters associated with pterygium excision? The study also investigated the effects of surgical treatment of pterygium on different aspects of visual performance.

Significant improvement of the mean visual acuity was found in the current study in both study groups postoperatively. The improvement included both UCVA and BCVA with no significant difference between both groups. Improvement in the visual acuity following surgical excision was owed in previous researches to reconstruction of the normal surface, improvement in the mean surface regularity index, surface asymmetry index as well as aberration coefficient (6, 7, 8).

In a related study, Razmjoo *et al.* (9) found that the UCVA and BCVA to be improved from 0.31 ± 0.26 and 0.19 ± 0.21 LogMar preoperatively to 0.14 ± 0.17 and 0.03 ± 0.04 LogMar postoperatively, respectively. This also agreed with other investigators who confirmed the previous results (10, 11).

The amount of induced astigmatism was reduced postoperatively, so the topographic cylinder decreased significantly after removal of the pterygium in both groups, this result resembles that of Yagmar *et al.* (12) who found that the topographic cylinder changed from 4.65±3.02 to 2.33±2.26D postoperatively. Comparable results were noted by other investigators as well (13).

Lacking disparity between both groups; the spherical equivalent of manifest refraction was

improved after surgery due to a decrease in astigmatism caused by the growth of the pterygium on the corneal surface. Kheirkhah *et al.* (14) also found similar results in their study. They found a postoperative reduction of anterior corneal surface astigmatism of about 2.74 diopters. Similar findings were reported by other investigators (15,16).

Garg *et al.* (17) found that using amniotic membrane graft and conjunctival autograft techniques supplementing pterygium excision surgeries were more effective in reducing astigmatism than pterygium excision surgery using bare sclera technique. But they reported no significant differences between both grafting techniques as regards to keratometric astigmatic reduction. This was also in agreement with the current study.

The mean keratometric power increased postoperatively in both operated groups as a result of the significant steepening of the flat meridian (Kf) with no significant differences between the study groups using two different graft techniques. The postoperative changes in the steep meridian (Ks) could be due to the coupling effect on the cornea. These results were in agreement with that of Altan-Yaycioglu *et al.* (4) who compared keratometric changes after five different surgical techniques using keratometry only and had no difference between all surgical methods used. Similar keratometric and topographic changes were reported in previous studies following merely the use of conjunctival autografts (15, 18) or with the use of different techniques (19).

As anticipated, there were no statistically significant changes found in the posterior corneal surface parameters in the two studied groups preoperatively or postoperatively since surgical manipulations did not involve the posterior corneal surface. These results agree with Kheirkhah *et al.* (14) results who reported insignificant decreased mean K of the posterior corneal surface changed from 0.35 ± 0.39 D preoperatively to 0.32 ± 0.2 D postoperatively.

In the current study, no significant differences were found regarding postoperative apical corneal thickness from that of preoperative values in both conjunctival autograft and amniotic membrane groups. The difference between both groups was also not significant. **Oltulu *et al.*** ⁽⁷⁾ investigated the changes caused by pterygium surgery on the cornea and anterior chamber using Pentacam without significantly different changes in anterior chamber parameters were found.

CONCLUSIONS

Pterygium excision can cause changes in the keratometric and cylindrical power of the anterior corneal surface without the affection of the posterior cornea or the corneal thickness. The corneal topographic changes were equally not dependent on the type of graft techniques used.

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Declaration of interest:

The authors report no conflict of interest.

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