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ORIGINAL ARTICLE

Relationship Between Pterygium Size and Accuracy of Intraocular Lens Power Calculation

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Abstract

Background: **Conjunctival tissue encroaches triangularly into the cornea to form pterygium. In a progressive pterygium, it may be red, thick, and fleshy, while in an atrophic pterygium, it may be pale, thin, and membranous. The precision of the estimated intraocular lens (IOL) power can be affected by significant corneal astigmatism brought on by a big pterygium.**

Objective: **To detect the relationship between pterygium size and its impact on IOL power calculation. That is for accurate calculation of IOL power before cataract surgery.**

Patients and methods: **A prospective, non-randomized controlled clinical trial was performed at the ophthalmology department of Al-Zahraa University Hospital, Al-Azhar University from January 2022 to July 2022. The AL-Azhar University Faculty of Medicine for Girls' Ethical Committee approved this study.**

Results: **There was a significant correlation found between the length (*P* value of <0.001), width (*P* value of <0.001) and CPTA% (*P* value of <0.001) of the pterygium and the stimulated astigmatism by Pearson Correlation Coefficient among patients group.**

Pearson correlation analysis showed highly strong relationships between the length, width and CPTA% of the pterygium and the IOL power change (preop−postop) in all formulas (*P* value < 0.001).

Conclusion: **If simultaneous surgery is being planned for eyes with pterygia that are 2.5−4.0 mm in length, 5.5−8.0 mm^2 in area, and less than 4 mm in width, the implanted IOL power should be at least 0.50 D lower than the expected IOL power.**

Keywords: Corneo-pterygium total area, IOL power calculation, Pterygium induce astigmatism, Pterygium

1. Introduction

Pterygium is a widespread condition altering the surface of the eye. It might happen at the same time as cataract because both diseases are very common in elderly persons. The bulbar conjunctiva and Tenon membrane have overgrown fibrovascularly over the cornea.[1]

Pterygium and senile cataract's specific aetiology and physiopathology are not yet known. Because both diseases are greatly increased by exposure to UV radiation.[2]

Significant corneal astigmatism brought on by a big pterygium can compromise the accuracy of the IOL power estimate.[3]

Even when pterygium and cataract surgery are done concurrently, a correct IOL power calculation is crucial for superior visual and refractive outcomes and subsequent patient satisfaction.[4]

We sought to evaluate the effects of pterygia on biometric measurements and the relationship between these results and pterygium size. Despite the fact that a pterygium associated with a cataract makes biometry difficult.

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2. Aim of work

To detect the relationship between pterygium size and its impact on IOL power calculation. That is for accurate calculation of IOL power before cataract surgery.

2.1. Study population and design

A prospective, non-randomized controlled clinical trial was performed at the ophthalmology department of Al-Zahraa University Hospital, Al-Azhar University from January 2022 to July 2022.

2.2. The study included 20 participants

Study Group: 20 eyes with primary pterygium.

Population of study: This study involves 20 individuals who had unilateral primary pterygium.

Inclusion criteria: The study comprised individuals with primary pterygium.

Exclusion criteria: Patients with a background of trauma or ocular surgery. Patients with scarring and corneal ectasia.

Study instrument and methods: history study (name, sex, age, occupation, past ophthalmic history and medical history). Full ophthalmic examination, which includes: Using LogMar visual acuity chart that was translated to decimal notation for statistical analysis, visual acuity and BCVA were measured. NIDEX autorefractometer for measuring refractive state. Utilising a TOPCON Slit-Lamp, a microscopic examination of the cornea, sclera, anterior chamber, iris, pupil, and lens is performed (SL). NIDEX air puff tonometer measurement of intraocular pressure (IOP). Using 90+ Lens TOPCON SL biomicroscopy, examine the fundus. Photos obtained on a mobile device were evaluated for size and vascularity of the pterygium. We graded the size and level of corneal involvement from pterygium, according to **Reda *et al.***[5] to 1, 2, and 3 grades. To enhance the exposure of the pterygium and make it easier to measure its proportions, the patients were instructed to stare in the most horizontal direction possible. By measuring the length from the limbus to the apex in millimetres and the width as the maximum vertical distance of the pterygium on the cornea, we were able to determine these measurements in the anterior segment image. Images were downloaded to a laptop and enlarged. The Image-J software was then used to measure the pterygium's dimensions. Before surgery, IOL power for both eyes was calculated using ocular biometry by the IOL Master 700.

2.3. Surgical procedures

Subconjunctival anaesthesia was used during all pterygium procedures. After blunt dissection, the pterygium head was detached from the cornea after anaesthesia was given. It was necessary to remove the subconjunctival tissue from beneath the pterygium's body.

With the use of wet field cautery, the bleeding spots were sealed off. The area beneath the pterygium was dried with a cotton bud while the pterygium's body was kept retracted onto the exposed sclera.

A free LCAG that had been relocated from the superior temporal bulbar conjunctiva to the excision site was used to create limbus-to-limbus overlap. By using a calliper to measure the exposed sclera, the transplant size was determined. Interrupted 8–0 polyglactin sutures were then used to secure the transplant.

Postoperative Evaluation and Follow up: Microscopic examination of the anterior segment using TOPCON SL. Visual acuity measurement using Landolt visual acuity chart. Refractive status using NIDEX autorefractometer. Ocular biometry 1 month and 3 months after operation.

2.4. Statistical analysis

Version 20.0 of the statistical software for social sciences was used to evaluate the recorded data (SPSS Inc., Chicago, Illinois, USA). The mean and standard deviation were used to express quantitative data (SD). Frequency and percentage were used to express qualitative data.

The following tests were done:

(1) Paired sample *t*-test of significance was used when comparing between related sample.
(2) χ^2 test of significance was used in order to compare proportions between qualitative parameters.

Using Pearson's correlation coefficient (r) test, the degree of correlation between two sets of variables was assessed.

(1) The range of values for ‘r’ is from −1 to 1 0 (no linear correlation).

A perfect positive correlation is one. Perfectly adverse correlation is one.

Positive: Increasing the independent variable causes the dependent variable to increase.

Negative: Increasing the independent variable causes the dependent variable to drop.

(1) Scatter plot: a graph in which the values of two variables are shown along two axes, with the arrangement of the points showing the presence of correlation.
(2) The allowable margin of error was set at 5%, and the confidence interval was set at 95%. The *P* value was therefore deemed significant as follows:

Probability (*P*-value).

(1) *P* values that were less than 0.05 were deemed significant.
(2) *P* values of less than 0.001 were regarded as very significant.
(3) *P* values greater than 0.05 were deemed insignificant.

3. Results

Twenty individuals were considered for this investigation. Seventeen (85%) males and three (15%) females. In group 1 fourteen eyes (70%) had anterior segment pathology (cataract) and six (30%) eyes were free. Considering age, their mean age was 54.65 ± 8.55 (range, 30–60) (Table 1).

Table 1. Distribution of demographic information among study groups.

Demographic data	Total ($n = 20$)
Age (years)	
Range	40–70
Mean ± SD	54.65 ± 8.55
Sex	
Female	3 (15%)
Male	17 (85%)
Anterior segment pathology (Cataract)	
No	6 (30%)
Yes	14 (70%)

At 1,3 months after surgery, the corneal astigmatism decreased from 4.23 ± 3.83 to 1.51 ± 1.58 ($P = 0.003$), 1.40 ± 1.43($P = 0.002$), respectively (Table 2).

In the study group, The average K values before surgery were considerably lower than the average K values after surgery. (P value = 0.005). (Table 3).

Significantly positive relationships between the preoperative and postoperative IOL power changes and the horizontal length, width and CPTA% of pterygium in all formulas were discovered (Tables 4–6).

4. Discussion

It is challenging to determine IOL power in patients with lense opacity and pterygium because central keratometry alterations may take place in the pterygium-affected eyes. Significant corneal astigmatism caused by a big pterygium can compromise the accuracy of the IOL power estimate.[6]

Cataract surgeons must understand how pterygium influences the IOL power and corneal astigmatism assessment before deciding on the optimal surgical techniques. Because of the close correlation between PIA and its size, it was anticipated that the IOL power would increase in eyes with pterygia.[7]

Previous research have noted a strong connection between pterygium prevalence and male sex, age, and gender. In our study, older age groups had a

Table 2. Comparison between corneal astigmatism 'd' Pre and postoperative pterygium surgery (After 1 month and after 3 months) among study group.

Corneal astigmatism (d)	Range	Mean ± SD	Paired Sample *t*-test		*P* value
			MD ± SE	*t*-test	
Before surgery	0.34–11.9	4.23 ± 3.83			
After 1 month	0–5	1.51 ± 1.58	2.72 ± 0.79	3.451	0.003*
After 3 months	0–4.5	1.40 ± 1.43	2.83 ± 0.79	3.599	0.002*

Using: Paired Sample *t*-test.
*P value < 0.05 S.

Table 3. Comparison between K readings 'd' Pre and postoperative pterygium surgery. (After 1 month and after 3 months) among study group.

k readings (d)	Range	Mean ± SD	Paired Sample *t*-test		
			MD±SE	*t*-test	*P* value
Before surgery	37.2–46.33	42.39 ± 2.37			
After 1 month	40.88–47.37	43.94 ± 1.66	−1.55 ± 0.48	−3.257	0.004*
After 3 months	40.88–47.37	43.90 ± 1.65	−1.15 ± 0.48	−3.160	0.005*

Using: Paired Sample *t*-test.
*P value < 0.05 S.

Table 4. Relation between horizontal length 'mm' and IOL power change among study group.

IOL Power change	Horizontal Length (mm)			ANOVA	P value
	<2.5 mm (n = 6)	2.5−4 mm (n = 7)	>4 mm (n = 7)		
	Mean ± SD	Mean ± SD	Mean ± SD		
Barrett	0.17 ± 0.26	0.86 ± 0.38	4.14 ± 1.63	30.241	<0.001**
SRK/T	0.00 ± 0.00	0.50 ± 0.00	4.00 ± 1.87	25.960	<0.001**
Holladay	0.08 ± 0.20	0.64 ± 0.38	4.43 ± 2.11	23.077	<0.001**
Hoffer Q	0.25 ± 0.27	0.86 ± 0.38	4.64 ± 2.15	22.328	<0.001**

Using: Mann-Whitney test.
*P value < 0.05 S; **P value < 0.001 HS.

Table 5. Relation between width 'mm' and IOL power changes among study group.

IOL Power change	Width (mm)		U test	P value
	≤4 mm (n = 7)	>4 mm (n = 13)		
	Mean ± SD	Mean ± SD		
Barrett	0.21 ± 0.27	2.65 ± 2.05	−3.103	0.006*
SRK/T	0.07 ± 0.19	2.38 ± 2.25	−2.685	0.015*
Holladay	0.21 ± 0.39	2.65 ± 2.50	−2.530	0.021*
Hoffer Q	0.36 ± 0.38	2.88 ± 2.51	−2.616	0.017*

Using: U-Mann-Whitney test.
*P value < 0.05 S; **P value < 0.001 HS.

higher prevalence, and more men than women were affected.

Regarding BCVA, there was improvement in BCVA before and after pterygium surgery. After three months, the mean BCVA considerably increased from 0.450.22 logMAR units (preoperative range: 0.05−0.8 logMAR units) to 0.630.24 logMAR units (postoperative). This could be related to the significant improvement of astigmatism which decreased in most patients. There was a significant improvement in cylindrical refraction after 1 month from pterygium surgery (P value = 0.003). There was a significant improvement in cylindrical refraction after 3 months from pterygium surgery (P value = 0.002).

According to **Sharma *et al.***[8] the mean BCVA showed a significant improvement after a year, going from 0.008 0.03 logMAR units postoperatively to 0.667 0.24 logMAR units (0.3−1 logMAR units) preoperatively.

Preoperatively average K values in the study group were noticeably lower than postoperatively average K values (P value = 0.005).

Koc *et al.*[9] the biometric information and the average K value in the two groups, which supports our findings. Average K levels before to surgery were lower in the study group than in the control group. (P = 0.002). Additionally, the preoperatively average K values for the study group were substantially lower than the postoperatively mean K values.

In our study we found a considerable reduction in the average corneal astigmatism from 4.23 ± 3.83D preoperatively to 1.40 ± 1.43D three months after surgery.

In our study there was a significant correlation found between the length (r-value 0.739 and P value of <0.001), width (r-value 0.704 and P value of <0.001), and CPTA% (r-value 0.786 and P value of<0.001), of the pterygium and the induced astigmatism by Pearson Correlation Coefficient among patients group.

In keeping with our findings, **Tang *et al.***[3] exhibited considerable associations using pearson correlation and linear regression analysis between PIA and the pterygium width, length, area, and cross-sectional area (r2 = 0.42, 0.53, 0.56, and 0.37, respectively; all with P values 0.001). Height of the pterygium was not linked with PIA (P = 0.274).

Table 6. Relation between CPTA% and IOL power change among study group.

IOL Power change	CPTA%			H-test	P value
	<5.5% (n = 6)	5.5−8% (n = 5)	>8% (n = 9)		
	Mean ± SD	Mean ± SD	Mean ± SD		
Barrett	0.17 ± 0.26	0.80 ± 0.45	3.44 ± 1.98	11.912	<0.001**
SRK/T	0.00 ± 0.00	0.50 ± 0.00	3.22 ± 2.24	9.567	0.002*
Holladay	0.08 ± 0.20	0.50 ± 0.35	3.67 ± 2.37	10.691	<0.001**
Hoffer Q	0.25 ± 0.27	0.80 ± 0.45	3.83 ± 2.46	9.552	0.002*

Using: H-Kruskal Wallis test.
*P value < 0.05 S; **P-value <0.001 HS.

Sharma *et al.*[8] In agreement with our findings, the average corneal astigmatism significantly decreased from 1.979 0.84 D preoperatively to 0.54 0.18 D one year after surgery.

Prior to and during pterygium surgery, the AL values in our study were comparable (*P*-value >0.05).

In line with our findings, **Koc** *et al.*[9] found that the AL values in the two groups were comparable ($P = 0.528$), and that the preoperative and postoperative AL values were similar ($P = 0.543$).

In this study, there was a computed IOL power differential between pre and post pterygium surgery that was statistically different (*P* value 0.05).

In line with our findings, **Koc** *et al.*[9] demonstrated that the computed IOL power values prior to surgery were greater than the values following surgery ($P < 0.001$ for all values).

In this study, the Barrett formula showed that an IOL power change of 0.5 D, 0.5–1.0 D, and 1.0 D occurred in 4 eyes (20.0%), 5 eyes (25.00%), and 11 eyes (55.00%), respectively. An IOL power change of 0.5 D was found in 6 eyes (30.0%) using the SRK/T formula, followed by 0.5–1.0 D in 7 eyes (35.00%) and 1.0 D in 7 eyes (35.00%). IOL power changes of 0.5 D were noted using the Holladay method in 6 eyes (30.0%), 0.5–1.0 D in 4, and 1.0 D in 10 eyes (50.00%). 13 eyes (65.00%) in the Hoffer Q trial revealed IOL power changes of less than 0.5 D, 0.5–1.0 D, and more than 1.0 D.

In this subject, the study group's computed IOL power values and mean K values at 3 months after surgery and those in the control group were comparable. (mean K, *P* value = 0.265; SRK/T, *P* value = 0.329; Barrett, *P* value = 0.301; Hoffer Q, *P* value = 0.298; Holladay 1, *P* value = 0.302).

Koc *et al.*[9] demonstrated that the study group's 3 months. Average K, AL, and estimated IOL power values after surgery were comparable to those in the control group. (mean K, P Z.105; AL, P Z.642; SRK/T, P Z.112; SRK II, P Z.089; Hoffer Q, P Z.143; Haigis, P Z.253; Holladay 2, P Z.082). This is in line with our study.

In our study, the horizontal pterygium length and the change in IOL power between the preoperative and postoperative periods showed statistically significant positive relationships (*P* value 0.001) across all formulas (Barrett, SRK/T, Holladay, and Hoffer Q).

It demonstrates that for all formulas, the threshold pterygium length causes an IOL power calculation deviation of at least 0.5D. The findings show that for all formulas, pterygium less than 2.50 mm creates less than 0.5 in IOL power, 2.5mm–4 mm creates between 0.5 and 1 D change in IOL power, and larger than 4 mm creates more than 1D change.

In our investigation, there were substantial positive associations between the preoperative and postoperative changes in IOL power and the width of the pterygium (*P* values = 0.006, 0.015, 0.021, and 0.017 in Barrett, SRK/T, Holladay and Hoffer Q). It demonstrates that for all formulas, the threshold pterygium width causes an IOL power calculation deviation of at least 0.5D. The information indicates that pterygia wider than around 4.00 mm cause a 0.5D or higher variation in IOL calculation.

In our investigation, there were substantial positive associations between the preoperative and postoperative IOL power values and the CPTA% of pterygium. It demonstrates that for all formulas, the threshold pterygium corneo-pterygium total area% results in a 0.5D or higher variation in the IOL power calculation. The data show that for all formulas, pterygium higher than or equal to 8% results in more than 1D change in IOL power estimates. Pterygium less than or roughly 5.5% results in less than 0.5D change in IOL power. All formulas had highly significant connections between the length, width, and CPTA% and the change in IOL power (preop-postop).

The striking correlations **Tang** *et al.*[3] found between the pterygium width, area length and cross-sectional area the anticipated reduction in IOL power ($r2 = 0.18$, 0.15, 0.15 and 0.09, respectively), confirmed our findings. The height of the pterygium did not correspond to the anticipated change in IOL power. The pterygium width was the only persistent predictor of the projected change in IOL power after stepwise regression analysis. Only the pterygium width was a reliable predictor of the anticipated change in IOL power, according to their analysis of the effects of the four pterygium parameters using stepwise linear regression. Additionally, they found that the projected IOL error was >0.5D if the pterygium width was less than 4 mm.

4.1. Conclusion

In conclusion, the only procedure that can be used to treat individuals with pterygium-associated cataracts without producing biometric anomalies is cataract surgery if the pterygium's horizontal length is less than 2.50 mm, its area is less than 5.5 mm, and its breadth is less than 4 mm. The estimated IOL power can be used if simultaneous surgery is preferred. If the pterygium surpasses specified thresholds, it is advisable to undergo surgery before having cataract surgery. If simultaneous surgery is being planned for eyes with pterygia that are 2.5–4.0 mm in length, 5.5–8.0 mm^2 in area, and less than 4 mm in width, the implanted IOL power should be at least 0.50 D lower than the expected IOL power.

Authorship (Authors' contribution)

Study conception and design that include: preparing material, study procedures, collection of the data and analysis contributed to the all authors.

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