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Corneal Topographic Changes after Correction of Ptosis by Levator Muscle Resection Measured by Scheimpflug Imaging

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Abstract

Background: Blepharoptosis is a drooping of the upper eyelid. The effect of ptosis surgery on corneal topography is debatable and needs to be identified.

Aim of Study: To evaluate the corneal topographic changes after levator resection surgery in patients affected by congenital or acquired ptosis.

Patients and Methods: This is a prospective study included 20 eyes with moderate to severe ptosis and a levator function range of 6-10mm and with the probability to be subjected to clinical examination and topographic investigations. Patients underwent between 14 to 20mm of transcutaneous levator muscle resection. The patients underwent complete ophthalmological examination, routine lid examination for ptosis and corneal topography. Topographic parameters included K1, K2, astigmatic axis and power and pachy apex.

Results: After surgical ptosis repair, corneal topography demonstrated a reduction in K1 of 0.12 ±0.28 diopters (D) which was non statistically significant, also k2 showed a reduction of –0.12±0.28 diopters (D) and that difference is not considered statistically significant. Regarding corneal astigmatism it increased by 0.02 ±0.29 diopters (D) and by measuring the *p*-value of that change it is not considered statistically significant. Both corneal astigmatism axis and pachy apex didn't show statistically significant change.

Conclusion: Correction of ptosis by levator muscle resection increased corneal astigmatism six weeks after surgery with non-significant degree.

Key Words: *Scheimpflug imaging – Correction of ptosis.*

Introduction

BLEPHAROPTOSIS is defined as an abnormal low-lying upper eyelid margin with the eye in primary gaze. The normal adult upper lid lies 1:2 mm below the superior corneal limbus and is highest just nasal to the pupil **[1]**.

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Blepharoptosisis divided into two categories: congenital and acquired. The main type of congenital ptosis is myogenic due to the improper development of the levator muscle. Acquired ptosis can be further sub-divided into the following classifications: Neurogenic, myogenic, aponeurotic, mechanical and traumatic. Most cases of acquired blepharoptosis are secondary to aponeurotic causes such as involutional changes, a disinsertion, or a dehiscence which reduces its ability to lift the eyelid **[2]**.

Surgical procedures designed to correct ptosis should be directed toward correction of the underlying pathologic condition. The 3 categories of surgical procedures most commonly used in ptosis repair are external (transcutaneous) levator advancement, internal (transconjunctival) levator/tarsus/Müller muscle resection approaches and frontalis muscle suspensions **[3]**.

Surgery that reposts the upper lid may modify pressure applied on the opposing cornea and alter preexisting corneal curvature. This changes possibly modify corneal refraction and may lead to persistent blurred vision following ptosis repair, upper blepharoplasty and implantation of gold weight **[4]**.

By use of corneal topography, many researcher reported that some patients who undergo blepharoplasty and ptosis repair had significant refractive changes **[5]**.

Aim of the study: To evaluate the corneal topographic changes after levator resection surgery in patients affected by congenital or acquired ptosis.

Patients and Methods

A prospective study included 20 eyes of patients with moderate to severe ptosis whose levator muscle function ranged from 6 to 1 0mm recruited from

outpatient clinic of Ophthalmology Department, Ain Shams University Hospitals in the period between December 2020 to June 2021. We included in our study male and female ptotic patients with levator function more than 5mm and can have topographic examination(more than 4 years old), while we excluded all patients who underwent previous corneal or eyelid surgery, patient with corneal distorting disease such as pterygium, keratoconus or contact lens wearer and patients with special syndrome such as Marcus Gunn jaw winking syndrome.

All patients underwent the following:

Complete ophthalmological examination included uncorrected visual acuity (UCVA), best corrected visual acuity (BCVA) assessment, full slit lamp examination, fundus examination, clinical examination of III, V and VI cranial nerves, extraocular muscle motility, tear film break up time.

Specific ptosis examination: Palpebral fissure height measurement: While eyes in primary position, the distance between upper and lower lid margin is measured using a ruler in pupillary plane. Levator excursion measurement: Eyebrow is fixed by a finger to exclude the effect of frontalis muscle. Patient is asked to do maximum downgaze then maximum up gaze and maximum lid excursion is measured by a ruler in pupillary plane. Margin-reflex distance1 (MRD1): While eyes in primary gaze, the distance between upper eye lid margin and corneal light reflex is measured by a ruler.

Corneal topography: Using OCULUS Pentacam® anterior segment analyzer, corneal topography was done for assessment of K1, K2 corneal astigmatism power and axis and corneal pachy apex.

Surgical procedure: Levator muscle resection.

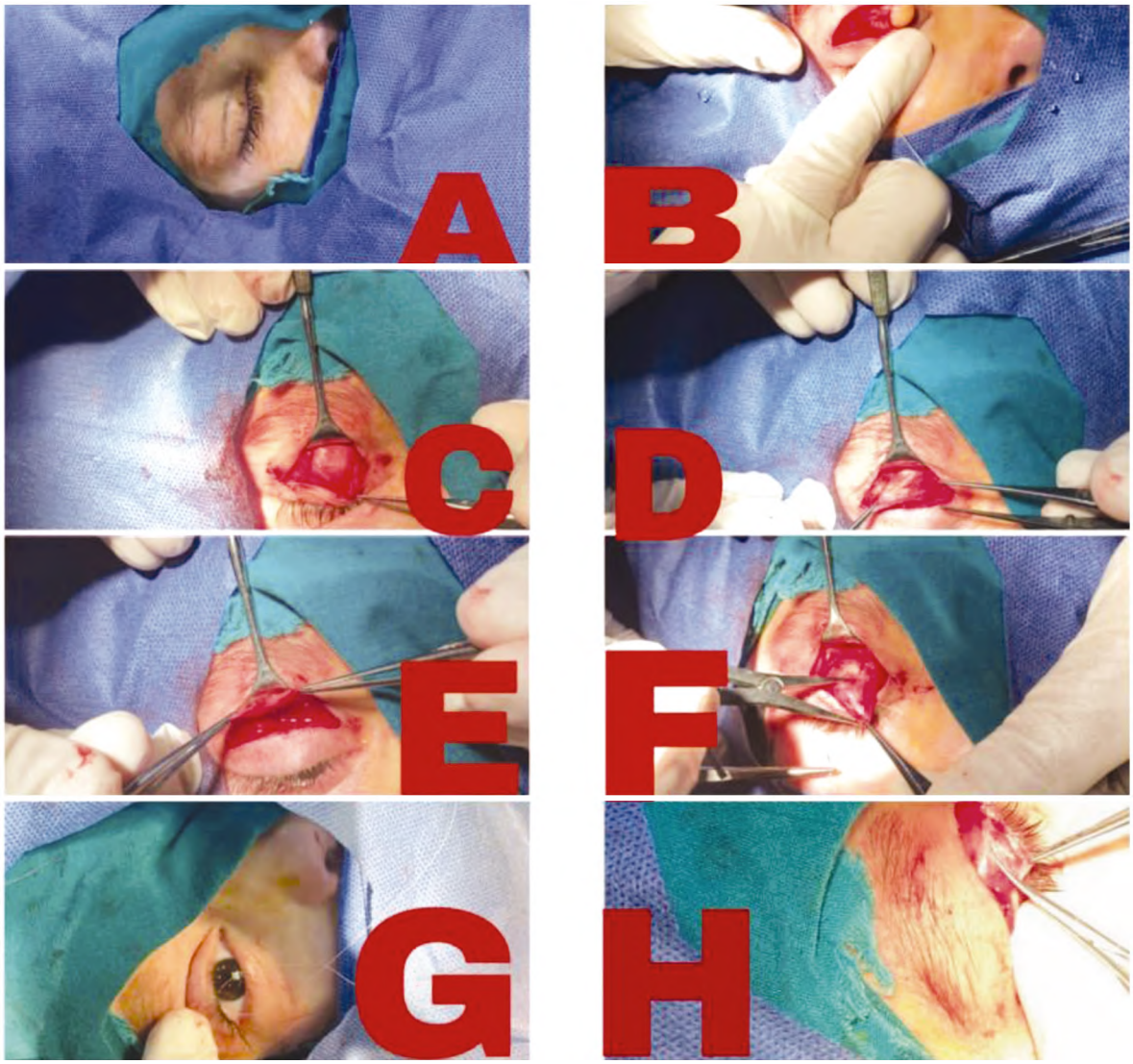

Fig. (1): Steps of levator muscle resection: (A) Marking of the site of the proposed lid crease. (B) Incision of skin and orbicularis muscle then opening of orbital septum to expose preaponeurotic fat which is land mark for levator muscle. (C) Retraction of preaponeurotic fat to expose levator muscle. (D) Separation of levator muscle from its insertion in ant. Tarsal surface. (E) Separation of lateral and medial horns from their insertions. (F) Double armed 5’0 vicryl sutures passed through the tarsus. (G) Intraoperative assessment of eyelid position. (H) Resection of the measured excess portion of the muscle Then closure of orbicularis and skin.

The operative procedures were carried out at Ophthalmology Department, Ain Shams University Hospitals. All preoperative examination and investigations were repeated six weeks after surgery. The study was conducted according to tents of declaration of Helsinki and received the approval of the ethical and scientific committees of Ain Shams University.

Results

Analysis of the demographic data demonstrated that; Age range was 6:52, 50% of patients (10 patients) were females and 50% of patients (10 patients) were males. Clinical examination showed a variable range of levator function: Good levator muscle function was found in 10 cases and fair levator function was found in 10 eyes Also clinical examination showed that degree of ptosis ranged from moderate ptosis 13 (65%) to severe ptosis 7 cases (35%).

On analysis of pre and postoperative data we found that K1 decreased in most of cases (60%) and increased in 30% of cases, while it remained stable in 10% of cases. Fig. (2).

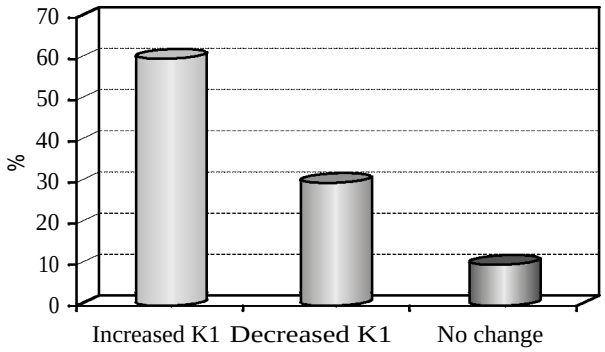

Fig. (2): The change of K1 after surgery.

On the other side we compared the values of K2 before and after surgery and found that it increased in 30% of cases, decreased in 55% of cases and didn't change in 15% of cases. Fig. (3).

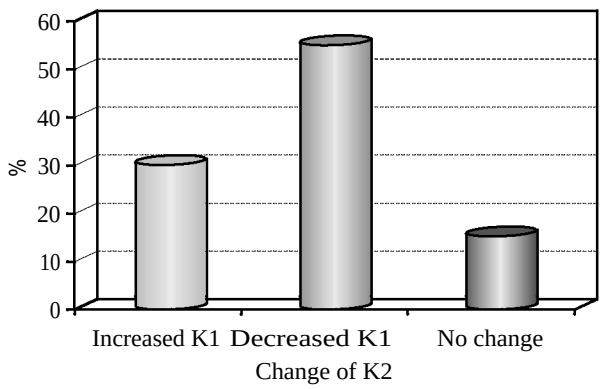

Fig. (3): Change of K2 in studied patients.

With further analysis of K1, we compared post-operative mean value with preoperative mean value and revealed that K1 decreased from 43.00 ± 1.28 preoperatively to 42.84± 1.36 postoperatively, this change was statistically non significant with *p*-value of 0.065. Also K2 decreased from 44.11 ± 1.22 to 43.99± 1.44 and this change is not considered statistically significant with *p*-value of 0.060. Table (1).

Table (1): Comparison of K1 and K2 before and after surgery.

	Before No.=20	After No.=20	Test value•	*p*-value	Sig.
K1:					
Mean ± SD	43.00± 1.28	42.88± 1.37	1.955	0.065	NS
Range	41.1-45.1	41-45.3			
K2:					
Mean ± SD	44.11± 1.22	43.99± 1.44	–1.997	0.060	NS
Range	42.3-45.8	41.9-46.1			

p-value >0.05: Non-significant (NS);
p-value <0.05: Significant (S).
p-value <0.01: Highly significant (HS).
•: Paired *t*-test.

We studied corneal astigmatism and found that 10 cases (50%) showed increase in astigmatism, 8 cases (40%) showed decrease in astigmatism, while 2 cases (10%) didn't change. With further analysis of corneal astigmatism data we found that the mean corneal astigmatism increased from 1.11 ± 1.02 pre-operatively to 1.13± 1.19 post-operatively and this change is not statistically significant (*p*-value 0.908), also comparing postoperative with preoperative corneal astigmatism axis we found that the difference was not statistically significant from mean of 114.74±70.19 preoperative to mean of 138.30±65.05 postoperative, with *p*-value of 0.135. Table (2).

Table (2): Comparison between corneal astigmatism and corneal astigmatism axis before and after surgery.

	Before No.=20	After No.=20	Test value‡	*p*-value	Sig.
Corneal astigmatism:					
Mean ± SD	1.11± 1.02	1.13± 1.19	–0.116	0.908	NS
Range	0.3-3.9	0.3-4.5			
Corneal astigmatism axis:					
Mean ± SD	114.74± 70.19	138.30± 65.05	–1.495	0.135	NS
Range	9.7-178.2	12.7-180			

p-value >0.05: Non significant (NS).
p-value <0.05: Significant(S).
p-value <0.01: Highly significant (HS).
‡: Wilcoxon Rank test.

Table (3) Comparison between patients underwent 14:16 mm and patients underwent 18:20 mm of levator muscle resection.

	Levator resection 18:20 mm	Levator resection 14:16 mm	Test value	*p*-value	Sig.
	No.=7	No.=13			
Before:					
K1:					
Mean ± SD	42.39±0.97	43.33± 1.34	–1.639	0.118	NS
Range	41.1-43.6	41.1-45.1			
K2:					
Mean ± SD	43.70± 1.23	44.33± 1.21	–1.105	0.284	NS
Range	42.3-45.8	42.3-45.8			
Corneal astigmatism:					
Mean ± SD	1.36± 1.17	0.98±0.95	0.787	0.442	NS
Range	0.4-3.9	0.3-3.9			
Corneal astigmatism axis:					
Mean ± SD	112.87±70.61	115.75±72.83	–0.085	0.933	NS
Range	9.7-173	9.7-178.2			
Pachy apex:					
Mean ± SD	569.43±25.19	557.54±24.83	1.016	0.323	NS
Range	532-613	524-613			
After:					
K1:					
Mean ± SD	42.19±0.92	43.25± 1.45	–1.754	0.096	NS
Range	41-43.4	41-45.3			
K2:					
Mean ± SD	43.46± 1.43	44.28± 1.41	–1.234	0.233	NS
Range	41.9-46.1	41.9-46.1			
Corneal astigmatism:					
Mean ± SD	1.40± 1.44	1.01± 1.11	0.683	0.503	NS
Range	0.3-4.5	0.3-4.5			
Corneal astigmatism axis:					
Mean ± SD	150.43±61.08	131.77±68.58	0.601	0.555	NS
Range	12.7-180	12.7-180			
Pachy apex:					
Mean ± SD	566.43±35.23	555.62±30.18	0.722	0.480	NS
Range	526-618	524-618			
Difference:					
K1:					
Mean ± SD	–0.20±0.29	–0.08±0.27	–0.954	0.353	NS
Range	–0.8-0.1	–0.8-0.2			
K2:					
Mean ± SD	–0.24±0.30	–0.05±0.23	–1.555	0.137	NS
Range	–0.6-0.3	–0.4-0.3			
Corneal astigmatism:					
Mean ± SD	0.044±0.3 84	0.030±0.285	0.095	0.926	NS
Range	–0.47-0.73	–0.47-0.73			
Corneal astigmatism axis:					
Mean ± SD	37.56±60.37	16.02±50.32	0.853	0.405	NS
Range	–5.7-127	–31.3-127			
Pachy apex:					
Mean ± SD	–3.00± 16.99	–1.92± 12.30	–0.164	0.872	NS
Range	–28-27	–28-27			

p-value >0.05: Non significant (NS). *p*-value <0.01: Highly significant (HS). ‡: Wilcoxon Rank test.
p-value <0.05: Significant (S). •: Paired *t*-test.

Regarding corneal pachy apex it didn't show statistically significant change after surgery.

We compared the results of cases who underwent 14 to 16mm of levator muscle resection (13 cases) with the results of cases who underwent 18 to 20mm of levator resection (7 cases).

On comparing preoperative data of patients in both groups we found that there was no statistical significant difference between both groups regarding all studied parameters.

After surgery we compared postoperative data with preoperative data in both groups and found that: K1 and K2 decreased in both groups with non-statistically significant degree corneal astigmatism increased in both groups with non-statistically significant degree.

We also compared the amount of change in studied parameters between both groups and found the difference was non statistically significant in all studied parameters Table (3).

Discussion

Eyelid ptosis is a commonly encountered problem. The effect of ptosis and ptosis correction procedures on the cornea have been documented by many authors.

Ptosis may be associated with visual and functional impairment and cosmetic problems. Treatment of ptosis is indicated where vision is impaired or where there is an undesired appearance. The vision can be impaired not only when the upper eyelid covers the pupil but even for refractive reasons. Previous studies indeed suggest that the eyelid pressure, in ptotic eyes, can modify corneal shape. Skaat et al., [6].

On contrary to this popular conclusion Vihlen and Wilson, [7] evaluated corneal toricity by keratometry in 195 eyes and reported no correlation between corneal toricity and lid tension.

In our study we investigated the effects of eyelid ptosis surgery on corneal topographic parameters that were measured by Pentacam rotating Scheimpflug camera. Detailed study of corneal parameters included K1, K2, corneal astigmatism (value & axis), and pachy apex.

In this study K1 decreased from (43.00 ± 1.28) preoperative to (42.88 ± 1.37) postoperative with p-value of 0.065, and K2 decreased from (44.11 ± 1.22) preoperative to (43.99 ± 1.44) postoperative with p-value of 0.060.

Our results matched the results of Youssef et al., [8] who found that the flattest (K1) decreased from (42.5 ± 1.2) preoperative to (42.5 ± 1.7) with p-value of 0.864 and the steepest (K2) meridians of the studied subjects in the present study decreased from 43.7 ± 1.4 preoperative to 43.41 ± 1.7 with p-value of 0.703 1 month after ptosis surgery, then further decreased 3 months after ptosis surgery, but none of these changes was statistically significant throughout the study.

Regarding corneal astigmatism there was increase from (1.11 ± 1.02) preoperative to (1.13 ± 1.19) postoperative with p-value of 0.908.

Zinkernagel et al., [9] who used Orbscan 2 both before and 3 months after surgery reported that the average change in total astigmatism after ptosis surgery was 0.20D with p-value less than 0.05.

Cadera et al., [10] in their study on changes in astigmatism after surgery for congenital ptosis reported an overall increase in average astigmatic refractive error by 0.30 dioptres. 36% of study eyes changed by more than 0.75D. Results were similar for both fashia lata sling and levator resection.

Garima et al., [11] reported that the average preoperative astigmatism was 1.28D while the average postoperative astigmatism was 1.71D. The difference 0.43D had a p-value of <0.001. Klimex et al., [12] in their study on the change in refractive error after unilateral levator resection for congenital ptosis reported that the mean refractive change in the operated eye was 1.23D sphere (p=0.061) and 0.83D cylinder (p=0.002). The latter was statistically significant. Within the group of control eyes, no significant mean spherical or cylindrical changes were found at the last postoperative visit.

This differs from the results of Savino et al., [5] who found that the mean value of average K=43.36D preoperatively and 43.20D 4 months postoperatively with a change of –0.15, and mean value of corneal astigmatism=1.37D preoperatively and 1.11D 4 months postoperatively, with a mean change of –0.26 with p-value of 0.501.

This difference from our results may be due to different topography analyzer (Sirus) compared to ours (Pentacam), long follow-up period (4 months) compared to ours (6 weeks) and different age group (14: 84) compared to ours (6: 52).

Also, Kao et al., [13] in their study on astigmatic change following congenital ptosis surgery reported an average decrease of 0.18D in astigmatism which has no statistical significance.

This difference from our results may be due to their long follow-up period 12 months, and different surgical procedures levator resection and sling suspension, while we used levator resection only. Karabulut et al., **[14]** found that astigmatism decreased from –1.13 ±0.93 preoperative to –1.01 ± 0.83 postoperative with p-value of 0.356 This difference from our results may be due to different procedure used Müller muscle resection compared to levator muscle resection utilized by us, and different topography analyzer (Sirus) compared to ours (Pentacam).

Gingold et al., **[15]** reported no statistical change in refractive error, keratometry, and toricity after surgery in patients with acquired ptosis and direction of the axis remained relatively stable in their study. Corneal astigmatism axis shifted from (114.74±70.19) preoperative to (138.30 ±65.05) postoperative with p-value of 0.135.

This is nearly the same as the results of Karabulut et al., **[14]** who found that the astigmatism axis shifted from 113.93 ±76.80 preoperative to 111.79±77.88 postoperative with p-value of 0.325.

Our study showed that there was decrease in corneal pachy apex after surgery from 561.70 ± 24.98 to 559.40±31.55 with p-value 0.461. This result matched results of study done by Savino et al., **[5]** who found that central corneal thickness did not show significant change postoperative.

Also, Karabulut et al., **[14]** found that central corneal thickness did not show significant change postoperative.

Conclusion:

Correction of ptosis by levator muscle resection increased corneal astigmatism six weeks after surgery with non-statistically significant degree.

Recommendations:

It's wise to conduct a similar study with larger sample size.

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التغيرات الطبوغرافية للقرنية بعد إصلاح ارتخاء الجفن عن طريق تقصير العضلة الرافعة للجفن وقياسها باستخدام نظام الشمبفلج

المقدمة: ارتخاء الجفن يعنى سقوط الجفن العلوى ووجوده فى موضع منخفض عن موضعه الطبيعى وطالما ظل تأثير اصلاح ارتخاء الجفن على تضاريس القرنية محل نقاش مما يجعله فى حاجة إلى المزيد من الدراسة.

الهدف من الدراسة: تهدف هذه الدراسة إلى دراسة التغيرات التى تحدث فى تضاريس القرنية بعد جراحات ارتخاء الجفن العلوى.

طريقة البحث: دراسة مستقبلية شملت عشرين عيناً ما بين الارتخاء المتوسط والشديد للجفن العلوى للعين وبتفاوت فى القوة الوظيفية للعضلة الرافعة للجفن ما بين ٦ إلى ١٠ مم، خضع جميع المرضى لعملية اصلاح ارتخاء الجفن عن طريق تقصير العضلة الرافعة للجفن ما بين ١٤ إلى ٢٠ مم. تم إجراء كشف رمدى كامل للمرضى مع تقييم خاص لحالة ارتخاء الجفن ودراسة تضاريس القرنية للمرضى جميعاً

النتائج: أظهرت النتائج أن جميع التغيرات التى طرأت على المعاملات محل الدراسة لم تكن لها دلالة إحصائية مع أنها أدت إلى زيادة درجة اللانقطية.

الخلاصة: إصلاح ارتخاء الجفن عن طريق تقصير العضلة الرافعة يؤدى إلى زيادة درجة اللانقطية فى القرنية بصورة ليس لها دلالة إحصائية.

التوصية: نوصى بإجراء الدراسة على عدد أكبر من المرضى.