Nasal Myectomy of the Inferior Oblique Muscles for Recurrent Elevation in Adduction

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Purpose: Recurrence of inferior oblique overaction (IOOA) after recession or anterior transposition of the inferior oblique (IO) muscles is a common problem. We have been treating such cases by nasal myectomy of the IO, where a segment of approximately 5 mm is removed from the nasal portion, leaving the temporal portion of the IO with its insertion and its ancillary origin, the neurofibrovascular junction, intact. Here we report long-term findings on this procedure. ***Methods:*** Records were analyzed on 72 eyes belonging to 40 patients with recurrent IOOA of grade +1 or more, who received nasal myectomy of the inferior oblique (NMIO) in one (8 cases) or both (32 cases) eyes, and who had a minimum of 3 months follow-up. ***Results:*** At follow-up (range 3.6 months to 12 years; median 26 months), 27 patients (68%) showed no IO overaction, whereas 11 (28%) showed improvement of at least one grade point and 2 (5%) showed no improvement. Of the patients with residual IO overaction, three received additional surgery: in two of these patients IO overaction was subsequently eliminated while no additional follow-up was available for the third patient. The effects of NMIO on dissociated vertical deviation were variable. ***Conclusion:*** In 95% of these patients nasal myectomy of the IO resulted in reduction and in many cases elimination of IO overaction. An advantage of this procedure is that the temporal portion of the muscle, with its ancillary origin and insertion, is preserved. (J AAPOS 2004;8:462-465)

Over-elevation of the eye in adduction is traditionally termed "inferior oblique overaction" (IOOA). Primary IOOA (not associated with superior oblique weakness) often develops during childhood in patients with infantile esotropia, accommodative esotropia, or intermittent exotropia[1]; its causes may be mechanical, innervational, or both, and its etiology is not completely understood.[2] Two widely used treatment options are recession and anterior transposition of the inferior oblique (IO) muscle. However, both procedures potentially lead to recurrence of IOOA, although the reports on incidence of such recurrence vary and may differ across specific techniques.[3-6] Over the past decades, various procedures have been utilized for further weakening of the IO in cases of recurrent IOOA, including the denervation-extirpation procedure,[5,7] re-recession of the IO, nasal myectomy,[8,9] and most recently, anterior and nasal transposition (ANT).[10,11] Each of these options may have advantages and disadvantages, although no long-term follow-up data on nasal myectomy of the inferior oblique (NMIO) and ANT are available. Here we present results from a large series of patients in whom we performed NMIO (either bilaterally or unilaterally) as treatment for recurrent IOOA.

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METHODS

Patients

Medical records of three of the authors (D.R.S. Jr, D.R.S. Sr, and G.R.B.) were reviewed to identify consecutive cases that were treated for recurrent IOOA. Inclusion criteria were as follows: recurrent IOOA of grade +1 or more (on the standard scale from −4 to +4) in at least one eye after previous recession or anterior transposition of the IO, treatment with NMIO, and at least 3 months of post-operative follow-up. Forty patients (median age 6.0 years; range 2.0 to 15.5 years) were found that met the inclusion criteria. Pre-operative deviations, in particular, dissociated vertical deviation (DVD), and the grade of IOOA were evaluated. Follow-up data from each patient's last visit (or, for patients who required additional surgery, from the last visit prior to subsequent surgery) were used to evaluate post-operative IO muscle action, vertical deviation, and DVD. For patients who underwent additional surgery, an inventory was made of the procedures performed and of the reasons for additional surgery.

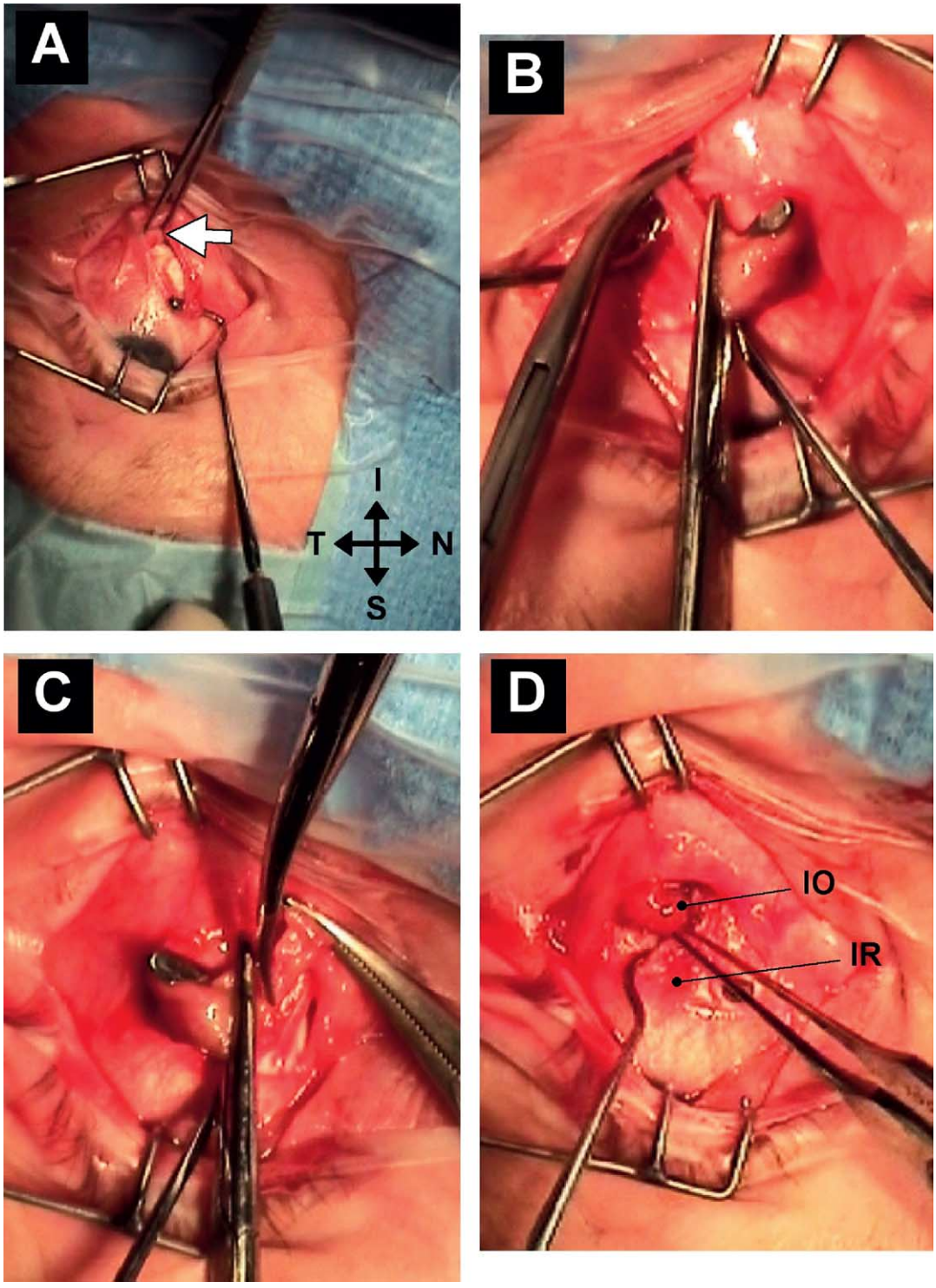

FIG 1. Surgeon's view of an adult patient to illustrate the elemental steps in the technique of NMIO. (This patient is not part of the current study sample.) The operated eye is the left eye, in which the IO had previously been recessed. The black arrows serve to orient the viewer: N = nasal, S = superior, T = temporal, I = inferior. (A) Identifying the IO (white arrow) after isolating the IR with a muscle hook. (B) Stretching the exposed nasal portion of the IO using two hemostats. (C) Excising the portion of the IO between the two hemostats. (D) Placing the IO back posteriorly. IO = Inferior oblique; IR = Inferior rectus.

TABLE 1 Results of NMIO as a function of primary surgical procedure

IOOA after NMIO	Overall ($N = 40$)	Primary Procedure: Recession OU ($N = 8$)	Primary Procedure: Transposition OU ($N = 29$)	Primary Procedure: One Recession & One Transposition ($N = 3$)
Eliminated	27 (68%)	6 (75%)	19 (66%)	2 (67%)
Improvement*	11 (28%)	2 (25%)	8 (28%)	1 (33%)
No Improvement	2 (5%)	0	2 (7%)	0
Worsened	0	0	0	0

*Improved by ≥1 grade point but not eliminated.

Surgical Technique

Our NMIO technique resembles that described previously.[8] In brief, the patient is placed in supine position under general anesthesia. An inferonasal cul-de-sac incision is made and carried down to the bare sclera. The inferior rectus (IR) muscle is isolated from its nasal border, and the eye is then rotated superiorly (Figure 1A) and the IO is identified. Then the insertion of the IO is exposed, and temporal traction is placed on the muscle, while retracting its capsule nasally. Thus the nasal segment of the IO is visualized nasal to the IR, where the IO abruptly narrows (the "nasal notch"). The nasal portion is then isolated with two muscle hooks and stretched (Figure 1B). Hemostats are placed across the muscle near the lateral border of the IR and approximately 5 mm nasal to that point. The portion of the IO muscle between the two hemostats is excised (Figure 1C). The muscle is cauterized near both hemostats; cauterization is particularly heavy on the side of the muscle nearest the neurofibrovascular junction. That end of the muscle is then placed posteriorly (Figure 1D). Any opening in Tenon's capsule is sutured to prevent fat protrusion or fat adherence syndrome. The conjunctiva is closed and Tobradex solution (Alcon Laboratories, Inc., Fort Worth, TX) is instilled.

RESULTS

Twenty-nine patients (73%) had undergone bilateral anterior transposition of the IO muscles as primary procedure; eight patients (20%) had previously undergone bilateral recession of the IO muscles, while the remaining three patients (8%) had had a recession in one eye and anterior transposition in the other eye. Pre-operative findings included a typical combination of V-pattern deviation, hypertropia, and/or DVD. The median grade of IOOA was +2 (range +1 to +3).

Most patients (32 cases) underwent NMIO bilaterally, while the remaining patients (eight cases) received the procedure unilaterally, resulting in a total sample of 72 eyes on which NMIO was performed. Twenty-seven patients (68%) underwent simultaneous surgery to the medial rectus (MR) or lateral rectus (LR) muscles for the correction of a horizontal deviation.

Follow-up ranged from 3.6 months to 12 years (median 26 months). Median post-operative IO muscle action grade was 0 (range −1 to +1.5). Overaction was eliminated in 27 patients (68%), while in 11 additional patients (27%), a reduction of IOOA of at least 1 grade point was achieved. Two patients (5%) showed no improvement or less than 1 grade point change. None of the patients showed worsening of IOOA. None of the patients showed evidence of fat adherence syndrome (severe limitation of elevation). Subsequent additional surgery for strabismus including residual IOOA was performed in three cases (8%; in one patient both LR muscles were recessed and supraplaced, while both MR muscles were advanced; one patient received a unilateral superior oblique tuck, and one patient underwent a bilateral ANT procedure[11] to the IO muscles). Tables 1 and 2 show an overview of the results of NMIO taking into account the primary procedure and whether NMIO was performed in one eye or both eyes. Success rates were similar in patients who had previously received recession and patients who had previously received transposition ($z = 0.081$, $P = 0.94$ for elimination of IOOA, and $z = 0.167$, $P = 0.87$ for elimination and improvement combined; test for two proportions with continuity correction). Success rates of unilateral and bilateral NMIO procedures were similar as well ($z = 0.090$, $P = 0.93$ for elimination of IOOA, and $z = 0.194$, $P = 0.85$ for elimination and improvement combined).

TABLE 2 Results of bilateral vs. unilateral NMIO

IOOA after NMIO	Overall ($N = 40$)	Bilateral NMIO ($N = 32$)	Unilateral NMIO ($N = 8$)
Eliminated	27 (68%)	21 (66%)	6 (75%)
Improvement*	11 (28%)	10 (31%)	1 (13%)
No Improvement	2 (5%)	1 (3%)	1 (13%)
Worsened	0	0	0

*Improved by ≥1 grade point but not eliminated.

Of the 25 patients who presented with DVD pre-operatively, DVD was eliminated in six cases (24%) and improved in four additional patients (16%). No change in DVD was recorded in 13 patients (52%), while 2 patients (8%) seemed to have worsened. Two patients (5%) developed anti-elevation syndrome (AES)[12] after unilateral NMIO.

DISCUSSION

Recurrent elevation in adduction is a recognized problem, and several treatment options exist. Further recession in recessed cases is not likely to be very effective since the

muscle is often already maximally recessed (ie, the IO insertion was reattached at the lateral border of the IR, 6 to 8 mm posterior to the insertion of the IR) or recessed 2 to 4 mm lateral to that maximally recessed point. An alternative option is denervation and extirpation. This destroys the temporal portion of the IO, eliminating any future use of this part of the muscle for anterior or anterior–nasal transposition. In cases where the IO was previously transposed for IOOA with DVD, the denervation and extirpation procedure would eliminate the effect of the transposition, which helped control the DVD; the DVD may become worse.

Advantages of NMIO are the preservation of the temporal portion of the IO, thus keeping future surgical options open. The hazards of the NMIO procedure include hemorrhage from the end closest to the NFVB and fat adherence syndrome from failure to close openings in Tenon's capsule. In this study, which was retrospective and not randomized and which may therefore suffer from interpretive biases, the NMIO procedure eliminated IOOA in the vast majority of patients. None of the patients showed evidence of fat adherence syndrome. DVD was improved or eliminated in only 40% and deteriorated in 5% of the patients.

We contribute the effectiveness of this procedure to the anatomical role of the neurofibrovascular bundle (NFVB). The NFVB attaches to the IO 2 mm temporal to the IR, 12 mm from the IO insertion, and 25 mm from the IO origin. It serves as an ancillary origin of the posterior-temporal fibers of the IO muscle following anterior transposition.[13,14] It also stabilizes the nasal two-thirds of the IO in its original pathway with direct or indirect attachment to the globe. These nasal two-thirds of the muscle may cause the recurrent IOOA, and removing a segment eliminates or reduces this overaction. If the temporal portion of the IO is causing an AES, that problem may persist following NMIO. Recurrent IOOA following anterior transposition may be difficult to distinguish from AES. The success of NMIO in the present study suggests that many cases of AES may be improved by this procedure; some of the failures may have been in those with true AES.

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