The Effect of Pterygium on Corneal Astigmatism

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Abstract

Objective : To determine the effect of pterygium on corneal astigmatism.

Method : Two hundred and forty three eyes of 173 patients with primary pterygium were included in the present study. The extension of pterygium was measured by slit lamp and corneal astigmatism was measured by corneal topography. Correlation of the data was discussed.

Results : The size of pterygium extended from 0.50 mm to 8.10 mm (2.11 ± 1.10). The diopter of corneal astigmatism ranged from 0.10 diopter to 14.60 diopter (1.86 ± 2.39). The axis of corneal astigmatism was found in vertical axis 156 eyes (64.2%), oblique axis 36 eyes (14.8%) and horizontal axis 51 eyes (21.0%). The degree of corneal astigmatism significantly correlated with the extension of pterygium on the cornea (R Square = 0.45, $p < 0.001$). When the extension of pterygium exceeded 2.25 mm, there was a chance of developing corneal astigmatism of 2 diopter or more (86.21% of sensitivity and 80% of specificity).

Conclusion : The extension of pterygium is significantly correlated with the degree of corneal astigmatism in the positive direction, with the highest percentage of with-the-rule astigmatism. Pterygium exceeding 2.25 mm of length should be considered within the limits of surgery.

Key word : Pterygium, Corneal Astigmatism

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Pterygium is fibrovascular tissue that extends to the cornea. It is caused by degeneration of conjunctiva, a result of exposure to ultraviolet ray for a certain period[1-3]. Not only does pterygium cause eye irritation and an unfavourable cosmetic effect, it also causes visual disturbance. When the lesion is large in size, it will block the visual axis and decrease the vision. Moreover, it distorts cornea and causes

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astigmatism[4-6]; so the vision will be decreased even if the lesion is still small in size and does not cause a direct blockage to the visual axis. Recent studies on the change of corneal curvature measured by keratometry[7-9], keratoscope[9-10], refraction[7,9-11] and computerized videokeratography[4,12] showed that pterygium caused with-the-rule astigmatism. However, the studied population was small. Gernerally, pterygium can easily be found in Thai people so the present study was done as a further reference of Thai people.

Objective

The study aimed to find the relationship between the extension of pterygium and corneal astigmatism. If the relationship between the extension of disease and the effect on corneal astigmatism is known, the extension of pterygium may be another indicator for surgery besides impaired vision, severe eye irritation or cosmetic reasons.

METHOD

This was a prospective study. Primary pterygium patients who came to see the ophthalmologist at Thammasat Hospital from April to November 2001 were selected. Patients who had had previous eye surgery, an accident to the eye, or corneal scar were excluded from this study.

Data concerning sex, age, side of the eye with pterygium and the location of pterygium such as nasal side, temporal side or both were collected.

The size of pterygium was measured by the same ophthalmologist using a slit lamp (Haag-Streit Bern Z2981, Switzerland). Measurement was done in horizontal axis from limbus to tip of the lesion with the scale in millimeters. Measurement of corneal curvature was done by the same technician using corneal topography (Orbscan II, Orbtek, Salt lake city USA). The corneal astigmatism was determined by simulated keratometry astigmatism measured by Orbscan topography in positive cylinder.

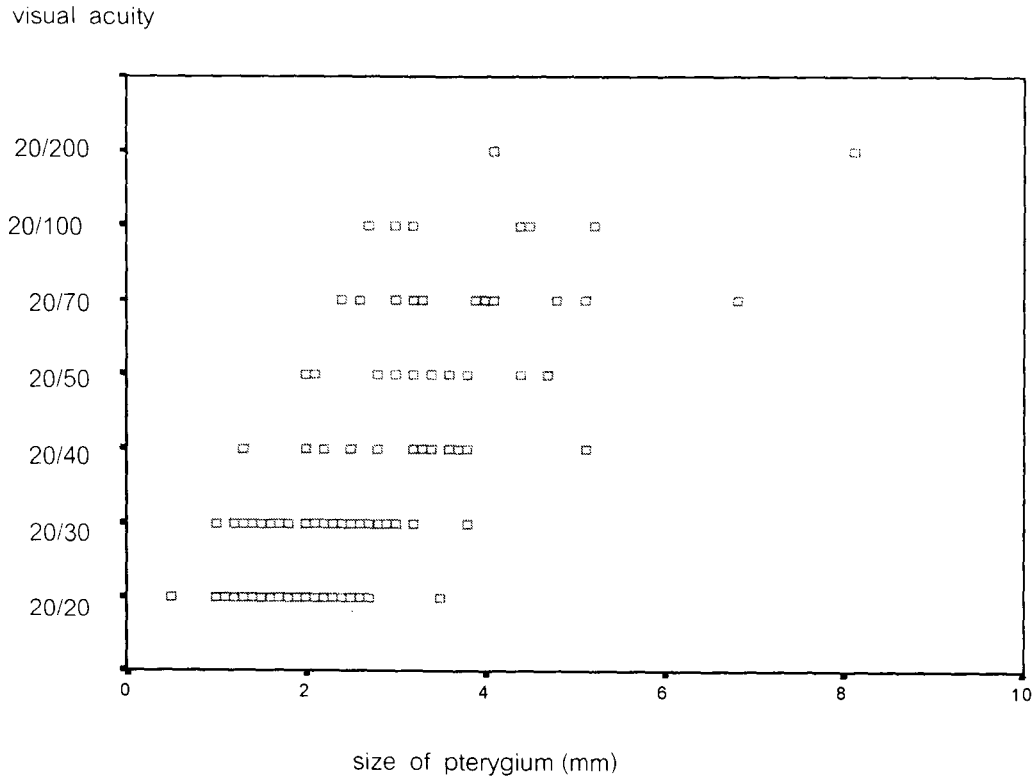

Fig. 1. The relation between size of pterygium and visual acuity.

RESULT

Two hundred and forty-three eyes of 173 patients with primary pterygium were included. The age of the patients ranged from 22 to 80 years with the mean age ± SD of 52.88 ± 14.03. Sixty-three patients were male (36.4%) and 110 patients were female (63.6%). The lesion affected the right and left eyes of 126 (51.9%) and 117 (48.1%) respectively. Location was detected at nasal side, temporal side and both of 223 (91.8%), 9 (3.7%) and 11 (4.5%) respectively. The length of pterygium that extended into the cornea varied from 0.5 mm to 8.1 mm. The mean was 2.11 mm and SD was equal to 1.10. The relation between the size of pterygium and visual acuity is shown in Fig. 1. The larger the pterygium, the lower the visual acuity.

Simulated keratometry astigmatism ranged from 0.1-14.6 diopter with a mean of 1.86 and SD of 2.39. The axis from 0 to 180 degrees was categorized as follows: Horizontal axis (exceeding 0 to 30 degrees and exceeding 150 to 180 degrees) was found in fifty-one eyes (21.0%), oblique axis (exceeding 30 to 60 degrees and exceeding 120 to 150 degrees) was found in thirty-six eyes (14.8%), vertical axis (exceeding 60 to 120 degrees) was found in one hundred and fifty-six eyes (64.2%). The size of pterygium significantly correlated with the corneal astigmatism. The larger the pterygium, the more the astigmatism of the cornea. (R Square = 0.45, $p < 0.001$) (Fig. 2-3).

From the data, when using 2 diopter of corneal astigmatism as the criterion, the statistic result by Receiver Operating Characteristic (ROC) Curve Analysis is shown in Fig. 4 (using sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, positive predictive value, negative predictive value to plot the curve). The area under the curve was 0.882 ($p < 0.001$ Ho : true area = 0.5). The size of pterygium that caused corneal astigmatism was greater than or equal to 2 diopter with sensitivity and specificity was shown in Table 1. Pterygium greater than or equal to 2.25 mm caused corneal astigmatism greater than or equal to 2 diopter with the highest sensitivity plus specificity in prediction (86.21% of sensitivity and 80% of specificity).

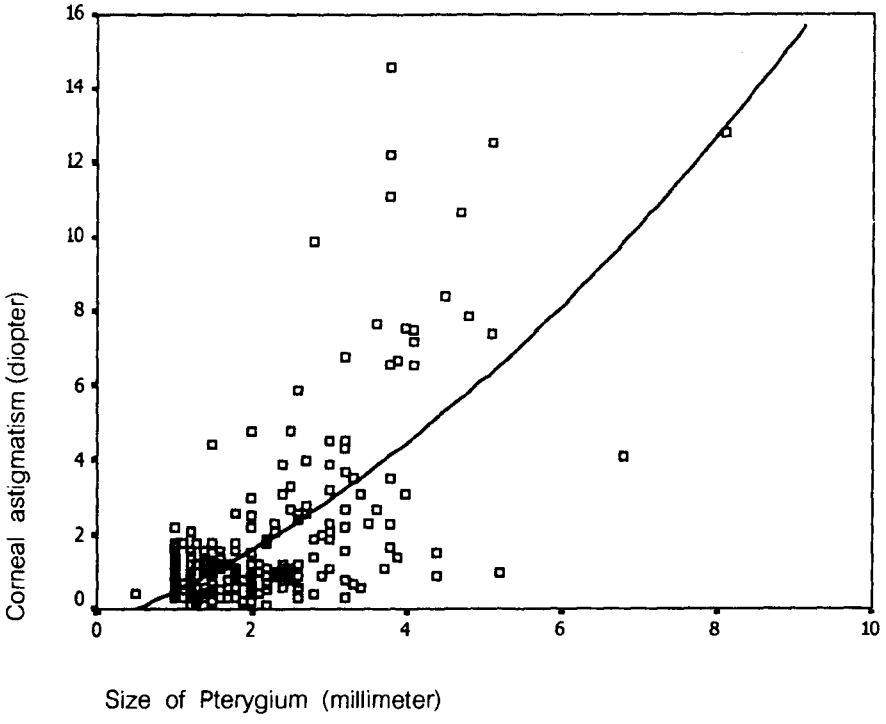

Fig. 2. Correlation between size of pterygium and corneal astigmatism. (Quadratic Regression $Y = a + b_1X + b_2 X^2$)

DISCUSSION

In the present study, the number of females was greater than males. It is possible that female patients have more concern about the disease and its cosmetic effect.

The result revealed that both eyes have an equal chance of developing pterygium (51.9% and 48.1%). The nasal side is the most common location (91.8%). The exact reason for this has not been discovered yet. The study of Kwok and Coroneo revealed that ultraviolet rays focused 20 times more on the nasal limbus than the temporal side. This could be why pterygium develops more on the nasal side[13].

Simulated keratometry data, measured by using corneal topography which shows corneal astigmatism and corneal curvature was used in the present study. The data provides the power and location of the steepest and flattest meridian from a reconstructed corneal surface analogous to values provided by a keratometer which is more reliable than the conventional keratometric reading, especially in eyes with a non spherocylindrical surface because simulated keratometry values are calculated based on numerous dioptic data points on three mire rings or more, whereas the conventional keratometry evaluates the corneal refraction only from three or four data points on a single mire ring[14,15]. But in advanced pterygium, the result from corneal topography could have errors. The way to correct this is to do many measurements and use the average value.

As in other studies, the size of pterygium significantly correlates with corneal astigmatism. Tomidokoro et al studied 19 eyes and found that regular astigmatism and higher order irregularity significantly correlated with the size of pterygium[5]. Another study by Tomidokoro et al with 163 eyes revealed that the size of pterygium significantly correlated with spherical power, astigmatism, surface regularity index and surface asymmetry index[6]. Lin and Stern studied 33 eyes and found that the extension of pterygium was longer than 45 per cent of corneal radius would effect vision[4]. The study of 52 eyes by Seitz et al revealed that there was a relation between the size of pterygium and astigmatism,

Method : Quadratic regression
Dependent variable : Corneal astigmatism (diopter)
Independent variable : Size of pterygium (millimeter)
Listwise Deletion of Missing Data

Multiple R	0.66735
R Square	0.44535
Adjusted R Square	0.44073
Standard Error	1.78513

Analysis of variance:

DF	Sum of Squares	Mean	Square
Regression	2	614.09447	307.04724
Residuals	240	764.80405	3.18668

F = 96.35323 Signif F = 0.0000

Variables in the Equation

Variable	B	SE B	Beta	T	SigT
(Size of pterygium)	0.793154	0.316821	0.366359	2.503	0.0130
(Size of pterygium) **2	0.106589	0.050256	0.310378	2.121	0.0350
(Constant)	-0.413814	0.426250		-0.971	0.3326

Corneal astigmatism = -0.41 + 0.79 (Size of pterygium) + 0.11 (Size of pterygium)^2

Fig. 3. Statistic Correlation between size of pterygium and corneal astigmatism. (Quadratic Regression $Y = a + b_1X + b_2 X^2$)

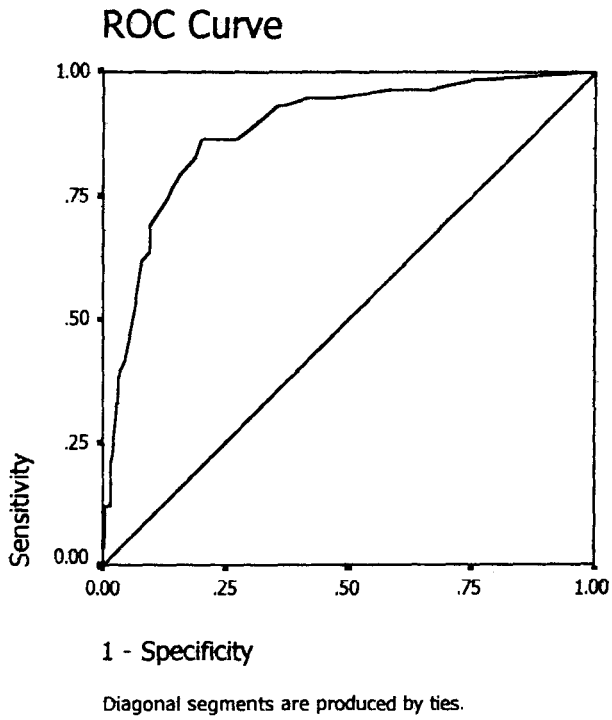

Fig. 4. ROC curve (corneal astigmatism greater than or equal to 2 diopter).

surface regularity index as well as surface asymmetry index[16].

Oner et al suggested that when the length of pterygium exceeded 3 mm, it should be excised since there was a significant correlation to corneal astigmatism[17]. Avisar et al suggested that pterygium excision should be considered when the size of pterygium exceeded 1.1 mm or more than 16 per cent of the corneal radius because it would cause more than 1 diopter of corneal astigmatism[18]. From the present study, when the size of pterygium exceed 2.25 mm, there was a chance of developing corneal astigmatism of 2 diopter or more (86.21% of sensitivity and 80% of specificity) which should be the indicator for surgery. However, the patient's visual acuity must be evaluated and eye irritation and cosmetic value should be discussed.

Total corneal astigmatism in the patient with pterygium is the result of both naturally occuring astigmatism and a induced effect of the disease. From the present study, most patients (64.2%) with the steepest axis of astigmatism usually have vertical meridian. This is the same finding as in other studies [8,10,19-21], whereas the naturally ocurring astigmatism can occur in any axis so pterygium may cause with-the-rule astigmatism of the cornea. With-the-rule astigmatism in patients with pterygium may be from the tractional force of contractile elements within the lesion itself, and it distorts and flattens the cornea [22]. Another possible mechanism may be a localized pooling of tears at the pterygium apex, leading to corneal flattening observed by using corneal topometry and topography[9].

SUMMARY

Pterygium decreases vision even if the size is not so big as to directly block the visual axis. The larger the pterygium detected, the more astigmatism will be found. Mostly it causes with-the-rule astigmatism. When the size of pterygium exceeds or equals 2.25 mm, corneal astigmatism can develop and be more or equal to 2 diopter, which may be another indication for surgery.

Table 1. Pterygium produce corneal astigmatism greater than or equal to 2 diopter.

Size of pterygium (mm) greater than or equal to	Sensitivity	Specificity	Sensitivity + specificity
-0.5	100.00	0.00	100.00
0.75	100.00	0.54	100.54
1.05	98.28	22.70	120.98
1.15	98.28	24.32	122.60
1.25	96.55	33.51	130.07
1.35	96.55	37.30	133.85
1.45	96.55	42.16	138.71
1.55	94.83	51.89	146.72
1.65	94.83	55.14	149.96
1.75	94.83	58.38	153.21
1.85	93.10	63.24	156.35
1.95	93.10	64.32	157.43
2.05	86.21	72.97	159.18
2.15	86.21	75.14	161.34
2.25	**86.21**	**80.00**	**166.21**
2.35	82.76	81.08	163.84
2.45	79.31	84.32	163.63
2.55	74.14	87.03	161.16
2.65	68.97	90.27	159.24
2.75	63.79	90.27	154.06
2.85	62.07	91.89	153.96
2.95	60.34	92.43	152.78
3.1	51.72	93.51	145.24
3.25	41.38	95.68	137.05
3.35	39.66	96.22	135.87
3.45	37.93	96.76	134.69
3.55	36.21	96.76	132.96
3.65	32.76	96.76	129.52
3.75	32.76	97.30	130.06
3.85	22.41	97.84	120.25
3.95	20.69	98.38	119.07
4.05	17.24	98.38	115.62
4.25	12.07	98.38	110.45
4.45	12.07	99.46	111.53
4.6	10.34	99.46	109.80
4.75	8.62	99.46	108.08
4.95	6.90	99.46	106.36
5.15	3.45	99.46	102.91
6	3.45	100.00	103.45
7.45	1.72	100.00	101.72
9.1	0.00	100.00	100.00

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ผลของต้อเนื้อต่อค่าสายตาเอียงที่กระจกตา

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วัตถุประสงค์ : เพื่อศึกษาผลของต้อเนื้อต่อค่าสายตาเอียงที่กระจกตา

วิธีการ : ได้ศึกษาต้อเนื้อที่เป็นครั้งแรกในผู้ป่วย 173 ราย 243 ตา วัดขนาดต้อเนื้อโดยใช้ slit lamp วัดความโค้ง-เอียงของกระจกตาโดยใช้เครื่อง Orbscan corneal topography

ผลการศึกษา : ขนาดของต้อเนื้อที่งอกเข้าไปในกระจกตา 2.11 $\pm$ 1.10 (0.5–8.1) มิลลิเมตร ค่าความเอียงของกระจกตา 1.86 $\pm$ 2.39 (0.10–14.6) diopter มุมของแกนที่เอียงมากจัดเป็นกลุ่มตามแนวตั้งพบ 156 ตา (ร้อยละ 64.2) แนวเฉียงพบ 36 ตา (ร้อยละ 14.8) และแนวนอนพบ 51 ตา (ร้อยละ 21.0) ขนาดของต้อเนื้อและความเอียงของกระจกตามีความสัมพันธ์กันในเชิงบวกอย่างมีนัยสำคัญทางสถิติ (R Square = 0.45 $p < 0.001$) ถ้าขนาดของต้อเนื้อมากกว่าหรือเท่ากับ 2.25 มิลลิเมตร จะทำให้มีโอกาสเกิดค่าสายตาเอียงที่กระจกตามากกว่าหรือเท่ากับ 2 diopter โดยมีค่าความไว (ร้อยละ 86.21) และความจำเพาะ (ร้อยละ 80) ในการทำนายรวมกันได้สูงสุด

สรุป : ขนาดของต้อเนื้อมีความสัมพันธ์กับการเอียงของกระจกตา ขนาดต้อเนื้อยิ่งมากจะพบกระจกตาเอียงได้มากขึ้น และส่วนมากพบเป็นการเอียงแบบ with-the-rule astigmatism ถ้าพบว่าขนาดของต้อเนื้อมากกว่าหรือเท่ากับ 2.25 มิลลิเมตร มีโอกาสที่จะทำให้กระจกตาเอียงมากกว่าหรือเท่ากับ 2 diopter เป็นข้อบ่งชี้ที่น่าจะต้องทำการผ่าตัดรักษา

คำสำคัญ : ต้อเนื้อ, ค่าสายตาเอียงที่กระจกตา

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