The Effect of Pterygium Surgery on Corneal Topography

Adnan Cinal, MD; Tekin Yasar, MD; Ahmet Demirok, MD; Habibe Topuz, MD

**OBJECTIVE:** The aim of this prospective randomized clinical study was to evaluate the effect of pterygium surgery on the corneal topography using a computerized corneal topography system.

**PATIENTS AND METHODS:** Computerized corneal topography was performed on 27 patients with primary pterygium before and after pterygium excision surgery. The topographical changes that occurred following surgery were evaluated using paired and unpaired two-tailed t-test and Pearson coefficient of correlation analyses. Simulated keratometric astigmatism at the central 3 mm and the total mean refractive powers of the whole cornea were measured before and after surgery. Following surgery, flattened or steepened corneal areas were determined.

**RESULTS:** Simulated keratometric astigmatism at 3 mm was found to be 2.30 ± 2.08 D (0.2 - 7.63) preoperatively and 0.82 ± 0.74 D (0.06 - 2.79) postoperatively. The difference between these two values was statistically significant (t = -3.46, P = 0.002). Total mean refractive power of the whole cornea was found to be 42.26 ± 0.63 (40.80 - 43.64) preoperatively and 43.69 ± 0.88 (41.50 - 44.90) postoperatively and the difference was 1.42 ± 0.87. There was a statistically significant high difference (t = 28.36, P < 0.001). When preoperative and postoperative corneal topographies were compared, the whole cornea was found steeper at the postoperative period except a little region in the superior nasal quadrant.

**CONCLUSION:** We believe that corneal topographical changes caused by the pterygium are almost reversible after surgical treatment, and postoperatively the cornea becomes steeper.


---

**INTRODUCTION**

Pterygium is a frequently seen pathology in the ophthalmology practice. Pterygium that spreads over the cornea is caused by visual disturbance and cosmetic problems. While pterygium surgery has been performed for years, the effects of surgery on the corneal topography have not been well documented. To our knowledge, there is only one study.1 Only two keratometry studies have been reported in the literature, and these evaluated only the central 3 mm of the cornea.2,3

The effects of pterygium operation on the corneal topography using a computerized corneal topography system were evaluated in this study.
PATIENTS AND METHODS

Cases and Operations

Included in the study were 27 eyes of 27 patients with primary pterygium (18 right eyes, 9 left eyes) examined between October 1997 and June 1998. Indications for the surgery were cosmetic problems and corneal astigmatism.

The criterion for entry in the study included patients with primary pterygium. Patients with a history of ocular surgery, ocular trauma, contact lens wear, keratoconus, or anterior segment diseases other than pterygium were excluded.

All pterygia were located nasally, never temporally. The maximum extension of each pterygium onto the cornea along the 180° horizontal meridian was measured using a slit-lamp microscope with a Castroviejo caliper. Mean pterygium length was found to be 3.28 ± 1.39 mm (1-6 mm).

Operations were done under topical anesthesia with 0.4% oxibuprocaine and intraconjunctival xylocaine injections. The pterygium was cut from its apex and then pulled and peeled, and excised with some conjunctiva. Remnants over the cornea were shaved. Cauterization was done to the limbal region. Then 0.02% concentration of mitomycin-C was applied to the pterygium region with a sponge for 3 minutes. This region was then washed with saline solution for 5 minutes. No suture was applied, and the sclera was left bare. A tobramycin 0.3% drop was applied, and the eye was patched. All the operations were done by two surgeons using the same technique. At the postoperative period, the eyes were patched until corneal reepithelization occurred, and tobramycin, 0.3% drop, was used qid. When the corneal epithelium healed, 1% drop dexamethasone was used qid for 1 month while IOP was kept under control.

Corneal Topography Examinations

All patients underwent an examination including a complete history, manifest refraction, and videokeratography. Appplanation tonometry, artificial tears, or artificial means of opening the eyelid (use of an eyelid speculum) were not permitted before or during topography using the Corneal Analysis System (CAS) (EyeSys Laboratories, Inc., version 2.1). CAS software provides a 24 meridian numeric map with 301 points. The map covers the 10 mm central cornea. Before starting the study, the videokeratograph was calibrated according to the user's manual provided by EyeSys Laboratories.

Videokeratographs were taken by having the patient place his or her chin on the chin rest and fixate on a green light using the target eye. Blinking was allowed except just before the image was captured on the computer. Good alignment was determined by clear focusing of the vertical and horizontal crosshairs with the central third of the nasal and temporal focusing aperture. Image quality was evaluated by assessing the completeness and continuity of the rings. If the central 6 digitized edges of the rings of the keratograph were not complete or continuous, the image was discarded and repeated until a satisfactory image was obtained. Videokeratographs were taken in the same examination room, under the same lighting conditions, and by the same experienced ophthalmologist. If peripheral rings were incomplete (corneal topography was too distorted for automated digitization by the CAS), videokeratograph images were reprocessed manually by the author (AC) according to the user's manual to ensure completing the incomplete rings. After processing, the keratographs displayed numeric maps using the standard relative scale.

Computerized corneal topography was applied to all the patients at the preoperative and postoperative third day, first week, first, second, third, and fourth months. Corneal topography measurements were evaluated for the study before surgery and after the last postoperative visit.

Data Analysis

Corneal topographic maps (numeric maps) were divided into 301 fields in 24 meridians. For output, a diagram with 301 fields was constructed, representing the right corneal topography. The left eyes were reproduced as mirror images. The refractive values of the 301 defined points of numeric map were allocated to the respective fields. The values of refractive power in each of the 301 corneal fields of 27 eyes were stored.

We allocated one color to each field, representing its mean refractive power for all groups. In this way, we produced a color-coded map showing the distribution of the mean refractive power of patients throughout the cornea. We also compared refractive power of each field of all the assessments, and the significance levels of the unpaired t-tests were superimposed on the color-coded map. We used batch-by-batch statistical analysis of topography that permits an investigation of different pathologic processes on induced corneal asymmetry. Based on the simulated keratometric read-
**Table 1. Correlation Analysis Results Between Some Features of Patients**

<table>
<thead>
<tr>
<th>Features</th>
<th>( r_p ) and ( P ) values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pterygium size and surgically induced corneal astigmatism</td>
<td>( r_p: 0.46, P = 0.02 )</td>
</tr>
<tr>
<td>Pterygium size and preoperative astigmatism</td>
<td>( r_p: 0.63, P = 0.001 )</td>
</tr>
<tr>
<td>Pterygium size and postoperative astigmatism</td>
<td>( r_p: 0.45, P = 0.02 )</td>
</tr>
<tr>
<td>Preoperative astigmatism and surgically induced corneal astigmatism</td>
<td>( r_p: 0.96, P &lt; 0.001 )</td>
</tr>
<tr>
<td>Preoperative astigmatism and postoperative astigmatism</td>
<td>( r_p: 0.22, P = 0.30 )</td>
</tr>
</tbody>
</table>

ings, astigmatic changes after pterygium operation were evaluated according to the vector analysis method.

The axes of astigmatism at the 3 mm central of cornea were assessed as follows: The cylinder was with-the-rule if the positive cylinder axis between 60° and 120°. It was against-the-rule if it was between 0° and 30° or 150° and 180°. The cylinder was oblique if the positive cylinder axis was between 31° and 59° or 121° and 149°.

**Statistical Analysis**

Data were expressed in diopters as mean ± standard deviation and were compared using paired two-tailed \( t \)-tests, with \( P \) values of less than 0.05 considered statistically significant. To determine whether or not there were linear correlations between some parameters, statistical correlation analysis (two-tailed, Pearson coefficient of correlation) was used.

**RESULTS**

The mean age was 46.56 ± 11.22 in the patients. Cosmetic correction was achieved in all patients following operations. No complication or recurrence was seen during the follow-up period. Postoperative follow-up time was 2.52 ± 0.98 months (1-4 months).

Preoperative simulated keratometric astigmatism was reduced in 25 patients, and increased in 2 patients after surgery. Simulated keratometric astigmatism at the central 3 mm was found to be 2.30 ± 2.08 D (0.2-7.63), preoperatively and 0.82 ± 0.74 D (0.06 - 2.79), postoperatively. The difference between these two means was statistically significant (\( t = -3.46, P = 0.002 \)). The surgically-induced corneal astigmatism was 2.33 ± 2.55 D (0.37 - 7.94). There was significant positive linear correlation between pterygium size and amount of the surgically-induced corneal astigmatism at the central 3 mm. (\( r_p: 0.46, P = 0.02 \)). There were also significant positive linear correlations between pterygium size and preoperative corneal astigmatism (\( r_p: 0.63, P = 0.001 \)) and between pterygium size and postoperative corneal astigmatism (\( r_p: 0.45, P = 0.02 \)).

We found highly significant positive linear correlation between preoperative corneal astigmatism and the surgically induced corneal astigmatism (\( r_p: 0.96, P < 0.001 \)). No linear correlation between preoperative corneal astigmatism and postoperative corneal astigmatism was found (\( r_p: 0.22, P = 0.30 \) (Table 1). Corneal astigmatism at the central 3 mm decreased in 81.5% of the patients at the postoperative period. Mean positive astigmatic axis at the 3 mm was 72.41 ± 18.9 degrees preoperatively and 43.70 ± 35.2 degrees postoperatively. There was a statistically significant difference between the two mean axes (\( t = -4.1, P < 0.001 \)). The distribution of astigmatic axes in the groups is given in Table 2. As shown in the “Table With the Rule” astigmatism changed to “Against the Rule,” and “Oblique” astigmatism after operation. Pre- and post-operative topography results of one typical pattern for patients with pterygium are shown in Figures 1 and 2.

Total corneal refractive power was established using mean values of 301 points of the cornea. Total refractive power was 42.26 ± 0.63 D (40.80 - 43.64) preoperatively, and 43.69 ± 0.88 D (41.50 - 44.90) postoperatively; and the difference was 1.42 ± 0.87 D. There was a highly significant difference (\( t = 28.36, P < 0.001 \)).

When the average values of preoperative corneal topographies were evaluated, the steepest region was superior quadrant. Also a region located at the inferi-

---

**Table 2. The Distribution of Astigmatic Axes in the Groups**

<table>
<thead>
<tr>
<th></th>
<th>With the Rule</th>
<th>Against the Rule</th>
<th>Oblique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preop</td>
<td>20(74%)</td>
<td>-</td>
<td>7(26%)</td>
</tr>
<tr>
<td>Postop</td>
<td>6(22%)</td>
<td>10(37%)</td>
<td>11(41%)</td>
</tr>
</tbody>
</table>
or temporal close to the central point was steeper than the other regions (Figure 3). The cornea was flat especially at the midline and nasal quadrant where the pterygium was located. When the figure established using average values of postoperative corneal topographies was evaluated, the postoperative corneal topographies were different than those of the preoperative topographies (Figure 4).

The steepest part of the cornea was located at the central 3 mm circle, and the peripheral cornea remained flatter than the central. But the inferior nasal quadrant was the flattest part of the cornea.

When pre- and post-operative corneal topographies were compared, the whole cornea except a little region in the superior nasal quadrant was found to be steeper at the postoperative period (Figure 5). The increase in postoperative refractive power was found especially at the central cornea, horizontally located in the pterygium region.

When changes of the corneal topography following pterygium operations were statistically evaluated, at the postoperative period, the cornea was found significantly steeper than the preoperative period except a thin zone located at the superior, inferior, and nasal quadrants (Figure 6).

**DISCUSSION**

Pterygium is a frequently seen disease in ophthalmology and has a negative effect on corneal topography that causes visual disturbance and cosmetic problems. The most frequently used method of pterygium treatment is surgical excision. It is known that the corneal astigmatism at 3 mm, which is induced by pterygium, is decreased following pterygium excision, but it is not certain yet how the whole of the cornea is effected by this operation. In this study we evaluated and discussed changes of corneal topography follow-
Figure 5. Mean refractive differences between preoperative and postoperative corneas (right eye, all values were expressed in diopters).

Figure 6. Results of statistical analysis of mean refractive power between preoperative and postoperative corneas.

ing pterygium excision.

Soriano et al.3 reported that corneal astigmatism at the central 3 mm decreased from 2.41 D to 1.29 D after pterygium surgery. George et al.4 revealed that it decreased from 5.90 D to 1.90 D following the surgery, and they reported significant visual recovery. Corneal astigmatism at 3 mm also decreased from 2.30 D to 0.82 D in our patients following surgery. When a pterygium that causes astigmatism is excised, the cornea returns partially to its original topography pattern. But in some cases astigmatism persisted up to 1.60 D as reported at other studies. We believe the causes of this astigmatism sequela must be investigated. Is it because of surgical methods or characteristics of the cornea and pterygium?

Alison et al.4 reported that pterygia extending >45% of the corneal radius or within 2.5 mm of the visual axis produce increasing degrees of astigmatism. The higher the pterygium size, the higher the preoperative and postoperative corneal astigmatism will be. The surgical excision of pterygium in early stages will result in lower postoperative corneal astigmatism and better visual capacity.

Soriano et al.3 revealed that there was a positive linear correlation between preoperative astigmatism, and the difference between pre- and post-operative astigmatism. We also found that there was a positive linear correlation between preoperative astigmatism and the surgically induced corneal astigmatism. Additionally, there was a positive linear correlation between pterygium size and the surgically-induced corneal astigmatism.

We expected some linear relations between preoperative astigmatism and postoperative astigmatism, but these could not be found. This may be related to the unexpected effects of surgery on corneal astigmatism in some patients like those with increased astigmatism after surgery. However, the small number of patients in our study might have played a role in these results.

Astigmatism was with the rule in the preoperative period in 74% of patients. Against the rule, astigmatism was not seen in this period. But after the operation, 41% of astigmatism was oblique and 37% was against the rule. With the rule, astigmatism was found in only 22% of the patients. These results revealed that astigmatic axis changed from with the rule to against the rule after surgery. Pterygium surgeons should consider this point before operation.

In the cases with pterygium, the cornea was found flatter between pterygium region and corneal apex.5-9 In our study, preoperative corneas were flat by the pterygium effect, and this flattening effect was especially seen horizontally on the nasal quadrant where the pterygium was located. There is no agreement about these changes caused by the pterygium. Some hypotheses about these effects are: pterygium compresses the cornea,10 the tears that collected around the cornea shows the cornea much flatter,5 and the pterygium pulls and distorts the cornea.7,11

Stern et al.1 reported that the cornea was improved, corneal anomalies disappeared, and surface regularity and asymmetry indices were significantly decreased following operations. But they had no data about how the cornea would be much steeper. In our study, we found postoperative corneal topography pathphy and the central cornea was found steeper than
the periphery. The flattening on the horizontal line of the cornea disappeared and the cornea was reunited with its symmetric patterns. For that reason, we believe that changes on the cornea that occurred because of the pterygium can dissolve using suitable surgical methods.

The changes that occurred following surgery were seen especially and significantly at the flattened regions (especially horizontal lines that crossed the central cornea) by the pterygium effect.

As a result, we believe that corneal topographical changes caused by the pterygium are almost reversible by surgical correction, and the postoperative cornea becomes steeper than the preoperative cornea. Preoperative astigmatic axis may change from with the rule to against the rule. More detailed studies are necessary for supporting these data.

**REFERENCES**


