Corneal Astigmatism Changes After Ptosis Correction in Two Age Groups of Patients with Congenital Ptosis

Apatsa Lekskul
Mahidol University Ramathibodi Hospital
Tunyarat Tangphikunatam
Mahidol University Ramathibodi Hospital
Phantaraporn Tangtammaruk (pp.phantaraporn@gmail.com)
Mahidol University Ramathibodi Hospital https://orcid.org/0000-0001-7390-1545

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Abstract

Purpose: To evaluate postoperative corneal astigmatism changes after ptosis correction in groups of young and older patients with congenital ptosis.

Patients and Methods: A prospective cohort study of 28 patients (56 eyes) with congenital ptosis enrolled at Ramathibodi Hospital was performed from April 2018 to June 2019. Within this group of patients there were 6 cases of bilateral congenital ptosis and 22 unilateral cases of congenital ptosis forming a total of 34 individual ptotic eyes for the study. The patients were categorized into two groups: early-age group (aged ≤5 years,) comprising of 14 eyes and older-age group (aged >5 years) comprising of 20 eyes. The preoperative visual acuity, amblyopic status, ptosis severity, and refractive error of both groups were evaluated prior to ptosis correction. All patients underwent ptosis correction with either levator resection or frontalis sling. Following the correction, the refractive error was measured after a follow-up period of at least 6 months. The astigmatism results were classified into three subgroups: with-the-rule, against-the-rule and oblique astigmatism.

Results: The mean age at diagnosis was 8.91 ± 7.05 years. From the study group, amblyopia was found in 13 out of 28 patients (46.4%). The most common type of astigmatism was with-the-rule astigmatism, making up 24 out of 34 ptotic eyes (70.6%). A postoperative astigmatism change of >0.50 diopters was found in 4 out of14 eyes (28.6%) in the early-age group and in 6 out of 20 eyes (30.0%) in the older-age group (Rate ratio, 1.43; 95% CI, 0.34–6.07).

Conclusion: Astigmatism was reduced following ptosis correction, with no statistically significant difference in the amount of reduction between the two age groups. As there is no significant difference, surgical correction can be deferred in patients of all age groups with anisometropic amblyogenic ptosis until appropriate surgical planning is possible.

Introduction

Congenital ptosis is a condition in which the upper eyelid falls to a lower-than-normal position. This condition usually presents at birth or within the first year of life.[1] The development of congenital ptosis originates from the dystrophic, fat-infiltrated and fibrous tissue of the levator palpebrae superioris muscles. In severe cases, the drooping eyelids cover the cornea and pupil, resulting in visual deprivation. Moreover, drooping eyelids can impact corneal astigmatism, refractive error and amblyopia, which subsequently causes permanent visual loss.[1–7] Some studies[3–4] have reported that high corneal astigmatism is frequently associated with congenital ptosis because eyelid ptosis modifies the anterior corneal surface.

Treatment options for congenital ptosis are patching regimens, spectacles or surgical correction. Indication for surgical correction is required to reduce visual deprivation. Anisometropic amblyopia is another relative indication for surgical correction in order to modify the anterior corneal surface and to restore corneal symmetry and corneal astigmatism.[4]

In Southeast Asia, there have been no reports regarding the characteristics of patients with congenital ptosis, such as their refractive status and astigmatism type, and how the timing of surgical intervention affects refractive changes between young and older-age groups. Our study aims to evaluate postoperative corneal astigmatism changes after ptosis correction in different age groups of patients with congenital ptosis in Thailand.

Material And Methods

This prospective cohort-study was approved by the Human Research Ethics Committee, Faculty of Medicine of Ramathibodi Hospital, Mahidol University, and adhered to the tenets of the Health Insurance Portability and Accountability Act and the Declaration of Helsinki. Written informed consent was obtained from all participants and their guardians for their clinical records to be used in this study.

Patients

The diagnosis of congenital ptosis was based on the presence of drooping eyelids since birth or within the first year of life. Amblyopia was defined as best corrected visual acuity (BCVA) less than 20/40 and greater than two Snellen chart lines of difference in BCVA between the two eyes. Amblyopia in young children was defined by the patient's lack of fixation or their inability to follow objects in the ptotic eye during the induced tropic test compared with the normal eye.

The exclusion criteria included ocular surgery (except for refractive surgery), paralysis, strabismus, trauma or neurological diseases.

Twenty-eight patients (56 eyes) of various ages, with either unilateral or bilateral congenital ptosis, were scheduled for ptosis-correction surgery from April 2018 to June 2019 and were enrolled in our study. Patients were divided into two groups: an early-age group (aged ≤ 5 years) comprising of 14 eyes, and an older-age group (aged > 5 years) comprising of 20 eyes, forming a total of 34 individual eyes for the study.

All patients underwent complete ophthalmic examinations. BCVA was measured by age-appropriate methods which include the preferential-looking test, Allen chart or Early Treatment of Diabetic Retinopathy (ETDRS) chart. The results were noted in Snellen fraction (feet) and were converted to Log of the minimum angle of resolution (LogMAR). Cycloplegic refraction was recorded after administering two drops of 1% cyclopentolate, 10 minutes apart, in all patients and then a third drop was administered 10 minutes after the second drop if the pupil size was less than 6 mm. Refractive error was measured using standard retinoscopy. The spherical equivalent (SE) was calculated as the sum of the dioptric power of the sphere and one-half of the cylinder power. Myopia was defined as negative SE of more than − 0.50 diopters (D) and hyperopia was defined as positive SE of more than + 0.50 D. Astigmatism was classified as with-the-rule (WTR) when the steeper meridian was close to 15° from the vertical meridian (90°) and against-the-rule (ATR) when the steeper meridian was close to 15° from the horizontal meridian (180°).

Oblique astigmatism (OA) was classified when the steeper meridian was not close to either side of the vertical or horizontal meridian.

Marginal reflex distance 1 (MRD1) was used to classify ptosis severity into mild (MRD1 ≥ 2 mm), moderate (0 ≤ MRD1 < 2 mm) or severe (MRD1 < 0 mm). Levator function was classified as poor (≤ 4 mm), fair (5–9 mm) or good (≥ 10 mm).

Each patient underwent ptosis correction: by levator resection, if levator function was fair or their ptosis was moderate-to-severe; or by frontalis sling, if levator function was poor or their ptosis was severe. Refraction tests were performed 6 months after surgery to compare corneal astigmatism changes in the different age groups.

Statistical analysis

All results and data are summarized as mean ± standard deviation. Categorical and continuous variables were compared using the chi-squared test and one-way analysis of variance, respectively. Differences with $p < 0.05$ were considered statistically significant. To compare postoperative astigmatism changes between the early and older-age groups, we used the incidence rate ratio and 95% confidence interval for the rate ratio. All analyses were performed using SPSS software (version 25.0 for Windows).

Results

Of the 28 patients (56 eyes) included in this study, the congenital ptosis was bilateral in 6 patients (21.4%) and unilateral in 22 patients (78.6%). The mean age of diagnosis was 8.91 ± 7.05 years old, with a male: female ratio of 1.33: 1. The preoperative clinical presentations in the ptotic eyes are demonstrated in Table 1 with no statistical difference between the two age groups. WTR astigmatism was the most common type and was found in 24 out of 34 ptotic eyes (70.6%). Twenty-one cases had severe ptosis, i.e., MRD1 < 0 mm, and 50% had fair levator function, i.e., 5–9 mm. More importantly, the ptosis had caused preoperative amblyopia in up to 13 of 28 patients (46.4%). Following the ptosis-correction surgery, there was improvement in astigmatism in both groups as shown in Table 2. In the early-age group, a postoperative astigmatism change of more than 0.50 D was found in 4 of 14 eyes (28.6%). Similarly, this was observed in 6 of 20 eyes (30.0%) in the older-age group. However, the change was not statistically different between the two age groups (incidence rate ratio of 1.43; 95% confidence interval of 0.34–6.07).

Table 1
Clinical presentations of the ptotic eye

	Ptotic eyes	
	early-age group N = 14	older-age group N = 20
Visual acuity (logMAR)	0.33 ± 0.32	0.34 ± 0.28
Amblyopia (patients)	5	8
- Deprivation	3	4
- Refractive error	2	4
Marginal reflex distance 1 (mm)	0.53 ± 1.26	0.28 ± 1.60
Ptosis severity		
- Mild (MRD1 ≥ 2 mm)	2	3
- Moderate (0 ≤ MRD1 < 2 mm)	4	4
- Severe (MRD1 < 0 mm)	8	13
Mean levator function (mm)	4.85 ± 2.61	5.27 ± 2.71
Levator function		
- Poor (≤ 4 mm)	1	2
- Fair (5–9 mm)	7	10
- Good (≥ 10 mm)	6	8
Operation		
Frontalis sling (patients)	7	10
Levator resection (patients)	7	10

Table 2
Comparison of refractive and astigmatism changes before and after ptosis correction surgery

Number of eyes	Ptotic eye prior operation		Ptotic eye post operation	
	early-age group (N = 14)	older-age group (N = 20)	early-age group (N = 14)	older-age group (N = 20)
Spherical equivalent refraction (diopters)	-1.34 ± 5.13	-1.08 ± 5.60	0.46 ± 6.03	-0.17 ± 5.63
Astigmatism (diopters)	-1.73 ± 0.76	-1.73 ± 0.85	-1.37 ± 0.60	-1.32 ± 0.95
Astigmatism type (eyes)				
- With the rule	10	14	10	15
- Against the rule	1	1	1	0
- Oblique astigmatism	4	2	4	2

Discussion

Refraction-associated congenital ptosis has been investigated in previous studies.[2–4] Eyelid ptosis affects the anterior corneal surface, which then induces refractive changes because of corneal refractive error and astigmatism.[4] Huo et al[8] found that unilateral ptosis was associated with myopia. Paik et al[2] reported that ptotic eyes had higher amounts of astigmatism, with the OA and WTR types being the most common. Consistent with previous studies,[2–4, 8] we found a higher amount of astigmatism in the ptotic eyes compared with the fellow eyes, and WTR astigmatism was the most common type of astigmatism in ptotic eyes (70.6%).

Amblyopia has also been found to be higher in those with congenital ptosis compared to the general population.[2,7] According to one study, childhood-ptosis-associated amblyopia was reported in about 7.9 per 100,000 births.[9] Other previous studies[2,7,9,10] found that the incidence of amblyopia was between 14% and 21%. Our study showed a higher incidence of amblyopia (46.4%) in the Thai patients under this study. This resulted from more than half of our cases (62.8%) demonstrating severe ptosis and 53.9% from the visual deprivation. The main etiology of amblyopia was occlusion of the visual axis, which is similar to the results of Grinpentrog et al,[9] who reported that half of ptosis-associated amblyopia cases were the result of visual deprivation. Another cause of amblyopia was the correlation between the amounts of anisometropia. Ptotic eyes showed higher amounts of both SE and astigmatism, compared with the fellow eyes. Previous studies[3,7] also reported that more than half of amblyopia cases came from refractive error, which is not different from our study (46.2%).

There has been controversy regarding the benefit of the timing for correction of ptotic eyes, in terms of anisometropic amblyogenic ptosis. Surgical intervention at an earlier age might provide benefits in terms of early refractive change to the cornea, better visual outcome and less emotional trauma associated with the surgery. Conversely, waiting to perform surgical correction at an older age allows patients to be more cooperative with examinations, producing better anatomical results and refractive stability. Wu et al[11] reported that there was no significant visual benefit from surgical correction of congenital ptosis in patients at 2 years or younger, compared with patients operated upon between 2 to 5 years of age. Based on a retrospective chart review of 62 patients, Cadera et al[12] reported that changes in cylinder were not statistically significant between patients in their younger and older-age groups (< 4 years old and ≥ 4 years old, respectively). A recent study[2] in an Asian population also reported no significant change in the magnitude of astigmatism between age groups after surgical correction, but a significant increase OA in postoperative eyes.

Our study is the first prospective study, apart from that by Kumar et al,[13] to include all ages of patients with congenital ptosis, especially those under the age of 5. We compared the astigmatic change after surgical correction between early-age and older-age groups. After ptosis correction, there was an improvement in SE and astigmatism in the ptotic eyes in both groups. However, the improvement in astigmatism did not significantly differ between the two groups. Thus, early surgical intervention might not produce significant benefits in terms of astigmatic change. Surgical correction could be delayed in cases of anisometropic amblyopic ptosis until appropriate surgical planning is done.

The limitation of our study was the small number of congenital ptosis cases,since the numbers might not have been enough to demonstrate statistical significance. Another limitation was that we did not include corneal topography, to examine the characteristics of corneal astigmatism before and after surgery because we tested children under 5 years old and because of the associated research costs.

Conclusion

Following ptosis-correction surgery, there was an improvement in SE and astigmatism. However, the change was not different between the two age groups, so surgical correction could be delayed in patients with anisometropic amblyogenic ptosis. Proper management, including cycloplegic refraction, spectacles, patching and surgical planning, and a follow-up plan should be developed to prevent amblyopia and subsequent permanent visual loss.

Declarations

Informed consent

Informed consent was obtained from all individual participants included in the study. Ethical approval was waived by the Human Research Ethics Committee Faculty of Medicine Ramathibodi Hospital, Mahidol University and adhered to the tenets of the Health Insurance Portability and Accountability Act and the Declaration of Helsinki in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

Disclosure

The authors report no conflicts of interest in this work.

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