

Surgical Management of Convergence Excess Esotropia

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Received: 15-11-2022, Accepted: 14-1-2023, Published online: 16-9-2023

EJO(MOC) 2023;3(3):137-142.

Short title: Surgical Management of Convergence Excess Esotropia

Abstract

Propose: The purpose of this study was to evaluate retro-equatorial myopexy (faden operation) of medial rectus muscles for the treatment of near-distance disparity esotropia.

Patients & Methods: This study included 14 patients with convergence excess esotropia not responding to bifocal glasses. All patients underwent bimedial recession based on far angle combined with retro-equatorial myopexy at 12–14mm from insertion (faden operation). A satisfactory result was defined as orthophoria or esotropia less than 10 prism diopters (Δ) at near and distance with reduction of the near-distance disparity to less than 10 Δ . All patients were followed up for 1 year in average and 6 months at least for stability of correction and onset of consecutive exotropia

Results: 1 case (7%) had residual esotropia at far, 2 cases (14%) had residual near–far disparity and no cases had consecutive exotropia;

Conclusion: Faden operation is effective in management of convergence excess esotropia. However, it is quite difficult technique. Larger sample size and longer follow-up periods are still needed.

Keywords: Near far disparity, AC/A ratio, Faden operation

INTRODUCTION

Convergence excess esotropias include a group of strabismus disorders where misalignment at near exceeds that at distance by at least 10 Δ after full hyperopic correction¹.

One of the common causes of convergence excess is high accommodative convergence to accommodation ratio (AC/A). However, convergence excess can also be found in patients with normal or even low AC/A ratios^{2,3}.

The surgical management of convergence excess esotropia represents a challenging problem. Bifocals have been used to control convergence excess since the nineteenth century. However, their effectiveness is limited in many cases^{4,5}. Different surgical approaches have been described to reduce distance–near disparity with variable degrees of effectiveness and complications. These approaches include slanted medial rectus recession, posterior fixation sutures, medial rectus

muscle pulley posterior fixation, marginal myotomy, and combined resection-recession of medial rectus muscles⁶⁻¹⁵.

Faden operation was first described by Cuppers in 1912. Faden means a “suture” in German and the muscle is fixed posteriorly 12–14 mm behind the insertion, thus decreasing the force of rotation of the fadened muscle¹⁶. In esotropia with increased accommodative convergence ratio, Faden operation with recession significantly reduces the near-distance disparity without much change in the distance alignment⁵. However, the conventional Faden is difficult to perform as the Faden site is usually 12–14 mm from the insertion, which is too posterior for accessibility⁴.

Bilateral MR Faden surgery with or without recession has been recommended for the treatment of patients with partially accommodative ET associated with a high AC/A ratio¹⁰. Trials that studied the effect of bimedial faden with recession in the

Egyptian Journal of Ophthalmology, a publication of Mansoura Ophthalmic Center.

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treatment of partially accommodative ET with high AC/A ratio had reported that 70–88% of patients achieved ≤ 10 prism diopter ET, 81–93% had their DND collapsed to ≤ 10 prism diopter, and 71–84% of patients attained a grade of binocularity⁵.

PATIENTS AND METHODS

This was a prospective, interventional, randomized clinical trial on patients attending outpatient clinic of strabismus unit in Mansoura Ophthalmic Center, Mansoura University, Egypt from August 2019 till March 2022.

Inclusion criteria

A total of 14 patients with convergence excess esotropia who have near esotropia that is greater than distance esotropia by 10Δ or more who have worn spectacles incorporating full cycloplegic refraction for at least three months with failure of bifocal spectacles to correct this disparity for at least one month or failure of child to cope with bifocal glasses. There was no lower age limit for the study, provided that the patient is cooperative for an accurate prism and cover testing at both near and distance fixation on an accommodative. Patients with high, normal or low AC/A ratio was included in this study.

Exclusion criteria

- 1- Satisfactory alignment and binocular vision with bifocal add for near fixation.
- 2- Previous strabismus surgeries.
- 3- Amblyopia at the time of surgery
- 4- Oblique muscle dysfunction.
- 5- History of infantile esotropia.
- 6- Any media opacities, retinal disease, optic disc disease or other ocular problems.
- 7- Neurologic problems.

Methods

The following data has been obtained for each study participant:

Personal history taking:

1. Age.
2. Complete medical history.
3. Complete ophthalmic history including glass wear, ocular trauma or any ocular surgeries.

Ophthalmic examination:

1. Visual acuity and best corrected visual acuity measurement using the Landolt's broken ring chart or LEA chart.
2. Refraction measurements will be performed with cyclopentolate 1% instilled 30–40 minutes before retinoscopy or autorefractometer.
3. Motility examination in all directions of gaze for duction and version movements with assessment of under-actions or over-actions of each extra-ocular muscle if present.
4. Measurement of angle of deviation at near and at distance with glasses using prism and alternate cover test.
5. Slit lamp biomicroscopy.
6. Fundus examination using indirect ophthalmoscopy or non-contact lens slit-lamp biomicroscopy.
7. AC/A ratio was measured for cooperative patients by gradient method in near fixation, by measuring the difference between angle at near fixation with and without +3 lenses divided by +3 while wearing full cycloplegic correction. Patients were classified according to AC/A ratio into 3 categories:
 - a. Normal AC/A ratio (range: 3-5:1).
 - b. High AC/A ratio ($>5:1$).
 - c. Low AC/A ratio ($<3:1$).

Surgical procedure:

Patients underwent recession of both medial rectus muscles according to distance angle combined with retro-equatorial myopexy 12–14 mm from the medial rectus muscle insertion (Faden operation).

Outcome measures

- The primary outcome was orthophoria or esotropia less than 10Δ at near and distance fixation, and reduction of the near-distance disparity to less than 10Δ even if achieved using glasses (refractive glasses not bifocal nor prismatic glasses provided that it maintains best corrected visual acuity at far and near without inducing asthenopia)

- The patients have been followed up at 1 week postoperatively and then at 1, 3, 6 months for the stability of correction and incidence of consecutive exotropia.
- The final results were based on the deviation measured at the last follow-up examination.

Ethical Consideration

- The study protocol was submitted for approval by Mansoura medical research ethics committee, faculty of medicine, Mansoura University.
- Informed consent was obtained from each participant in the study after assuring confidentiality.

RESULTS

The mean age of all patients was 5.50 ± 1.91 years. There were 6 males (42.9%) and 8 females (57.1%).

Table 1: AC/A ratio level in all patients

AC/A level	n (%)
Normal	12(85.7)
Low	0
High	2(14.3)
AC value	4.43 ± 0.938
Mean \pmSD	

Patients were classified according to AC/A ratio as shown in Table 1 into 3 categories: normal AC/A ratio (range: 3-5:1), low AC/A ratio (<3:1) and high AC/A ratio (>5:1). There were 12 cases (85.7%) with normal AC/A ratio, no cases with low AC/A ratio and 2 cases (14.3%) with High AC/A ratio.

The average spherical equivalent values of both eyes in all cases were 2.18 ± 1.31 . According to the average spherical equivalent, patients were categorized according to the type of refractive error into myopic, emmetropic and hyperopic error of refraction. All patients were hyperopic.

Table 2: Comparison of pre- and post-operative angles in all cases

Preoperative angles	
Far (With glasses)	22.86 ± 7.26
Near (With glasses)	41.07 ± 9.03
Disparity	18.21 ± 3.72
Postoperative angles	
Far (With glasses)	1.71 ± 3.87
Near (With glasses)	5.36 ± 6.64
Disparity	3.65 ± 2.26
Reduction of Disparity	14.57 ± 5.43

Pre- and post-operative angles were measured for far and near fixation as shown in Table 2. The disparity values shown in Table 2 are the difference between far and near angles for pre and post-operative measurements. Positive values represent eso-deviation while negative values represent exo-deviations. Pre-operative far angle measurements were 22.86 ± 7.26 while pre-operative near measurements were 41.07 ± 9.03 . Pre-operative near far disparity was 18.21 ± 3.72 .

Mean post-operative far angle measurements were 1.71 ± 3.87 while mean post-operative near measurements were 5.36 ± 6.64 . Post-operative near far disparity were 6.38 ± 2.26 . As shown in Table 2, reduction of near-far disparity was 14.57 ± 5.43 .

Successful reduction of near-far disparity was achieved in 12 cases. 2 cases (14.2%) had residual near-far disparity.

There was 1 case (7.1%) of residual esotropia for distance fixation. There were no cases of consecutive exotropia developed during the follow up period. The final success rate was 85.7%.

DISCUSSION

The mean age of all cases was 5.50 ± 1.91 years. This is comparable to¹⁷ who found that mean age in all cases was 5.88 years and² who found mean age in all cases to be 6.4 years.

There were 6 males (42.9%) and 8 females (57.1%) in all cases. This was comparable to² who found male cases to be 47% and female to be 53% of all cases included.

We found 71.73% of cases to have normal AC/A ratio which was much higher than² and¹⁸ who found it to be 46.4% and 48% respectively and slightly higher than¹⁹ who found it to be 57%.

In this study, 21.7% of patients had high AC/A ratio. This is lower than that reported in² and¹⁸ who reported it to be 46.4% and 51% respectively and to some extent comparable with¹⁹ who found it to be 38%.

Only 6.57% of all cases in our study had low AC/A ratio. This is comparable to¹⁹ and² who found it to be 5% and 7.2% respectively but higher than^[18] who found it to be 1%.

The average spherical equivalent of both eyes in all cases was $+2.03 \pm 1.48$. This is comparable to¹⁷ who found mean refractive error spherical equivalent to be $+2.59$ ranging from $+0.63$ to $+4.38$. According to the average spherical equivalent of all cases, patients were categorized according to the type of refractive error into myopic, emmetropic and hyperopic error of refraction. There were no emmetropic patients in our study but 3 myopic patients (6.5%) and 43 hyperopic patients (93.5%). This is comparable to¹⁷ who found all cases (100%) to be hyperopic in their study and² regarding myopic cases which were 3.5% but not hyperopic cases which were 53.5% of cases nor emmetropic which were 43% of cases .

Regarding pre-operative angle measurements in our study, mean value for pre-operative far angle measurements for all cases was 23.22 ± 9.95 . This is higher than² whose mean value was 9.75 ± 7.50 and also higher than¹⁷ whose mean value was 12. This is probably because parents of children whose far deviations were not apparent were less likely to accept surgery so they were less likely to be included in our study. Mean value for pre-operative near angle measurements for all cases was 40.98 ± 11.52 . This is comparable to^[17] who found it to be 36

and higher than² who found it to be 30.50 ± 7 . We found mean pre-operative near far disparity for all cases to be 17.76 ± 3.58 . This is comparable to^{2, 19, 17} and²⁰ who found it to be 20.5 ± 5 , 23, 24, 16.5 respectively.

Regarding post-operative angle measurements in our study, mean values for post-operative far angle measurements for all cases was 1.71 ± 3.87 . Mean post-operative near measurements was 5.36 ± 6.64 . Our values (mean: 5.36 ± 6.64) were slightly less than² who found mean near angle measurements to be 9 ± 6 .

In this study, we found that mean post-operative near far disparity was 9 ± 6 ²⁰ found post-operative near far disparity to be to be 4 for "Faden" technique.

Mean value of reduction of near-far disparity in our study was 14.57 ± 5.43 . This is comparable to² who found mean values of reduction of disparity after surgery to be 11.5 for "Faden" and¹⁹ who found it to be 18.5.¹¹ found that reduction of distance far disparity was 16.9 for "Faden".

Regarding residual esotropia in this study, there was one case (7.1%) of residual esotropia for far & near. This is significantly lower than² who reported 28.6% of cases to have under-correction in "Faden" group which couldn't be corrected with monofocal glasses.

There were no cases of consecutive exotropia developed during the follow up period. Our results are comparable to² regarding "Faden" group as both of us found no cases of consecutive exotropia using this technique.

The success rate in our study was 85.7 % (12 cases). This is higher than who found it to be 71.4%.

CONCLUSIONS

Faden operation is effective procedure in management of convergence excess esotropia. However, it is quite difficult technique. Larger sample size and longer follow-up periods are still needed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

All data are included in this article.

ACKNOWLEDGEMENT: None

Conflict of Interest

Authors declare no conflicts of interest.

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Ethics declarations

Conflict of interest

Ehab Sultan, Manal Kasem, Ahmed M. Ismaeil, Tarek Mohsen, Rasha El Zeini. all authors have no conflicts of interest that are directly relevant to the content of this review.

Funding: No sources of funding were used to conduct this review.

Reviewer disclosures: No relevant financial or other relationships to disclose.

Declaration of interest: No financial affiliations or financial involvement with any organization or entity with a financial competing with the subject matter or materials discussed in the review.

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