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Asymmetric inferior oblique anterior transposition for incomitant asymmetric dissociated vertical deviation

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Abstract

Background—Inferior oblique anterior transposition (IOAT) is indicated in patients with incomitant dissociated vertical deviation (DVD) larger in adduction. In general, bilateral surgery is recommended in patients with DVD unless there is deep monocular amblyopia. The purpose of this study is to evaluate the results of asymmetric IOAT in patients with asymmetric incomitant DVD larger in adduction.

Methods—Retrospective chart review of the records of all patients with incomitant asymmetric DVD associated with inferior oblique (IO) overaction who underwent asymmetric IO weakening procedure. In all patients, the eye with more DVD in adduction underwent IOAT to the temporal corner of the insertion of the inferior rectus (IR) muscle, and the eye with less DVD underwent IOAT to a position 3–4 mm posterior to the insertion of the IR. No other muscles were operated simultaneously. No patient had previous surgery on any cyclovertical extracocular muscle.

Results—Fourteen patients were included. Mean age at surgery was 10.3 ± 8.8 years (range 4–33). Primary position DVD preoperatively was 18 ± 2 PD in the eye with the larger DVD compared to 1.1 ± 1.0 PD postoperatively ($p < 0.0001$). DVD asymmetry between the lateral gaze with the largest DVD and the lateral gaze with the smallest DVD was 9.8 ± 3.1 PD (range 5–14 PD) preoperatively vs 1.1 ± 1.0 PD (range 0–2 PD), ($p < 0.0001$). Ten patients had preoperative V-pattern > 10 PD (24.7 ± 8.7 PD, range 12–50 PD) preoperatively vs no patients postoperatively (mean V-pattern 4.4 ± 2.0 PD), ($p < 0.0001$). Postoperative follow up was 1.6 ± 0.7 years (range 1–

3 years). *Conclusion* In patients with asymmetric incomitant DVD, asymmetric IOAT improves lateral incomitance without increasing the risk of antielevation, limitation in upgaze rotation, or hypertropia, or worsening the DVD in the eye with less deviation preoperatively.

Keywords

Dissociated vertical deviation; Inferior oblique; Hypertropia; Strabismus

Introduction

Dissociated vertical deviation (DVD) represents a common and challenging form of strabismus for pediatric ophthalmologists and strabismus surgeons. DVD most commonly occurs in patients with a history of infantile esotropia, and often is accompanied by bilateral over-elevation in adduction, also known as “inferior oblique (IO) over-action”. Multiple surgical techniques have been proposed for the treatment of DVD; however, superior rectus recession [1, 2] and inferior oblique recession or inferior oblique anterior transposition (IOAT) [3-5] are most commonly performed. Most clinicians agree that symmetric DVDs should be treated with symmetric surgery, either superior rectus recession or IOAT; however, when DVD is asymmetric between the two eyes, treatment decisions can be more challenging, and asymmetric surgery may be considered.

A common form of DVD in which the DVD is greater in adduction than abduction has been termed *incomitant DVD* [6]. Multiple authors have suggested that IOAT is more effective in incomitant DVD, due to the typical co-existence of inferior oblique over-action that is not addressed by superior rectus recession. However, the majority of studies evaluating IOAT for incomitant DVD have evaluated symmetric surgery, and have not specifically addressed cases where the incomitant DVD is also asymmetric, with a larger DVD in one eye than the other. In addition, there is a concern amongst some strabismus surgeons that unilateral IOAT may result in a high incidence of postoperative hypotropia [7, 8] due to antielevation syndrome [7-9].

The purpose of this study is to describe a cohort of patients undergoing asymmetric IOAT for the treatment of asymmetric incomitant DVD, and to evaluate post-surgical outcomes in this cohort.

Methods

This study was approved by the University of California Los Angeles Institutional Review Board, and conformed to the requirements of the United States Health Insurance Portability and Accountability act. The clinical records of all patients with the diagnosis of asymmetric DVD from the authors’ surgical databases were retrospectively reviewed. Those subjects who underwent asymmetric IO recession for the treatment of asymmetric DVD and had a minimum postoperative follow-up period of 1 year were included in the analysis. Our technique for performing IO recession been described previously [10]. Patients were excluded if there was any history of prior strabismus surgery for DVD, but not if they had horizontal rectus muscle surgery preceding the IO recession procedure. In all patients, the eye with more DVD in adduction underwent IOAT to insertion of the inferior rectus (IR)

muscle, and the eye with less DVD underwent IOAT to a position 3–4 mm posterior to the insertion of the IR.

The following preoperative and postoperative characteristics were recorded from the patients' charts: age at onset, age at surgery, best-corrected visual acuity, preoperative motor alignment at distance and near and in the cardinal positions of gaze, and an assessment of ocular ductions.

In general, visual acuity was assessed using projected age appropriate optotypes after a manifest or cycloplegic refraction. Ocular alignment was assessed using cover/uncover and alternate prism cover testing at distance (20 ft) in the cardinal gaze positions. Motor alignment at near was assessed at 14 in. All motor evaluations were done using spectacle correction. The magnitude of the DVD was determined by measuring the hyperdeviation of each eye independently; with the right eye fixing, the prism and the cover were placed over the left eye, the cover was moved over the right eye until the refixation movement of the left eye was neutralized. The procedure then repeated with the left eye fixing and the prism and the cover over the right eye. Patients were measured in primary and secondary gaze positions and then determining the additional prism required to neutralize the eye with the DVD. Ocular ductions were measured using a standard 4-point scale. The presence of an "A" or "V" pattern was calculated by subtracting the horizontal deviation in downgaze from that in upgaze. DVD asymmetry was calculated by subtracting the amount of DVD in the primary position with the smaller DVD from that with the larger DVD. IO over-action asymmetry was calculated by subtracting the duction representing elevation in adduction in the less over-acting eye from that in the eye with more apparent inferior oblique over-action.

Statistical analysis

Statistical analyses were performed using statistical software, JMP version 10.0 (JMP, Cary, NC, USA), and Microsoft Excel. Continuous variables were compared using a two-sided Student's *t*-test to compare mean values preoperatively to postoperatively. A *p*-value <0.05 was considered statistically significant.

Results

Fourteen subjects met the study inclusion criteria. The mean age at surgery was 10.3 ± 8.8 years (range 4–33). The mean postoperative follow-up length was 1.6 ± 0.7 years (range 1–3 years). All subjects had a previous diagnosis of infantile esotropia, and had previously undergone bilateral medial rectus recession at a mean age of 14 ± 5 months (range 11–24 months). Table 1 summarizes the changes seen in ocular motility measurements postoperatively. The mean larger DVD was 18 ± 2.5 PD, and was 8 ± 1.4 PD in the eye with the smaller DVD. DVD asymmetry was 9.8 ± 3.1 PD (range 6–14 PD). IO over-action asymmetry was 2 ± 0.7 (range 1–3). Preoperatively, ten patients had V-pattern (24.7 ± 8.7 PD, range 12–50 PD).

Postoperatively, all patients resulted in improvement of the lateral incomitance, DVD, and V-pattern esotropia. The mean larger DVD was significantly improved from preoperative values at 17.9 ± 2.5 PD to 1.3 ± 1 ($p < 0.0001$), and was 8 ± 1.4 PD in the eye with the

smaller DVD, decreasing to 0 ± 0 ($p < 0.0001$). DVD asymmetry was also reduced to 1.1 ± 1.0 postoperatively ($p < 0.0001$). The mean amount of V-pattern was reduced to 4.3 ± 2.0 PD ($p < 0.0001$). An characteristic patient example is depicted in Figs. 1 (preoperative) and 2 (postoperative).

Discussion

DVD is a difficult problem for strabismus surgeons to manage due to its variability and bilateral nature. Treatment of DVD often consists of either superior rectus recession or IOAT. For DVD that is worse in adduction, most clinicians agree that IOAT is the procedure of choice. IOAT was first advocated by Gobin [11], and was further popularized for the treatment of DVD by several other authors [3-5, 12-15]. These authors described results demonstrating the efficacy of this procedure in treating DVD with associated IO over-action. In 1989, Kratz et al. compared two groups of patients undergoing IOAT for DVD — one group underwent graded transpositions, while the other group underwent a standard anteriorization regardless of the grading of their DVD [4]. The results of their study showed that graded anteriorization was more successful in controlling DVD while preventing residual postoperative deviations. Of their patients, nine underwent asymmetric IOAT for asymmetric DVD. These nine patients all had marked improvement in DVD, with no patients having residual DVD greater than 4 PD. In this group of nine patients, follow-up ranged from 3 months in four of the patients to 9 months, and therefore longer-term results could not be addressed with this study. In their series of 61 children with infantile esotropia, Mims and Wood [5] described nine patients undergoing bilateral IOAT of the IO for DVD. Four of these patients underwent asymmetric surgery. The authors reported bilateral collapse of the DVD (< 10 PD) for all four patients, with follow-up ranging from 1 to 3 years. Bacal and Nelson described 55 patients with DVD and/or IO overaction undergoing IOAT. Of their 55 patients, two patients underwent asymmetric IOAT for bilateral DVD (three other patients underwent asymmetric surgery for IO overaction without DVD). Both of their patients had collapse of their DVD and a decrease in IO overaction [3]. Burke et al. studied 17 patients with DVD after IOAT with a minimum follow-up of 1 year, in an attempt to evaluate long-term results [13]. Of the patients included in the study, five underwent bilateral surgery for asymmetric DVD; their results showed that the procedure was more useful for DVDs measuring less than 15 PD in the long-term. In 1997, Black [12] described his results in 12 patients undergoing IOAT for DVD greater in adduction. In all but one patient, the IOAT was performed symmetrically; in one patient, the procedure was performed unilaterally. He described excellent results, with collapse of the DVD and no significant postoperative complications. Black's series is not directly comparable to our series described above, in that his cases were performed symmetrically. In 1998, Guemes and Wright [15] described the effect of graded anterior transposition of the IO muscle for a variety of patients with IO overaction. Their study included two patients with DVD who underwent asymmetric surgery. Both of these patients had good results, with a decrease in both DVDs and a collapse of DVD asymmetry. However, long-term postoperative follow-up was not available in these patients.

Although the aforementioned studies provide good evidence of the usefulness of IOAT for incomitant DVD, they do not specifically address the sub-class of patients, such as those that

we have studied, in which the DVD is markedly asymmetric between the two eyes. Our data reveal that asymmetric IOAT may be a useful method by which to treat patients with asymmetric DVD. We did not note any induction of hypotropia, A-pattern, or anti-elevation. In addition, the DVD, DVD asymmetry, and IO over-action asymmetry improved significantly postoperatively. After 1 year of follow-up, our results persisted, and patients demonstrated remarkably good ocular alignment. It should be noted that although several other authors have recommended asymmetric DVD surgery as described above, the anterior transposition in our subjects was never anterior to the insertion of the inferior rectus muscle, unlike most other case series [3, 5, 7, 13]. Other authors have recommended adding a superior rectus recession in cases of DVD with asymmetry greater than 5 PD [16, 17], but in this case series, we have shown that asymmetric DVD is also readily treatable with asymmetric IOAT without the addition of superior rectus recession, thereby avoiding the possibility of limiting upgaze from a combined IOAT/superior rectus recession. A main advantage of asymmetric IOAT is the ability to collapse an asymmetrical DVD without the need to operate on a second muscle (such as the superior rectus). For this reason, we suggest that surgeons consider asymmetric IOAT in cases with DVD asymmetry greater than 5 PD.

The results of this study should be understood within the context of its limitations. This was a retrospective study with a relatively small sample size due to the specificity of our inclusion and exclusion criteria. However, despite its limitations, this study reveals important findings for the management of patients with asymmetric incomitant DVD, larger in adduction. Our data suggests that bilateral asymmetric IOAT may be useful in decreasing DVD, DVD incomitance, IO overaction, and V-pattern, and therefore should be considered in this population.

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Fig. 1.
Preoperative patient example

Fig. 2.
Postoperative patient example

Table 1

Preoperative and postoperative characteristics of patients with asymmetric DVD undergoing asymmetric inferior oblique anterior transposition

	Preoperative	Postoperative	<i>P</i> -value*
Larger DVD	17.9 ± 2.5 PD	1.3 ± 1.0 PD	<0.0001
Smaller DVD	8 ± 1.4 PD	0 ± 0 PD	<0.0001
DVD asymmetry	9.8 ± 3.1 PD	1.1 ± 1.0 PD	<0.0001
Larger inferior oblique over-action	3.5 ± 0.5	0±0	<0.0001
Smaller inferior oblique over-action	1.6 ± 0.5	0±0	<0.0001
Inferior oblique over-action asymmetry	1.9 ± 0.7	0±0	0.001
V-pattern	24.7 ± 8.7 PD	4.3 ± 2.0 PD	<0.0001

DVD dissociated vertical deviation

*
P-values from 2-tailed Student's *t*-test