

Lateral rectus muscle recession and the vertical palpebral fissure height: to do or not to do inter-muscular septum dissection?

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Abstract

• In this study, we aimed to evaluate changes of vertical palpebral fissure height (VPFH) after unilateral lateral rectus muscle recession. Twenty-five and twenty-six patients who were candidates for lateral rectus muscle recession were assigned into “with” and “without” intermuscular septum dissection study arms. The VPFH was measured at one-day before surgery and in two weeks and three months, postoperatively. Three months after surgery, significant increase of VPFH was observed in both groups (Paired *t*-test; $P=0.005$). Also, less widening of VPFH was observed in “with intermuscular septum dissection” group (Change in VPFH in “with intermuscular septum dissection” vs “without intermuscular septum dissection” groups: 0.48 mm vs 1.34 mm; ANCOVA test; $P<0.001$). However, such results were not observed two weeks post-operatively (Change in VPFH in “with intermuscular septum dissection” vs “without intermuscular septum dissection” groups: -0.28 mm vs 0.28 mm; ANCOVA test; $P=0.302$). Intermuscular septum dissection is recommended in lateral rectus muscle recession to partially prevent the undesirable increment of VPFH.

• **KEYWORDS:** intermuscular septum; lateral rectus muscle recession; vertical palpebral fissure height

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INTRODUCTION

Unwanted alterations in the lid position are among well-known complications of extra-ocular muscle surgery. In the literature, several studies have evaluated changes in the vertical palpebral fissure height (VPFH) following vertical strabismus surgeries; especially in cases of inferior rectus recession^[1-5]. More recently, there have been a growing body of evidence indicating widening of VPFH following unilateral or bilateral horizontal rectus muscle recession^[6-8]. The purpose of our study was to evaluate changes of VPFH following lateral rectus muscle recession for treatment of exotropia. Also, for the first time, we sought to assess the possible effects of intermuscular septum dissection in this regard.

METHODS

Design and Participations Criteria This study was ran with an interventional prospective cohort design. Participants were recruited between March 2015 and March 2016 at Feiz Eye Hospital of Isfahan, Iran. Fifty-one patients were selected and allocated in two groups of “with intermuscular septum dissection” vs “without intermuscular septum dissection” using block randomization. Subjects were eligible if they were candidates for unilateral/bilateral lateral rectus muscle recession for treatment of exotropia. Exclusions were: sensory, restrictive or incomitant strabismus; history of previous orbital/strabismus surgery; any sight threatening ophthalmic disease except exotropia; high amounts of exotropia that mandates resection of medial rectus muscle (recession & resection procedure); abnormal lid margin; and patients who failed to attend follow-up visits.

Evaluation and Follow-up At baseline, all of the participants underwent a detailed ophthalmological examination. All of the participants were evaluated one day before surgery, two weeks and three months after intervention.

Fissure Height Assessment VPFH was defined as highest vertical distant between upper and lower lid margin. Patients' heads were placed on slit lamp while one eye was covered. Two photographs were taken by digital camera. Photographs were analyzed using ImageJ software version 1.41 (National

Table 1 Baseline variables

Variable	With dissection	Without dissection	P (between groups)
Age, mean±SD, y	23.69±12.08	18.60±17.03	0.222 ^a
Male: Female, n (%)	15 (57.7):11 (42.3)	14 (56):11 (44)	0.903 ^b
Recession (mm)	7.46±1.58	8.16±1.77	0.143 ^a
Exotropia (PD)	43.27±8.94	46.60±11.43	0.251 ^a
VPFH (mm)	11.40±1.30	11.28±0.91	0.697 ^a

PD: Prism diopter; VPFH: Vertical palpebral fissure height; SD: Standard deviation. ^aIndependent samples *t*-test; ^bChi-square test.

Table 2 Baseline-2wk and baseline-3mo changes of palpebral fissure height

Variable	With dissection	Without dissection	P (between groups)
Baseline VPFH (mm)	11.40±1.30	11.28±0.91	0.697 ^a
After 2wk VPFH (mm)	11.12±1.36	11.56±1.15	0.302 ^b
Baseline-2wk changes (95%CI; mm)	-0.28 (-0.64-0.06)	0.28 (-0.09-0.65)	-
P (within groups)	0.1054 ^c	0.134 ^c	-
After 3mo VPFH (mm)	11.88±1.39	12.62±0.98	<0.001 ^b
Baseline-3mo changes (95%CI; mm)	0.48 (0.16-0.81)	1.34 (1.09-1.59)	-
P (within groups)	0.005 ^c	<0.001 ^c	-

CI: Confidence interval; VPFH: Vertical palpebral fissure height. ^aIndependent samples *t*-test; ^bANCOVA (adjusted for baseline); ^cPaired sample *t*-test.

Institutes of Health; rsbweb.nih.gov/ij) and mean values of two photos were used.

Surgery Lateral rectus muscle recession was performed according to the methods described elsewhere^[9]. All of the patients were hospitalized for one day after surgery. Patients were assessed one day, two weeks and three months after surgery for possible complications of strabismus surgery, e.g. post-operative infection, allergic reactions, foreign body granuloma, conjunctival inclusion cyst, conjunctival scarring, fat adherence and slipped muscle.

Ethics and Statistics The study was conducted in accordance with the tenets of Helsinki Declaration, and all participants provided written informed consent. The Ethics Committee of Isfahan University of Medical Sciences approved the study.

All of the analyses were done using SPSS software (version 22; SPSS Inc., Chicago, IL, USA). Chi-Square test and independent sample *t*-test were used for inter-group comparisons at baseline. Changes of palpebral fissure within each group and between groups were assessed by paired sample *t*-test and ANCOVA test, respectively. For all of the analyses, *P* value <0.05 was considered as significant.

RESULTS AND DISCUSSION

This study enrolled fifty-one eyes of which, twenty-six eyes (9 patients with bilateral and 8 with unilateral recession) and twenty-five eyes (10 patients with bilateral and 5 with unilateral recession) were allocated in “with intermuscular septum dissection” vs “without intermuscular septum dissection” groups, respectively. Baseline data of patients are presented in Table 1.

Table 2 represents “baseline-2wk” and “baseline-3mo” analysis of VPFH changes, respectively. None of the participants experienced significant complications of strabismus surgery; two cases had mild conjunctival scarring.

In this study, we have shown that horizontal strabismus surgery has significant effects on VPFH; this is in line with previous three studies indicating increment of VPFH following such procedures as a side effect^[6-8]. In addition, this project questioned whether dissection of intermuscular septum can alter the magnitude of such unwanted changes in VPFH. Interestingly, our three months follow-up results suggest a beneficial role for dissection of intermuscular septum in this regard.

In the literature, for the first time in 2005, a study consisting of 36 patients (including 24 patients with medial rectus muscle recession and 12 patients with lateral rectus muscle recession) showed that VPFH would significantly change three months after intervention^[6]. Also, this study demonstrated that in most of the patients, changes appear to occur in the lower lids while the upper lids give different responses to surgeries on rectus muscles. Moreover, widening of VPFH had a dose-dependent correlation with amount of recession e.g. a single recession or resection by 7.7 mm would lead to a mean change in lid fissure width of 1 mm^[6]. The second study was performed by Santos de Souza Lima *et al*^[7] in 2011. They enrolled 59 patients (17 with exotropia and 42 with esotropia). Medial rectus muscle recession and lateral rectus muscle recession were done in 79 and 25 eyes respectively. After three months, VPFH widened significantly as much as 1.0±0.8 mm and 0.96±0.8 mm, respectively. In addition, increasing VPFH was larger in patients with unilateral muscle recession/resection^[7].

In the most recent study of the field in 2013, Lee *et al*^[8] had shown that 35 percent of patients had significant increment of VPFH lasting at least 6mo post-operatively.

Results of the present study, widening of VPFH after horizontal strabismus surgery, are in agreement with the literature. Also, this result adds a practical notion in order to partially prevent VPFH changes following horizontal strabismus surgery by

dissection of intermuscular septum. Our 3mo follow-up results suggest that in the “with intermuscular septum dissection” group, increment of VPFH occurred less than in the “without intermuscular septum dissection” group (Change in VPFH in “with intermuscular septum dissection” vs “without intermuscular septum dissection” groups: 0.48 mm vs 1.34 mm; ANCOVA test; $P<0.001$; Table 2). Such a difference could not be detectable at 2wk of follow-up, maybe due to the primary surgical inflammation and oedema (Change in VPFH in “with intermuscular septum dissection” vs “without intermuscular septum dissection” groups: -0.28 mm vs 0.28 mm; ANCOVA test; $P=0.302$; Table 2).

Until now, limited reasons were mentioned for widening of palpebral fissure following horizontal rectus muscle surgeries. Transposition of horizontal rectus muscles to posterior position in globe could change position of globe in orbital space and consequently could lead to widening of palpebral width. Similarly, these changes also occur in slipped muscle complication^[10]. Bilateral dissection of both horizontal muscles in Duane syndrome leads to significant pullback of globe and secondary increment of VPFH^[11]. In a study by Lagrèze *et al*^[6], it is suggested that changes of muscle tension during horizontal surgery leads to transposition of anterior-posterior axis of globe and consequently alterations in VPFH. Such justifications can partially explain our results as we found alterations in VPFH following lateral rectus recession. However, we think that the anatomical junction of the intermuscular septum with inferior lid septum can explain why dissection of such adhesions can decrease VPFH changes following lateral rectus recession.

As it is well known, the lower eyelid is plainly bound to the inferior rectus muscle through its sheath's fascial extensions. Also, the superior eyelid and the levator muscle are loosely connected to superior rectus muscle. Hence, surgical manipulation of these muscles causes inadvertent changes in the palpebral fissure. The intermuscular septum is located between rectus muscles^[12]. Thus, based on our clinical findings and previous anatomical evidences, changes in horizontal rectus muscles can also cause changes in eyelids position. In other words, eyelids are probably linked with all rectus muscles through their facial extensions and the intermuscular septum between them. Our results indicate that, we can obviate such eyelid alterations by careful dissection of interconnecting structures, *i.e.* the intermuscular septum.

This study reinforced the literature regarding the possible increment of VPFH following horizontal strabismus surgery. In addition, we showed that such alterations occur less in patients who had undergone intermuscular septum dissection. All candidates for horizontal strabismus surgery should be informed about possible increment of VPFH as a surgical side effect. Further studies are required in order to validate these findings in larger cohorts of different ethnic groups with longer follow-up.

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Authors' contributions: The conception and study design were made by Abtahi MA, Zandi A, Jahanbani-Ardakani H, Mandegarfar E, Mahaki B and Abtahi SH. The data collection was done by Mandegarfar E, Zandi A, Jahanbani-Ardakani H, Abtahi SH. The final approval was done by Abtahi MA, and Abtahi SH. The manuscript drafting were made by Zandi A, Jahanbani-Ardakani H, Abtahi SH, Mandegarfar E, Mahaki B and Abtahi MA. Critical revision and review performed by Abtahi SH and Mandegarfar E. All the authors read and approved the final manuscript.

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