CLINICAL STUDY

Inferior oblique syndrome: an under-recognised complication of strabismus surgery

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Abstract

Purpose **To show the predictive factors that would indicate the possibility of inferior oblique inclusion when considering surgery on a previously operated lateral rectus muscle. We also aim to highlight the importance of freeing any inferior oblique attachment to the lateral rectus muscle during either a resection or a recession procedure.**

Methods **A retrospective review was undertaken of 39 patients who had previously had horizontal muscle surgery. Pre- and post-operative ocular position and rotations were compared. Using the hypothesis that a vertical element to the strabismus or a deficiency of vertical ocular rotation may result from inclusion of inferior oblique fibres during lateral rectus surgery, we compared the groups using the Fisher Exact two-tailed test.**

Results **Eight of the 39 patients were identified as having inferior oblique inclusion. Six were found to have a vertical deviation in the primary position and 6 a deficiency of vertical rotation.**

Conclusion **A vertical deviation or a deficiency of vertical rotation are significant predictors of inferior oblique inclusion into the lateral rectus insertion. Re-operation to free the inferior oblique fibres often fails to reduce the vertical deviation, and hence there is a need for careful dissection of the inferior oblique during the primary surgery.**

Key words Inferior oblique muscle, Inferior oblique inclusion, Vertical deviation, Lateral rectus muscle, Resection, Recession

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Inferior oblique (IO) inclusion is the inadvertent incorporation of the IO muscle into the lateral rectus (LR) muscle after surgery to the LR. It is a similar condition to IO adherence syndrome, where abnormal fascial connections between the LR and IO muscles cause a mechanical limitation of abduction of the eye.[1] Price[2] described the 'L' deformity of the IO as a restrictive hypotropia occurring gradually after LR surgery, with the IO muscle found incorporated into the insertion of the LR. Helveston *et al.*,[3] in their description of IO inclusion, stated that the anterior fibres of the IO may be included in the insertion of a LR muscle that had previously been treated surgically. Including the IO with the LR in a resection resulted in the anterior border of the IO being drawn superiorly and anteriorly. Including the IO with the LR during a recession resulted in it being drawn superiorly. A retrospective analysis of this condition seen in our practice is reported.

Materials and methods

A retrospective analysis was undertaken of the case notes of all patients who had previously had horizontal muscle surgery and required further surgery to the LR. All were operated on by one surgeon (I.B.M.) over the period April 1995 to January 1996. Any patients who had a recently acquired neurogenic or mechanical strabismus were excluded from the study. Entry criteria were fulfilled by 39 patients.

Pre-operative measurements of the horizontal and vertical angles had been recorded in prism dioptres (PD), measured by the alternate prism cover test, on all patients at both $\frac{1}{3}$ m and 6 m. Post-operative deviations had been recorded in the same manner. In all cases any deficiency of ocular rotation had been recorded using a scale such that 0 indicated full movement and −4 was no movement beyond the midline. The presence or absence of IO inclusion at surgery had been recorded in all

Table 1. *Pre-operative deviations in groups A and B*

	Av. no. of previous operations (range)	Original deviation
Group A (n = 8)	1.5 (1–3)	Esotropia = 5 Exotropia = 3
Group B (n = 31)	2.3 (1–11)	Esotropia = 20 Exotropia = 7 Unknown = 4

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Table 2. *Pre-operative deviation and motility*

Patient no.	Original deviation	Pre-operative deviation	Vertical motility defect	Horizontal motility defect
1	ET	ET and Hypo for near, XT and Hyper for distance	Elevation in abduction – 1	Abduction – 2
2	XT	XT and Hypo	Elevation – 1	Abduction – 1, adduction – 1
3	ET	XT and Hyper	Elevation in adduction – 1	Adduction – 2
4	ET	XT and Hyper	None	Adduction – 3
5	XT	XT and Hypo	Elevation in Abduction – 1	Adduction – 2
6	XT	XT and Hypo	Elevation in abduction – 1/2	Abduction – 1/2
7	ET	XT	Elevation in abduction – 3	Abduction – 1, adduction – 1
8	ET	ET	None	Abduction – 1

ET, esotropia; XT, exotropia; Hypo, hypotropia; Hyper, hypertropia.

cases in the surgical notes. All cases had a recording of the forced duction test performed at the beginning of the surgical intervention. The number of previous operations along with the type of surgery and the original deviation were recorded if known. Post-operative data had been collected an average of 3.5 months post-operatively.

Results

Of the 39 patients fulfilling the entry criteria only 8 were found to have IO inclusion at surgery, giving an incidence of 20.5%. The patients were then analysed in two groups: group A (8 patients) with IO inclusion and group B without IO inclusion (31 cases).

In group A the average number of previous operations was 1.5 (range 1–3) and in group B it was 2.3 (range 1–11). The original deviations in group A and B are shown in Table 1.

Group A

Of the 8 patients in group A the original deviation was esotropic in 5 and all had previously undergone a LR resection. The remaining 3 had had a LR recession for exotropia. Six of the 8 patients (75%) had a vertical deviation in the primary position (Table 2). The vertical deviation is defined in relation to the fixing eye. With the exception of the patient with the vertical deviation that changed from near to distance, the patients who had undergone a LR recession were all hypotropic and those with a previous resection were hypertropic. The resection procedures produced a greater vertical deviation (av. 11 PD, range 5–16 PD) than the recessions (av. 4.25 PD, range 3.5–5 PD). The deficiencies in vertical and horizontal movement are illustrated in Table 2.

Table 3. *Comparison of vertical motility and deviaton in groups A and B*

	Vertical deviation	No vertical deviation
Group A		
Deficiency of vertical motility	5	1
No vertical motility deficiency	1	1
Group B		
Deficiency of vertical motility	2	4
No vertical motility deficiency	5	20

Group B

Group B contained 31 patients who were further divided into two subgroups according to whether there was any vertical deviation in the primary position.

In subgroup 1, of the 22 patients without a vertical deviation in the primary position only 2 (9%) showed a deficiency of elevation.

In subgroup 2, 9 patients were found to have a vertical deviation but 2 of these were excluded from the analysis as this deviation was associated with DVD, defined as a spontaneous elevation of either eye under cover. Only 2 of the remaining 7 (28.5%) had a deficiency of elevation.

A comparison table summarising the vertical deviations and deficiency of vertical rotation of the two groups is shown in Table 3.

All patients found to have inclusion of the IO into the LR insertion underwent dissection of the adherence with freeing of the IO fibres. Of the 6 cases with a vertical deviation prior to surgery only 2 had a reduction in the height measurement post-operatively (Table 4).

Discussion

We found an incidence of IO inclusion of 20.5%, which is comparable to Helveston *et al.*'s figure of 29%.[3] We also noted that IO inclusion followed both resection and recession procedures, with resection producing the higher incidence. Helveston *et al.* found 68% of IO inclusions were associated with LR resection and 32% with recession. The incidence of a vertical deviation in the primary position in our study was 75% while Helveston reported that 89% of his cases showed this defect. Cline[4] found that all 38 cases in his study had a vertical strabismus in the primary position. Our vertical deviations were equally divided into hypotropias and

Table 4. *Vertical changes in inferior oblique inclusion: near measurements*

Case no.	Pre-operative deviation (PD)	Post-operative deviation (PD)
1	12	2
2	5	6
3	12	12
4	11	10
5	5	5
6	3	3

PD, prism dioptres.

Table 5. *Summary table for logistic regression*

	Variable	Chi-squared statistic	Degrees of freedom	p value	Improvement to model by adding next variable: Chi-squared statistic	Degrees of freedom	p value
Stage 1	Vertical deviation	6.5	1	0.01			
Stage 2	Vertical motility deficiency	11.7	2	0.003	5.2	1	0.02

hypertropias, which is in agreement with both Helveston *et al.* and Cline. Ocular motility examination showed deficiencies in direct elevation, elevation in adduction and elevation in abduction. Only deficiencies in elevation in adduction have been reported previously. All our patients were also found to have a deficiency of adduction, abduction or a combination. This horizontal defect was found at re-operation not to be due to previous supramaximal recession, muscle slippage or over-resection.

Releasing the IO fibres failed to reduce the vertical deviation in all but 1 case (Table 4). The possible explanation in this case is that the inclusion was released and a myectomy was performed. Helveston *et al.* found that all but 1 patient had a persistent vertical defect but Cline reported that the majority of his cases had improvement of the vertical element post-operatively. Price[2] repaired the 'L' deformity by severing the adhesions between the IO and LR muscles and returning the IO to its normal anatomical position. Cline suggests that the borders of the LR muscle should be cleaned carefully to avoid inclusion. Using the hypothesis that a vertical element to the strabismus or a deficiency of vertical ocular rotation may result from inclusion of IO fibres during lateral rectus surgery, we compared groups A and B using a Fisher Exact two-tailed test (Table 5). If the groups are analysed using the pre-operative vertical deviation in the primary position as a predictor of this condition then there is a significant difference between the two groups at the $p = 0.01$ level. Using a second variable defined as deficiency of vertical ocular rotations there is significance at the $p = 0.02$ level. Comparing the groups using restrictions of horizontal rotations as a variable shows no significant difference ($p = 0.16$), but in combination with either of the other two predictors increases the chance of the condition being present. In a consecutive strabismus, the presence of a vertical deviation in the primary position or a deficiency of vertical rotation are significant predictors of IO inclusion into the LR insertion. If a horizontal restriction of rotation is also present then the likelihood of this condition being present is higher. We would suggest that the best treatment of this condition would be prevention by good surgical technique at the primary strabismus procedure.

References

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