
原 著

DISTRIBUTION OF LENTICULAR ASTIGMATISM IN A PRE-CATARACT SURGERY POPULATION

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Abstract : Recently custom ablation of LASIK (laser in situ keratomileusis) has rapidly evolved. It could achieve supervision temporarily, but we suspect that the vision could deteriorate due to against-the-rule astigmatism decades after the operation.

To clarify this concern, we evaluated distribution of the total and corneal astigmatism of 101 eyes of 65 pre-cataract surgery patients (mean age : 73 years). Then we calculated the lenticular astigmatism by vector analysis.

The mean amounts of total and corneal astigmatism were $1.22 \pm 1.50D$ and $0.97 \pm 0.84D$ each. The percentages of no astigmatism: oblique: with-the-rule: against-the-rule were 32: 4: 15: 50 and 7: 28: 26: 40, respectively.

The mean amount of lenticular astigmatism measured by vector analysis was $1.6 \pm 1.4D$. The percentage of no astigmatism: oblique: with-the-rule: against-the-rule was 2: 0: 39: 59. This biased distribution of astigmatism might have contributed to the biased distribution (no and against-the-rule) of total astigmatism.

These data indicate that in a pre-cataract surgery population against-the-rule astigmatism is predominant in both corneal and lenticular astigmatism. We suspect that custom correction of adolescent eyes, in which with-the-rule astigmatism is predominant, might elicit more against-the-rule astigmatism when they reach pre-cataract surgery age population, leading to a decline in quality of vision.

Key words : total astigmatism, corneal astigmatism, lenticular astigmatism, with-the-rule astigmatism, against-the-rule astigmatism

INTRODUCTION

LASIK (laser in situ keratomileusis) has become the most popular method of surgical correction of refractive errors. To further improve the quality of vision, custom ablation of LASIK has evolved^{1, 2)}. This method includes measurement of wavefront aberration, eyetracking, and customized excimer laser ablation in order to achieve supervision³⁾.

However, the human cornea and lens undergo aging changes. Custom-ablated young eyes may gradually develop undesirable against-the-rule astigmatism as they become older.

It has been reported that against-the-rule astigmatism is predominant in aged population⁴⁾,

but the distribution of lenticular astigmatism has been reported only rarely⁵.

In the present study, we measured total and corneal astigmatism and calculated the distribution of the lenticular astigmatism of a pre-cataract surgery population, in order to consider the issue described above.

MATERIAL AND METHODS

We retrospectively reviewed the pre-cataract surgery examination charts of 101 eyes of 65 consecutive patients who had undergone surgery between 1999 and 2000 in the Ohyodo Hospital, Nara, Japan. The charts included age, keratometry, and non-cycloplegic refraction measured by an auto-refractometer (NIDEK).

Then we measured the lenticular astigmatism by subtracting the corneal astigmatism from the total astigmatism by vector analysis described by Waring and Holladay⁶.

The types of astigmatism were defined as follows.

Less than 0.25 diopters of astigmatism was defined as no astigmatism. When the axis of astigmatism was 0–30 or 150–180 degrees, it was defined as with-the-rule. Similarly, 60–120 degrees were defined as against-the-rule, and others as oblique⁷.

RESULTS

Fig. 1 to Fig. 3 depict the distribution of the astigmatism of total, corneal, and lenticular astigmatism. The percentages of no astigmatism: oblique: with-the-rule: against-the-rule were 32: 4: 15: 50 in the total, 7: 28: 26: 40 in the corneal, and 2: 0: 39: 59 in the lenticular astigmatism.

Table 1 shows the amount of astigmatism in each type. The mean amounts of the total, corneal, and lenticular astigmatism were 1.22, 0.97, and 1.63 diopters respectively.

DISCUSSION

Liang⁵ reported that in young populations corneal astigmatism constituted most of the total astigmatism, and that lenticular astigmatism had a tendency to neutralize corneal astigmatism. In elderly populations lenticular astigmatism markedly changed, eliciting irregular astigmatism. Artal⁸ reported similar aging changes using a corneal topography system and a Hartmann-Shack sensor.

In our study of elderly patients the mean amounts of total and corneal astigmatism were $1.22 \pm 1.50D$ and $0.97 \pm 0.84D$ each. The percentage of against-the-rule astigmatism in corneal astigmatism was 40%, which increased to 50% in total astigmatism. These data indicate that the lenticular astigmatism of elderly patients might not neutralize corneal astigmatism, as reports have described previously^{5, 8}.

However, the percentage of no astigmatism in the total astigmatism was 32%, whereas that in the corneal astigmatism was 7%, indicating that in about one third of cases a neutralizing effect of the lenticular astigmatism was present.

The unique property of the present study is that the lenticular astigmatism in the precataract surgery population was measured by vector analysis, which had been rare to our knowledge.

It is interesting to note that the distribution of lenticular astigmatism is markedly biased.

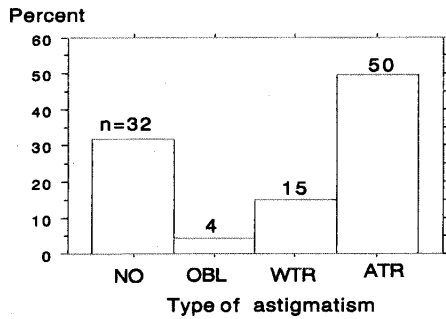


Fig. 1. Distribution of the type of astigmatism of the total astigmatism. No represents no, WTR represents with-the-rule, ATR represents against-the-rule, and OBL shows oblique astigmatism.

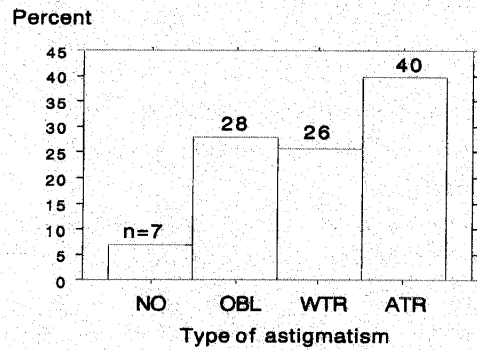


Fig. 2. Distribution of the type of astigmatism of the corneal astigmatism. No represents no, WTR represents with-the-rule, ATR represents against-the-rule, and OBL shows oblique astigmatism.

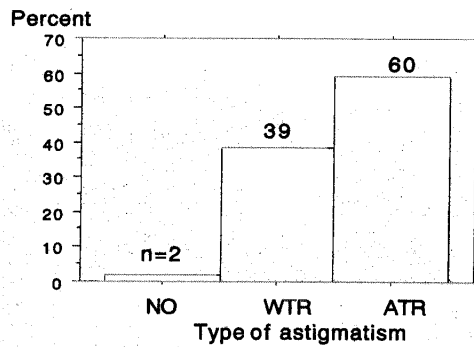


Fig. 3. Distribution of the type of astigmatism of the lenticular astigmatism. No represents no, WTR represents with-the-rule, ATR represents against-the-rule astigmatism. No oblique astigmatism was present.

Table 1. shows the distribution of the dioptric amount of the astigmatism of each category. SD represents standard deviation, n means number of the eyes.

	Mean	SD	n	Min	Max
Total astigmatism	1.22	1.50	101	0	10.00
Corneal astigmatism	0.97	0.84	101	0	4.63
Lenticular astigmatism	1.63	1.41	101	0	8.17

That is, about 60% was against-the-rule, and about 40% was with-the-rule astigmatism. The percentage of no astigmatism: oblique: with-the-rule: against-the-rule of the total astigmatism was 32: 4: 15: 50. The biased distribution of lenticular astigmatism might indicate that in some cases the neutralizing effect that is frequently observed in young populations still remains, whereas in other cases aging changes deprive this effect.

Hayashi⁹⁾ measured corneal topography of numerous patients of various age groups. They found that the cornea became more and more against-the-rule astigmatism as the patients became older.

It appears that as people become older the cornea becomes more against-the-rule astigmatism and the lens becomes less compensating. We have to understand these aging changes of the ocular media when we perform keratorefractive surgery. In our institute we prefer to undercorrect with-the-rule astigmatism and fully correct against-the-rule astigmatism of young patients because of the reasons described above.

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