A comparative study of ocular aberrations: before and after pterygium surgery.

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Background: *Pterygium can distort the corneal surface of the eye, causing astigmatism and higher-order aberrations that affect vision. Pterygium surgery may reduce ocular aberrations.*

Purpose: *To evaluate the effect of pterygium excision on ocular aberrations.*

Methods: *Thirty-two patients with primary pterygium were enrolled. Values of ocular aberration consisting of defocus, astigmatism, secondary astigmatism, coma, secondary coma, trefoil, spherical aberration, quadrafoil and pentafoil were measured with wavefront analysis technique. These parameters were recorded before and one-month after the pterygium excision. Results were analyzed by paired t-test.*

Results: *Of the 32 patients, there were 9 males (28%) and 23 females (72%), mean age was 58.4+/-10.6 years. Mean ratio of pterygium size to a corneal diameter was 0.31+/-0.02. Fourteen patients (44%) had uncorrected visual acuity greater than 20/40 in the affected eyes, and 21 patients (66%) had visual acuity greater than 20/40 after pterygium excision. Mean values of ocular aberrations in micrometers (before and after surgery) were 0.91±0.88, 0.45±0.75 for defocus, 0.22±0.52, 0.32±0.19 for astigmatism, 0.09±0.81, -0.01±0.07 for secondary astigmatism, -0.03±0.20, -0.07±0.12 for coma, -0.05±0.10, 0.02+/-0.03 for secondary coma, 0.70±0.45, 0.09±0.15 for trefoil, -0.01±0.07, 0.01±0.03 for secondary trefoil, 0.29±0.08, 0.05±0.05 for spherical aberration, -0.10±0.13, 0.14±0.09 for quadrafoil and -0.02±0.09, 0.02+/-0.04 for pentafoil. All parameters showed no statistical difference pre-surgery and one-month post-surgery ($p>0.05$) except for spherical aberration ($p=0.012$).*

Conclusion: *Excision of pterygium can reduce spherical aberration.*

Conflict of interest: *none.*

Keywords: *pterygium, pterygium surgery, wavefront analysis, ocular aberrations*

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Introduction

Pterygium is a disease of the ocular surface with a wing-shaped growth of fibrovascular tissue on the corneal surface. The occurrence of pterygium is associated with long-term ultraviolet light exposure.[1] It can cause dry eye, ocular irritation, visual disturbances and cosmetic impairment.

When a pterygium significantly invades the cornea, it can distort the shape of the anterior surface of the eye, causing astigmatism and higher order aberrations.[2-5] These aberrations can cause many abnormal image perceptions such as glare (intensification of light sources), halos (circles of light around light sources), coma (light to be smeared like the tail of a comet) and starburst patterns (patterns of small lights around light sources). Several studies evaluated the effects of post pterygium excision on refraction and regular astigmatism, which are the lower order aberrations.[6-8] In irregular astigmatism, the principle meridians are not perpendicular to each other, therefore could not form spherical and cylindrical patterns. Recently, regarding corneal higher aberrations, wave-front technology enables us to evaluate irregular astigmatism more precisely. But there is insufficient data regarding higher order aberrations.

Excision of pterygium eliminated the induced higher order aberrations. Levels of higher order aberrations that occur postoperatively may depend on multiple factors such as the size of pterygium involving the cornea, and the duration of pterygium presentation.[9-11]

This study was designed to measure the alteration of higher order aberrations in pterygium excision eyes by comparing between preoperative and postoperative eyes, using wavefront technology.

Methods

A prospective, comparative study was performed at Thammasat eye center in Thailand between January 2015 – July 2017. Thirty-two patients with primary pterygium planned for pterygium excision were included. All patients underwent pterygium excision with amniotic membrane transplantation. Exclusion criteria were a history of previous ocular surface surgery, ocular trauma, corneal scarring, recurrent pterygium and the patients who cannot be examined by wavefront analysis.

This study has been approved by the ethics committee of Thammasat University, Thailand. Informed consent was obtained from all patients. The authors verified that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research, adhering to the tenets of the declaration of Helsinki. There are no conflicts of interest in this study.

Patients planned for pterygium excision with amniotic membrane graft were examined before and at one month after surgery. General eye examination included visual acuity using a Snellen chart. Pterygium sizes were measured with a slit lamp by using a slit beam positioned horizontally from the limbus to the head of the pterygium. Corneal diameter was measured by using a slit beam positioned horizontally from the limbus to limbus. Ocular aberrations values including defocus, astigmatism, secondary astigmatism, coma, secondary coma, trefoil, secondary trefoil, spherical aberration, quadrafoil and pentafoil were measured with Analyzer II Diagnostic device, WaveLight®, Alcon, Switzerland by the same technician. Those parameters were

recorded before pterygium excision and one-month after the operation.

After surgery, topical steroids, topical antibiotics and artificial tears were prescribed and adjusted by surgeons.

Statistical analysis was performed using the paired t-test for comparing between preoperative and postoperative measurements. A P value of less than 0.05 was considered significant.

Results

In this study, there were 32 patients (23 females and 9 males) with mean age 58.4+/-10.6 years. Preoperatively, there were 14 patients (44%) had uncorrected visual acuity greater than 20/40 in the involved eyes and 21 patients (66%) had uncorrected visual acuity greater than 20/40 after pterygium excision. Mean pterygium size was 5.6±0.3 millimeters. Mean corneal diameter was 11.2±0.1 millimeters. Mean ratio of pterygium size to corneal diameter was 0.3±0.1 millimeters. There was no pterygium recurrence at one month after surgery. (Table 1)

Table 1: Baseline clinical characteristics of patients

n = 32	Results
Age (years) Mean ±SD	58.4±10.6
Gender - Female (n) - Male (n)	 23 (72%) 9 (28%)
Surgical technique - Pterygium excision with AMT (n)	 32(100%)
Size (mm) Mean ±SD - Corneal diameter - Horizontal size of pterygium - Horizontal size of pterygium / corneal diameter	 11.2±0.1 5.6±0.3 0.3±0.1
Patients at 1 month visit (n)	32(100%)
Recurrence at 1 month visit (n)	0(0%)
Uncorrected visual acuity > 20/40 - Pre-operation (n) - Post-operation (n)	 14(44%) 21(66%)

Mean and standard error of ocular aberrations in micrometers before and after surgery were described in table 2. Of all the parameters included in this study, only spherical aberration showed statistically significant difference between before and one-month post-surgery ($p<0.05$).

Table 2: Mean ± Standard Error values (micrometers) of ocular aberrations in eyes with pre and post pterygium surgery

Type of Aberrations	Pre-surgery	1-month post-surgery	P-value (paired t-test)
Defocus	0.91±0.88	0.45±0.75	0.585
Astigmatism	0.22±0.52	0.32±0.19	0.852
Secondary astigmatism	0.09±0.81	-0.01±0.07	0.318
Coma	-0.03±0.20	-0.07±0.12	0.810
Secondary Coma	-0.05±0.10	0.02±0.03	0.427
Trefoil	0.70±0.45	0.09±0.15	0.127
Secondary Trefoil	-0.01±0.07	0.01±0.03	0.787
Spherical aberration	0.29±0.08	0.05±0.05	0.012
Quardrafoil	-0.10±0.13	0.14±0.09	0.135
Pentafoil	-0.02±0.09	0.02±0.04	0.656

Discussion

The effect of pterygium on optical irregularity and distortion is well known.[2-5] It has been documented that pterygium excision significantly improved visual acuity.[6,10,12] Results similar to that of our study, uncorrected visual acuity was found to be improved after pterygium excision. The most important part of the optical quality of the eye comprised of corneal wavefront aberrations.[13]

Comparison of pre and postoperative wavefront analysis parameters showed that surgical treatment of the pterygium improves numerous parameters.[9-11] Ozgurhan et al. reported the significant reduction of ocular aberrations, including total wavefront aberration, higher order aberration, trefoil, and coma after pterygium surgery.[11] Pesodovs et al. also reported that Zernike polynomial wavefront aberrations especially trefoil were largely eliminated by surgery[9] as well as the previous study of Razmjoo et al. showed that surgical treatment of the pterygium improved higher order aberration, quadrafoil, vertical coma and secondary astigmatism.[10] Gumus et al. showed the reduced postoperative aberrations continue to change beyond the early postoperative period even into the 1-year postoperative period.[14]

Our results demonstrated that many parameters of ocular aberrations, measured by wavefront technique, underwent changes after pterygium excision. Only spherical aberration significantly decreased after pterygium excision. The other parameters, including defocus and trefoil, were improved after pterygium surgery but were not significantly different. This may be due to our small sample size and the rather short duration of data collection (one month after pterygium excision).

In the future, the further studied should be conducted under a larger number of

sample size and longer follow-up period to get more significant results.

Conclusion

Pterygium has influence on ocular aberrations and excision of pterygium can reduce spherical aberration.

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