

Effects of Ocular Parameters on Medial Rectus Faden Operation with Recession for Esotropia^{*,**}

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Abstract

Background: In the treatment of infantile and accommodative esotropia medial rectus (MR) recession combined posterior fixation suture (Faden operation) can be used. But, there is very limited literature on effect of ocular parameters (axial length, medial rectus width and the distance of medial rectus insertion to limbus) to this operation. **Objective:** To evaluate effects of ocular parameters on medial rectus Faden operations with recession for esotropia. **Material and Methods:** In this retrospective study, 38 patients (57 eyes) who underwent Faden operation with unilateral or bilateral recession (4 - 4.5 mm) on medial rectus were divided into three groups according to axial length, medial rectus width and the distance of medial rectus insertion to limbus. Preoperative and postoperative deviations compared. **Results:** 11 cases were infantile esotropia, 46 cases were acquired esotropia. Female/male rate was 19/19. The mean preoperative amount of esotropia at near was 49.95 ± 17.36 prism diopters (PD) and postoperative 1 week 11.77 ± 11.14 PD, 1 month 12.02 ± 11.52 PD and 6 months 9.46 ± 10.19 PD. The mean preoperative amount of esotropia at distance was 38.84 ± 19.03 PD and postoperative 1 week 7.25 ± 11.29 PD, 1 month 6.54 ± 10.52 PD and 6 months 4.40 ± 9.08 PD. Due to axial length, in shorter eyes, the decrease in mean postoperative deviation was statistically significant. Due to medial rectus width and the distance of medial rectus insertion, there was no statistically significant difference. **Conclusions:** Axial length has an effect on medial rectus Faden operations with recession but medial rectus width and

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medial rectus insertion distance from limbus do not.

Keywords

Esotropia, Faden Operation, Axial Length, Medial Rectus Width, Medial Rectus Distance from Limbus

1. Introduction

The management of essential infantile esotropia and convergence excess accommodative ET is highly controversial and has changed over the years. Some authors recommended bimedial rectus recession with the target angle. Others advocate adding posterior fixation suture to the medial rectus (MR) recession for controlling convergence excess ET. Other procedures such as marginal myotomy and slanted recession are less popular [1]-[6].

Many recommendations can be found in the literature about effectiveness of MR recession combined with posterior fixation suture (Faden operation) in high AC/A ratio accommodative ET [3] [5] [6].

The term “faden” is the German word for suture or string [1]. The faden operation, also termed *posterior fixation suture*, first described by Cüppers in 1974 to treat incomitant strabismus [2].

It is used to weaken the rotational force of a rectus muscle when the eye rotates towards the faden muscle. The faden procedure is performed by suturing the rectus muscle to sclera, 12 mm to 14 mm posterior to the rectus muscle insertion. This pins the rectus muscle to the sclera so when the eye rotates towards the fadened muscle, the arc of contact cannot unravel. The faden suture thus creates a new insertion posterior to the original insertion. This posterior insertion shortens the moment arm when the eye rotates towards the fadened muscle. Shortening the moment arm reduces the rotational force as the eye rotates towards the fadened muscle [1].

The faden operation may be helpful when the patient has an esotropia with a high AC/A ratio. Other indications for the faden operation have been reported including sixth nerve paresis, dissociated vertical deviation, nystagmus compensation syndrome, and nystagmus in primary position without a face turn. In addition, some have advocated using the faden operation on the lateral rectus muscle in patients with Duane’s retraction syndrome, and significant upshoot and downshoot [1] [3] [4] [5].

In the literature, there is very limited knowledge on effect of ocular parameters on this operation. Do axial length, medial rectus width and the distance of medial rectus insertion to limbus have effect on success rate?

The aim of this study is to evaluate effects of ocular parameters (axial length, medial rectus width and the distance of medial rectus insertion to limbus) on medial rectus Faden operations with recession for esotropia.

2. Patients and Methods

2.1. Study Design

In this retrospective study, the medical records from 38 patients who underwent the Faden operation on medial rectus muscles with recession for the treatment of esotropia between December 2005 to February 2007 in Beyoglu Eye Research and Training Hospital in İstanbul were reviewed.

The study was approved by the ethics committee of the Istanbul Professor Dr. N Reşat Belger Beyoglu Education and Research Eye Hospital Institutional Review Board. The study and the data collection conformed to all local laws and were compliant with the principles of the Declaration of Helsinki. Informed consent was obtained from each participant; for children younger than 18 years of age, consent was obtained from one or both of the parents.

2.2. Examination

Inclusion criteria were accommodative and partially accommodative esotropia (refractive or nonrefractive) and esotropia at near exceeding esotropia at distance by at least 10 prism diopters (PD).

Exclusion criteria were ocular or systemic diseases, a history of previous intraocular or strabismus surgery, neurological or developmental disorders, and a follow-up period of less than 1 year. Patients who had undergone concurrent oblique muscle surgery were also excluded.

The patients underwent a standard ophthalmologic examination, including refraction (cycloplegic refraction via sciascopy and autorefractometer, best corrected visual acuity, slit-lamp biomicroscopy, and detailed funduscopy. Visual acuity measurements were obtained with Snellen charts or Lea symbols. Ocular motility was evaluated with alternate prism and cover testing at 6 m and 33 cm and with the Krimsky test for patients of a younger age. Ductions and versions were examined and documented using traditional methods. Examinations were performed preoperatively and postoperatively at 1, 3, and 6 months.

2.3. Surgical Procedure

All surgeries were performed by one surgeon (B.G.) under general anaesthesia. All patients received a posterior fixation suture on one or both medial rectus muscles at 12.50 or 13.50 mm from the insertion of the muscle with a nonabsorbable suture (5.0 Ethibond Excel (Ethicon, Somerville, NJ)). After careful dissection of the connective tissues around the muscle, the suture was fixed to the sclera on both sides of the muscle and a knot was made (**Figure 1**). In the recession group, unilateral or bilateral recession (4 - 4.5 mm) was done and the Faden operation was performed followed by medial rectus recession.

A posterior fixation suture was performed based on the modified method of Cuppers described by de Decker [4], and recommended guidelines based on the degree of esotropia were followed [4]. MR muscles were sutured at 12.50 - 13.50 mm

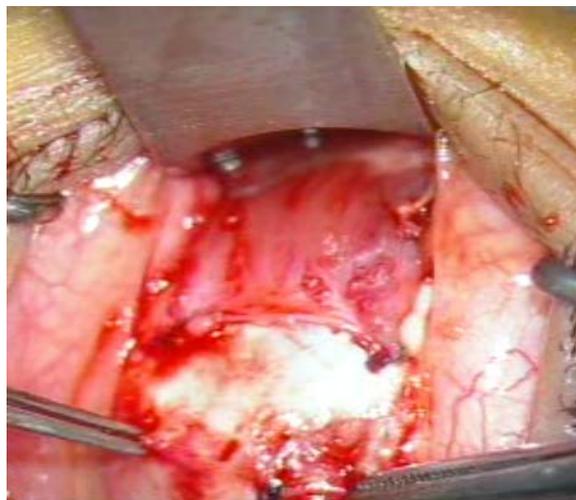


Figure 1. Faden suturing.

from the insertion based on the angle of deviation (12.50 mm from the insertion for 20 - 30 pd of deviation angle, 13 mm for 40 pd, 13.50 mm for ≥ 50 pd).

Postoperatively, orthotropia or esotropia of <10 pd at near and distance fixations with available optical correction and an elimination of near–distance disparity were jointly considered to be a satisfactory outcome.

Preoperative and postoperative axial length, medial rectus width and the distance of medial rectus insertion to limbus were obtained. According to axial length, medial rectus width and the distance of medial rectus insertion to limbus cases were divided into three groups (axial length; ≤ 21 mm, 21 - 22 mm, ≥ 22 mm. medial rectus width; ≤ 10.50 mm, 10.50 - 12 mm, ≥ 12 mm. The distance of medial rectus insertion to limbus; ≤ 4.25 mm, 4.25 - 5 mm, ≥ 5 mm). All groups were compared according to preoperative and postoperative deviation.

2.4. Data Analysis

The Statistical Package for the Social Sciences (SPSS) software (version 11; SPSS, Inc., Chicago, IL) was used for the data analysis. Categorical variables were presented as numbers, and numerical variables were expressed as means and standard deviations. The Kolmogorov–Smirnov test was used to assess the normal distribution of the data and the Mann-Whitney, Kruskal-Wallis and Paired Sample Test used. A *P* value of less than 0.05 was considered statistically significant.

3. Results

11 eyes were infantile esotropia, 46 eyes were acquired esotropia. Female/male rate was 19/19.

The comparison of deviations at distance and at near between preoperative and postoperative 1 week, 1 month and 6 months were statistically significant, (Tables 1-7, Figure 2 and Figure 3). After surgery, the amount of deviation decreased both at distance and near fixation.



Figure 2. 70 PD ET preoperative.



Figure 3. After 1 week Bimedial 4 mm recession + 13.50 mm Faden operation.

Table 1. Surgical data.

Type of Operation	Amount of case and (%)	Amount of recession and Faden
Unilateral recession + Fd	19 (50%)	4.342 ± 0.239 mm recession and 13.01 ± 0.32 mm Fd
Bilateral recession + Fd	19 (50%)	4.302 ± 0.248 mm recession and 12.84 ± 0.22 mm Fd
Total	38 (100%)	4.324 ± 0.241 mm recession and 12.89 ± 0.27 mm Fd

Table 2. Preoperative and postoperative 1 week deviations, correction amounts, correction percentage and p value at distance.

	Preop Deviation PD	Postop 1 week PD	Correction PD	Correction %	P value
Unilateral MD ± SD	27.68 ± 15.13	5.63 ± 6.70	22.05	92.1	<0.001
Bilateral MD ± SD	44.42 ± 18.46	8.05 ± 11.88	36.37	81.84	<0.001
Total MD ± SD	38.84 ± 19.03	7.25 ± 1.29	77.96	77.96	<0.001

Table 3. Preoperative and postoperative 1 week deviations, correction amounts, correction percentage and p value at near.

	Preop Deviation PD	Postop 1 week PD	Correction PD	Correction %	P value
Unilateral MD ± SD	37.74 ± 4.52	10.74 ± 9.72	27.00	66.82	<0.001
Bilateral MD ± SD	56.05 ± 5.43	12.29 ± 11.88	43.76	79.28	<0.001
Total MD ± SD	49.95 ± 17.35	11.77 ± 11.14	38.18	75.12	<0.001

Table 4. Preoperative and postoperative 1 month deviations, correction amounts, correction percentage and p value at distance.

	Preop Deviation PD	Postop 1 month PD	Correction PD	Correction %	P value
Unilateral MD ± SD	27.68 ± 15.13	5.74 ± 11.30	21.95	92.1	<0.001
Bilateral MD ± SD	44.42 ± 18.46	6.95 ± 10.24	37.47	85.95	<0.001
Total MD ± SD	38.84 ± 19.03	6.54 ± 10.52	32.3	87.99	<0.001

Table 5. Preoperative and postoperative 1 month deviations, correction amounts, correction percentage and p value at near.

	Preop Deviation PD	Postop 1 month PD	Correction PD	Correction %	P value
Unilateral MD ± SD	37.74 ± 4.52	12.16 ± 12.71	25.58	67.11	<0.001
Bilateral MD ± SD	56.05 ± 5.43	11.95 ± 11.06	44.11	79.31	<0.001
Total MD ± SD	49.95 ± 17.35	12.02 ± 11.52	37.93	75.24	<0.001

Table 6. Preoperative and postoperative 6 month deviations, correction amounts, correction percentage and p value at distance.

	Preop Deviation PD	Postop 6 month PD	Correction PD	Correction %	P value
Unilateral MD ± SD	27.68 ± 15.13	4.37 ± 11.05	23.32	94.65	<0.001
Bilateral MD ± SD	44.42 ± 18.46	4.42 ± 8.08	40	90.59	<0.001
Total MD ± SD	38.84 ± 19.03	4.40 ± 9.08	34.44	91.94	<0.001

Table 7. Preoperative and postoperative 6 month deviations, correction amounts, correction percentage and p value at near.

	Preop Deviation PD	Postop 6 month PD	Correction PD	Correction %	P value
Unilateral MD ± SD	37.74 ± 4.52	10.26 ± 11.22	27.47	71.8	<0.001
Bilateral MD ± SD	56.05 ± 5.43	9.05 ± 9.77	47	84.72	<0.001
Total MD ± SD	49.95 ± 17.36	9.46 ± 10.19	40.49	80.41	<0.001

According to medial rectus width and the distance of medial rectus insertion to limbus, between in all three groups comparison of correction in deviation, the difference was not statistically significant. But according to axial length between in all three groups comparison of correction in deviation, the difference was statistically significant. In ≤ 21 mm group the correction was higher than 21 - 22 mm group and ≥ 22 mm group. And in 21 - 22 mm group correction was higher than ≥ 22 mm group. So when axial length is shorter the correction in deviation was higher (**Table 8** and **Table 9**).

4. Discussion

In esotropia treatment with posterior fixation suture with or without MR muscle recession is controversial [3] [4] [6] [7] [8]. And also, The Faden procedure is a difficult surgery and has some complications like globe perforation. Because muscles are sutured posteriorly, behind the equator and near to the vortex veins. Experienced surgeons can minimise the risk of complications.

Although it has some disadvantages, we found that Faden operation with or without MR muscle recession is effective for the treatment of esotropia.

Some authors reported that 76% - 86% of patients with convergence excess were capable.

of maintaining satisfactory near ocular alignment with bilateral Faden operations on the MR muscles at an average of 2 - 3 years of follow-up [7]. In our studies, 80.4% of cases showed satisfactory near ocular alignment.

Table 8. Findings in axial length group.

Axial Length	Preoperative Deviation At Distance PD	Preoperative Deviation At Near PD	Postoperative 6 month Deviation At Distance PD	Postoperative 6 month Deviation At Near PD
≤ 21 mm MD \pm SD	36.42 \pm 13.41	46.42 \pm 12.13	-1.25 \pm 4.33	1.00 \pm 5.88
21.00 - 22.00 mm MD \pm SD	36.92 \pm 16.50	48.81 \pm 15.70	5.96 \pm 10.37	11.38 \pm 10.86
≥ 22 mm MD \pm SD	43.00 \pm 24.72	53.74 \pm 21.89	5.84 \pm 8.27	12.16 \pm 8.81

Table 9. Findings in axial length group.

Axial Length	Mean Correction At Distance PD & %	Mean Correction At Near PD & %
≤ 21 mm group MD \pm SD	37.67 \pm 15.05 102.08% \pm 12.87%	45.42 \pm 13.43 97.12% \pm 13.45%
21.00 - 22.00 mm group MD \pm SD	30.96 \pm 15.25 91.37% \pm 45.60%	37.42 \pm 16.67 76.36% \pm 22.70%
≥ 22 mm group MD \pm SD	37.16 \pm 23.82 86.30% \pm 26.27%	41.58 \pm 19.72 75.42% \pm 18.99%

De Decker, evaluated 235 patients who had a Faden procedure on the MR muscles and reported that 181 (76.5%) achieved a satisfactory outcome after 2 - 3 years of follow-up [4]. In our series, a satisfactory outcome of 91.94% at 6 month postoperatively. But, our follow-up time is not as long as de Decker. And some authors reported that by the time the effectiveness of this surgery decreases [3]. So, maybe by the time our patients' satisfactory outcomes would decrease.

Akar *et al.* reported that 7.9% showed secondary exotropia at an average of 4.8 years of follow-up [3]. In our study, 6 Month postoperatively, only 3 patient had overcorrection.

Von Noorden performed Faden operations on previously recessed MR muscles in 12 patients with a persistent convergence excess-type esotropia. He reported that the operation reduced the deviation in all but one patient and was more effective at near fixation than at distance fixation [9]. In our series, reduction of the near deviation was higher than reduction of the distance deviation after 6 month postoperatively.

Medial rectus muscle width is 10.30 mm on average [10]. In our study mean medial rectus muscle width was 11.09 ± 1.06 mm. To the best of our knowledge there is no data on relationship between postoperative correction of deviation and MR muscle width in conventional strabismus surgery and Faden surgery. In our study we did not find any correlation. There was no effect of MR muscle width on Faden operation. This may be due to 1/3 of muscle fixation on sclera.

Mims *et al.* did not find any correlation on deviation amounts and the distance of medial rectus muscle insertion to limbus in infantile esotropia patients [11]. In our study, mean distance of medial rectus muscle insertion to limbus was 4.78 ± 0.59 mm. There was no correlation between postoperative correction amount of deviation and distance between muscle insertion to limbus.

Kushner *et al.* found that there was an inverse correlation between axial length and correction in deviation in conventional esotropia surgery [12]. In our study, our findings were similar. In patients with longer axial lengths, the amount of deviation corrections was smaller. In patients with shorter axial lengths, the corrections were bigger.

Krzizok *et al.* found that there was an inverse correlation between axial length and correction in deviation in faden operation in esotropia surgery [13]. In eyes with longer axial length, correction in deviation decreased.

A limitation of this study is that it does not include controls. But, it is understandable that to establish a control group is very difficult and time assuming and also there are some ethical issues.

5. Conclusions

Faden operations, unilaterally or bilaterally, on MR muscles with recession were a successful surgical treatment option that resulted in the reduction of the near and distance deviations in esotropia.

In eyes with shorter axial lengths, the decrease of postoperative deviations was more than longer axial lengths. The medial rectus width and the distance of medial rectus insertion to limbus had no effect on Faden surgery.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The authors declare that they have no competing interests.

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