

Analysis of the Effects of Medial Rectus Muscle Resection for Recurrent Exotropia

Young-Woo Suh, IL Hun Seo, Yoonae A. Cho, Seung-Hyun Kim

Department of Ophthalmology, Korea University College of Medicine, Seoul, Korea

Purpose: The purpose of this paper is to investigate how much correction is obtained per millimeter of medial rectus (MR) resection for recurrent exotropia after bilateral lateral rectus (BLR) recession, and to determine the difference in the effects between unilateral and bilateral resection, and the influence of previous lateral rectus (LR) recession on the effects of MR resection.

Methods: A total of 59 patients who had undergone MR resection after BLR recession were included in this study. The unilateral group consisted of 38 patients and bilateral group, 21 patients. Thirty patients in the unilateral group were divided into two groups: patients who had undergone previous LR recession of 7 mm or greater (21 patients) and less than 7 mm (9 patients). Main outcome measures were average deviation corrected per millimeter of MR resection at 1 month postoperative.

Results: The average effect of MR resection was 4.2 prism diopters (PD, 2.0 to 6.7 PD)/mm. The average effect in the unilateral group was 4.2 PD/mm and 4.1 PD/mm in the bilateral group. There was no significant difference between groups ($p = 0.60$). The average effect in the recession 7 mm or greater group was 4.0 PD/mm, and the average effect in the recession less than 7 mm group was 4.2 PD/mm ($p = 0.698$).

Conclusions: The effect of MR resection per millimeter was variable. The laterality and previous amount of LR recession did not influence the effect of MR resection. These variable outcomes dictate that caution be exercised when MR resection is performed for recurrent exotropia.

Key Words: Exodeviation, Oculomotor muscles, Strabismus

In patients with intermittent exotropia, there is a tendency toward exotropic drift over time because of the high rate of undercorrection [1]. Raab and Parks [2] suggest a table of lateral rectus (LR) recession targeting 10 prism diopters (PD) of overcorrection for intermittent exotropia in the immediate postoperative period and suggest that overcorrection of exotropia in the early postoperative period results in the best long-term outcomes for intermittent exotropia. This results in an average effect of LR recession of about 3 PD/mm [3].

Olitsky et al. [4] report some variability in the effects of muscle resection per millimeter. They explained that this var-

iability might be related to surgical methods and amount of previous surgery, but point out the advantages of the muscle resection technique on the antagonist muscle compared to re-recession or marginal myotomy in recurrent strabismus.

In recurrent exotropia after bilateral LR recession, LR re-recession is often ruled out due to the large degree of recession of the LR in the previous surgery. As a result, unilateral or bilateral medial rectus (MR) resection is most often chosen for secondary operations in recurrent or undercorrected exotropia cases. The variable effects of MR resection per millimeter have been reported, but there has been no extensive review of the effects of MR resection. The aim of this study is to investigate the degree of correction obtained per millimeter of MR resection, the difference of effects per millimeter between unilateral and bilateral MR resection groups, and the difference of effects of MR resection according to the previous amount of LR recession in recurrent exotropia after bilateral LR recession.

Received: July 26, 2010 Accepted: October 13, 2010

Reprint requests to Seung-Hyun Kim, MD, PhD. Department of Ophthalmology, Korea University Ansan Hospital, #516 Gojan-dong, Danwon-gu, Ansan 425-707, Korea. Tel: 82-31-412-5160, Fax: 82-31-414-8930, E-mail: ansaneye@hanmail.net

* This study was presented at 33rd Meeting of the European Strabismological Association, 2009, Serbia.

© 2011 The Korean Ophthalmological Society

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Materials and Methods

A retrospective analysis was conducted of all patients who had undergone unilateral or bilateral MR muscle resection between January 1994 and December 2007 for recurrent intermittent exotropia, which had developed after bilateral LR recession.

Fifty-nine patients who had undergone previous bilateral LR recession were included in this study. The subjects were divided into two groups. Patients who had undergone unilateral MR resection were in the unilateral group (38 patients), and those patients who had undergone bilateral MR resection represented the bilateral group (21 patients). The effects of MR resection in both groups were analyzed. When performing unilateral MR resection, the non-dominant eye was selected [5].

Patients who had a lack of cooperation, those with myopia and hyperopia greater than 2 diopters (D), anisometropia above 2 D, and amblyopia with corrected vision worse than 20 / 25 were excluded from this study.

The following parameters were reviewed and analyzed: the amount of LR recession at 1st surgery, deviation before and after MR resection, the amount of MR resection, and the effects of MR resection per millimeter at 1 month postoperative. Alternate prism cover testing was performed at a distance of 6 m with the patient in the primary and secondary gaze positions. Alternate prism cover testing was then performed in the primary gaze position at 30 cm.

Unilateral or bilateral MR resection was performed under general anesthesia. Before pre-place sutures were made, extensive dissection of the connections to the overlying Tenon's capsule and the intermuscular membrane 10 mm or more from its insertion site were performed. Following the pre-place sutures, the muscle was cross-clamped with a hemostat just distal to the suture line, followed by transection of the muscle 1 mm anterior to the suture line. The muscle was disinserted and resected. The resected rectus was then securely attached to the sclera at the original insertion site using a long scleral tunnel suture technique. We performed one muscle resection for less than or equal to 20 PD of exodeviation, two muscle resection for exodeviation of greater than or equal to 30 PD, and one or two muscle resection for exodeviation of 21 to 29 PD.

The angle of deviation was measured 1 month after sur-

gery to estimate the effects of MR resection. This effect was analyzed at 1 month postoperative because the main focus of this study is on the pure effect of medial rectus resection. In the long-term follow up, the degree of binocularity can cause a change in strabismic angle secondarily.

The effect of medial resection for each millimeter was calculated as the value of the angle of preoperative deviation minus postoperative deviation at 1 month postoperative, divided by the total amount of resection. In the bilateral resection group, the total resection amount was calculated by adding each individual resection amount.

The 30 patients among the unilateral resection group with accessible medical records were divided into two groups: patients with previous LR muscles recession greater than or equal to 7 mm (A group, 21 patients) and less than 7 mm (B group, 9 patients).

Statistical analysis was performed using the Mann-Whitney *U*-test and Pearson's correlation in the SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). Differences in the age at MR resection surgery, the mean effects of MR resection per millimeter, and effects of unilateral MR resection according to previous degree of LR recession were analyzed between the two groups.

Results

At the time of the MR resection, the average age of the unilateral group was 12.47 ± 6.74 years (range, 7 to 48 years), and the average age of the bilateral group was 12.38 ± 8.50 years (range, 7 to 47 years). A significant difference was not found ($p = 0.252$) between the two groups. The average deviation angle at the distal distance of the unilateral group was 20.3 ± 2.90 PD (range, 15 to 25 PD) and the average deviation angle in the bilateral group was 27.0 ± 3.98 PD (range, 25 to 40 PD).

The mean amount of LR recession in each eye in the first surgery was 6.80 ± 0.75 mm (range, 5 to 8 mm). The average amount of medial rectus resection in the unilateral group was 3.98 ± 0.71 mm (range, 2.5 to 6.0 mm) and 6.04 ± 0.84 mm (range, 5 to 8 mm) in the bilateral group.

Table 1 is a summary of the mean postoperative change in deviation and the mean effect per millimeter of MR resection. The average deviation corrected per millimeter of MR resection was 4.15 ± 1.11 PD (range, 2.0 to 6.7 PD).

Table 1. Effects of medial rectus resection according to the amount

Resection amount (mm)	No. of patients	Mean correction of deviation angle (PD)	Mean effects per millimeter (PD/mm)
<4	14	15.18 ± 3.78	4.74 ± 1.49
$4 \leq <5$	20	15.80 ± 3.93	3.80 ± 0.95
$5 \leq <6$	9	23.56 ± 2.46	4.57 ± 0.49
$6 \leq <7$	10	26.15 ± 6.14	4.22 ± 0.90
$7 \leq$	6	25.67 ± 4.03	3.23 ± 0.59
Total	59	19.59 ± 6.30	4.15 ± 1.11

PD = prism diopters.

There was no correlation between the average effect per millimeter and the amount of MR resection (Pearson's correlation $r = 0.114$, $p = 0.425$).

The average correction per millimeter of MR resection in the unilateral group was 4.21 ± 1.21 PD and 4.05 ± 0.91 PD in the bilateral group. The effects of resection were greater in the unilateral resection group, but there was no statistically significant difference ($p = 0.60$) between the two groups.

In the analysis of the difference of effects according to the amount of previous LR recession, the average effect per millimeter was 3.99 ± 1.02 PD in group A (LR recession greater than or equal to 7 mm) and 4.15 ± 1.19 PD in group B (LR recession less than 7 mm). The effects of resection were greater in the unilateral B group, but the difference was not statistically significant ($p = 0.70$).

Discussion

The amount of MR resection required for recurrent exotropia after bilateral LR recession is difficult to determine, especially in children for whom adjustable surgery is not an option. A useful normogram according to strabismic angle has not yet been defined because the effect is quite variable and resection techniques differ among surgeons.

The chosen degree of resection is based upon an individual surgeon's experience and protocol. Kim and Kim [6] reported that their average deviation corrected was 3.41 ± 0.60 PD/mm, and Chae et al. [7] reported that the mean effects per millimeter of MR resection were 3.53 ± 0.17 PD/mm. Our study found results of 4.15 ± 1.11 PD/mm, but effects ranged from 2.0 to 6.7 PD/mm.

In this study, the average deviation corrected per millimeter of MR resection did not differ significantly between the unilateral and bilateral groups. Possible explanations for the variable effect of MR resection per millimeter and the lack of correlation between the degree and effect of MR resection include variability in the thickness and tonus of the MR. Further study of the relationship between the effects of MR resection and these factors is needed.

In the current study, there was no difference in the effect of MR resection per millimeter between the two previous LR recession groups. Cho and Kim [8] reported that all the new insertion of the 5 to 8 mm recessed LR was anterior to the

functional equator. If the insertion of the previously recessed LR was posterior to the functional equator, this would result in a larger difference in MR resection per millimeter because the tonus of the LR would decrease markedly [9]. In the current study, LR tonus change was mild with only 5 to 8 mm of previous LR recession, which was not enough to make a difference between the two LR recession groups.

In conclusion, the average effect of MR resection was 4.15 ± 1.11 mm and there was no significant difference between the two study groups with regard to the laterality of MR resection and the amount of previous LR recession in this study. However, the effects of MR resection were widely varied. The most important conclusion of this study is that surgeons should be aware of the variability of the effects of MR resection.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

References

1. Zibrandtsen P, Rindziunski E, Gregersen E. Ten years follow-up of surgery for intermittent exotropia. *Acta Ophthalmol (Copenh)* 1986;64:374-8.
2. Raab EL, Parks MM. Recession of the lateral recti. Early and late postoperative alignments. *Arch Ophthalmol* 1969;82:203-8.
3. Dadeya S, Kamlesh. Long-term results of unilateral lateral rectus recession in intermittent exotropia. *J Pediatr Ophthalmol Strabismus* 2003;40:283-7.
4. Olitsky SE, Kelly C, Lee H, Nelson LB. Unilateral rectus resection in the treatment of undercorrected or recurrent strabismus. *J Pediatr Ophthalmol Strabismus* 2001;38:349-53.
5. Lennerstrand G. Effects of surgery on the dominant eye in exodeviations. *Acta Ophthalmol (Copenh)* 1986;64:391-6.
6. Kim SC, Kim MM. The efficacy of unilateral rectus resection in the reoperation of strabismus. *J Korean Ophthalmol Soc* 2003;44:904-10.
7. Chae SH, Chun BY, Kwon JY. The effect of unilateral medial rectus muscle resection in patients with recurrent exotropia. *Korean J Ophthalmol* 2008;22:174-7.
8. Cho YA, Kim SH. Role of the equator in the early overcorrection of intermittent exotropia. *J Pediatr Ophthalmol Strabismus* 2009;46:30-4.
9. Urist MJ. Unilateral intermittent exotropia. *Ann Ophthalmol* 1976;48:260-7.