Comparative study of astigmatic changes following pterygium excision with conjunctival autograft transplantation

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ABSTRACT
This prospective clinical study compared the corneal astigmatism before and after pterygium excision surgery with conjunctival autograft transplantation. The study included 37 eyes of 37 patients diagnosed with pterygium. All participants underwent pterygium excision with conjunctival autograft transplantation and were examined preoperatively and on the first and third month post-intervention. Comprehensive ophthalmic examination was done and measurements included: pterygium size, uncorrected and best corrected visual acuity and corneal astigmatism. Preoperative and postoperative values were compared using the nonparametric Wilcoxon signed-ranks test. The mean pterygium horizontal length was 2.18 mm (range 1–4 mm). A statistically significant correlation was observed between the pterygium length and preoperative astigmatism. The mean corneal astigmatism preoperatively was 1.26 ± 1.18 D and decreased to 0.84 ± 0.73 D three months after the intervention (p < 0.001). The mean UCVA (uncorrected visual acuity) preoperatively was 0.75, improving to 0.77; the mean BCVA (best corrected visual acuity) before surgery was 0.86, improving to 0.87 after the procedure. These results demonstrated that the amount of induced astigmatism increased in proportion to the size of the pterygium increase. The corneal astigmatism tended to decrease significantly following pterygium excision with conjunctival autograft transplantation.

Introduction
Pterygium is a common disorder of the ocular surface. It represents as a wing-shaped fibrovascular proliferation of the bulbar conjunctiva, which encroaches onto the cornea. It is located in the interpalpebral area, most frequently in its nasal part. Ultraviolet radiation has been suggested as a major environmental factor in pterygium formation [1]. The exact pathogenesis is incompletely understood. Different environmental factors, such as sunlight, dry, dusty, windy climate, some occupational factors lead to ocular surface inflammation, tear film disturbances and damage of limbal stem cells. These progenitor cells are located in the corneoscleral limbus, in the so-called palisades of Vogt, and are responsible for the self-renewal of corneal epithelium and its regeneration after injury. Limbal stem cells act as a functional barrier between the cornea and conjunctiva and their local deficiency leads to conjunctivalization of the corneal surface with vascularization and thus to pterygium formation [2]. Some authors define opthalmic pterygium as a stem cell disorder with premalignant features [3].

Pterygium leads to ocular surface irritation, inflammation, foreign body sensation and cosmetic problems. It affects vision due to induced astigmatism or due to direct invasion of the pupillary plan and visual axis. Pterygium causes flattening of the cornea in the horizontal meridian and consequently results in with-the-rule corneal astigmatism, which is irregular in advanced stages of the disease. Pterygium leads to deterioration of visual performance not only by causing refractive changes but also by causing a significant increase in corneal wavefront aberrations [4].

Pterygium is treated mainly by surgery. The main unsolved problem in pterygium surgery is the tendency for recurrence. The gold standard treatment is conjunctival autografting following pterygium excision, giving low rate of recurrences and complications.

In the present study, our aim was to evaluate the effect of surgery on the changes in visual acuity and corneal astigmatism following pterygium removal with conjunctival autograft transplantation.

Subjects and methods
Thirty seven eyes of 37 patients (22 males, 15 females) with primary pterygia were enrolled in the study. The study was performed in the Ophthalmology Clinic in Sofia.
Military Medical Academy – Sofia between January 2015 and February 2017. After obtaining informed consent, comprehensive ophthalmic examination was performed on all patients before the surgery. This included slit-lamp examination with anterior segment photography, measurement of the pterygium’s size (the distance from the limbus to the apex), uncorrected and best corrected visual acuity, corneal astigmatism – flat and steep corneal meridian dioptric values. Keratometry was performed with an automated autorefractokeratometer. All participants underwent pterygium excision with conjunctival autograft transplantation. Surgical procedures were performed using the same technique in all patients and included the following steps: after topical and subconjunctival anaesthesia administration, the pterygium was removed from the ocular surface with resection of the Tenon’s capsule under the body of the lesion; conjunctival autograft was harvested from the upper temporal quadrant of the bulbar conjunctiva of the same eye with care to obtain a Tenon-free graft; the limbal end of the autograft was placed over the limbal area of the surgical bed and sutured with 10/0 nylon sutures. The pterygium tissue was sent for histopathological analysis. Following surgery, the patients were treated with topical antibiotic, steroid and lubricant drops and sutures were removed at the 2nd postoperative week visit. Patients were re-examined in the 1st and 3rd month after intervention and visual acuity and astigmatic changes (flat and steep corneal meridian dioptric values and astigmatism axis) measurements were performed.

Data are presented as mean values with standard deviation (±SD). Statistical analysis was done using SPSS version 13.0. Comparison between preoperative and postoperative astigmatic values was made using the nonparametric Wilcoxon signed-ranks test. Statistical significance was considered at \( p < 0.05 \).

**Results and discussion**

In the present study, we investigated 37 eyes of 37 patients (22 males, 15 females). The mean age of the participants was 62.3 ± 15.4 years (range 28–86 years) (Table 1). All eyes had primary nasal pterygium. We investigated 16 (43.24%) right eyes and 21 (56.76%) left eyes.

| Sex   | \( N \) | %   | Mean  | SD  | Min  | Max  |
|-------|--------|-----|-------|-----|------|------|
| Male  | 22     | 59.5| 61.4  | 13.6| 36.0 | 83.0 |
| Female| 15     | 40.5| 63.6  | 18.0| 28.0 | 86.0 |
| Total | 37     | 100.0| 62.3  | 15.4| 28.0 | 86.0 |

We divided the examined eyes into two groups, depending on the size (corneal involvement) of the pterygium: grade I for pterygium size of less than 2 mm and grade II for pterygium size equal to or greater than 2 mm. In our study, 12 eyes (32.4%) had grade I pterygia and 25 eyes (67.6%) had grade II pterygia (Table 2).

The mean preoperative astigmatism in the eyes with grade I pterygia was 0.67 ± 0.63 (range 0.00D–2.25 D) and in eyes with grade II pterygia, 1.55 ± 1.28D (range 0.00–5.00 D) (Table 3).

The comparison between the pre- and post-operative values of corneal astigmatism and visual acuity was performed using Wilcoxon signed-ranks test (nonparametric test). The preoperative refractive cylinder was 1.26 ± 1.18 D (range 0.00D–5.00D), which improved to 0.84 ± 0.73 D (range 0.00D–3.00D) \( p < 0.001 \) postoperatively. The mean UCVA (uncorrected visual acuity) preoperatively was 0.75 ± 0.29 (range 0.08–1.00) and improved to 0.77 ± 0.29 (range 0.08–1.00) \( p = 0.005 \). The mean BCVA (best corrected visual acuity) preoperatively was 0.86 ± 0.28 (range 0.08–1.00) and improved to 0.87 ± 0.28 (range 0.08–1.00) postoperatively \( p = 0.034 \). The visual acuity remained the same in 27 eyes (72.97%), 10 eyes (27.03%) showed 1- or 2-line improvement in vision (Tables 4–6). Neither complications, nor recurrences developed during the follow-up period.

Pterygium causes irritation, redness, ocular surface inflammation and tear film instability. The visual complaints of patients with pterygium are associated with induced astigmatism or are due to direct invasion of the visual axis. The flattening of the cornea in the horizontal meridian that accompanies the development of pterygium results in induced-with-the-rule corneal astigmatism. It in turn leads to blurred vision, reduced contrast sensitivity, halos and distortion.

The exact mechanism underlying the flattening is not completely clear. Some authors [5,6] have considered the main role of pooling of tears and formation of tear meniscus between the corneal apex and the elevated head of pterygium, but have excluded any role of fibrovascular traction. Other investigators like Budack et al. [7] hypothesized that the flattening of the cornea is due to the mechanical traction exerted by the lesion.

In this study, we explored whether there was relationship between the size (corneal invasion) of pterygium and the amount of induced astigmatism. According to

### Table 1. Patients’ profile.

| Pterygium size, mm | \( N \) | %   | Mean  | SD  | Min  | Max  |
|-------------------|-------|-----|-------|-----|------|------|
| < 2 mm            | 12    | 32.4|       |     |      |      |
| ≥ 2 mm            | 25    | 67.6|       |     |      |      |
| Total             | 37    | 100.0|       |     |      |      |

### Table 2. Grading the pterygia into two grades.

| Pterygium size, mm | \( N \) | %   | Mean  | SD  | Min  | Max  |
|-------------------|-------|-----|-------|-----|------|------|
| < 2 mm            | 12    | 32.4|       |     |      |      |
| ≥ 2 mm            | 25    | 67.6|       |     |      |      |
| Total             | 37    | 100.0|       |     |      |      |
our results, there was statistically significant correlation between the size of pterygium and induced astigmatism ($p = 0.011$). This observation was in agreement with Lin and Stern [8], who also found a significant correlation between pterygium size and induced corneal astigmatism. They reported that pterygia induce asymmetric with-the-rule astigmatism and that lesions extending to over 45% of the corneal radius or within 3.2 mm of the visual axis produce an increasing degree of induced astigmatism. Mohammad-Salih and Sharif [9] studied the relationship between pterygium size (extension, width and total area) and corneal astigmatism. They reported that pterygium extension and total area have a stronger correlation with corneal astigmatism than does width, and suggested that surgical intervention is indicated when pterygium extension exceeded 2.2 mm. Kampitak [10] studied the effect of pterygium on corneal astigmatism and reported that the extension of the lesion significantly correlated with the degree of corneal astigmatism in the positive direction with the highest percentage of with-the-rule astigmatism. The author reported that when the horizontal extension of pterygium is more than 2.25 mm, there was a chance of developing corneal astigmatism of 2 D or more and that size should be considered within the limits of surgery. According to Avisar et al. [11], when primary pterygium reaches more than 1 mm in size from the limbus, it induces with-the-rule significant astigmatism. They reported that topographic astigmatism tends to be improved by successful removal of the lesion and suggested early surgical intervention. Altan-Yaycioglu et al. [12] investigated the astigmatic changes following pterygium removal using five different methods and concluded that it is better to remove the pterygium when it measures nearly 2 mm in horizontal length. In our study, we also found that the main difference in induced corneal astigmatism was between pterygia smaller than 2 mm and those bigger than 2 mm in length.

Conclusions

Pterygium is an ocular surface lesion that causes flattening of the cornea and thus induces with-the-rule corneal astigmatism. The astigmatic changes induced by the lesion were hemiastigmatic due to the location of pterygium predominantly in the nasal interpalpebral area. This astigmatism tended to increase with the increasing size of the lesion. Conjunctival autografting was successful in preventing pterygium recurrence. The present study confirmed that successful surgical excision of pterygium with conjunctival autograft – the ‘gold standard’ procedure – results in significant reduction of induced corneal astigmatism and provides visual and cosmetic improvement.

Disclosure statement

No potential conflict of interest was reported by the authors.
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