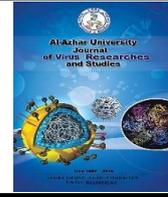




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The Effect of Horizontal Strabismus Muscle Surgery on the Vertical Palpebral Fissure Height

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Abstract

Strabismus is one of the commonly encountered ophthalmological diseases. Recessions and resections of the medial or lateral rectus muscles, the most commonly used procedures for the correction of horizontal comitant strabismus have effect on the vertical palpebral fissure height (VPFH). The aim of the study was to assess the effect of horizontal strabismus surgery on the palpebral fissure height. This was a prospective study included 30 patients (43 eyes) who had horizontal strabismus. Patients were divided into two groups: group A who underwent recession surgery, group B who underwent recession-resection surgery. Vertical eyelid fissure width measurements were compared before and after treatment. Digital imaging analysis and the metric ruler were used to measure vertical palpebral fissure height. Regarding to vertical palpebral fissure height, no significant difference was found between group A and B ($P.>0.05$). Within group A, a significantly higher mean was found at 3 months after surgery, in comparison to 2 weeks after surgery ($P.\leq 0.05$). Our study showed that unilateral or bilateral horizontal rectus muscle recession may induce a post-operative widening of the vertical palpebral fissure width. Recession-resection surgery also may affect the vertical palpebral fissure height.

Keywords: Horizontal Strabismus Muscle, Vertical Palpebral Fissure Height.

1. Introduction

Horizontal comitant strabismus is the largest group of strabismus and it is classified into esotropia and exotropia [1]. Various treatments of strabismus, including glasses prescription, surgical procedures, and Botox injections are significant and they have advantages and disadvantages [2]. Recession and resection of the medial or lateral rectus muscles are the most commonly performed procedures for the correction of horizontal comitant strabismus which have few side effects on the palpebral aperture [3]. Moving the attachments of the horizontal rectus

muscles posteriorly in strabismus surgery may induce changes in the position of the eye in the orbit and may cause vertical palpebral fissure widening [4]. This effect is unclear but may be due to transposition of the horizontal rectus muscles to posterior position in the globe and this could change the position of the globe in the orbital space [4] Or due to changes in muscle tension which may result in displacement of the eye in the Antero – posterior axis [5]. A slipped or lost muscle may also induce widening in the palpebral fissure height [4]. The purpose of this work was to assess the

effect of horizontal strabismus surgery on the palpebral fissure height.

2. Patients and Methods

This was a prospective, non-randomized, and interventional study. It was carried out from October 2020 to April 2022 at “the ophthalmology department of Alzahraa University Hospital”. The study was included 30 patients (43 eyes) from 4 to 55 years old with comitant horizontal strabismus who underwent strabismus surgery in the ophthalmology department at Al Zahraa University Hospital. Patients with incomitant squint, vertical squint and who had previous ocular surgery, including oblique muscle surgery were excluded.

2.1 Study Tools and Procedures

History taking (age, gender, the age of onset of strabismus, previous treatment like glasses, occlusion or surgery, history of systemic diseases, family history of squint, past history of ocular trauma or other ocular surgery). Pre and post-operative full ophthalmological examination was done. The examination included measurement of uncorrected and best corrected visual acuity using landlot’s Snellens chart, refractive status using NIDEK ARK510A autorefractometer, slit lamp examination of anterior segment and posterior segment examination using indirect ophthalmoscope, measurement of intraocular pressure and measuring of pre-operative and post-operative angle of strabismus.

Measurement of vertical palpebral fissure height (VPFH): To take digital photographs, Patients were positioned with their chin and forehead resting on the slit-lamp and a metric ruler is fixed and centered to the forehead rest (Figure1 and 2). Then, Patients were then asked to fixate on a distant target while the other eye was covered, and three consecutive photos were taken. Photographs were taken one day before, two weeks and three months after

the surgical procedure. Morphometric analysis of the digital photographs was performed using Image J software. The image of the ruler in each photograph was used to calibrate the digital camera and obtain a semi-automatic measurement of the vertical eyelid fissure (with the operator identifying the location of the fissure). The palpebral fissure height was measured by the metric ruler also to confirm the results of the program.

2.2 Ethical Considerations

All procedures were conducted in accordance with Helsinki standards as revised in 2013 and approved by the ethics committee of Al-Azhar University. An informed written consent was obtained from each participant in this study after explaining the purpose of the study and before participation in the study.

2.4 Statistical Analysis

The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Data was presented and suitable analysis was done according to the type of data obtained for each parameter. $P > 0.05$: Non-significant (NS), $P < 0.05$: Significant (S).

3 .Results

Thirty patients (43 eyes) with horizontal strabismus who met the inclusion criteria were classified into two groups. Group A, who had recession surgery included 17 patients (11 patients had bilateral lateral rectus recession, 2 patients had bilateral medial rectus recession and 4 had unilateral lateral rectus recession with total 30 eyes) (6 were males (35.3%) and 11 were females (64.7%) with mean age 14 ± 9.5 years and range from 4 to 40 years). Group 2; who had recession-resection surgery

included 13 patients (4 were males (30.8%) and 9 were females (69.2%) with mean age 25.2 ± 16.5 years and range from 4 to 55 years). Mean age was significantly higher in group B, in comparison to group A ($P < 0.05$) (Table 1). A total 30 patients were enrolled in the study: 28 had exotropia (14 patients had alternating exotropia and 14 patients had unilateral exotropia) and 2 patients had esotropia (Table 2). The mean

pre-operative deviation was 48.24 ± 12.98 PD in group A (range, 30 PD – 70 PD) and 55.38 ± 13.30 PD in group B (range, 35 PD – 85 PD) (Table 3). In this study, regarding VPFH, no significant difference was found between group A and B ($P > 0.05$). Within group A, a significant higher mean was found at the 3rd month after surgery, in comparison to 2 weeks after surgery ($P \leq 0.05$). (Table 4 and 5)

Table (1): Demographic data of the study group.

Demographic data		Group A (Recession) (n= 17)	Group B (Recession-Resection) (n= 13)	P.value
Males	N (%)	6 (35.3%)	4 (30.8%)	0.7978
Females	N (%)	11 (64.7%)	9 (69.2%)	
Age (y)	Mean \pm SD. Range	14 \pm 9.5 4-40	25.2 \pm 16.5 4-55	0.027

P-value >0.05: Non-significant, n (Number), SD (Standard deviation), Chi-square test.

Table (2): Comparing type of horizontal strabismus between two groups.

Diagnosis	Group A (n=17)		Group B (n=13)	
	N	%	N	%
Alternating esotropia	1	5.9	0	0
Alternating exotropia	8	47.1	6	46.2
Infantile esotropia	1	5.9	0	0
Unilateral exotropia	7	41.2	7	53.8
<i>Chi square</i>	1.784			
<i>P.Value</i>	0.6184			

No significant difference in diagnosis between two groups ($P > 0.05$). Chi-square test.

Table (3): Comparing angle of deviation between two groups.

Angle of deviation (PD)	Group A (n=17)		Group B (n=13)		P.value
Preoperative angle (mean \pm SD)	48.24 \pm 12.98		55.38 \pm 13.30		0.150
Postoperative (N, %)					
	NO.	%	NO.	%	0.3846
Esodeviation \leq 10 PD	10	(59%)	2	(15%)	
Exodeviation \leq 10 PD	5	(29%)	6	(46%)	
Orthotropia	2	(12%)	5	(39%)	

PD: Prism diopter, SD: Standard deviation, n: Number, No significant difference in pre and post-operative angle between two groups ($P > 0.05$), Chi-square test.

Group A (recession surgery):



Figure 1: a) 7ys old female patient with 45 PD of alternating exotropia. b) 2 weeks after bilateral lateral rectus recession 9 mm with 6 PD (esophoria) showing minimal narrowing in the vertical palpebral fissure height. c) 3 months after surgery with widening in vertical palpebral fissure height in comparison to the pre-operative vertical palpebral fissure height.

Group B (Recession-Resection surgery):



Figure 2: a) 13ys old female patient with 50 PD of alternating exotropia. b) and c) Showing orthotropia and narrowing in the vertical palpebral fissure height at 2 weeks and 3 months after right lateral rectus recession 9mm, medial rectus resection 6mm in comparison to the pre-operative vertical palpebral fissure height.

Table (4): Changes in the VPFH 2 weeks and 3 months after surgery in comparison to before surgery.

VPFH	Group A (30 eyes)	Group B (13 eyes)
After 2 weeks	N, %	N, %
VPFH widening.	10 (33.3%)	1 (7.7%)
VPFH narrowing.	14 (46.7%)	8 (61.5%)
VPFH constant	6 (20%)	4 (30.8%)
After 3 months	N, %	N, %
VPFH widening.	23 (76.7%)	5 (38.7%)
VPFH narrowing.	3 (10%)	1 (7.7%)
VPFH constant	4 (13.3%)	7 (53.8%)

VPFH: Vertical palpebral fissure height. N: Number.

Table (5): Comparing VPFH using (Image J software) between two groups before and after surgery.

VPFH	Group A n=17(30 eyes)	Group B (n=13)	P.value
	Mean \pm SD	Mean \pm SD	
Before surgery	0.98 \pm 0.19	0.95 \pm 0.13	0.238
After 2 weeks	0.93 \pm 0.17	0.87 \pm 0.12	0.189
After 3 months	1.06 \pm 0.18	0.98 \pm 0.19	0.412
P.value	0.0431*	0.0634	---
P1	0.4247	0.1161	---
P2	0.2167	0.0903	----
P3	0.0380*	0.6427	---

VPFH: Vertical palpebral fissure height, SD: Standard deviation, n: Number, P1: Before surgery vs 2 weeks after surgery, P2: before surgery vs 3 months after surgery, P3: 2 weeks after surgery vs 3 months after surgery, * $P \leq 0.05$ is considered significant, ANCOVA test.

Table (6): Comparing VPFH (using metric ruler) between two groups before and after surgery.

VPFH using metric ruler	Group A n=17(30 eyes)	Group B n=13	P.value
	Mean \pm SD	Mean \pm SD	
Before surgery	0.98 \pm 0.19	0.95 \pm 0.23	0.6985
After 2 weeks	0.93 \pm 0.17	0.88 \pm 0.13	0.3861
After 3 months	1.05 \pm 0.18	0.96 \pm 0.2	0.2064
P.value	0.0103*	0.3510	---
P1	0.4247	0.3489	---
P2	0.2784	0.9068	----
P3	0.0222*	0.2384	---

VPFH: Vertical palpebral fissure height, SD: Standard deviation, n: Number, P1: Before surgery vs 2 weeks after surgery, P2: Before surgery vs 3 months after surgery, P3: 2 weeks after surgery vs 3 months after surgery, * $P \leq 0.05$ is considered significant; VPFH: Vertical palpebral fissure height, ANCOVA test.

4. Discussion

Unwanted changes in the palpebral aperture are among well-known complications of extraocular muscle surgery [6]. Recession of a horizontal rectus muscle causes widening of the vertical palpebral fissure height while resection decreases its height, and the amount change may be related to the surgery done on the rectus muscle [7]. In our study, in group A: 2 weeks after surgery, VPFH increased in 10 eyes (33.3%), decreased in 14 eyes (46.7%) and remained constant in 6 eyes (20%) and 3 months after surgery, VPFH increased in 23 eyes (76.7%), decreased in 3 eyes (10%) and remained constant in 4 eyes (13.3%). In group B, after 2 weeks, VPFH increased in 1 eye (7.7%), decreased in 8 eyes (61.5%) and remained constant in 4 eyes (30.8%) and after 3 months, VPFH increased in 5 eyes (38.7%), decreased in 1

eye (7.7%) and remained constant in 7 eyes (53.8%) (Table 4). We found that horizontal strabismus surgery may induce changes in the palpebral fissure height. And these results are in the line with Abtahi et al. (2018) who found that horizontal strabismus surgery has a significant effect on the vertical palpebral fissure height [6]. And Lee et al. (2013) who found that thirty five percent of the patients showed palpebral fissure widening lasts at least 6 months after unilateral rectus muscle recession [8]. Also, Lagreze (2005) found that recessions induced a widening of the lid fissure and resections induced a narrowing of the palpebral fissure, mainly because of changes of the lower lid position. That study was on 36 patients with strabismus who underwent surgery on one horizontal extra ocular muscle only. The width of the lid fissure and the position

of the upper and lower lids in relation to the pupil center were measured before and 3 months after surgery [9]. Changes in the eyelid position also occur in more than 90% of patients undergoing vertical rectus muscle surgery and this occur due to the close anatomic relation between the levator palpebrae superioris and the superior rectus muscle and between the lower eyelid retractors and the inferior rectus muscle [10].

5. Conclusion

Our study suggests that unilateral or bilateral horizontal rectus muscle recession may induce a postoperative widening of the vertical palpebral fissure width. Recession-resection surgery also affects the vertical palpebral fissure height, but its effect is less than recession surgery only on the eye.

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This effect may be due to that recession surgery induces widening while resection surgery induces narrowing in the fissure height and their effects oppose each other. This post-operative palpebral fissure widening can be particularly noticeable after unilateral surgery.

5. Recommendations

More studies about the cause of this change in the palpebral fissure after the horizontal strabismus surgery are required, to decrease this effect especially in unilateral eye surgery.

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