



ORIGINAL RESEARCH

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Evaluation of strabismus surgery effects on anterior segment measurements using pentacam

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Abstract

To evaluate and compare preoperative and postoperative anterior segment parameters in patients who underwent unilateral or bilateral medial rectus muscle surgery. Fifty-one eyes of 30 patients were enrolled in the retrospectively designed study. Anterior segment parameters were measured via Pentacam prior to surgery and after the surgery. Besides anterior segment evaluation detailed routine ophthalmic examination was also performed for each participant. All patients had successful surgery correction. No complication was observed during follow-up period. No changes were noted in visual acuity and intraocular pressure. Statistical changes were observed in corneal astigmatism ($P=0.009/0.005$), corneal volume ($P=0.012$), and anterior chamber volume ($P=0.024$). Strabismus surgery might cause anterior segment parametric changes in short-term follow up, which might be reversible through the compensation process. Scheimpflug imaging is an anterior segment imaging system and these changes can be measured by Pentacam.

Keywords: Strabismus, anterior eye segment, corneal topography

Introduction

The basic goal of strabismus surgery is to align the eyes to their primary position. Previous studies have reported several factors related to surgical outcomes in horizontal strabismus: preoperative angle deviation, near and distance angle deviation difference and age of the patient at the time of surgery [1-3].

It has been identified that several temporary anterior segment changes have been occurred following strabismus surgery [4-6]. These changes are thought to be due to the alteration of extraocular muscle tension on corneal topography, which may cause by transmission via the sclera to the cornea, edema of the orbit and eyelid changes in ciliary body circulation or changes in the crystalline lens [7-9].

The effects of ocular surgery on the anterior segment have been better understood with the use of imaging systems [10]. Scheimpflug imaging (Pentacam) is one of the anterior segment imaging systems in clinical use today to evaluate these changes.

In this study, we aimed to investigate the effects of strabismus surgery on visual acuity, intraocular pressure and anterior segment parameters.

Material and Methods

Patients and Study Design

The retrospectively designed study was conducted at an eye center. The study protocol conformed to the tenets of the Declaration of Helsinki and informed consent was obtained from all participants or their parents. Fifty-one eyes of 30 patients with esotropia were recruited in the study. Patients who were not compatible to maintain fixation for Pentacam (Oculus, Inc., Berlin, Germany) analysis were excluded. The patients were assessed before surgery and at month 1 and 3 after surgery for the statistical evaluation. Best-corrected visual acuity (BCVA), biomicroscopic anterior

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and fundus examination and intraocular pressure (IOP) were the parameters studied beside anterior segment parameters measured with Pentacam.

Measurements

The Pentacam (Oculus Inc, Berlin, Germany) measurements were performed by a single experienced and masked observer. The patient was asked to put his/her chin on the chin rest and the forehead against the head rest and open both eyes and look at the fixation target. The examiner aligned the joystick until the rotating Scheimpflug camera automatically captured 25 single images within 2 seconds for each eye. The measurements were checked under the quality specification window; only correct measurements were accepted (comment box reading "OK"). If the comment box was marked yellow or red, the examination was repeated. Maps with poor centration were repeated in order to provide a best-fit toric/ ellipsoid reference surface. From the Pentacam examination: We measured flat (K_1) / steep (K_2) and maximum simulated (K_m) keratometric readings, astigmatism, axis, posterior elevation (PE), corneal thickness of the center (CCT), anterior chamber depth (ACD; center, 3 mm nasal and temporal points from the center), corneal volume (CV) and anterior chamber volume (ACV) were recorded into an excel worksheet.

Surgery

All strabismus surgical procedures were performed by the same experienced surgeon under general anesthesia. The surgical technique was applied by conjunctival incisions on muscle insertion and conventional recession without recession of the opposing muscle. Muscle was sutured directly to the sclera with the use of a 6.0 double armed polyglactin 910 suture.

Statistics

The data of the study was analyzed by using Statistical Package for the Social Sciences (SPSS) version 19.0. Statistical analysis was performed with the paired t test and analysis of variance (ANOVA) for multiple comparisons using Tukey's post-hoc test. P values of less than 0.05 were considered statistically significant for all statistical analyses.

Results

The mean age of 30 patients was 16.40 ± 9.26 years (range, 3-40 years). 54 % of the patients were female and the left were male. The baseline BCVA was 0.222 logMAR. BCVA was 0.252 logMAR at month 1 and was 0.207 at month 3. There was no statistical alteration in the mean of BCVA during follow-up period ($P=0.254$). We also observed no statistical changes in the mean of IOP measurements during follow-up. (13.04 ± 4.42 mmHg prior to surgery, 14.52 ± 3.88 mmHg at postoperative month 1 and 13.46 ± 5.08 mmHg at postoperative month 3; $P=0.192$).

All patients had esotropia with a mean preoperative deviation measured using a prism of 20.56 prism diopters (range: 15 to 25 prism diopters). All of 51 eyes underwent horizontal isolated medial rectus muscle recession only. Bilateral medial rectus muscle recession was performed in 21 patients and unilateral medial rectus muscle recession was applied in 9 patients. The mean amount of medial rectus muscle recession was 5.40 ± 1.02 mm (range, 5.0-8.0 mm).

We observed statistical changes only in corneal astigmatism in both postoperative 1st and 3rd month when compared to baseline values (Table 1). While CV was statistically changed at month 3 after surgery, ACV alteration was in the significant level at month 1 (Table 1).

Table 1. Represents the alteration and P values of the Pentacam measurements at baseline, postoperative month 1 and postoperative month 3

	Preoperative	Postoperative 1 st Month	P Value*	Postoperative 3 rd Month	P Value*
K_1 (D)	43.03 ± 1.15	43.19 ± 1.10	0.296	43.05 ± 1.03	0.364
K_2 (D)	44.11 ± 1.89	44.24 ± 1.95	0.177	44.14 ± 1.78	0.357
K_m (D)	43.64 ± 1.52	43.87 ± 1.42	0.190	43.66 ± 1.33	0.338
C.Astg.(D)	1.09 ± 1.11	3.23 ± 2.79	0.005†	2.73 ± 2.09	0.009†
Axis(Deg.)	120.12 ± 71.83	147.87 ± 46.08	0.054	132.34 ± 50.23	0.290
PE	8.20 ± 6.38	7.09 ± 7.91	0.155	7.11 ± 6.09	0.062
CCT(μm)	546.94 ± 48.29	543.34 ± 42.39	0.311	541.46 ± 41.79	0.118
ACD(mm)	2.98 ± 0.31	2.99 ± 0.26	0.896	2.97 ± 0.28	0.647
CV(mm ³)	60.61 ± 4.51	60.17 ± 4.02	0.333	59.63 ± 3.93	0.012†
ACV(mm ³)	175.14 ± 27.46	168.74 ± 25.60	0.024†	172.66 ± 27.29	0.418

Data were expressed as mean $\pm$ SD.

K=keratometry; K_m =maximum keratometry; C.Astg.=corneal astigmatism; CCT=central corneal thickness; PE=posterior elevation; ACD=anterior chamber depth; CV=corneal volume; ACV=anterior chamber volume; ACD=anterior chamber depth.

*Statistically analyzed with repeated variance analysis test.

†Statistically significant.

Discussion

Strabismus surgery may cause some refractive and anterior segment changes. Although some studies in the literature have reported that postoperative alterations may last for as long as 1 year following surgery [11], these changes are mostly thought to be transient [12]. The influence of extraocular muscle tension on corneal topography is considered as an important contributing mechanism [13].

The Pentacam is a corneal topography system that operates according to the Scheimpflug principle to create an image of the illuminated plane that appears completely sharp from the anterior surface of the cornea to the posterior surface of the crystalline lens [14]. The camera provides an overall view of the anterior segment of the eye that can be used to generate data on corneal power, elevation, curvature, pachymetry, and depth of the anterior eye chamber [15].

The purpose of this study was to investigate the effect of isolated medial rectus muscle recession surgery on the refractive error, corneal measurements, and anterior chamber depth and corneal volume measured by corneal topography.

Kwito S et al [16] documented muscle recession may lead flattening in the adjacent quadrant. However, Hainsworth DP et al [9] reported muscle tension alteration, which resulted in a global change over the corneal surface rather than a change in the adjacent quadrant, so reciprocal compensation could be the reason for the refractive errors and this might be the cornerstone for alterations in the anterior chamber parameters.

Emre S et al [4] used the Pentacam to study the effects of strabismus surgery on the anterior chamber and found that 6 patients who underwent recession-resection surgery were prone to change in the anterior chamber volume.

Jung JH et al [17] designed a prospective study including 28 patients who underwent either horizontal muscle recession or recession plus resection of both horizontal muscles. They concluded that patients with strabismus had an ACD change during the early postoperative period. However, the ACD returned to its preoperative state by 3 months after surgery. These results showed that extraocular muscle surgery might induce reversible changes for the anterior segment parameters. In contrast to this study we did not note any statistical changes in ACD. Moreover, we observed statistical changes in CV and ACV.

Noh JH et al [18] have reported that lateral rectus muscle recession resulted in short-term changes in refractive error in their cohort study. They think that all the changes might be due to postoperative tissue edema and trauma, which resolves over time. They observed a decrease in change after 1 month, which could be due to the effects of compensation by other quadrants of the eye or resolution of the surgical induced tissue damage. Parallel to this study we also observed statistical changes in astigmatism both at 1st and 3rd month following surgery and these alterations showed a decrease pattern in change compared to baseline.

We observed an increase in K_1 , K_2 and K_m at both month 1 and 3 compared to baseline with a less increase at 3rd month, but all these alterations were statistically insignificant. Parallel to K_1 , K_2

and K_m changes, we observed an increase in corneal astigmatism at both month 1 and 3 compared to baseline with a less increase at 3rd month but in contrast to K_1 , K_2 and K_m changes, alterations in corneal astigmatism were statistically significant.

Conclusion

In conclusion, our study demonstrates that altered muscle tension caused by horizontal muscle recession has some significant effects on anterior chamber parameters, which can be measured with Pentacam Scheimpflug camera. We observed statistical changes in astigmatism at both 1st and 3rd month after surgery. We also noted statistical changes in ACV and CV at 1st and 3rd month of follow-up period, respectively. We observed a decrease in increase which may show some reversible changes probably due to the effects of compensation. Sample size, follow-up period are the limitations for our study, so new studies with larger sample size and longer follow-up are warranted to clarify the clinical results.

Competing interests

The authors declare that they have no competing interest.

Financial Disclosure

All authors declare no financial support.

Ethical approval

Consent of ethics was approved by the local ethics committee.

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