Topographic, Refractive and High Order Coma Aberration Changes after Successful Ptosis Surgery in Egyptian Infantile to Adolescent Ptosis Patients

Tarek Saleh , Tamer A. Refai[*]
Research Institute of ophthalmology
Giza-Egypt 12211

[*]*Contributing Author'email: tamerrrefa [AT] outlook.com*

_____

ABSTRACT---

Objective: To study the effects of successful ptosis surgery on corneal topography,astigmatism and high order coma aberration in Egyptian infantile to adolescent patients with stable ptosis.Methods: 18 eyes of 12 egyptian patients in the infantile to adolescent age groups (age ranged from 4-21 years ;mean 13±7.64 years) with various degrees of ptosis underwent successful ptosis surgery. Computed corneal topography, refraction and high order coma aberration were studied before surgery and then at 3 month postoperatively. For each studied item ,mean value,standard deviation,minimum and maximum values were calculated by statistical analysis by SPSS. Comparison (T-test) and Pearson correlation tests were also done. The effects of degree of ptosis on the results was also studied.Results: The steepest Sim K1 decreased by a mean value of 0.07±0.39D and the average K value decreased by a mean value of 0.01±0.28D at 3 month postoperatively . The mean value of the Sphere changed from -2.11±1.94D preoperatively to -2.23±1.71D 3 month postoperatively with t-test denoting a non significant change (P>0.05). The Cylinder decreased by a mean value of -0.25±0.78D at 3 month postoperatively .A statistically significant correlation (p<0.05) existed between the postoperative decrease in cylinder and the postoperative reduction in the steepest K1 readings. The high order Among the study aberration decreased by a mean value of -0.001±0.050µ at 3 month postoperatively which was significantly correlated(p<0.05) with the postoperative reduction in the cylinder. Similarly,a highly significant correlation (p<0.01) existed between the postoperative reduction in the high order coma the degree of ptosis before the surgery.Conclusions: Following successful ptosis surgery ,astigmatism decreases by a mean value of -0.25±0.78D which was significantly correlated with reduction of the high order coma aberration .Similarly,the degree of preoperative ptosis significantly affects the postoperative reduction in the high order coma aberration. Therefore,patients undergoing surgical correction of ptosis, may have improvement in their visual quality as well as uncorrected visual acuity after their successful ptosis correction.

Keywords---Ptosis Surgery,Topography-Refractive-High order coma

_____

1. INTRODUCTION

Ptosis of the upper eyelid is a condition in which the upper lid margin is in an abnormally inferiorly displaced position. With ptosis, the eyelid may cover a significant portion of the cornea and pupillary aperature, sometimes enough to cause visual impairment[1,2].Some lid disorders as well as changes in lid position have been found to affect corneal topography.[3-6].Similarly some studies had shown that successful ptosis surgery could have a beneficial effect on corneal topography.[7-9]. Changes in lid position (i.e:during reading) can also induce corneal aberrations . [10].

In this work we tried to study the topographic and refractive changes that could happen after successful ptosis correction in infantile to adolescent Egyptian patients and their correlation with changes in the high order coma aberration trying to understand and advice patients (and their parents) about how visual acuity and visual quality could change after surgery.

2. MATERIALS AND METHODS

The study included 19 eyes of 12 patients arriving at the oculoplasic unit, in the research institute of ophthalmology ,Giza, Egypt in the interval between December 2011 and October 2013.Cases were chosen in which degree of ptosis was stable for at least 6 months and thereby surgery was planned to fully correct the abnormal lid position. Before surgey, patients were examined for uncorrected visual acuity, best corrected visual acuity, cycloplejic refraction and autorefraction done by an autorefractometer model Topcon RM 5000, Japan Corneal topography and high order coma aberration were studied by

Optical path difference (OPD) Scan (Nidek ARK-1000,Nidek Co LTD, Japan). Cases with were previous eyelid, refractive,or ocular surgery, existence of diseases affecting corneal surface; like, keratoconus,or pterygium as well as those with unsucessful ptosis surgery were excluded from the study. Accurate measurement of the upper eyelid position (to determine degree of ptosis) as well as upper lid excursion (to detect levator function) was done in all cases . The simulated keraometric readings (SIM K) readings for the 3 mm-Zone were taken from the axial map where Sim K1 stands for the steepest keratometric reading and Sim K2 stands for the flattest keratometric reading. The astigmatism values were taken from the OPD scan. The wavefront aberrations where measured at 4.0 mm zone for the 6th order. Patients were asked to blink twice to smooth the corneal surface to give a reproducible measurement. OPD scans were repeated at least 3 times until accurate scans were achieved and included in the study. The initial measurement was performed before surgery and then repeated at 3 months after surgery following complete wound healing. Graded levator resection was considered for patients with good to fair levator function ,while frontalis sling was considered for patients with poor levator function aiming to fully correct the ptosis in either case. Topical antibiotic/steroid ointment was applied in the eye and on the wound three times per day and sutures were removed 6 to 8 days after surgery .Patients were seen at regular intervals up to 3 months after surgery. We considered as well as many previous investigators [11-13] that cases with eyelid margin position postoperatively within 1 mm of the desired height (or within 1 mm of symmetry) to represent a successful result and these cases were included in the study. Cases with unsucessful results were excluded from the study. For each studied item ,mean value,standard deviation,minimum and maximum values were calculated by statistical analysis by SPSS. Comparison (T-test) and Pearson correlation tests were also done. The effects of degree of ptosis on the results was also studied.

3. RESULTS AND DISCUSSION

3.1 Results

19 eyes of 12 patients ,of which there was 9 eyes of female patients and 10 eyes of male patients. The age ranged from 4-21 years (mean 13 ± 7.64 years). Preoperatively Sim K1 ranged from 43.1-48.15D (mean value 44.72 ± 1.61). The Sim K2 ranged from 41.55-46.62D (mean 43.33 ± 1.68). The average K reading (Km) ranged from 42.60-47.39D (mean 44.03 ± 1.61D). The Cylinder (Cyl) ranged from 0 to -2.25D (mean -1 ± 0.71D). The Sphere (Sph) ranged from -0.50 to -7.25D (mean -2.11 ± 1.94D). The high order Among the study aberration (Coma. Aberr) ranged from -0.178 to 0.120 (mean -0.019 ± 0.074).

Postoperatively:

Sim K1 ranged from 42.88-47.87D (mean value of 44.65 ± 1.52). The Sim K2 ranged from 41.67-46.17 (mean value of 43.39 ± 1.61D). The average K reading (Km) ranged from 42.41-46.99D (mean value of 44.02 ± 1.52D). The Cylinder (Cyl) ranged from 0 to -2.25D D (mean value of -0.75 ± 0.70D). The Sphere (Sph) ranged from -0.75 to -6.25D D (mean value of -2.23 ± 1.71D). The high order Among the study aberration (Coma aberr) ranged from -0.087 to 0.132 (mean value of -0.017 ± 0.063).

The mean value of Sim K1 decreased from 44.72 ± 1.61D preoperatively to 44.65 ± 1.52D 3 month postoperatively with t-test showing a value of 0.70 (P=0.49, i.e>0.05) denoting a non significant change. The mean value of Sim K2 changed from 43.33 ± 1.68D preoperatively to 43.39 ± 1.61D 3 month postoperatively with t-test showing a value of 0.61 (P=0.56, i.e >0.05) denoting a non significant change. The mean value of Km decreased from 44.03 ± 1.61D preoperatively to 44.02 ± 1.52D 3 month postoperatively with t-test showing a value of 0.09 (P=0.93, i.e >0.05) denoting a non significant change (Table 1 & Chart 1).

Table 1: Showing the average value for Steepest,flattest and mean keratometric readings in Diopters (D)both preoperatively and 3 months postoperatively after ptosis surgery, their comparison by t-test and the significance for cases among the study.

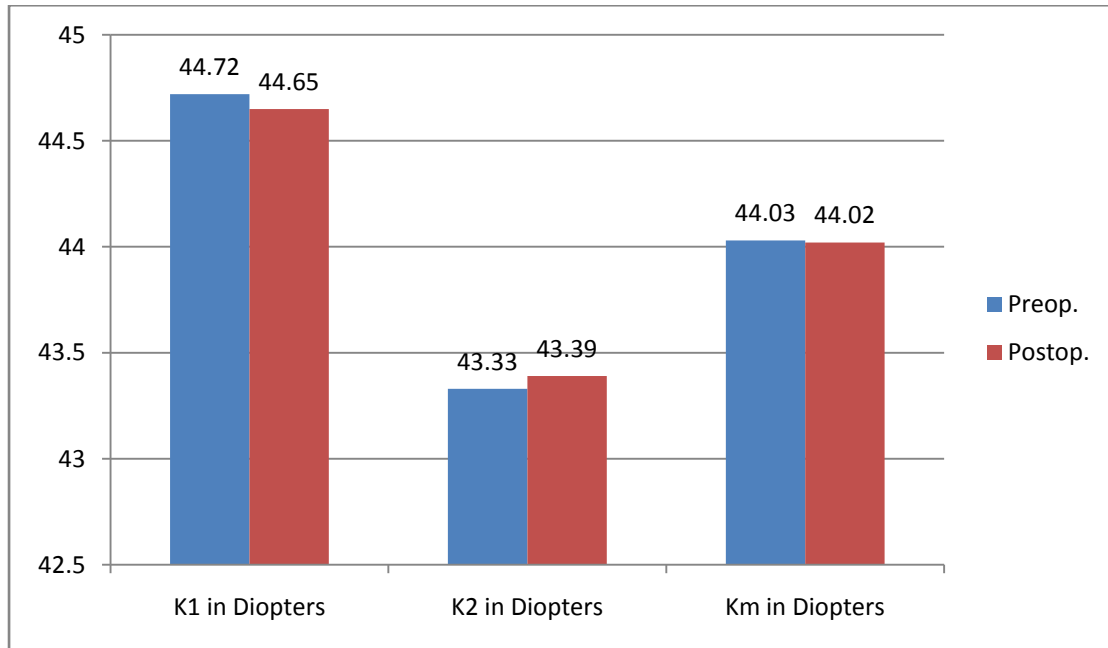| Item	Preop	Post.Op	T-test	P-value	Significance level	Significance
K1	44.72±1.61D	44.65±1.52D	0.70	0.49	>0.05	Non significant
K2	43.33±1.68D	43.39±1.61D	0.61	0.56	>0.05	Non significant
Km	44.03±1.61D	44.02±1.52D	0.09	0.93	>0.05	Non significant

Chart 1: Showing the average K1, K2 and mean keratometric readings in dioptres both preoperatively and 3 months postoperatively after ptosis surgery.

The steepest Sim K1 decreased by a mean value of 0.07±0.39D and the average K value decreased by a mean value of 0.01±0.28D at 3 month postoperatively.

The mean value of the Cylinder decreased from -1±0.71D preoperatively to - 0.75±0.70D 3 month postoperatively with t-test showing a value of 1.32 (P=0.21,i.e >0.05) denoting a non significant change. The mean value of the Sphere changed from -2.11±1.94D preoperatively to -2.23±1.71D 3 month p ostoperatively with t-test showing a value of 0.71 (P=0.49, i.e>0.05) denoting a non significant change (Table 2 & Chart 2).

Table 2: Showing the average value for Cylinder and Sphere in dioptres (D) both preoperatively and 3 months postoperatively after ptosis surgery ,their comparison by t-test and the significance for cases among the study.

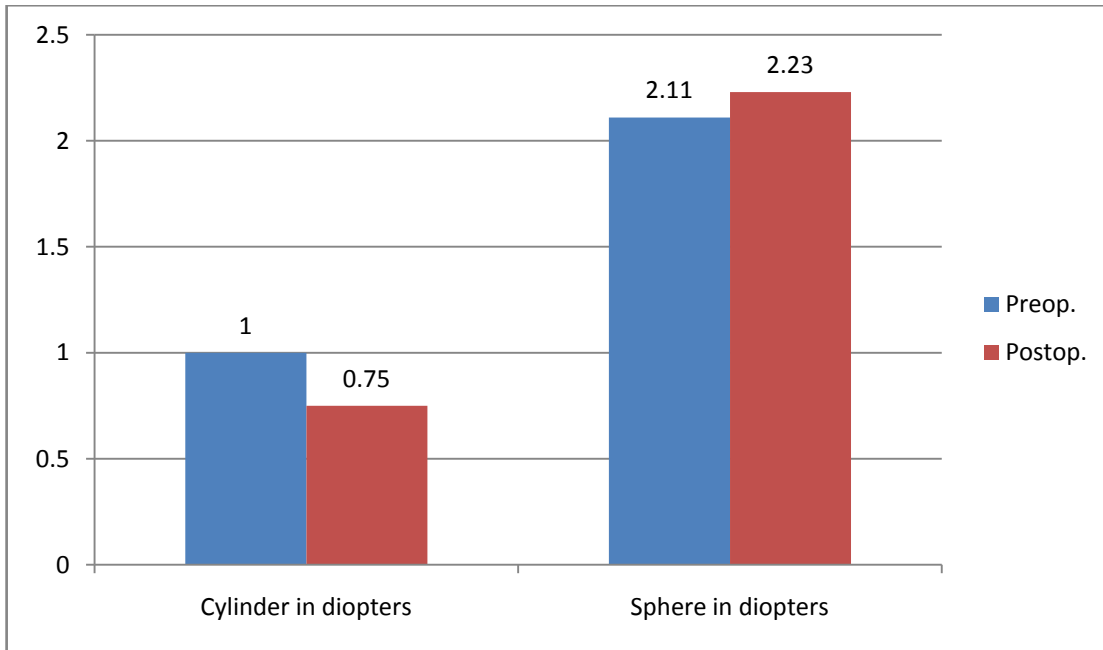| Item	Preop.	Post. Op	T- test	P-value	Significance level	Significance
Cylinder	-1±0.71D	-0.75±0.70D	1.32	0.21	>0.05	Non significant
Sphere	-2.11±1.94D	-2.23±1.71D	0.71	0.49	>0.05	Non significant

Chart 2: Showing the average Cylinder and Sphere in dioptres both preoperatively and 3 months postoperatively after ptosis surgery.

The Cylinder decreased by a mean value of -0.25±0.78D at 3 month postoperatively.

A non significant correlation (p>0.05) existed between the degree of ptosis before the surgery and the postoperative decrease in cylinder (Table 3).

Table 3:showing the Pearson correlation "r" between the degree of ptosis before surgery and the average postoperative decrease in Cylinder in dioptres (D) and the significance for cases among the study.

Item	Correlation coefficient "r"	P value	Significance
Postop. Cylinder Decrease vs Degree of Ptosis	0.10	>0.05	non significant

A statistically significant correlation (p<0.05) existed between the postoperative decrease in cylinder and the postoperative reduction in the steepest K1 readings among cases under study(Table 4).

Table 4: Showing the Pearson correlation "r" between the postoperative decrease in the cylinder and the postoperative decrease in the steepest K1 readings and the significance for cases among the study.

Item	Correlation coefficient "r"	P- value	Significance
Postop. Cylinder decrease vs Postop. decrease in the steepest K1 reading	0.26	<0.05	Statistically significant

The mean value of the high order Among the study decreased from -0.019±0.074 (μ) preoperatively to -0.017±0.063 (μ) 3 month postoperatively with t-test showing a value of 0.07 (P=0.94 ,i.e>0.05) denoting a non significant change(Table 5 & Chart 3).

Table 5: Showing the average value for high order Among the study aberration in microns (µ) both preoperatively and 3 months postoperatively after ptosis surgery ,their comparison by t-test and the significance for cases among the study.

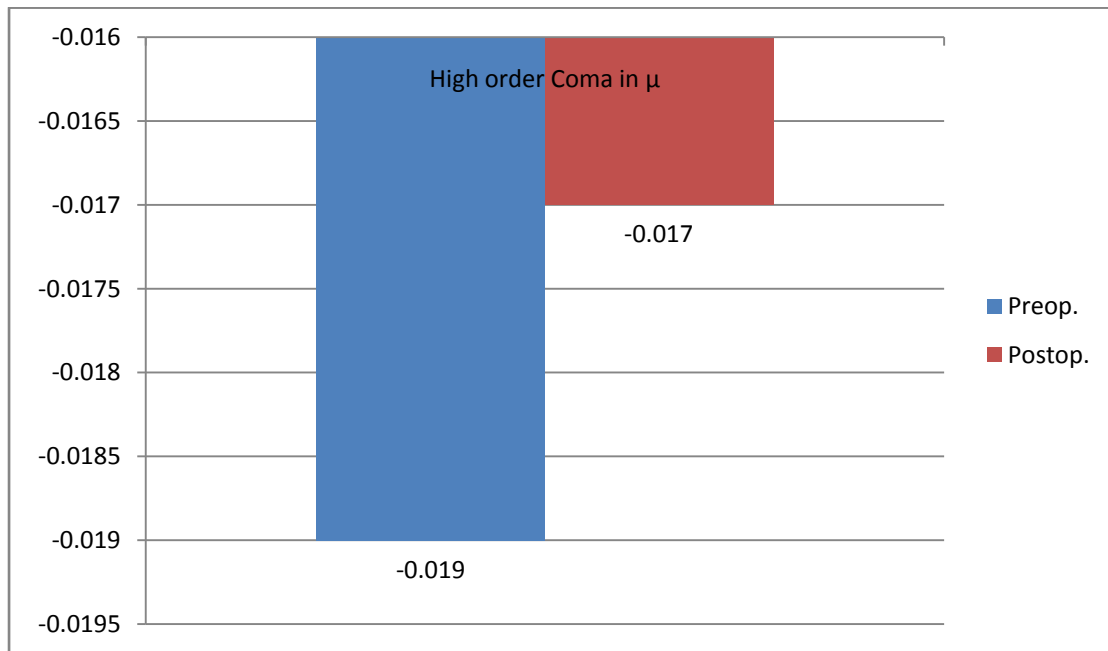| Item	Preop.	Post. Op	T-test	P-value	Significance level	Significance
Coma Aberr	-0.019±0.074	-0.017±0.063	0.07	0.94	>0.05	Non significant

Chart 3: Showing the average high order Among the study aberration in microns(µ) both preoperatively and 3 months postoperatively after ptosis surgery.

The high order Among the study aberration decreased by a mean value of -0.001±0.050µ at 3 month postoperatively.

A statistically significant correlation (p<0.05) existed between the postoperative reduction in the high order coma and the postoperative decrease in cylinder among cases under study(Table 6).

Table 6: Showing the Pearson correlation "r" between the postoperative decrease in the high order coma aberration and the postoperative decrease in the cylinder and the significance for cases among the study.

Item	Correlation coefficient "r"	P-value	Significance
Postop. Cylinder decrease vs Postop. decrease in coma aberration	0.35	<0.05	Statistically significant

A highly significant correlation (p<0.01) existed between the degree of ptosis before the surgery and the postoperative reduction in the high order coma and among cases under study (Table 7).

Table 7: Showing the Pearson correlation "r" between the postoperative decrease in the high order coma aberration and the degree of ptosis before surgery and the significance for cases among the study.

Item	Correlation coefficient "r"	P-value	Significance
Postop. decrease in coma aberration Degree of ptosis	0.63	<0.01	highly significant

3.2 Discussion

Ptosis of the upper eyelid may have a significant impact on the patient's functional status. [3]. Some studies had shown that ptosis correction by different techniques could have an effect on corneal topography probably because alteration of the eyelid pressure on the cornea may change the corneal shape and its refractive characteristics. [14]. However, other study claims that the changes in sphere and cylinder were not statistically significant after ptosis correction. In this study , the effect of successful ptosis surgery on the corneal topography and refraction were studied, comparing our results with previous studies together with studying high order coma aberration changes in these patients to find out if there is a beneficial effect on the patient's visual quality.

Zinkernagel etal, in a study on 24 eyes of 13 patients with involutional ptosis; found that there was a mean change in simulated keratometry at 3 months after surgery of 0.25±0.25D .There was a mean change in total astigmatism of 0.25 diopter (D) after ptosis surgery(P=.02) [14].

Brown etal, studied 24 eyes with ptosis and they found that after ptosis repair, the average diopteric change as measured by keratometry and by corneal videokeratography (CVK) was approximately 0.60 diopters (D) [9].

Byard etal, studied 13 eyes with congenital ptosis managed with unilateral levator resection for long-term changes in refractive error in the operated eye ,with refractive changes in the non-operated contralateral eye were used as age-matched controls. The mean spherical change was 0.41D (range 0.12–1.50D) in the operated eye, and 0.40D (range 0.25–2.00D) in the non-operated eye, while, the mean cylindrical change was 0.38D (range 0.25–1.00D) in the operated eyes, and 0.21D (range 0.50–1.75D) in the non-operated eye. However the differences were not statistically significant [15].

In our study that involved 19 eyes of 12 patients with stable ptosis included in the study with age ranged from 4-21 years (mean 13±7.64 years) we found that:

The steepest Sim K1 decreased by a mean value of 0.07±0.39D and the average K value decreased by a mean value of 0.01±0.28D at 3 month postoperatively and this reduction was less than that found by ***Zinkernagel etal*** [14]**,** but we worked on younger age groups than their study**.** The mean value of the Cylinder decreased from - 1±0.71D preoperatively to - 0.75±0.70D 3 month postoperatively with t-test denoting a non significant change (P>0.05). The mean value of the Sphere changed from -2.11±1.94D preoperatively to -2.23±1.71D 3 month postoperatively with t-test denoting a non significant change (P>0.05). The Cylinder decreased by a mean value of -0.25±0.78D at 3 month postoperatively and this reduction is comparable to ***Zinkernagel etal*** [14]**,** study. Slighly higher results was obtained by ***Byard etal*** [15] but on a longer follow up time.A statistically significant correlation (p<0.05) existed between the postoperative decrease in cylinder and the postoperative reduction in the steepest K1 readings . The mean value of the high order Among the study decreased from - 0.019±0.074 (μ) preoperatively to -0.017±0.063 (μ) 3 month posto peratively with t-test denoting a non significant change (>0.05). The high order Among the study aberration decreased by a mean value of - 0.001±0.050μ at 3 month postoperatively. A statistically significant correlation (p<0.05) existed between the postoperative reduction in the high order coma and the postoperative decrease in cylinder among cases under study. A highly significant correlation (p<0.01) existed between the degree of ptosis before the surgery and the postoperative reduction in the high order coma and among cases under study. The report about the high order Among the study changes after ptosis surgery and their correlations with other studied items were included in our study but not in previous studies.

4. CONCLUSIONS

Following successful ptosis surgery **,**astigmatism decreases by a mean value of -0.25±0.78D which was significantly correlated with reduction of the high order coma aberration .Similarly, the degree of preoperative ptosis significantly affects the postoperative reduction in the high order coma aberration. Therefore, patients undergoing surgical correction of ptosis, may have improvement in their visual quality as well as uncorrected visual acuity after their successful ptosis correction.

5. ACKNOWLEDGMENT

6. REFERENCES

[1]   N .Uzcategui, S.C. Dresner, comprehensive ptosis management; George L. Spaeth, Ophthamic surgery Principles and practice ,vol.47 pp.459-470, 2003.

[2]   T.J.Federecci, D.R.Meyer, L.L.Lininger,Correlation of the vision related functional impairment associated with blepharoptosis and the impact of blepharoptosis surgery, Ophthalmology vol.106, pp.1705-1712, 1999.

[3]   C.B.Cosar, C.J.Rapuano, E.J.Cohen, P.R,Laibson Chalazion as a cause of decreased vision after LASIK. Cornea vol. 20,pp.890–891, 2001.

[4]   A.Goldhahn, T.Schrom, A.Berghaus, A.Krause, G.Duncker,Corneal astigmatism as a special complication after lid-loading in patients with lagophthalmos. Ophthalmologe vol. 96,pp.494–497,1999.

[5]   J.G.Ford, R.M.Davis, J.W.Reed, R.G.Weaver, T.E.Craven, M.E.Tyler , Bilateral monocular diplopia associated with lid position during near work. Cornea vol. 16,pp. 525–530,1997.

[6]   K.C.Golnik , E.Eggenberger, Symptomatic corneal topographic change induced by reading in downgaze. J Neuroophthalmol vol. 21,pp. 199–204,2001.

[7]   W.Cadera, R.B.Orton, O.Hakim , Changes in astigmatism after surgery for congenital ptosis. J Pediatr Ophthalmol Strabismus vol. 29, no. 2, pp. 85-88,1992.

[8]   D.E.Holck, J.J.Dutton, S.R.Wehrly , Changes in astigmatism after ptosis surgery measured by corneal topography. Ophthal Plast Reconstr Surg. Vol. 14,no.3,pp. 151-158,1998.

[9]   M.S.Brown, I.M.Siegel, R.D.Lisman , Prospective analysis of changes in corneal topography after upper eyelid surgery. Ophthal Plast Reconstr Surg. Vol. 15,no.6,pp. 378-383,1999.

[10]   T.Buehren,M.J.Collins, L.Carney , Corneal aberrations and reading. Optom Vis Sci vol.,80,pp. 159–166,2003.

[11]   C.A.Cates, A.G.Tyers , Outcomes of anterior levator resection in congenital blepharoptosis. Eye vol.15,no.6,pp. 770–773,2001.

[12]   T.J.McCulley, R.C.Kersten, D.R.Kulwin, W.J.Feuer , Outcome and influencing factors of external levator palpebrae superioris aponeurosis advancement for blepharoptosis. Ophthal Plast Reconstr Surg vol. 19,no 5,pp. 388–393,2003.

[13]   M.J.Lucarelli, B.N.Lemke , Small incision external levator repair: technique and early results. Am J Ophthalmol. Vol. 127,no.6,pp.637–644,1999.

[14]   M.S.Zinkernagel, A.Ebneter, D.Ammann-Rauch D, Effect of Upper Eyelid Surgery on Corneal Topography; Arch Ophthalmol. Vol.125,no.12,pp. 1610-1612,2007.

[15]   D.B.Byard, V.Sood, C.A.Jones ,Long-term refractive changes in children following ptosis surgery: a case series and a review of the literature .Inernational Ophthalmology.vol.34,no.6,pp.1303-1307,2014.