

# The Effect of Epiblepharon Surgery on Visual Acuity and With-the-Rule Astigmatism in Children

Na Mi Kim<sup>1</sup>, Jae Ho Jung<sup>2</sup>, Hee Young Choi<sup>1,3</sup>

<sup>1</sup>Department of Ophthalmology, Pusan National University Hospital, Busan, Korea

<sup>2</sup>Department of Ophthalmology, Pusan National University Yangsan Hospital, Yangsan, Korea

<sup>3</sup>Medical Research Institute, Pusan National University, Busan, Korea

**Purpose:** To evaluate the effect of epiblepharon surgery on visual acuity and with-the-rule astigmatism in children compared to patients without surgical treatment.

**Methods:** We undertook a retrospective case control study and reviewed the charts of 202 eyes treated with epiblepharon surgery and of 142 eyes without surgery. The surgical procedure for epiblepharon correction used rotating suture techniques. Data regarding age, best corrected visual acuity, and degree of astigmatism were recorded. Baseline and 1-, 3-, 6-, and 12-month postoperative data were collected. The chi-square test, Student's *t*-test and general linear model analysis for repeated measures were applied.

**Results:** The mean astigmatism in the surgical group decreased from  $1.10 \pm 1.02$  diopter (D) preoperatively to  $0.84 \pm 1.05$  D at 3 months after surgery ( $p < 0.05$ ). However, there was no statistically significant difference compared to the non-surgical group during the first year. The general linear model analysis comparing the mean astigmatism between the two groups over time showed a significant group-time interaction ( $p < 0.05$ ). Within the surgical group, the higher baseline astigmatic subgroup and the 5- to 8-year-old group demonstrated greater cylinder reduction over time. The change in mean visual acuity was not significant in either group.

**Conclusions:** Significant astigmatic reduction was found after surgical correction in epiblepharon patients. Patients with higher baseline astigmatism exhibited greater astigmatic reduction after epiblepharon surgery. These results suggest that, in order to reduce astigmatism, an epiblepharon operation should be considered in patients with a high level of astigmatism.

**Key Words:** Astigmatism, Epiblepharon, Visual acuity

Epiblepharon is a congenital lid anomaly in which a fold of skin and the underlying orbicularis muscle tilt the lashes, often pushing them against the globe [1,2]. This condition is frequently observed in Asian infants and children. Patients with epiblepharon suffer not only from tearing, photophobia, ocular irritation, frequent blinking of the eye, and foreign body sensation, but also from visual disturbances caused by corneal injury [3]. In addition to these effects, astigmatism is more frequently observed in patients with epiblepharon compared to the normal population [4,5].

Many reports have addressed changes in visual acuity (VA) and astigmatism seen after epiblepharon surgery in children [4,6,7]. However, no case-control study comparing outcomes in epiblepharon patients who underwent surgery compared to those who did not has been conducted. Moreover, almost all previous studies have been directed at short-term astigmatic changes resulting from epiblepharon correction [4,6,7].

The purpose of this study was to evaluate the efficacy of epiblepharon correction for astigmatic changes in patients with epiblepharon compared to a non-surgical control group. We also investigated various factors for their correlations with functional outcomes.

## Materials and Methods

We performed a retrospective case-control study of con-

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Reprint requests to Hee Young Choi, Department of Ophthalmology, Pusan National University Hospital, #1-10 Ami-dong, Seo-gu, Busan 602-739, Korea. Tel: 82-51-240-7324, Fax: 82-51-242-7341, E-mail: hychoi@pusan.ac.kr

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**Table 1.** The distribution of the surgical and non-surgical groups according to age and initial astigmatism at the first visit

	Surgical group (n=166)	Non-surgical group (n=94)	Total (n=260)
According to age (yr)			
Subgroup 1 (< 5)	30 (18.1)	30 (31.9)	60 (23.1)
Subgroup 2 (5 to < 8)	64 (38.6)	54 (57.4)	118 (45.4)
Subgroup 3 ( $\geq$ 8)	72 (43.4)	10 (10.6)	82 (31.5)
According to initial astigmatism (diopter)			
Subgroup A (< 2)	136 (81.9)	81 (86.2)	217 (83.5)
Subgroup B (2 to < 4)	24 (14.5)	8 (8.5)	32 (12.3)
Subgroup C ( $\geq$ 4)	6 (3.6)	5 (5.3)	11 (4.2)

Values are presented as number (%).

secutive eyes that underwent epiblepharon correction to reduce subjective symptoms and severe punctate keratopathy at Pusan National University Hospital between July 2002 and June 2007. Data from the epiblepharon population that did not have epiblepharon operations was included as a control. In the non-surgical control group, a doctor recommended epiblepharon surgery but the parents of the patients refused the operation for reasons such as cost, age, and anticipated complications. Institutional review board policy did not require permission for this study due to the use of medical records that were part of a routine clinical practice.

A total of 344 eyes that met the eligibility criteria were included in this study. The eligibility criteria for all subjects were 1) subjects younger than 12 years, with more than 12 months' follow-up and 2) subjects demonstrating prominent corneal touch by cilia and related subjective symptoms. The exclusion criteria were 1) subject had an eyelid problem such as congenital entropion, ptosis, or ectropion; 2) subject had a history of ocular surgery; and 3) subject had some other ocular condition related to VA such as amblyopia, keratoconus, congenital cataract, or glaucoma. Among the 344 eyes diagnosed with epiblepharon, we excluded 24 eyes with oblique astigmatism and 60 eyes with against-the-rule astigmatism in order to simplify the effect of the operation on astigmatic changes.

Baseline examinations consisted of slit lamp examination, screening for strabismus, VA testing, cycloplegic refractive examination, and fundus examination. VA was converted to a logarithm of the minimum angle of resolution units from decimal notation using the VA conversion chart for statistical analysis. For the cycloplegic refractive examination, 1.0% cyclopentolate hydrochloride was dropped into the eye 3 times at 10-minute intervals to confirm the loss of pupillary light reflex. A refraction test was then performed. Astigmatism measurement was performed through cycloplegic refraction with an autorefractometer (Auto Ref-Keratometer RK-F1; Canon, Tokyo, Japan) We used the average values of cylinder and axis based on 3 readings. Follow-up visits were scheduled at 1 month, 3 months, 6 months, and 12 months post-operatively, or after the first visit.

We compared the surgical and the non-surgical groups. Then, to evaluate factors related to the significant change in

astigmatism in the surgical group, we divided the groups into subgroups based on the subject's age at the time of surgery (subgroup 1, younger than 5 years; subgroup 2, 5 to 8 years; subgroup 3, 8 years and older) and initial astigmatism (subgroup A, < 2 diopter [D]; subgroup B, 2-4 D; subgroup C,  $\geq$  4 D) (Table 1).

All surgeries were performed by a single surgeon (HYC). The patients who suffered from prominent corneal touch by cilia and related subjective symptoms underwent epiblepharon surgery regardless of baseline astigmatism. The surgical procedure for epiblepharon correction used rotating suture techniques [8]. After marking the excess skin of the lower eyelid in an elliptical shape, hemostasis of the eyelid was obtained by injecting a mixture of 1% lidocaine with 1:100,000 epinephrine. Infralash skin incision and excision of pretarsal orbicularis muscle were performed. The subcutaneous tissue of the skin-muscle flap was then sutured to the exposed tarsal plate with interrupted and buried 8-0 nylon stitches in order to rotate the direction of the lashes. After meticulous hemostasis, the skin was closed with continuous fast absorbing 6-0 plain gut sutures.

The SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. The chi-square test and Student's *t*-test were applied for comparisons of initial demographic features such as age, sex, astigmatism, VA, and follow-up period between the surgical and the non-surgical groups. A general linear model analysis for repeated measures and the Student's *t*-test were used to compare changes in astigmatism over time between the two groups. The general linear model - repeated measures ANOVA analysis was used to evaluate the significance of changes in astigmatism and VA over time among the subgroups. A *p*-value of less than 0.05 was considered statistically significant.

## Results

One hundred and thirty patients were included in the final study. Of the patients who underwent epiblepharon operations, 39 were boys and 44 were girls. The control group (epiblepharon patients without surgery, or the non-surgical group) included 24 boys and 23 girls. Baseline characteristics and comparisons between the two groups are shown in

**Table 2.** Demographic features of the surgical and the non-surgical groups

	Surgical group (n=166)	Non-surgical group (n=94)	p-value
Age at baseline (yr)	6.4 ± 2.3	5.2 ± 1.8	0.32*
< 5	30	30	0.35†
5 to < 8	64	54	
≥ 8	72	10	
Sex			
Male	78	48	0.20†
Female	88	46	
Cylinder (diopter) at baseline			
< 1	94	51	0.32†
1 to < 2	42	30	
2 to < 3	16	7	
3 to < 4	8	1	
≥ 4	6	5	
Visual acuity at baseline (logMAR)	0.09 ± 0.08	0.10 ± 0.16	0.41*
Astigmatism at baseline (diopter)	1.10 ± 1.02	1.07 ± 1.18	0.83*
Follow-up duration (mon)	18.5	16.8	0.23*

logMAR=logarithm of the minimum angle of resolution.

\*t-test; †Chi-square test.

**Table 3.** Changes in mean astigmatism and best corrected visual acuity (BCVA) over time in the surgical and non-surgical groups

		Baseline	1 mon	3 mon	6 mon	1 yr
Astigmatism (diopter)	Surgical group	1.10	0.97	0.84	0.85	0.83
	p-value†	-	(0.290)	(0.046)*	(0.041)*	(0.01)*
	Non-surgical group	1.07	1.21	1.09	1.08	1.11
	p-value†	-	(0.457)	(0.871)	(0.920)	(0.801)
BCVA (logMAR)	Surgical group	0.09	0.10	0.07	0.09	0.08
	p-value†	-	(0.159)	(0.458)	(0.888)	(0.402)
	Non-surgical group	0.10	0.11	0.09	0.06	0.07
	p-value†	-	(0.819)	(0.779)	(0.083)	(0.176)

logMAR = logarithm of the minimum angle of resolution.

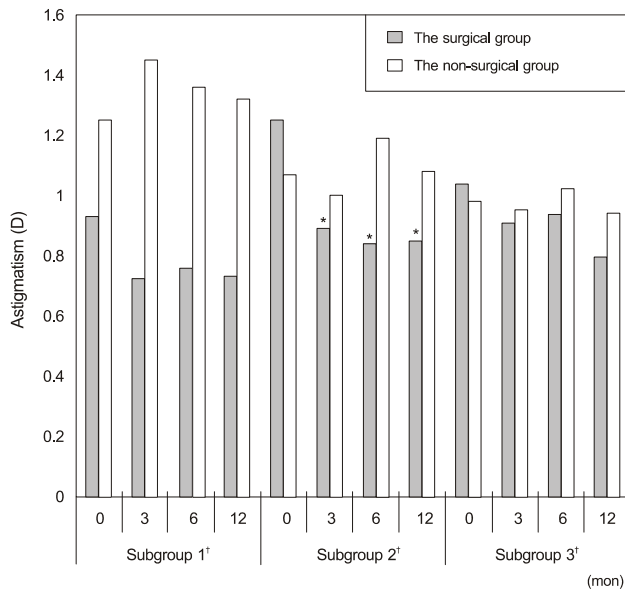
\*p < 0.05; †Compared to baseline, t-test.

Table 2. There were no significant differences between the two groups with regard to age, gender, follow-up period, best corrected visual acuity (BCVA), and degree of astigmatism.

The mean astigmatic readings for each group at each follow-up visit are shown in Table 3. The mean astigmatic refractive error in the surgical group decreased from 1.10 ± 1.02 D preoperatively to 0.84 ± 1.05 D at 3 months postoperatively to 0.83 ± 0.72 D at 1 year postoperatively (p = 0.046, p = 0.01). The average astigmatic refractive error in the non-surgical group was 1.07 ± 1.18 D at baseline and 1.11 ± 1.13 D at 1 year (p = 0.80). There was no statistically significant difference in this group (Table 3). The general linear model analysis, which compared the mean astigmatism between the surgical and the non-surgical groups over time, showed a significant group-time interaction (p = 0.04), indicating that the difference in astigmatism between the two groups varied significantly over time. The mean BCVA change was not significant in both groups during follow-up visits.

In the surgical group, after surgery the subgroups (defined by age; subgroup 1, 2, and 3) showed decreasing cylinders over time. The cylinder was significantly decreased in subgroup 2 at 3 months, 6 months, and 1 year after surgery (p = 0.05, 0.04, 0.02). No significant age-related differences were noted in the non-surgical group (Fig. 1). There was also no difference in VA changes according to age in either the surgical group or the non-surgical group.

We also examined the association between astigmatic changes and initial cylinder values in both the surgical and non-surgical groups (subgroup A, B, and C) (Fig. 2). In the surgical group, there was a statistically significant decrease in astigmatism in subgroups B and C after 3 months postoperative. In the non-surgical group, there were no significant astigmatic decreases for any initial astigmatism level. There was no association between baseline astigmatism and VA changes in either group.

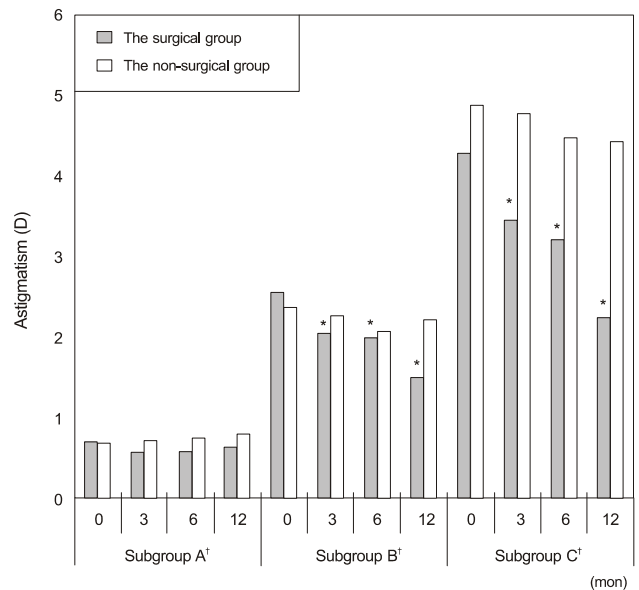


**Fig. 1.** Mean astigmatism for each age subgroup in the surgical and non-surgical groups. There was a statistically significant decrease in astigmatism in subgroup 2 at 3 months postoperative (from  $1.25 \pm 1.02$  diopter [D] to  $0.89 \pm 0.96$  D with-the-rule astigmatism,  $p = 0.049$ ).  $p < 0.05$ ; <sup>†</sup>Subgroup 1, younger than 5 years; subgroup 2, 5 to 8 years; subgroup 3, 8 years and older.

**Discussion**

A few investigators have reported a relationship between astigmatism and epiblepharon. Shih and Huang [4] found that 52.4% of patients in their epiblepharon group had astigmatism of over 1.0 D and 11.2% of patients in their non-epiblepharon group had astigmatism of over 1.0 D. Preechawai et al. [5] observed that 52.2% of patients had astigmatism of 1 D or more and the astigmatism was largely with-the-rule. Our findings are very similar to those of previous studies. In our study, 44.2% of patients had astigmatism of 1.0 D or greater.

The mechanism of astigmatism in epiblepharon has yet to be elucidated. There are several possibilities for the cause of astigmatism in epiblepharon patients. First, astigmatism has been reportedly induced by abnormal eyelid tension in patients with ptosis [9] or eyelid tumors [10]. Also, high correlations between eyelid morphology, corneal spherocylinder [11,12], and lid-induced transient corneal topography changes after reading [13] support the idea that the mechanical force of the eyelid influences corneal contour. Likewise, corneal curvature may be changed because of the mechanical force created by abnormal eyelid tension from redundant horizontal skin folds in epiblepharon patients. Secondly, astigmatism could be caused by changes in corneal curvature related to frequent rubbing and blinking, similar to other corneal surface diseases, such as keratoconus [14]. This hypothesis was also supported by the report that a small amount of astigmatism could be produced immediately by rubbing [15]. Third, another hypothesis holds that continuing corneal erosion induces cellular apoptosis and cytokine release [16]



**Fig. 2.** Mean cylinder changes in subgroup A, B, and C over 1 year. Within the surgical group, the higher baseline astigmatic subgroup demonstrated greater cylinder reduction over time compared to the lower astigmatic subgroup at 1 year postoperative.  $p < 0.05$ ; <sup>†</sup>Subgroup A, < 2 diopter (D); subgroup B, 2 to < 4 D; subgroup C,  $\geq 4$  D.

and results in corneal remodeling, such as keratoconus [17]. Likewise, continuous corneal erosion due to epiblepharon may induce corneal remodeling and astigmatism. After epiblepharon surgery, the abnormal eyelid tension created by redundant horizontal skin folds and prolonged corneal irritation from eyelashes or aggressive rubbing of the eyes may be improved. Therefore epiblepharon surgery could possibly reduce corneal astigmatism.

Conflicting reports on the relationship between epiblepharon correction and astigmatic changes exist. Preechawai et al. [5] found that surgery did not affect astigmatism, especially in young children. Lee et al. [6] reported that mean astigmatism decreased from 1.28 D before surgery to 1.19 D one month after surgery, but this decrease did not represent a statistically significant change. In contrast, Baek et al. [7] reported that astigmatic changes progressed significantly from 1.39 D before surgery to 1.22 D at 3 months after surgery. They found mainly with-the-rule astigmatism, both before and after surgery. Similarly, another report showed that astigmatism decreased from a preoperative mean of 1.34 D with-the-rule astigmatism to a postoperative mean of 1.10 D with-the-rule astigmatism in all patients [18]. In our study, the average astigmatic refractive error in the surgical group significantly decreased from 1.10 D preoperatively to 0.84 D at 3 months postoperatively. In contrast, the non-surgical group demonstrated no significant change in astigmatic refractive error during the 1-year follow-up period. Baek et al. [7] reported that the postoperative change of astigmatism was not statistically significant 1 month after surgery, but the reduction of astigmatism at 3 months was statistically

significant. They suggested that astigmatic changes were progressed 3 months after surgery. Our results were similar to those of Baek et al. [7]. Alternation of the eyelid pressure on the cornea may change the corneal shape and its refractive characteristics and the authors presumed that this corneal remodeling may take at least 3 months. Future studies are required for further understanding of corneal remodeling pathogenesis and time periods.

We observed that age and degree of initial astigmatism were significantly related to the change in astigmatism after surgery. Shih and Huang [4] reported that children with epiblepharon at 4 to 7 years of age had significantly greater astigmatism than normal 4 to 7 year old children. However, astigmatism was not significantly changed postoperatively. Preechawai et al. [5] found that comparison of pre and postoperative astigmatism in patients younger than 5 years old at the time of surgery showed no significant changes in astigmatism at 1 to 2 years of follow-up. In contrast, Park et al. [18] reported that the reduction of astigmatism after epiblepharon surgery was statistically significant in the 5- to 7- year age group. Kim et al. [19] also reported that patients who were younger than 6 years of age showed significantly greater decreases in astigmatism during 2 years of follow-up. Our results were similar to those of Preechawai et al. [5], Park et al. [18], and Kim et al. [19]. Our study showed that the significant mean astigmatism change in the 5- to 8-year-old surgical group (subgroup 2 in the surgical group) was  $1.25 \pm 1.02$  D at the baseline and  $0.89 \pm 0.96$  D after 3 months postoperatively. In 2 age groups,  $< 5$  years and  $\geq 8$  years (subgroup 1 and 3 in the surgical group), there were no statistically significant decreases in astigmatism. There was no difference in astigmatic changes according to age in the non-surgical group. It is thought that the 5- to 8-year-old surgical group showed larger changes in astigmatism after surgery because their preoperative astigmatism was 1.25 D, a value higher than that of the  $< 5$  years old surgical group, which was 0.93 D, or that of the  $\geq 8$  years old surgical group, which was 1.04 D. This result is consistent with the result of Kim et al. [19], who reported that higher preoperative degrees of astigmatism were associated with larger postoperative changes in astigmatism.

In our study, higher astigmatic groups exhibited greater astigmatic reduction during the first postoperative year. The 2 to 4 D and  $\geq 4$  D groups in the surgical group (subgroup B and C in the surgical group) represented significant astigmatism reduction after 3 months postoperatively. In contrast, there was no statistically significant difference in the non-surgical group, according to baseline astigmatism. Kim et al. [19] reported that the higher baseline cylinder group ( $\geq 4$  D) exhibited greater cylinder reduction over time compared to the lower cylinder group ( $< 4$  D). Our results were very similar to those of Kim et al. [19]. In particular, subgroup C showed at least 4 D astigmatism, patients who did not undergo epiblepharon surgery did not show any significant change as their astigmatism was 4.9 D at the first visit and was 4.5 D one year later while patients who underwent

epiblepharon surgery showed remarkable decreases as their astigmatism was 4.3 D preoperatively and 2.3 D one year after the surgery. Since patients with severe astigmatism of 4 D or higher may be more prone to developing amblyopia, given the results mentioned above, it is desirable for epiblepharon patients with severe astigmatism to undergo early epiblepharon surgery.

Lee et al. [6] and Baek et al. [7] reported significant improvement in BCVA 1 month after surgery. Kim et al. [19] also reported that there was improvement in BCVA from 1 month to 2 years and 3 months to 2 years after epiblepharon surgery. However, our results showed that there was no statistically significant change in BCVA during the first postoperative year in both the surgical and non-surgical groups. A previous study reported that the mean BCVA was increased due to improvement in astigmatism and treatment of amblyopia after epiblepharon surgery [19]. In contrast, we excluded subjects who had ocular conditions, such as amblyopia, that related to VA. Therefore, BCVA results differ between our study and the previous report [19].

Other papers that have studied the association between epiblepharon surgery and astigmatism have used either no control group [5-7,9] or normal persons (without epiblepharon) in the same age range as control groups [4,19]. In this study, however, a group of patients with epiblepharon who did not undergo surgery but were followed up was used as a control group. Thus, the association between epiblepharon surgery and astigmatism in epiblepharon patients could be known more accurately.

There are several limitations in this study. First, astigmatism was not analyzed according to keratometric values, but rather it was analyzed according to the absolute values of astigmatism diopters. Second, patients were divided into three groups based on age and there were differences in the amounts of astigmatism at the first visit among the subgroups. Third, patients were also divided into subgroups based on the degree of astigmatism at the first visit and there were large differences in the numbers of individuals in each of the subgroups, although the prevalence of severe astigmatism should naturally be lower than that of mild astigmatism. Fourth, since patients who could be followed up for at least one year were retrospectively studied, there is a possibility that only those patients who showed relatively good postoperative compliance, in other words patients with good outcomes, were included in the study. Thus it is quite likely that these differences may have affected the results of analyses and statistics.

In conclusion, the astigmatism of the surgical group decreased significantly compared to the non-surgical group and there was no statistically significant difference in VA between the surgical and non-surgical group. Patients with more severe astigmatism in the surgical group exhibited greater astigmatic reduction after epiblepharon surgery. Since patients with severe astigmatism may be more prone to the development of amblyopia, it is considered desirable for

epiblepharon patients with severe astigmatism to undergo early epiblepharon surgery.

## Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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