The Outcome of Bilateral Medial Rectus Muscle Recession in Esotropia

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Abstract

***Purpose*:** To identify the postoperative surgical outcomes and the changes in deviation in patients treated by bilateral medial rectus (BMR) recession for small to large angle esotropia with a minimum follow-up of two years

***Methods*:** In this retrospective and consecutive case series, we reviewed medical records of 130 patients who had recession surgery for correction of esotropia between 2001-2011 in a tertiary center in Tehran. Patients were excluded if neurological abnormalities or developmental delays were documented and if structural eye abnormalities were present.

***Results*:** One month after operation (n=109), there were 85 successful cases (orthophoria or deviation less than 10 prism diopter), 18 cases of undercorrection, and six cases of overcorrection. The success rate at two years after surgery (n=82) was 78.2% with 13.3.% undercorrection and 8.5% over correction. The preoperative angle of esodeviation and patients' age are found to significantly influence the response to the surgery.

***Conclusion*:** Surgery was effective because of high success rate and acceptable alignment after two years follow-up. Dose response increased in patients with larger angle of preoperative deviation, and was lower for patients who were older at the time of the surgery.

***Keywords*:** Esotropia, Bilateral Medial Rectus Muscle Recession

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Introduction

Various medical and surgical techniques have been proposed for treatment esotropia, it is still controversial which method is most effective. A variety of medical treatments include: amblyopia therapy (covering the eye, atropine), using optical devices (glasses, prism), drugs (miotics, botulinum toxin) and orthoptics.[1] Congenital cases are rarely resolved without surgical treatment. However, surgery should be considered after correction of severe refractive errors and treatment of amblyopia. Strabismus surgery involves methods of muscle weakening and strengthening. Recession is the standard surgical technique to weaken muscles while resection is used to strengthen the muscles. There are two main surgery methods for esotropia: the most common form is bilateral medial rectus (BMR) muscle recession in which the amount of recession specified by preoperative angle of deviation.[2] The alternative is medial rectus muscle recession combined with resection of the ipsilateral lateral rectus muscle.[3]

Preoperative conditions that influence effectiveness of surgical correction are important factors to determine the precise extent of the procedure. In patients with esotropia underwent BMR muscle recession, the change in the degree of ocular alignment per millimeter of rectus recession, increases significantly with higher preoperative deviation degree. Also, there is a negative correlation between response to surgery and patients' age.[4,5]

In spite of many guidelines to the amount of muscle recession, the response to the surgery is not entirely consistent in many cases. This might be due to different medial rectus muscle contraction in different angles of esotropia, e.g. because of medial rectus muscle contraction in larger angles of esotropia, less recession might lead to better results. On the other hand, in older patients with degenerated muscle more recession might be needed. This issue motivated us to study the results of BMR muscle recession as the main technique in patients with esotropia.

Methods

In this retrospective study, medical records of 355 patients with esotropia, who underwent BMR muscle recession surgery (adjustable suture technique is also included) at Rassoul Akram Hospital, Tehran, from March 2001 to November 2011, were reviewed. Patients with recession>7 millimeter (mm) in each eye, sphere> +4 diopter (D) in each eye, retinal and optic nerve abnormalities, vertical deviations, injection of butolinum toxin in rectus muscles, any prior surgery on eyes, and the existence of A, V or X pattern of esotopia were excluded from the study. As a result, only 130 patients remained in our study. Study variables included age at surgery, gender, preoperative refractive errors in each eye, preoperative near and distance esotropia, the amount of recession in each eye, postoperative near and distance esotropia (one month, three months and two years after the surgery), postoperative near and distance exotropia (one month, three months and two years after the surgery), dose response in near and distance (one month, three months and two years after the surgery) (Table 1). All measurements had been performed by a proficient optometrist to carefully detect the amount of refraction and angle of deviation. Data were extracted from medical records of patients. Refractive errors had been measured after cycloplegia. The angle of strabismus was determined in the primary position at 40 cm (recorded as the near esodeviation) and six m (recorded as distance esodeviation), by using the alternate prism and cover test when possible, or by using the Krimsky test if the afore mentioned method was not possible; due to insufficient vision or poor cooperation in these patients. Mean of near and distance esotropia or exotropia was calculated for each patient and was called ET for esotropia and XT for exotropia. Dose response is defined as the response of each patient's angle deviation to the amount of recession, and is calculated from the following formula: [(preoperative esotropia) - postoperative residual esotropia + postoperative consecutive exotropia] **/** (sum of the amount of recession in both eyes).

Outcome of the surgery were considered successful if patients achieved ≤8 PD of ocular alignment. Patients were divided into different groups based on age and preoperative angle of esodeviation, and dose response was compared among these groups. Also, in order to study, the effect of recession

on residual ET (under-correction) or postoperative XT (over-correction), patients were divided into two groups: those who underwent the muscle recession ≥6.5 mm and those with the muscle recession <6.5 mm. The postoperative exotropia and residual esotropia were then compared between these two groups. All data were analyzed by using the SPSS16 software. Results were expressed as Mean±SD. Spearman Correlation was used for measures of association. We used *t*-Test and ANOVA for parametric and Wilcoxon signed rank test, Friedman test, and Mann-Whitney U for non-parametric analysis.

Ethical considerations

The patients' information remained confidential.

Table 1. Definition of variables

Variable	Parameters
Age at surgery (years)	<2 2-6 6-10 10-20 >20
Amount of recession	≥6.5 mm <6.5 mm
Deviation angle based on two classifications (Prism diopter, PD)	20-25 20-29 26-30 30-39 31-35 40-50 36-40 ≥51 41-45 46-50 51-60 ≥61

Results

Of 130 patients enrolled in this study, 63 cases (48.5%) were female and 67 cases (51.5%) were male with mean age of 7.16±7.84 ranged from six months to 48 years. Mean of preoperative refraction were 1.26 D ±1.47 and 1.37 D±.43 in right and left eye, respectively.

One hundred patients (76.9%) suffered from hyperopia, and 16 patients (12.3%) had myopia in their right eye. 101 patients (77.7%) suffered from hyperopia and 16 ones (12.3%) had myopia in their left eye.

One hundred and nine patients had one month follow-up, 122 patients had three months follow-up, and 82 patients had a two years follow-up as well. Mean angle of preoperative esotropia was 46.09 PD ±1.30 (20-100 PD), changed to 2.50 PD ±6.07 one month, 3.16 PD ±6.76 three months and 2.14 PD ±5.98 two years after the operation. Based on Wilcoxon signed rank test, difference between angle of preoperative esotropia and postoperative esotropia was statistically significant (p=0.001).

Results of surgery after one month, three months and two years of follow-up is summarized in table 2.

Mean of recession in right and left eyes were 5.69±0.71 (4-7 mm) and 5.64±0.75 (3.5-7 mm), respectively.

Versus 6.5 mm or higher recession on right or left eyes of 29 patients, less than 6.5 mm recession was performed on right or left eyes of 101 patients. The results have shown in tables 3 and 4.

Using Mann-Whitney U test, consecutive XT and residual ET was compared one month, three months and two years after the surgery between two groups (<6.5 mm and ≥6.5 mm recession) which were not statistically significant (p>0.05).

Mean dose response one month, three months and two years postoperation were 3.91±0.93, 4.02±1.23 and 4.02±1.14, respectively.

Results of Spearman Correlation test showed dose-response one month and three months after the surgery had a significant negative correlation with age at the time of surgery [(p=0.04, R=-0.19) and (p=0.02, R=-0.20)]. Negative correlation between age and dose response after two years was not statistically significant (p=0.06, R=-0.20) (Figures 1, 2, 3).

Also, there was a significant positive correlation between dose-response one month, three months and two years after the operation and the angle of preoperative esodeviation (R=0.52, p<0.001), (R=0.42, p<0.001), (R=0.52, p<0.001).

Results of *t*-Test showed mean dose response one month, three months and two years after the surgery between different age groups was statistically significant just in age groups under and over 20 year old, only in three months follow-up (p=0.006). We also compared mean dose responses one month, three months and two years after the surgery between patients under two years and over two years old. Results showed no significant

difference between these two groups (p>0.05).

Two different classifications have been done based on preoperative ET and mean dose response one month, three months and two years after the surgery were compared between these groups as is shown in table 4. Results of analyses revealed that means dose responses are significantly different between these groups in two classifications (p<0.001).

Also, the mean residual ET, the mean consecutive XT, and the mean dose responses one month, three months and two years after the surgery were compared using Friedman test. The results suggested that except for the three months postoperative XT that was significantly more than one month postoperative XT (p=0.01), there was no significant difference between results one month, three months and two years after the surgery (Table 5).

Table 2. Results of surgery after one month, three month and two years of follow-up

	One month F/U (n=109)	Three months F/U (n=122)	Two years F/U (n=82)
Residual ET	18 (16.4%)	25 (20.4%)	11 (13.3%)
Consecutive XT	6 (5.5%)	19 (15.4%)	7 (8.5%)
Orthotropia	85 (78.1%)	78 (64.2%)	64 (78.2%)

Table 3. Results of ≥6.5 mm recession after one month, three month and two years of follow-up

	One month F/U	Three months F/U	Two years F/U
Residual ET	3 (10.34%)	4 (13.79%)	1 (3.44%)
Consecutive XT	-	6 (20.68%)	2 (6.89%)

Table 4. Results of <6.5 mm recession after one month, three months and two years of follow-up

	One month F/U	Three months F/U	Two years F/U
Residual ET	14 (13.86%)	21 (20.79%)	10 (9.90%)
Consecutive XT	6 (5.94%)	13 (12.87%)	5 (4.95%)

Table 5. Comparison of dose response in different patients group based on preoperative angles of esotropia

Angle of esotropia (PD)	Follow-up after the surgery	N	Mean of dose response±SD
20-25 PD	One month	3	3.14±1.12
	Three months	4	3.29±0.96
	Two years	3	2.40±0.16
26-30 PD	One month	9	2.95±1.12
	Three months	9	3.41±0.96
	Two years	8	3.37±0.16
31-35 PD	One month	9	3.95±0.59
	Three months	10	4.26±1.03
	Two years	6	4.36±1.08
36-40 PD	One month	15	3.79±0.66
	Three months	19	3.76±0.94
	Two years	11	3.64±0.66
41-45 PD	One month	29	3.53±0.66
	Three months	31	3.41±0.87
	Two years	19	3.84±0.83
46-50 PD	One month	24	4.01±0.48
	Three months	25	4.05±0.67
	Two years	20	3.85±0.73
51-60 PD	One month	10	4.62±1.09
	Three months	13	4.69±1.30
	Two years	9	4.74±1.10
≥61 PD	One month	10	5.25±1.02
	Three months	11	5.89±1.27
	Two years	6	6.11±0.92

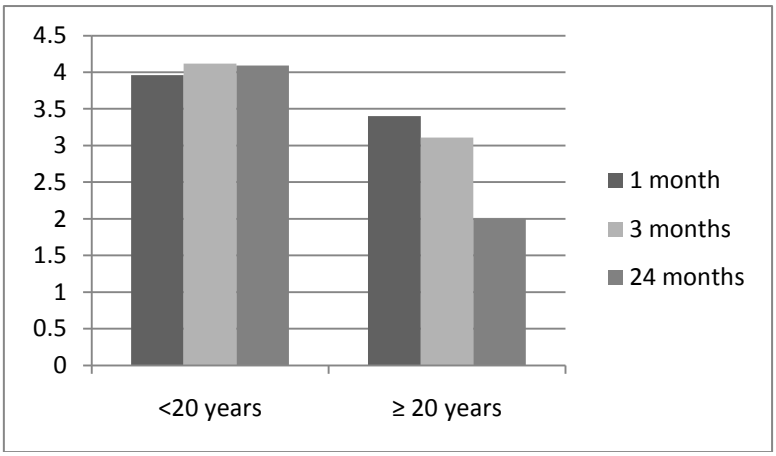

Figure 1. Mean of dose response one month, three months and two years after the surgery in patients under and over 20 years old

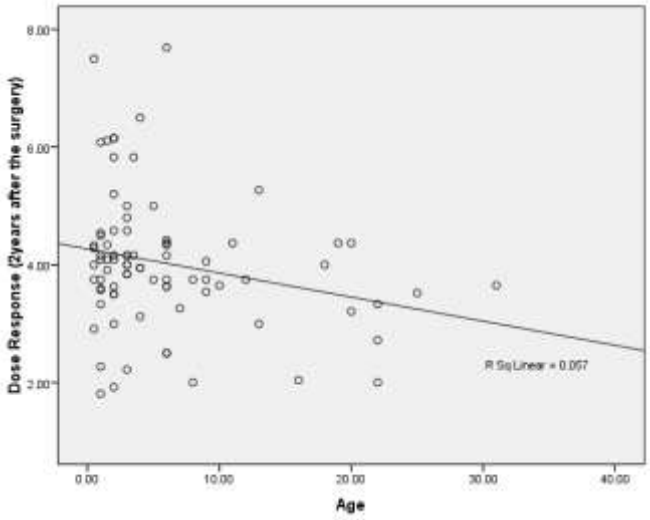

Figure 2. Correlation between dose response (two years after the surgery) and patients' age

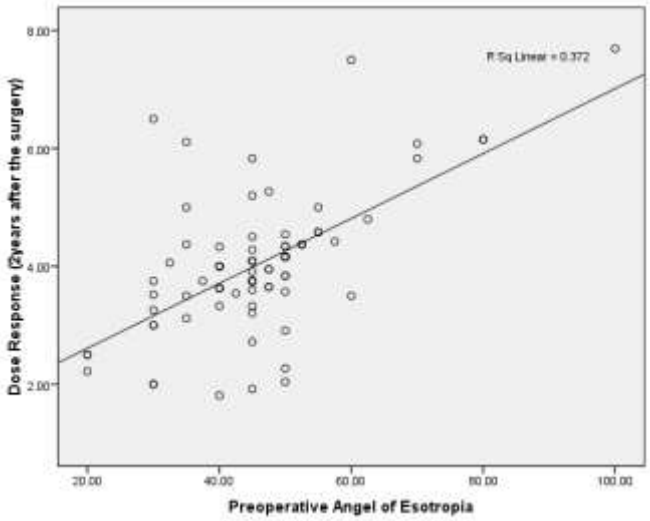

Figure 3. Correlation between dose response (two years after the surgery) and preoperative angle of esodeviation

Discussion

Various groups have studied the effects of different factors on the strabismus surgery results including the degree of alignment and the improvement in harmful sensory effects of strabismus. In this study, we have investigated postoperative one month, three months and two years dose response according to patients' age and the preoperative deviation angle.

Bilateral recession of medial rectus muscle for large-angle infantile esotropia (≥ 60 PD) has been described by some investigators but the literature has reported variable success between 60 and 91%.[6-8] In the present study 78.2% patients achieved to alignment two years after surgery. In a study on outcomes of the surgery in horizontal strabismus, success rate was 62% in patients with esotropia and 57% in exotropia. In Overall, the success rate was 60.2% which was related to the age younger than six years and preoperative deviation less than 30 degrees.[9] Other studies that followed cases at six months to one year to assess improvement of deviation angle reported 60-70% success in rate of surgery.[10-12] Our findings shows spontaneous improvement in angle of deviation over time.

Residual ET is a common problem following BMR recession for esotropia that frustrates either surgeons or patients. Various studies have reported an incidence of 40% for this condition.[12-14] In our study 16.4% of cases after one month and 13.3% after two years still had residual ET that is lower than those reported previously in the literature. Also, these findings are consistent with results of studies reported in most cases patients become orthotropic over time.[15] Choosing an appropriate treatment for this condition depends on size of the residual deviation, including considerations for both near and distance measurements.

In this condition, prism glasses or additional surgery can be recommended for correction of angle of deviation. Surgery is preferred when esotropia greater than 10-15 prism diopters (PD) persists for longer than 6-8 weeks even after full correction of hyperopia.[16]

Consecutive XT was seen in 5.5% of our cases after one month and in 8.5% after two years follow-up. A 40-year follow-up study on results of surgical treatment of childhood esotropia in 85 patients aged 2-24 years, reported an 21% incidence of consecutive exotropia. They found that multiple surgeries and presence of postoperative adduction deficit were the most important factors influencing the incidence of consecutive XT after surgery, whiles, age of onset, age at surgery and amount of surgery seems not to influence the risk of consecutive XT.[17] The reasons for developing late consecutive exotropia is not well defined. Various studies suggested binocularity, mechanical limitation of postoperative adduction, high hypermetropia, nystagmus, A/V patterns, family history of strabismus, and vertical deviations can be culprit.[18,19] We excluded patients with these conditions and a lower rate of consecutive exotropia in our study may be raised of this. Ludwig and Chow have reported the formation of scar remodeling with lengthening of the scar between the previously recessed muscle and the sclera as a reason of late onset consecutive exotropia in 50% of patients.[20]

The most common refractive error in our cases was mild hyperopia that is along side of other studies.[10] In patients with congenital esotropia, hyperopia is likely to be moderate. A study was conducted on 127 cases with congenital esotropia, reported 29.1% of cases had moderate hyperopia that does not influence deviation angle.[8]

The results of this study shows dose response is significantly different in various preoperative ET groups and has a significant positive correlation with patients' preoperative ET angle; the more preoperative deviation angle, the more change in eye's deviation degree of recession. In Kushner and colleagues' study,[21] Eighty-one patients with esotropia went through BMR muscle recession and followed one month and six months after the surgery. Results showed the change in the degree of ocular alignment per millimeter of rectus recession, increased with higher preoperative deviation degree (R[1wk]=0.707 and R[6mo]=0.651). In another study done by Abbasoglu and colleagues,[4] they also found that the change in the degree of deviation per millimeter of recession, increases with higher preoperative deviation degree ($p<0.0001$ and $r^2=0.33$). Umazume and colleagues[5] during 1984-1994 conducted

a research in Japan, to identify preoperative factors that influence the effectiveness of strabismus surgery in adults. In 48 esotropic patients, one of the factors which had a positive and significant correlation with response to surgery, one month and six months after the operation, was determined to be preoperative deviation (multiple R[1mo]=0.57 and multiple R[6mo]=0.77). According to these results, patients with larger angles of preoperative deviation may be exposed to a higher risk of over-correction. This issue might be due to better results of less recession of medial rectus muscle in larger angles of esodeviation because of the muscle's contraction.

Another result of this study was a significant negative correlation between patients' age and dose response one month and three months after the surgery. Also, dose response was found to increase significantly in age group under 20 years old in comparison with the group older than 20 years, in three months follow-up. Kushner and colleagues[9] also reported a negative correlation between response and patients' age ($p<0.0001$, r[6mo]=-0.509, r[1wk]=-0.489). Abbasoglu and colleagues[4] found age of onset of strabismus as the second important factor -the first one being preoperative deviation- affecting response to surgery. In the same way, less increase in response was noticed in patients who were older at the time of disease (R=0.44). The results of these studies also support the inverse correlation between age and dose response. This might be due to the fact that more recession is needed in older patients because of medial rectus muscle degeneration. In this group of patients, over-correction should also be avoided.

In our study, we compared the dose response one month, three months and two years after the operation between two age groups of <2 years old and ≥2 years old. The results showed no significant difference between these two age groups in dose response. Although we did not evaluate the effect of axial length on dose response in our study, this result suggests that axial length does not have a significant effect on dose response. In contrast, in a research done by Kushner and colleagues[21] on 36 esotropic patients with mean age 55±73 months, patients were visited one week and six months after the surgery to see the effect of axial length on response to surgery. It was concluded that axial length has an inverse significant correlation with response to strabismus surgery (R=-0.53). The same researchers conducted other studies that illustrated this correlation influences effectiveness of adult surgical correction.[21-23]

One of the limitations of our study, was the small sample size in adult group as well as the study type (retrospective). Finally, it is suggested that more studies with bigger sample size should be done on adult group. Also, prospective researches are necessary.

Conclusion

Our study on outcome of surgical treatment of esotropia showed a success rate similar to other studies reported around the world and after two years follow-up, an acceptable rate of orthotropia has been achieved. Regarding different dose responses in different age groups and different angles of esotropia, adjustable sutures found to be of value.

References

1. West CE, Asbury T. Strabismus. In: Riordan-Eva P, Whitcher JP, editors. Vaughan & Asbury's general ophthalmology. 17th ed. USA: Lange Medical Books/McGraw-Hill, 2008;229-48.
2. Skuta GL, Cantor BL, Weiss JS. Basic and clinical science course: Pediatric ophthalmology and strabismus. San Francisco: American Academy of Ophthalmology, 2010-2011;147-8.
3. Simson JW, Buckley EG, Drack AV, et al. Basic and clinical science course: Pediatric ophthalmology and strabismus. San Francisco: American Academy of Ophthalmology, 2002; 89-92,161-2.
4. Abbasoglu OE, Sener EC, Sanac AS. Factors influencing the successful outcome and response in strabismus surgery. Eye (Lond) 1996;10 (Pt 3):315-20.
5. Umazume F, Ohtsuki H, Hasebe S. Preoperative factors influencing effectiveness of surgery in adult strabismus. Jpn J Ophthalmol 1997;41(2):89-97.
6. Szmyd SM, Nelson LB, Calhoun JH, Spratt C. Large bimedial rectus recessions in conjenital esotropia. Br J Ophthalmol 1985;69(4):271-4.
7. Tolun H, Dikici K, Ozkiris A. Long-term results of bimedial rectus recessions in infantile esotropia. J Pediatr Ophthalmol Strabismus 1999;36(4):201-5.
8. Castro PD, Pedroso A, Hernández L, Naranjo RM, Méndez TJ, Arias A. Results of surgery for congenital esotropia. MEDICC Rev 2011;13(1):18-22.

9. Kampanartsanyakorn S, Surachatkumtonekul T, Dulayajinda D, Jumroendararasmee M, Tongsae S. The outcomes of horizontal strabismus surgery and influencing factors of the surgical success. J Med Assoc Thai 2005;88 Suppl 9:S94-9.
10. Wright WK. Esotropia. In: Wright WK, editor. Pediatric ophthalmology and strabismus. St. Louis: Mosby, 1995; 179-93.
11. Nucci P, Serafino M, Trivedi RH, Saunders RA. One-muscle surgery in small-angle residual esotropia. J AAPOS 2007;11(3):269-72.
12. Stager DR, Weakley DR Jr, Everett M, Birch EE. Delayed consecutive exotropia following 7-milimeter bilateral medial rectus recession for congenital esotropia. J Pediatr Ophthalmol Strabismus 1994;31(3):147-50.
13. von Noorden GK. A reassessment of infantile esotropia. XLIV Edward Jackson memorial lecture. Am J Ophthalmol 1988;105(1):1-10.
14. Shauly Y, Prager TC, Mazow ML. Clinical characteristics and long-term postoperative results of infantile esotropia. Am J Ophthalmol 1994;117(2):183-9.
15. Scott WE, Reese PD, Hirsh CR, Flabetich CA. Surgery for large-angle congenital esotropia. Two vs three and four horizontal muscles. Arch Ophthalmol 1986;104(3):374-7.
16. Jang GJ, Park MR, Park SC. Bilateral lateral rectus resection in patients with residual esotropia. Korean J Ophthalmol 2004;18(2):161-7.
17. Ganesh A, Pirouznia S, Ganguly SS, Fagerholm P, Lithander J. Consecutive exotropia after surgical treatment of childhood esotropia: a 40-year follow-up study. Acta Ophthalmol 2011;89(7):691-5.
18. Windsor CE. Surgically overcorrected esotropia: a study of its causes, sensory anomalies, fusional results, and management. Am Orthopt J 1966;16:8-15.
19. Bradbury JA, Doran RM. Secondary exotropia: a retrospective analysis of matched cases. J Pediatric Ophthalmol Strabismus 1993;30(3):163-6.
20. Ludwig IH, Chow AY. Scar remodeling after strabismus surgery. J AAPOS 2000;4(6):326-33.
21. Kushner BJ, Fisher MR, Lucchese NJ, Morton GV. Factors influencing response to strabismus surgery. Arch Ophthalmol 1993;111(1):75-9.
22. Kushner BJ, Lucchese NJ, Morton GV. The influence of axial length on the response to strabismus surgery. Arch Ophthalmol 1989;107(11):1616-8.
23. Kushner BJ, Vrabec M. Theoretical effects of surgery on length tension relationships in extraocular muscles. J Pediatr Ophthalmol Strabismus 1987;24(3):126-31.