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ANTERIOR TRANSPOSITION VERSUS MYECTOMY OF THE INFERIOR OBLIQUE MUSCLE IN THE TREATMENT OF DISSOCIATED VERTICAL DEVIATION

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A b s t r a c t

Anterior transposition of the inferior oblique muscle (ATIO) and myectomy of the inferior oblique muscle (MIO) are surgical methods for treating dissociated vertical deviation (DVD) and are also used in patients with coexisting inferior oblique muscle overaction (IOOA). In order to compare the outcomes of these methods, a study of ATIO and MIO was carried out on patients with DVD of at least 5 prism dioptres (PD) in the eye involved. We evaluated 73 eyes in 41 patients, of which 35 eyes were treated by ATIO and 38 by MIO. We recorded the size of preoperative and postoperative DVD, grade of the preoperative and postoperative IOOA, repeat surgeries and complications. The mean follow-up was 19.6 months in the ATIO group and 26.5 months in the MIO group, with a minimum of 6 months. In the ATIO group, the mean preoperative DVD was 13 PD and postoperative DVD was 4 PD, as compared with 15 PD and 3 PD in the MIO group. The presence or absence of IOOA had no effect on surgery outcome in either group. No serious complications of surgery were recorded. It is concluded that both ATIO and MIO are equally effective for DVD treatment regardless of the presence or absence of IOOA. When the patients also had IOOA, this was better corrected by the ATIO than the MIO procedure.

K e y w o r d s

Inferior oblique muscle overaction, Dissociated vertical deviation, Surgery, Anterior transposition, Myectomy

INTRODUCTION

Dissociated vertical deviation (DVD) is characterised by elevation, abduction and excyclotorsion of the nonfixing eye without corresponding hypotropia in the other eye. It is demonstrated by upward drifting and outward movement of the occluded eye on cover testing. DVD is usually, but not always, bilateral but asymmetrical. In addition to DVD, inferior oblique overaction (IOOA) is also responsible for excessive elevation of one or both eyes but only in adduction. Various surgical interventions on vertically acting muscles have been used to treat DVD. Most recently, two methods have been preferred, particularly when both DVD and IOOA are present, and these are anterior transposition of the inferior oblique muscle (ATIO) and myectomy of the inferior oblique muscle (MIO)

(*1- 12*). Inferior oblique overaction is often associated with infantile esotropia. (*10,11*). The objective of this prospective study was to compare the results of ATIO and MIO techniques in children who had DVD or DVD and IOOA.

MATERIALS AND METHODS

PATIENTS

We assessed all children, aged 6 months to 15 years, with DVD of 5 or more prism dioptres (PD) in one or both eyes that required surgery, who were treated at the Department of Paediatric Ophthalmology, Faculty of Medicine, Masaryk University in Brno between 1995 and 1999. All the children received correction for their refractive errors and occlusion therapy for amblyopia, when this was present. Of these, 41 patients (73 eyes) met the selection criteria for includion in the study; they were the patients with manifest or latent DVD, previous or planned recession or resection of the horizontal rectus muscles and children with concomitant preoperative IOOA. The patients who had paretic or restrictive strabismus, any prior surgery for the oblique muscle, vertical rectus muscle or concurrent vertical off-setting of the horizontal rectus muscles as well as children with any systemic disorder or syndrome that might have affected extraocular muscles were not included. DVD was measured by the method described by *Burke et al.* (*1*), using a prism and an alternate covering test in which the eyes, in primary position, are fixed at an adjustable target at a distance of 6 m and have full refractive corrections, when these are worn. Any concurrent horizontal deviation was neutralised using a horizontal prism. Subsequently, DVD in the other eye was measured in the same way. We evaluated any true hypertropia in primary eye position and in side gazes to distinguish between IOOA and DVD. In infants and very young patients, the Krimsky test was used once DVD in the involved eye had been revealed to its maximal extent by patch application for several seconds.

Two surgical techniques were used, i.e., anterior transposition of the inferior oblique muscle to the lateral border of the insertion of the inferior rectus muscle (ATIO) and myectomy of the inferior oblique muscle (MIO). Patients to be operated on were randomly selected for one or the other treatment. The ATIO treated group comprised 22 patients with 35 treated eyes and the MIO group included 19 children with 38 treated eyes. When possible, in addition to the measurements taken by the surgeon, preoperative and postoperative measurements were also taken by an orthoptist who was not aware of the surgical procedure to be used.

Oblique muscle function was estimated on a grading scale of 4- to 4+ (1- to 4-, underaction; 1+ to 4+, overaction) based on eye movements in an upward, a downward and a side gaze. Grade 1+ represented 1 mm of higher elevation of the adducting eye in gaze up and to the side. Grade 4+ indicated 4 mm of higher elevation.

SURGICAL TREATMENT

In both techniques, the inferior oblique muscle was approached through the conjunctiva and Tenon's capsule by an inferior-temporal fornix incision. During the procedure, the lateral rectus muscle was isolated by means of a 4–0 silk bridle suture or a muscle hook. Using the muscle hooks, the inferior oblique muscle was isolated from its fascial attachments both anteriorly and posteriorly.

Anterior transposition procedure. A straight, fine haemostat was placed across the inferior oblique muscle as close as possible to its insertion. A second, straight, fine haemostat was placed proximal to the first one. The muscle was then cut between these clamps and the cut edges cauterised. This technique results in a small (~2-mm) resection of the inferior oblique muscle and avoids the risk of cutting through the lateral rectus muscle or sclera. A 6–0, polyglactin suture (Vicryl, Ethicon) was passed through the stump and the muscle was reattached through scleral tunnels by using the crossed-swords technique so that the new insertion lay lateral to and colinear with the inferior rectus muscle insertion. The inferior oblique muscle was then inspected to ensure that no residual fibers remained that had not been anteriorly transposed. The conjunctiva was closed with another suture.

Myectomy procedure. This procedure differed in that the second clamp was placed across the belly of the inferior oblique muscle at a distance of 5 mm proximal to the distal clamp. The intervening 5 mm of the muscle was resected. The total resection was 7 mm long (5 mm plus 2 mm held by the two clamps). The conjunctiva was sutured up.

STATISTICAL ANALYSIS

The results were evaluated by nonparametric statistical methods (Mann-Whitney *U*, Wilcoxon, and Fischer's exact tests). The P value equal to or lower than 0.05 was considered statistically significant.

RESULTS

Data characterising the two groups show that the groups were very similar in size, patients' age, duration of follow up and the number of repeat surgeries (*Table 1*).

The assessment of postoperative deviation in terms of the mean value of prism dioptres showed that both surgical techniques were equally successful because the differences between pre- and postoperative values were significant (*Table 2*).

Table 1

Characteristics of the ATIO and MIO groups

Data	ATIO	MIO
Number of patients	22	19
Number of eyes treated	35	38
Mean age of patients in years (range)	5.4 (1.1–13.7)	6.1 (1.6–14.8)
Mean follow–up in months (range)	19.6 (7–43)	26.5 (8–52)
No. of repeat surgeries (%)	3/35 (8.6)	5/38 (13.2)
No. of eyes with limited elevation in abduction after surgery (%)	1/35 (2.8)	5/38 (13.2)

ATIO, anterior transposition of the inferior oblique muscle; MIO, myectomy of the inferior oblique muscle.

Table 2

The results of surgical techniques

Group	Number of eyes treated	Mean PD value of DVD (range)	
		Before surgery	After surgery
ATIO	35	13.0 (6–19)	4.0 (0–14) *
MIO	38	15.0 (7–22)	3.0 (0–13) **

ATIO, anterior transposition of the inferior oblique muscle; MIO, myectomy of the inferior oblique muscle; *PD*, prism dioptres; * $P < 0.05$ (before *vs* after surgery); ** $P < 0.02$ ((before *vs* after surgery; Wilcoxon test).

The outcomes of treatment by either ATIO or MIO were compared in relation to the preoperative presence of IOOA. In children who had both DVD and IOOA, ATIO was more effective in correcting inferior oblique overaction (*Table 3)*

The effectiveness of the two methods for treatment of large-angle DVD, i.e., more than 5 PDs, was compared and the results are presented in *Table 4*. The difference between the ATIO and MIO groups was not significant ($P = 0.76$, Fischer's exact test) regardless of the fact that, out of nine "excellent" eyes in the MIO group, five had a mildly limited elevation in abduction, as compared to only one eye out of 10 in the ATIO group.

Table 3

Results of ATIO and MIO surgery in children with DVD and coexisting IOOA

		Inferior oblique overaction estimated on a gradiang scale 1- to 4+ (mean values)	
Group	No. of eyes	Before surgery	After surgery
ATIO	35	1.0 (0 to +4)	0.0* (–1 to +2)
MIO	38	1.0 (0 to +3)	0.5ns (–1 to +2)

ATIO, anterior transposition of the inferior oblique muscle; MIO, myectomy of the inferior oblique muscle; ns, no significant difference; * P <0.05 (before vs after surgery; Wilcoxon test).

Table 4

Results of ATIO and MIO surgery in childen with large-angle DVD

Group	No. of eyes with PDs>15	Outcome of surgery			
		Excellent (0–4 PDs)	Good (5–9 PDs)	Fair (10–14 PDs)	Poor (>14 PDs)
ATIO	14	10	2	1	1
MIO	15	9	2	3	1

ATIO, anterior transposition of the inferior oblique muscle; MIO, myectomy of the inferior oblique muscle. PD, dioptre

DISCUSSION

Several different procedures have been used with varying success to surgically manage DVD. In the past, bilateral large (symmetrical or asymmetrical) inferior rectus resections were advocated but, in recent years, this procedure has been abandoned by many surgeons. At present, either large superior rectus recessions, small superior rectus recessions with a posterior fixation suture or anterior

transposition of the inferior oblique muscle are preferred. However, superior rectus muscle recession and inferior rectus muscle resection may alter lid position. In addition, large, supramaximal, superior rectus muscle recessions and inferior rectus muscle resections may result in postoperative vertical tropia and/or limitation of upgaze. Inferior oblique muscle weakening, using myectomy, has been reported to be effective in controlling DVD (*9,10,11*). When DVD is associated with IOOA, which is a frequent finding, ATIO is a useful technique (*11*) that, in addition, has no risk of compromising blood supply to the anterior segment of the globe. Evidence exists that ATIO adjacent or anterior to the inferior rectus muscle insertion reduces excyclotorsion (*12*).

In 1981, *Elliott and Nankin* published the first retrospective study comparing ATIO, as is performed today, with the conventional inferior oblique muscle recession in the treatment of IOOA and suggested that, by this procedure, the inferior oblique muscle was converted from an elevator to a depressor (*13*). An improvement in DVD was recorded in patients who had DVD associated with IOOA and underwent bilateral ATIO (*3,5*).

Several authors have evaluated the effectiveness of ATIO, with a graded anteriorisation of the inferior oblique muscle position or without it, in relation to inferior rectus muscle insertion in the treatment of DVD (*1–11*) These studies have shown that ATIO is effective in controlling both DVD and IOOA in the majority of cases.

The present study was designed to find out which of these two techniques was more effective in treatment of DVD in the presence of IOOA. In the eyes with no or low grade IOOA, there was no difference in the outcome of DVD treatment between the two techniques and neither surgery resulted in inferior oblique underaction. Good and comparable outcomes were also achieved by both methods in treating large-angle DVD, which is in agreement with the results of other studies (*14, 15*). However, the difference between the pre- and postoperative IOOA grades was significant only in the ATIO and not the MIO group. This indicates that, for children with DVD and greater inferior oblique overaction, ATIO is a more effective surgical treatment.

Kushner has shown that the limited elevation in abduction, a complication of ATIO, occurs when the transposition of the inferior oblique muscle anterior to the inferior rectus muscle insertion is greater than 1 mm (*16*). This complication, which results in either a Y or V pattern, is more likely to happen if the inferior oblique insertion is spread out when being reattached to the globe. As a result of this limitation, pseudo-IOOA may develop in the contralateral eye. However, in their retrospective study of myectomy and ATIO, *Gonzalez and Klein* noted only a transient limitation of upgaze in adduction (not abduction) in 49 eyes of 29 patients treated by ATIO. They placed the inferior oblique muscle to a point 3 mm posterior to the limbus and anterior to the lateral border of the inferior rectus

insertion (*7*). In our study, no limited elevation in abduction developed after surgery in the ATIO group.

When we compared the ATIO and MIO groups, we found a significant difference in the IOOA surgery outcome between these techniques. The ATIO group had better results of reduction in inferior oblique muscle overaction. In this study, the presence of A or V patterns was not taken into account in evaluation of treatment outcomes.

In conclusion, our comparison of two surgical methods of treating DVD showed that both MIO and ATIO were equally effective in correcting dissociated vertical deviation, regardless of whether overaction of the inferior oblique muscle was present or absent, but that IOOA was better reduced by anterior transposition of the inferior oblique muscle.

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PŘEDNÍ TRANSPOZICE A MYEKTOMIE DOLNÍHO ŠIKMÉHO SVALU V LÉČBĚ DISOCIOVANÉ VERTIKÁLNÍ DEVIACE

S o u h r n

Přední transpozice a myektomie dolního šikmého svalu jsou chirurgické metody uplatňující se v chirurgii zevních očních svalů při disociované vertikální deviaci (DVD) s eventuální přítomností primární hyperfunkce dolního šikmého svalu. Autoři provedli srovnávací studii s cílem zjistit zda přední transpozice dolního šikmého svalu nemůže přinést lepší výsledky než prostá myektomie tohoto svalu. V prospektivní komparativní randomizované studii je hodnocena přední transpozice a myektomie dolního šikmého svalu u pacientů s DVD větší než 5 prismatických dioptrií. Studie zahrnuje 73 očí u 41 pacientů, z toho 35 očí s přední transpozicí a 38 očí s myektomií. Je hodnocena velikost předoperační a konečné pooperační úpravy DVD, stupeň předoperační a konečné pooperační úpravy hyperfunkce dolního šikmého svalu, množství reoperací a výskyt komplikací. Střední doba sledování je 19,6 měsíců ve skupině dětí s přední transpozicí a 26,5 měsíců ve skupině dětí s myektomií. Střední hodnota předoperační DVD 13 prizmatických dioptrií se zlepšila na konečnou střední hodnotu 4 PD po operaci- přední transpozici dolního šikmého svalu. Ve skupině s myektomií došlo ke zlepšení z předoperační hodnoty DVD 15 PD na střední hodnotu 3 PD po operaci. Tyto rozdíly nejsou statisticky významné. Současný výskyt primární hyperfunkce dolního šikmého svalu neměl vliv na výsledky operací v obou skupinách. Nebyly zaznamenány žádné závažné komplikace po obou typech operací. Přední transpozice dolního šikmého svalu je efektivní operační metoda pro léčbu disociované vertikální deviace a přináší stejně dobré výledky jako myektomie dolního šikmého svalu. Při současném výskytu primární hyperfunkce dolního šikmého svalu je však pro redukci této poruchy účinnější metoda přední transpozice.

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