UOT: 617.758.1-089

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THE EFFECT OF HORIZONTAL RECTUS SURGERY ON POSTERIOR CORNEAL CURVATURE

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SUMMARY

Purpose – to investigate the effect of horizontal rectus muscle surgery for strabismus correction on posterior corneal curvature.

Materials and methods

Posterior corneal parameters of patients who underwent medial or lateral rectus muscle surgery (muscle recession, resection or combination procedures) were analyzed using a Pentacam device (Pentacam Oculus Optikgerate, Wetzlar, Germany). Tests were performed before and 1 month after surgery. The amount of change (Δ) in these parameters was compared between the groups that underwent single muscle and two-muscle surgery.

Results

Fifty eyes of 40 patients were included in the study. The mean age was 17.72±7.84 (5-36) years. The mean best corrected visual acuity (BCVA) was 0.86±0.31 (0.1-1) in Snellen. The mean deviation was 40.80±8.50 (20-50) prism diopter. A single muscle (medial or lateral rectus) recession operation was performed in 24 of the eyes. Two muscle surgeries (combination of recession and resection surgery to the medial and lateral rectus muscles) were performed on 26 eyes. In the whole group, cornea back flat-keratometry (K1b) decreased from -6.03±0.18 (-6.3-(-5.50)) to -6.01±0.20 (-6.40-(-5.60)) (p=0.115). Cornea back-steep keratometry (K2b) increased from -6.35±0.19 (-6.70-(-5.90)) to -6.41±0.20 (-6.90-(-6.10)) (p=0.037). Cornea back-mean keratometry (Kmb) remained constant at -6.19±0.17 (p=0.868). Posterior corneal astigmatism increased from 0.31±0.14 (0.1-0.6) to 0.33±0.16 (0.1-0.6) (p=0.276). ΔK2b was significantly higher in the group that underwent two-muscle surgeries (p=0.049).

Conclusion

Studies in the literature are mostly on the effect of strabismus surgeries on the anterior corneal surface. In our study, the effect of horizontal rectus surgery on the posterior cornea was investigated. In the short term, corneal back- steep keratometry was significantly increased after horizontal rectus surgery. This increase was greater in the group undergoing two-muscle surgery.

Key words: *corneal topography, posterior cornea, strabismus surgery, horizontal rectus muscle*

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HORİZONTAL REKTUS ƏZƏLƏ CƏRRAHİYYƏLƏRİNİN ARXA BUYNUZ QİŞA ƏYRİLİYİNƏ TƏSİRİ

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XÜLASƏ

Məqsəd – Çapıqlığın korreksiyası üçün həyata keçirilən horizontal rektus əzələ cərrahiyyəsinin posterior buynuz qişanın əyriliyinə təsirini araşdırmaq.

Materiallar və metodlar

Medial və ya lateral rektus əzələləri üçün resessiya, rezeksiyası və ya kombinasiya əməliyyatı keçirmiş xəstələrin posterior buynuz qişasının parametrləri Pentacam cihazı (Pentacam Oculus Optikgerate, Wetzlar, Almaniya) vasitəsilə təhlil edilmişdir. Testlər əməliyyatdan əvvəl və 1 ay sonra aparıldı. Bu parametrlərdəki dəyişiklik miqdarı (Δ) tək əzələ və iki əzələ əməliyyatı keçirmiş qruplar arasında müqayisə edilmişdir.

Nəticə

Tədqiqata 40 xəstənin 50 gözü daxil edilib. Orta yaş 17,72±7,84 (5-36) ildir. Orta ən yaxşı düzəldilmiş görmə kəskinliyi (BCVA) Snellendə 0,86±0,31 (0,1-1) olmuşdur. Orta sapma 40,80±8,50 (20-50) prizma diopteri idi. Gözlərin 24-də tək əzələ (medial və ya lateral rektus əzələləri) resessiya əməliyyatı edildi. 26 gözdə iki əzələ əməliyyatı (medial ve lateral rektus əzələlərine resessiya və rezeksiyanın birləşməsi) aparılmışdır. Bütün qrupda buynuz qişanın arxa düz-keratometriyası (K1b) -6,03±0,18 (-6,3-(-5,50))-dən -6,01±0,20-yə (-6,40-(-5,60)) (p=0,115) qədər azalmışdır. Buynuz qişanın arxa-dik keratometriyası (K2b) -6,35±0,19 (-6,70-(-5,90))-dən -6,41±0,20 (-6,90-(-6,10))-a (p=0,037) yüksəldi. Kornea geri-orta keratometriya (Kmb) -6,19±0,17 (p=0,868) səviyyəsində sabit qaldı. Arxa buynuz qişanın astiqmatizmi 0,31±0,14 (0,1-0,6)-dan 0,33±0,16 (0,1-0,6)-a (p=0,276) yüksəlib. İki əzələ əməliyyatı keçirən qrupda ΔK2b əhəmiyyətli dərəcədə yüksək idi (p=0,049).

Yekun

Ədəbiyyatda aparılan araşdırmalar daha çox çəpgözlük əməliyyatlarının buynuz qişanın ön səthinə təsiri ilə bağlıdır. Tədqiqatımızda horizontal rektus əməliyyatının posterior buynuz qişaya təsiri araşdırıldı. Qısa müddətdə horizontal rektus əməliyyatından sonra buynuz qişanın arxa səthinin dik keratometriyası əhəmiyyətli dərəcədə artmışdır. Bu artım iki əzələ əməliyyatı keçirən qrupda daha çox olub.

Açar sözlər: *buynuz qişanın topoqrafiyası, arxa buynuz qişa, çəpgöz cərrahiyyəsi, horizontal düz əzələ*

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ВЛИЯНИЕ ХИРУРГИИ ГОРИЗОНТАЛЬНОЙ ПРЯМОЙ МЫШЦЫ НА ЗАДНЮЮ КРИВИЗНУ РОГОВИЦЫ

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РЕЗЮМЕ

Цель – Изучить влияние операции на горизонтальную прямую мышцу на заднюю кривизну роговицы при лечении косоглазия.

Материалы и методы

Параметры задней роговицы пациентов, перенесших рецессию медиальной или латеральной прямой мышцы, резекцию и комбинированную операцию, анализировали с помощью устройства Pentacam (Pentacam Oculus Optikgerate, Вецлар, Германия). Анализы проводились до операции и через один месяц после операции. Величину изменения (Δ) этих параметров сравнивали между группами хирургических вмешательств на одной и двух мышцах.

Результаты

В исследование были включены 50 глаз 40 пациентов. Средний возраст составил 17,72±7,84 (5-36) лет. Средняя острота зрения с наилучшей кор-

рекцией (BCVA) по таблице Снеллена составила 0,86±0,31 (0,1–1). Среднее отклонение составило 40,80±8,50 (20-50) призменных диоптрий. Операция по рецессии одной мышцы (медиальной или латеральной прямой мышцы) была выполнена на 24 глазах. На 26 глазах выполнены две мышечные операции (сочетание рецессии и резекции медиальной и латеральной прямых мышц). Во всей группе показатель плоской кератометрии задней поверхности роговицы (K1b) снизился с -6,03±0,18 (-6,3-(-5,50)) до -6,01±0,20 (-6,40-(-5,60)) (p=0,115). Перпендикулярная кератометрия задней поверхности роговицы (K2b) с -6,35±0,19 (-6,70-(-5,90)) до -6,41±0,20 (-6,90-(-6)•10)) увеличилась (p=0,037). Среднее значение кератометрии задней поверхности роговицы (Kmb) оставалось постоянным на уровне -6,19±0,17 (p=0,868). Задний роговичный астигматизм увеличился с 0,31±0,14 (0,1-0,6) до 0,33±0,16 (0,1-0,6) (p=0,276). ΔK2b был достоверно выше в группе, перенесшей двухмышечные операции (p=0,049).

Заключение

Исследования в литературе в основном посвящены влиянию операции по поводу косоглазия на переднюю поверхность роговицы. В нашем исследовании изучалось влияние операции на горизонтальной прямой мышце на заднюю часть роговицы. В краткосрочной перспективе уровень K2b значительно увеличился после операции на горизонтальной прямой мышце. Это увеличение было больше в группе, перенесшей операцию на двух мышцах.

Ключевые слова: *топография роговицы, задний отдел роговицы, хирургия косоглазия, горизонтальная прямая мышца*

The effects of surgical interventions on extraocular muscles on corneal dynamics are a matter of curiosity. In different studies, the effects of strabismus surgeries on corneal and anterior chamber parameters have been discussed [1-4]. After recession or resection surgery, tension changes reaching the cornea through the sclera are among the main causes of corneal parameter changes after strabismus surgery [5]. The Pentacam topography device with its 360-degrees rotating Scheimpflug camera system is very useful in determining corneal and anterior chamber biomechanics.

In recent years, the role and effect of the posterior cornea has gained importance in understanding corneal biomechanics and biometric calculations. For this reason, it is important to know the changes in the posterior corneal curvature after horizontal rectus muscle surgery, but there are not enough studies on this subject in the literature.

Purpose - to investigate the effects of horizontal rectus surgeries on posterior corneal curvature with a Pentacam device.

Material and methods

Patients who underwent horizontal rectus surgery between September 2022 and January 2023 were examined. All patients underwent a comprehensive ophthalmic examination including best corrected visual acuity (BCVA), prism and cover test, slit lamp examination. Patients with previous ocular surgery, chronic ocular disease other than strabismus and refractive disorder, and chronic systemic disease were excluded from the study. A Pentacam device with Scheimpflug camera technology (Pentacam Oculus Optikgerate, Wetzlar, Germany) was used for corneal topography. K1b (Cornea back- flat keratometry), K2b (Cornea back-steep keratometry), Kmb (Cornea back-mean keratometry), posterior corneal astigmatism parameters were compared preoperatively and 1st month postoperatively. Patients were classified as those who had single muscle and two-muscle surgery. The mean differences (Δ values) for the parameters in which significant changes were detected in the whole study group were compared between the two groups. The Δ value for the variables was found by subtracting the mean of the preoperative values from the mean of the postoperative values. This research adhered to the principles outlined in the Declaration of Helsinki and was approved by the local institutional ethics committee. Informed consent was obtained from each participant or parent.

The corneal topography values obtained from the same patient preoperative and postoperative values were compared with the paired samples t test. Ocular parameters of the groups that underwent single and two-muscle surgery were compared with the independent t test. SPSS Statistics for Windows, (Version 21.0) software was used for the statistical analysis, with $p<0.05$ accepted as statistically significant.

Results

Table 1

K1b, K2b, Kmb and posterior corneal astigmatism in the preoperative and postoperative period

	Preoperative Mean ± SD (range)	Postoperative 1. Month Mean ± SD (range)	p value
K1b (D)	-6.03±0.18 (-6.3-(-5.50))	-6.01±0.20 (-6.40-(-5.60))	0.115
K2b (D)	-6.35±0.19 (-6.70-(-5.90))	-6.41±0.20 (-6.90-(-6.10))	0.037
Kmb (D)	-6.19±0.17 (-6.50-(-5.70))	-6.19±0.17 (-6.60-(-5.80))	0.868
Posterior corneal astigmatism	0.31±0.14 (0.1-0.6)	0.33±0.16 (0.1-0.6)	0.279

K1b: Cornea back- flat keratometry, K2b Cornea back-steep keratometry,
Kmb: Cornea back-mean keratometry,
D: Diopter. Paired sample t-test, p<0.05 statistically significant.
Results are denoted as mean ± standard deviation (range).

ΔK2b was significantly higher in the group that underwent two-muscle surgeries (p=0.049) (Table 2).

Table 2

K1b, K2b, Kmb, Posterior corneal astigmatism changes in the single muscle and two-muscle groups

	Single muscle (n=24)	Two-muscles (n=26)	p values
Δ K1b (D)	0.00±0.06 (-0.10-0.10)	0.03±0.10 (0-0.10)	0.225
Δ K2b (D)	0.00±0.05 (-0.10-0.10)	0.04±0.08 (-0.10-0.10)	0.049
Δ Kmb (D)	0.02±0.11 (0-0.30)	-0.01±0.04 (-0.10-0.10)	0.064
Δ Posterior corneal astigmatism	0.00±0.05 (-0.10-0.10)	0.02±0.10 (0-0.20)	0.297

Δ K1b: Change in cornea back- flat keratometry,
ΔK2b: Change in cornea back-steep keratometry,
ΔKmb: Change in cornea back-mean keratometry,
D: Diopter. Independet t-test, p<0.05 statistically significant.
Results are denoted as mean ± standard deviation (range)

Fifty eyes of 40 patients (20 female:20 male) were included in the study. The mean age was 17.72±7.84 (5-36) years. The mean best corrected visual acuity (BCVA) was 0.86±0.31 (0.1-1) in Snellen. The mean deviation was 40.80±8.50 (20-50) prism diopter. Twenty eyes had esodeviation, 30 eyes had exodeviation. A single muscle recession operation was performed in 24 of the eyes. Two muscle surgeries (combination of recession and resection) were performed on 26 eyes.

In the whole group, K1b decreased from -6.03±0.18 (-6.3-(-5.50)) to -6.01±0.20 (-6.40-(-5.60)) (p=0.115). K2b increased from -6.35±0.19 (-6.70-(-5.90)) to -6.41±0.20 (-6.90-(-6.10)) (p=0.037). There was no significant change in Kmb (p=0.868). Posterior corneal astigmatism increased from 0.31±0.14 (0.1-0.6) to 0.33±0.16 (0.1-0.6) (p=0.276) (Table 1).

Discussion

There are many studies in the literature examining corneal topographic changes after strabismus surgery, but there is no consensus on how strabismus surgery affects the cornea. Postsurgical changes in the attachment position of the muscles, change in the area of contact between the muscle and the sclera, and the healing process after repositioning can also cause changes in the corneal curvature [6,7]. In present study, we examined the effect of strabismus

surgery, which is rarely studied in the literature, on posterior corneal topographic parameters. For this hybrid Placido-Scheimpflug device is used with dual camera system [8].

Different studies have reported flattening of the adjacent corneal quadrant and reduced corneal strength after horizontal rectus surgeries [2,9,10-13]. Noh et al. also found a decrease in K1 and an increase in K2 and anterior corneal astigmatism at 1 month after LR recession [6]. Lee et al. reported a decrease in K1 and an increase in K2 in the 1st week after horizontal muscle recession and resection surgeries [10]. Bae et al. found that K1b decreased in the postoperative 1st week and increased in the 3rd month, but both were not statistically significant. In the same study, K2b was found to increase at the postoperative 3rd month, but this increase was not statistically significant [14]. We also found K1b decreased but this was not statistically significant, K2b increased statistically significantly at postoperative 1st month. This change in K2b was statistically significantly higher in the two-muscle surgery group than in the single-muscle surgery group. A flattening incision on a meridian in the cornea causes steepening 90 degrees away from that meridian, this is known as the coupling phenomenon [15]. Horizontal flattening and vertical steepening of the posterior cornea after horizontal muscle incision may be caused by a mechanism similar to the coupling phenomenon.

Currently, the role of the posterior cornea in determining keratometry in biometric measurements has gained importance. A better understanding of the effects of strabismus surgeries on posterior corneal curvature may contribute to the interpretation of topographic and biometric values of individuals with a history of strabismus surgery.

Conclusion

In the short term after horizontal rectus surgery, posterior corneal parameters are affected as well as anterior corneal parameters. Cornea back- steep keratometry was significantly increased. This increase was greater in the group undergoing two-muscle surge.

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