

Prevalence of Preoperative Corneal Astigmatism in Patients Undergoing Cataract Surgery at Mettapracharak Hospital, Thailand

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Objective: To describe and analyze the demography and distribution of preoperative corneal astigmatism in patients undergoing cataract surgery at Mettapracharak Hospital.

Material and Method: The medical records of consecutive patients who had cataract surgery between October 1, 2010 and September 30, 2011 at Mettapracharak Hospital were retrospectively reviewed and analyzed. Patient demographic and keratometric data were collected and analyzed.

Results: The present study evaluated the keratometric data in 2,688 eyes of 2,671 patients who had cataract surgery with the mean age of 66.23 ± 10.79 years. The mean corneal astigmatism was 1.09 D (range 0.00-8.50 D). Corneal astigmatism was higher than 1.00 D in 36.6%, between 0.51 D and 1.00 D in 37.9% and 0.50 D or less in 25.5% of eyes. The mean steep keratometry and flat keratometry values were 44.89 ± 1.52 D and 43.81 ± 1.57 D respectively. The magnitude of corneal astigmatism was positively correlated with age ($p < 0.001$) and there was a tendency for corneal astigmatism to increase with age above 50 years. Female had significantly steeper corneas than male. Corneal astigmatism was mainly against-the-rule (the steepest meridian at 180 ± 30 degrees). The type of corneal astigmatism was strongly correlated with age. Against-the-rule astigmatism increased with older age. While aging decreased with-the-rule astigmatism.

Conclusion: The present report showed the pattern of corneal astigmatism before cataract surgery in Thai governmental hospital, approximately one third of cataract patients had more than 1.00 D of astigmatism. This finding provide the important normative reference and help ophthalmologists to plan and manage the cost-effective correction of preexisting corneal astigmatism in cataract patients to achieve the best visual outcome.

Keywords: Preoperative corneal astigmatism, Cataract surgery

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The ultimate aim of the modern cataract surgery is to achieve optimal uncorrected visual acuity (UCVA). Refractive error, especially astigmatism after cataract surgery, is still a considerable problem. Therefore, reducing the preexisting astigmatism can further improve visual outcome after cataract surgery. Astigmatism can be reduced or eliminated by various surgical procedures, including selective position of phacoemulcification incision, corneal relaxing incisions, limbal relaxing incisions, and excimer laser keratectomy. Toric intraocular lens (IOL) implantation is another option that can correct high degrees of astigmatism in cataract patients.

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Previous studies showed that corneal astigmatism changes significantly with age⁽¹⁻³⁾. Therefore, with increasing numbers of patients having cataract and refractive lens exchange surgeries, it becomes mandatory to analyze such data in different age groups. The prevalence of regular corneal astigmatism in the cataract population has been reported with varied distribution of different amounts of corneal astigmatism⁽⁴⁻⁹⁾. However, these studies have largely been performed in Caucasian or Chinese population⁽⁸⁻¹²⁾. There was only one report in Thai cataract surgery candidates at Ramathibodi Hospital⁽¹³⁾. To our best knowledge, this is the first report of prevalence of preoperative corneal astigmatism in cataract patients in a large public hospital belonging to the Ministry of Public Health of Thailand.

The purpose of the present study was to assess the demography and distribution of corneal astigmatism before cataract surgery in a large sample of Thai

patients and to describe the distribution among different age groups to provide data for health care system in designing protocol and budget claim for toric intraocular lens implantation.

Material and Method

Medical records of 2,671 consecutive patients having cataract surgery at Mettapracharak Hospital were collected between October 1, 2010 and September 30, 2011. The present study was approved by the Hospital Ethics Committee. Inclusion criteria were cataract patients who had the cataract surgeries. Exclusion criteria were corneal irregular astigmatism and previous refractive surgery. All patients had keratometric measurement, using partial coherence interferometry (IOL master, Carl Zeiss Meditec AG) or a Canon RK-2 model auto kerato-refractometer (Canon USA) or both. The present study only chose the measurement from the operated eyes. If there were both measurements, we used the data from the IOL master. Corneal astigmatism was classified as with-the-rule when the axis of correcting minus cylinder was within 180 ± 30 degrees (the steep meridian of the cornea being within 90 ± 30 degrees), and against-the-rule when the correcting minus cylinder axis was within 90 ± 30 degrees (the steep meridian of the cornea being within 180 ± 30 degrees). The rest was designated as oblique axis. The subjects were divided into six age groups: 40 years or younger, 41 to 50 years, 51 to 60 years, 61 to 70 years, 71 to 80 years, and 81 years or older.

Statistical analysis was performed using the SPSS statistical package version 16. Descriptive statistics were obtained for each parameter according to each age groups. Statistically significant differences were assessed with the Student t-test ($p < 0.05$, defined as significant difference).

Results

The present study evaluated 2,688 eyes of 2,671 patients who had the cataract surgeries between October 2010 and September 2011 at Mettapracharak Hospital. Of the 2,688 analysed eyes, 1,148 were in men and 1,523 were in women. The average age was 66.23 ± 10.79 years. The mean corneal astigmatism in the studied population was 1.09 ± 0.87 diopter (D). The mean flat keratometry measurement was 43.81 ± 1.57 D and the mean steep keratometry measurement was 44.89 ± 1.62 D (Table 1). Corneal astigmatism was 0.50 D or less in 25.5%, between 0.51 D and 1.00 D in 37.9%, and higher than 1.00 D in 36.6%. Approximately

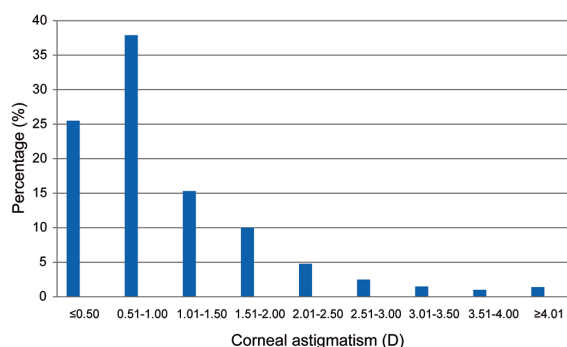


Fig. 1 The percentage of the corneal astigmatism distribution in the entire samples.

two thirds of all eyes had corneal astigmatism less than 1.00 D (Fig. 1). Patients aged 61 to 70 years accounted for 1007 eyes (37.46 %) of the total, follow by age 71 to 80 years (845 eyes, 31.43%) and 51 to 60 years

Table 1. Characteristics of patients

Characteristic	Value
Age (year)	
Mean \pm SD	66.23 \pm 10.79
Range	8, 95
Eyes (n)	2,688
Sex, n (%)	
Male	1,148 (42.98)
Female	1,523 (57.02)
Corneal astigmatism (D)	
Mean \pm SD	1.09 \pm 0.87
Range	0.00, 8.50
K1 (D)	
Mean \pm SD	43.81 \pm 1.57
Range	38.50, 48.91
K2 (D)	
Mean \pm SD	44.89 \pm 1.62
Range	40.00, 51.84

K1 = flat keratometry; K2 = steep keratometry

Table 2. The mean keratometric data by age groups

Age groups (year)	K1 (D)	K2 (D)	Corneal astigmatism (D)	Eyes (n)
≤40	43.44	44.91	1.47	53
41-50	43.68	44.70	1.02	156
51-60	43.79	44.70	0.91	471
61-70	43.86	44.83	0.97	1,007
71-80	43.84	45.04	1.20	845
≥81	43.56	45.25	1.69	156

K1 = flat keratometry; K2 = steep keratometry

(471 eyes, 17.52%). There was a tendency for flat and steep meridian values to gradually increase with age except for the patients younger than 50 years (Table 2). The magnitude of corneal astigmatism was positively correlated with age and the correlation was highly statistically significant ($p < 0.001$). Regarding the distribution of the astigmatism axis, corneal astigmatism was mainly against-the-rule axis (the steepest meridian at 180 ± 30 degrees) (1,409 eyes, 52.42%) whereas 610 eyes (22.69%) had a with-the-rule axis (the steepest meridian at 90 ± 30 degrees) and 669 eyes (24.89%) had an oblique axis (the steepest meridian between 120 and 150 degrees, or between 30 and 60 degrees). The type of corneal astigmatism was strongly correlated with age and the correlation was highly statistically significant ($p < 0.001$). Against-the-rule astigmatism increased with age while with-the-rule astigmatism decreased with age (Fig. 2). Female cornea was significantly steeper than that of male. The mean powers of the steepest and flattest part of the cornea in female were 45.13 and 44.02 D respectively, whereas those of male were 44.52 D and 43.53 D respectively.

Discussion

The present study determined the prevalence of different levels of corneal astigmatism in Thai patients with cataract surgeries in a governmental hospital. Details about the distribution of corneal astigmatism are crucial in designing suitable astigmatic correction. This analysis provides valuable information to the ophthalmologists for planning the future strategy regarding the methods for correcting of the corneal astigmatism. This result showed that the mean corneal astigmatism in our patients was 1.09 ± 0.87 D (range 0.00-8.50 D), which is slightly higher than reports in other population^(8-10,12) but similar to the report of Lekhanont et al from Ramathibodi Hospital in Thailand⁽¹³⁾ (1.05 ± 0.62 D) (Table 3). The mean flat keratometry (43.81 D) and steep keratometry values (44.89 D) were higher than both reports from Ferrer-Blasco et al⁽⁸⁾ (43.48 D/44.08 D) and Khan and Muhtaseb⁽¹⁰⁾ from the United Kingdom (43.43 D/44.46 D) but closer to the reports of Lekhanont et al⁽¹³⁾ (44.03 D/44.91 D), Guen et al⁽¹¹⁾ (43.57 D/44.64 D), and Chen et al⁽¹²⁾ (43.76 D/44.76 D) from China. These observations may be related to the racial factors. Corneal astigmatism of 1.00 D or less was presented in 63.4% while the astigmatism higher than 1.00 D was 36.6%, which was similar to the reports by Lekhanont et al⁽¹³⁾ in Thailand (37.8%). Reports from other countries also showed similar

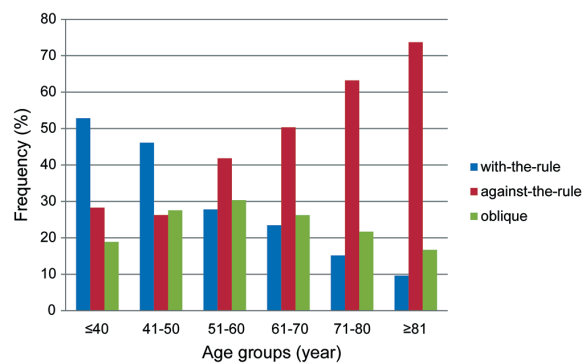


Fig. 2 Frequency distribution of the astigmatism axis among six age groups.

results^(8-10,12,13). Corneal astigmatism was higher than 1.50 D in 21.2%, higher than 2.00 D in 11.2%, higher than 2.50 D in 6.4 % and higher than 3.00 D in 3.9 %.

The present study also found a tendency for corneal astigmatism increased with age above 50 years; this might be explained by the influence of aging changes of the cornea. In the present study, with-the-rule corneal astigmatism was predominated in patients younger than 50 years old. With increasing age, against-the-rule corneal astigmatism became predominant. Similar results were reported in other researchers^(11,12) (Chinese population). Furthermore, the present study found women's corneas were significantly steeper. This observation was consistent with findings in previous studies⁽⁶⁾ that found male eyes had flatter corneal radii than female eyes.

The main limitation of our study was the retrospective data. Since the present study was done during routine clinical practices, the sources of keratometric values were auto kerato-refractometer, IOL master, or both. In case of measured both, we chose the data from IOL master.

Conclusion

The mean corneal astigmatism was 1.09 D (range 0.00-8.50 D) and mean keratometry values were 43.81 D and 44.89 D in flat and steep meridian respectively. Corneal astigmatism was higher than 1.00 D in 36.6%, between 0.51 D and 1.00 D in 37.9% and 0.50 D or less in 25.5% of eyes. Corneal astigmatism was mainly against-the-rule (52.2%) and increased significantly with age.

What is already known on this topic?

The prevalence of regular corneal astigmatism in the cataract population has been reported in

Table 3. Summary of clinical studies of the prevalence of corneal astigmatism in cataract patients

Patient demographics	Study (first author)						
	Present Thailand	Lekhanont (2011) Thailand	Ferrer-Blasco (2009) Spain	Hoffmann (2010) Germany	Khan (2011) United Kingdom	Guan (2012) China	Chen (2013) China
Age (year)							
Mean ± SD	66.23±10.79	68.21±9.19	60.59±9.87	74*	75.54±10.71	72.27±11.59	70.56±9.55
Range	8-95	42-96	32-87	ND	30-104	16-98	40-95
Eyes (n)	2,688	2,010	4,540	23,239	1,230	1,430	4,831
Patients (n)	2,671	1,005	2,415	15,448	746	827	2,849
Gender (%)							
Male	42.98	38.6	31.8	ND	46.0	43.4	36.0
Female	57.02	61.4	68.2	ND	54.0	56.6	64.0
Corneal astigmatism (D)							
Mean±SD	1.09±0.87	1.05±0.62	0.90±0.93	0.98±0.78	1.03±0.73	ND	1.01±0.69
Range	0.00-8.50	0.00-4.50	0.25-6.75	0.00-≥6.00	0.00-6.20	ND	0.05-6.59
>1.00 Diopter	36.60%	37.80%	34.80%	36.05%	40.41%	45.45%	41.30%
K1 (D)				K average			
Mean ± SD	43.81±1.57	44.03±1.56	44.48±1.61	43.32±1.50	43.43±1.48	43.57±1.56	43.76±1.53
K2 (D)							
Mean±SD	44.89±1.57	44.91±1.54	44.08±1.59		44.46±1.56	44.64±1.65	44.76±1.56
Axis	22.7 WTR 52.4 ATR 24.9 OBL	26.1 WTR 62.2 ATR 11.7 OBL	ND	46.8 WTR 34.3 ATR 18.9 OBL	ND	31.82 WTR 62.2 ATR 11.7 OBL	25.1 WTR 58.2 ATR 16.7 OBL

K1 = flat keratometry; K2 = steep keratometry; ND = no data; WTR = with-the-rule axis; ATR = against-the-rule axis; OBL = oblique axis

* Median

Caucasian or Chinese population. There was only one report in Thai cataract surgery candidates. To our best knowledge, the present is the first report of prevalence of preoperative corneal astigmatism in cataract patients in a large public hospital belonging to the Ministry of Public Health of Thailand.

What this study adds?

The authors reported pattern of corneal astigmatism before cataract surgery in a large cohort of patients in Thai governmental hospital. This finding can serve as an important normative reference. The demand for astigmatism correction with a toric intraocular lens will most likely continue to increase. The present study will help ophthalmologists and the hospital administrators to plan and to manage the cost-effective correction of preexisting corneal astigmatism to achieve the best possible visual outcome.

Potential conflicts of interest

None.

References

- Hayashi K, Hayashi H, Hayashi F. Topographic analysis of the changes in corneal shape due to
- Goto T, Klyce SD, Zheng X, Maeda N, Kuroda T, Ide C. Gender- and age-related differences in corneal topography. *Cornea* 2001; 20: 270-6.
- Ferrer-Blasco T, Gonzalez-Mejome JM, Montes-Mico R. Age-related changes in the human visual system and prevalence of refractive conditions in patients attending an eye clinic. *J Cataract Refract Surg* 2008; 34: 424-32.
- Hoffer KJ. Biometry of 7,500 cataractous eyes. *Am J Ophthalmol* 1980; 90: 360-8.
- Ninn-Pedersen K, Stenevi U, Ehinger B. Cataract patients in a defined Swedish population 1986-1990. II. Preoperative observations. *Acta Ophthalmol (Copenh)* 1994; 72: 10-5.
- Riley AF, Grupcheva CN, Malik TY, Craig JP, McGhee CN. The Auckland Cataract Study: demographic, corneal topographic and ocular biometric parameters. *Clin Experiment Ophthalmol* 2001; 29: 381-6.
- Olsen T, Thorwest M. Calibration of axial length measurements with the Zeiss IOLMaster. *J Cataract Refract Surg* 2005; 31: 1345-50.
- Ferrer-Blasco T, Montes-Mico R, Peixoto-de-Matos SC, Gonzalez-Mejome JM, Cervino A.

- Prevalence of corneal astigmatism before cataract surgery. J Cataract Refract Surg 2009; 35: 70-5.
9. Hoffmann PC, Hutz WW. Analysis of biometry and prevalence data for corneal astigmatism in 23,239 eyes. J Cataract Refract Surg 2010; 36: 1479-85.
 10. Khan MI, Muhtaseb M. Prevalence of corneal astigmatism in patients having routine cataract surgery at a teaching hospital in the United Kingdom. J Cataract Refract Surg 2011; 37: 1751-5.
 11. Guan Z, Yuan F, Yuan YZ, Niu WR. Analysis of corneal astigmatism in cataract surgery candidates at a teaching hospital in Shanghai, China. J Cataract Refract Surg 2012; 38: 1970-7.
 12. Chen W, Zuo C, Chen C, Su J, Luo L, Congdon N, et al. Prevalence of corneal astigmatism before cataract surgery in Chinese patients. J Cataract Refract Surg 2013; 39: 188-92.
 13. Lekhanont K, Wuthisiri W, Chatchaipun P, Vongthongsri A. Prevalence of corneal astigmatism in cataract surgery candidates in Bangkok, Thailand. J Cataract Refract Surg 2011; 37: 613-5.

ความชุกของภาวะกระจกตาเอียงก่อนผ่าตัดในผู้ป่วยที่ได้รับการผ่าตัดต้อกระจก ที่โรงพยาบาลเมตตาประชารักษ์ ประเทศไทย

นวลจิรา ปรกาศรุ่งทอง, ภูวัต จารุกำเนตคนก, สายจินต์ อธิประดิฐ

วัตถุประสงค์: เพื่อศึกษาและวิเคราะห์ ข้อมูล การกระจายของค่าความโค้งกระจกตาในกลุ่มผู้ป่วยก่อนเข้ารับการผ่าตัดต้อกระจก ในโรงพยาบาลเมตตาประชารักษ์วัดไร่ขิง

วัสดุและวิธีการ: การศึกษานี้เป็นการศึกษาเวชระเบียนย้อนหลังของผู้ป่วยที่มารับการผ่าตัดต้อกระจกทุกรายที่โรงพยาบาลเมตตาประชารักษ์วัดไร่ขิงตั้งแต่วันที่ 1 ตุลาคม พ.ศ. 2553 ถึง 30 กันยายน พ.ศ. 2554 โดยเก็บข้อมูลพื้นฐาน และค่าความโค้งของกระจกตา

ผลการศึกษา: การศึกษาครั้งนี้ ได้วัดค่าความโค้งกระจกตาในผู้ป่วยก่อนเข้ารับการผ่าตัดต้อกระจก จำนวน 2,688 ตา ในผู้ป่วย 2,671 ราย โดยผู้ป่วยมีอายุเฉลี่ย 66.23 ปี (พิสัย 8-95 ปี) ค่ากระจกตาเอียงเฉลี่ย 1.09 ไดออปเตอร์ (พิสัย 0.00-8.5 ไดออปเตอร์) กระจกตาเอียง มากกว่า 1 ไดออปเตอร์ พบในผู้ป่วยร้อยละ 36.6 กระจกตาเอียงระหว่าง 0.51-1.00 ไดออปเตอร์ พบร้อยละ 37.9 และเท่ากับหรือน้อยกว่า 0.50 ไดออปเตอร์ พบร้อยละ 25.5 ค่ากำลังความโค้งเฉลี่ยของกระจกตาในแนวแกนที่ชันมีค่า 44.89 ± 1.52 ไดออปเตอร์ และในแนวแกนที่แบนมีค่า 43.81 ± 1.57 ไดออปเตอร์ ความเอียงกระจกตามีค่ามากขึ้นตามอายุอย่างมีนัยสำคัญ (ค่า $p < 0.001$) และค่าความเอียงกระจกตามีแนวโน้มเพิ่มมากขึ้นตามอายุในผู้ป่วยที่อายุมากกว่า 50 ปี ค่าความโค้งกระจกตาในผู้ป่วยเพศหญิงมีค่าสูงกว่าเพศชาย กระจกตาที่เอียงโดยส่วนใหญ่เป็นรูปแบบ *against the rule* (ค่ากระจกตาที่ชันมากกว่าอยู่ในแนว 180 ± 30 องศา) และรูปแบบกระจกตาเอียงนี้มีความสัมพันธ์กับอายุอย่างมาก โดยรูปแบบ *against-the-rule* นี้ พบเพิ่มมากขึ้นสัมพันธ์กับอายุที่มากขึ้น ในขณะที่รูปแบบ *with-the-rule* (ค่ากระจกตาที่ชันมากกว่าอยู่ในแนว 90 ± 30 องศา) ลดลงในผู้ป่วยที่อายุมากขึ้น

สรุป: ผู้ศึกษาได้รายงานถึงรูปแบบและการกระจายของค่ากระจกตาเอียงในผู้ป่วยก่อนเข้ารับการผ่าตัดต้อกระจกในโรงพยาบาลเมตตาประชารักษ์วัดไร่ขิง โดยผู้ป่วยประมาณหนึ่งในสามมีภาวะกระจกตาเอียงมากกว่า 1 ไดออปเตอร์ ซึ่งข้อมูลที่ได้นี้เป็นข้อมูลสำคัญที่สามารถนำไปอ้างอิงและเป็นประโยชน์ต่อจักษุแพทย์ เพื่อวางแผนวิธีการรักษา คำนวณค่าใช้จ่ายในการแก้ไขภาวะกระจกตาเอียงในผู้ป่วยที่ต้องรับการผ่าตัดต้อกระจกเพื่อที่จะบรรลุเป้าหมาย ได้ระดับการมองเห็นที่ดีที่สุด