The results of adjustable suture technique in paediatric strabismus surgery

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Abstract

Purpose Adjustable suture technique (AST) has been shown to be an effective treatment method in adult strabismus. The application of AST is not well studied in children due to potential poor cooperation during adjustment and the concern that the adjustment process can not be completed. The present series evaluates the efficacy and safety of this technique in a preselected group of children between 7 and 15 years of age.

Methods A retrospective review of 89 consecutive children undergoing AST was completed to assess: (1) the ability to perform and complete adjustment in children; (2) the frequency of need to perform adjustment; and (3) accuracy of surgical alignment. Only patients with horizontal rectus muscle surgery were included.

Results All children successfully completed the AST on the first post-operative day. Of the 89 patients, 24 (27%) required further adjustment by the AST. The mean follow-up period was 13.1 months. Fifty-three patients (60%) had previous strabismus surgery (range 1 to 5 operations). Sixty-six (74%) patients achieved successful alignment. Complications included slipped muscles in 1 case and difficulty in recession of the lateral rectus muscle in 1 patient.

Conclusions Twenty-seven per cent of the patients required post-operative adjustment. The AST achieved an overall 74% successful alignment. Application of the AST should be considered in children with horizontal deviations over age 7 years, especially in the reoperations of esotropia.

Key words Adjustable suture, Paediatric, Strabismus surgery

The adjustable suture technique (AST) in strabismus surgery was first described by Jampolsky in 1970.^{1,2} It allows the surgeon the opportunity to adjust the desired position of alignment within 24 h after surgery while the patient is alert. The advantages of this technique are particularly great in patients who have

restrictive or paretic strabismus, as well as in cases of reoperation, thyroid eye disease, blow-out fractures, strabismus following retinal detachment surgery or combined horizontal and vertical strabismus problems, in which conventional surgery is more likely to be unpredictable.³⁻⁸

Most reports of this technique are in adults (over 15 years of age).^{3,5,6,7,9} Little information exists concerning paediatric strabismus disorders treated by the AST.

This study was undertaken to evaluate the results of the AST in children.

Materials and methods

All patients younger than age 15 years who had undergone horizontal strabismus surgery by the AST between January 1984 and December 1997 were included. All surgery was performed by one of the authors (A.L.R.). The study was limited to patients who had been followed for at least 6 weeks post-operatively, and had undergone horizontal recti muscle surgery by AST for esotropia (ET) and exotropia (XT), either as a primary or a reoperation procedure. Patients who had vertical rectus surgery for dissociated vertical deviation, paralytic strabismus, Duane's syndrome and restrictive disorders (e.g. blow-out fracture) were excluded.

Best corrected visual acuities, sensory information including the Worth 4-Dot test for fusion, stereopsis assessment by Titmus stereogram, and Binocular Visual Acuity Tests (BVAT) for distant stereoacuity testing, and the amount of recession, resection or advancement of the extraocular muscle (EOM) operated upon were recorded. The measurement of ocular alignment was based on the primary position for fixation at 6 m and 33 cm. Muscle versions were recorded using a 9-point scale before and after adjustment if repositioning of the muscle was required.¹⁰ These were recorded at 6 weeks, 6 months and at the latest visit if follow-up was longer than 6 months.

The AST performed was a modification of the method of Jampolsky.^{1,2} We used a limbal conjunctival approach for all patients and

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Table 1. Success rate of post-operative alignment

Group	No. of patients (n = 89)	Success rate
		No. (%)
1 Esotropia, primary surgery	19	16 (84)
2 Esotropia, reoperations	18	12 (67)
3 Exotropia, primary surgery	17	11 (65)
4 Exotropia, reoperations	35	27 (77)
Total		66 (74)

applied the adjustable suture to the recessed muscle using 6-0 purple-dyed polyglactin sutures. A bow-tie technique was used in the muscle sutures over a strand of 6-0 silk after the suture ends were brought back through the original muscle insertion. The silk suture was tied into a small loop to prevent its displacement and loss.³ A small 'bucket-handle' 6-0 vicryl suture was placed 1–2 mm anterior to the original insertion of the operated rectus muscle for mobilisation of the globe during adjustment if required.

All children were adjusted on the morning after surgery to ensure that the patient was alert and cooperative. Topical tetracaine anaesthesia was administered.

The surgical goal was to align esotropia to less than 5 prism dioptres (PD) of esodeviation, and exotropia to between 5 and 9 PD of esodeviation. Our criterion for post-operative success was an alignment less than 10 PD for horizontal deviations.

We classified the results into four groups separately: esotropia (ET) primary operations (group 1), ET reoperations (group 2), exotropia (XT) primary operations (group 3) and XT reoperations (group 4). The means of the pre-operative and post-operative alignments after adjustment (when necessary) at 6 weeks and 6 months were calculated for each group. Means of the final drifts based upon cumulative distribution functions were calculated. The drifts in the eso-direction (esodrift) were classified as negative and those in the exo-direction (exodrift) were classified as positive.

Results

Eighty-nine patients had strabismus surgery by the AST and satisfied our inclusion criteria. These children ranged from 7 to 15 years of age, with a mean age of 11.7 years. The distribution of the ages of children at surgery was as follow: 17 patients were between 7 and 9 years old, 34 were between 10 and 12 years old and 38 were between 13 and 15 years old. Adjustment of muscle position was required in 24 (27%) patients in order to achieve an alignment of within 10 PD deviation

horizontally. The average follow-up was 13.1 months and ranged from 1.5 to 72 months. Thirty-one (35%) patients in the study had improved stereoacuity.

The success rates of alignment of individual groups are summarised in Table 1. All groups achieved over 60% success rates. Thirty-seven children with esodeviations were included in the study. Nineteen had primary surgery in group 1 and 5 (26%) required adjustment post-operatively. Eighteen had previous strabismus surgery in group 2 and 8 (44%) required adjustment. Thirty-five per cent (13 patients) required adjustment post-operatively in the esotropic patients in total (Table 2). Reoperations in ET groups have a much higher adjustment rate (44% vs 26%). The post-operative drift varied from 16 PD eso to 29 PD exo with a mean of 2.2 PD exo. Twenty-eight patients in the esodeviation group drifted less than 10 PD in the eso or exo direction, 8 cases drifted in the exo direction and only 1 drifted in the eso direction up to 20 PD post-operatively. The post-operative drift was greater for children with previous strabismus surgery (4.3 PD exo compared with 1.6 PD exo), which may account for the greater success of the primary acquired ET group. Patients not requiring adjustment had a mean of 2.2 PD exo drift compared with only minimal drift (0.2 PD eso) of the adjusted group. Nearly 76% of patients with esodeviations had a final post-operative alignment within 10 PD of orthophoria with no ocular symptoms. Six children required reoperations.

Eleven patients (30%) had improvement of near stereoacuity and 2 patients (5%) had improvement of near and distant stereoacuity post-operatively in the esodeviation group. Ten of the 13 patients originally had no near stereoacuity by the Titmus stereoacuity test (negative for fly). Six of them achieved 200 seconds of arc of stereopsis or more. Of the 2 children who had improved distant stereoacuity, 1 achieved 180 and the other 240 seconds of arc by BVAT. The 13 patients with improved stereoacuity had a small range of post-operative drift (mean –1.7 PD eso-drift; range +6 PD exo-drift to –8 PD eso-drift).

Fifty-two children had exodeviations, with 35 of these having undergone previous surgery. Twenty-three per cent (12 patients) required adjustment (Table 2). The highest success rate was 77% in the exotropia reoperation group (Table 1), and this group has a similar post-operative adjustment rate (22.9%) compared with the primary exotropia group (23.5%). The mean post-operative drift after adjustment was 5.3 PD exo with a range of 30 PD eso to 26 PD exo. Nearly 70% of the children had a post-operative deviation within 10 dioptres of orthotropia. Thirty-eight patients in the

Table 2. Summary of all groups requiring adjustment

Group	No. of patients	Previous surgery	Patients adjusted	Adjustment type		Further surgery required
			No. (%)	Recession	Advancement	
Esotropia	37	18	13 (35)	6	7	6
Exotropia	52	35	12 (23)	11	1	7

exodeviations group drifted less than 10 PD (eso or exo direction). Fourteen cases drifted exo direction and only 2 patients drifted eso direction.

The post-operative drift seemed not to be influenced by the need for post-operative adjustment. The post-operative drift of the primary surgery group was much higher than that of the secondary surgery group (10.4 PD exo-drift compared with 1.4 PD exo-drift, respectively). The range of post-operative drift in patients with improved stereoacuity was much narrower (between -4 PD eso-drift and +10 PD exo-drift; mean +4.7 PD exo-drift). Eleven children (21%) had improved near stereoacuity (9 of them achieved 200 seconds of arc by the Titmus stereogram); 6 (12%) had improved distant stereoacuity (5 of them achieved 120 seconds of arc by BVAT). One patient has improved both distance and near stereoacuity.

One patient in the primary ET group was noted to have slippage of the recessed medial rectus muscle when reoperation was required 2 months after surgery. The pseudotendon was excised and the muscle advanced by 3.5 mm using the AST.

Discussion

The main objective of the AST is to obtain optimal post-operative alignment and to reduce the incidence of reoperations.^{3-6,8,9,11-18} To our knowledge, this is the first study to review experience with the AST in the paediatric age group.

The overall success rate of alignment was 74% in our series. The success rates for reoperations were lower than those for primary surgeries for both ET and XT patients. Twenty-eight per cent of patients required further adjustment post-operatively. We reviewed patients who required further adjustment. There was no significant difference in the number of patients who required adjustment post-operatively between the primary and reoperations groups. Thirty-four of 89 patients (38.2%) had improved stereoacuity post-operatively in this series.

All children successfully completed the AST on the first post-operative day. We advocate delaying the suture adjustment to the following day in the paediatric age group, to give the child more time to recover from the anaesthetic. This may encourage better cooperation for measuring the residual ocular deviation and adjustment. In addition, it may also avoid any nausea or vomiting within the first 24 h period post-operatively.

The AST may be successfully accomplished in children over age 7 years. It is important to have a mock trial 1 day pre-operatively to determine which children will be cooperative for the procedure. We apply topical anaesthetics (e.g. tetracaine) to the eye and use a cotton bud to exert gentle pressure on the bulbar conjunctiva. If the child can tolerate such a manoeuvre then it is feasible to proceed with AST. The child must agree with the decision and it should not be made exclusively by the parents and the doctor. The AST does take more time and the child may be tired the following day. Short rest periods between adjustment may be required. A lid

speculum should be avoided as it is very upsetting to children. Instruments are kept out of sight and adjusting more than one muscle in each eye is avoided. The access to the lateral rectus is easier than to the medial rectus as there is more room for adjustment. Parental support by holding the child's hand is helpful. A bucket-handle suture avoids direct contact with the globe and aids in rotation of the globe if required. We had difficulty in further recession of the lateral rectus muscle of one patient during adjustment. It is much easier to advance than recess the muscle during adjustment. The use of the 'bucket-handle' suture is particularly useful in such situation by applying counter-traction on the suture as the patient attempts to rotate the globe in the opposite direction. Keech *et al.*⁶ reported on 333 patients between the ages of 11 and 70 years who underwent strabismus surgery by the AST and found that approximately 50% required post-operative adjustment. Nearly 80% of their exotropic patients who required adjustment were overcorrected by greater than 10 PD before adjustment. In the esodeviation group, the distribution of over- and undercorrection (greater than 10 PD) was equal. Weston *et al.*¹⁴ reviewed 79 ET and 100 XT patients (age range 14-75 years) who underwent rectus muscle surgery with AST and reported that 40% required adjustment post-operatively. No significant difference in post-operative drift in alignment was found for primary surgeries versus reoperations for either ET or XT patients.

In our patients with esotropias, a larger exotropic drift occurred in the reoperation group than in the primary surgery group (+4.3 PD exodeviation vs +1.6 PD exodeviation). In the exodeviation group, the mean post-operative exotropic drift was up to +10.4 PD in the primary surgery group and only +1.4 PD exotropic drift in the reoperation group. There was a higher reoperation rate of nearly 30% in the primary exotropia group (5/17 patients) than in the reoperations group, of which only 2 (6%) required further surgery.

Cassin *et al.*¹⁸ studied 64 patients having conventional (nonadjustable) horizontal recti surgery, with an age range of 5 months to 56 years. They reported a major trend of drift toward the pre-operative position. Patients with poor fusion potential and patients following reoperations for both residual and consecutive deviations were found to have unpredictable changes of drift in both directions and magnitude of ocular alignment. They commented that the AST should be considered only for those cases with proven fusion potential, since non-fusing patients and those needing reoperations had erratic alignment drifts in the first 6 post-operative weeks.

In our study, over 80% of children in the primary ET group achieved successful alignment (5/19 (26%) required post-operative adjustment). Over 60% in the reoperations ET group achieved successful alignment (8/18 (44%) required adjustment). Up to 64% of the primary XT group were successful also (4/17 (24%) required adjustment post-operatively). In the reoperations XT group, over 70% had successful alignment and 8 (23%) required post-operative

adjustment. In patients who had improved stereoacuity after surgery (approximately 35%), the post-operative drift was much less in both esotropic and exotropic groups.

Wisnicki *et al.*⁷ reviewed 141 patients (mean age of 35 years; mean follow-up 7.5 months) who had horizontal recti surgery with AST and reported a reoperation rate of 7.1% for exodeviation and 5.3% for esodeviation. Their reoperation rate for esotropia under the age of 6 years was 19% when nine conventional (non-adjustable) strabismus procedures were performed. We report a reoperation rate of 15% in both eso- and exodeviation groups.

In summary, AST is a safe procedure with a low risk of complications. It is applicable in both primary and reoperation cases for children with horizontal deviations over age 7 years, especially in patients requiring reoperation of esotropia.

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