Superior Rectus Transposition and Medial Rectus Recession for Duane Syndrome and Sixth Nerve Palsy

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Background

- Multiple techniques described for improving eye position in Duane’s and 6\textsuperscript{th} nerve palsy --> horizontal muscle procedures don't address the abduction deficit
- E.g. Vertical muscle transposition (partial and full)
- Concerns are vertical deviations and anterior segment ischaemia
Methods

• Retrospective review of patients undergoing superior rectus transposition
• Children’s Hospital Boston
• Between 2006-2010
• Followed up for ≥ 6 weeks
• Exclusion
  • < 1 year old
  • Previous transposition surgery
Surgical Technique

1. medial rectus recession with adjustable “short tag noose”
2. Superotemporal incision, superior rectus isolated
3. Muscle cleared of surrounding attachments including levator
4. Muscle secured with double armed 6.0 polyglactin suture and detached

Figure 1. Diagram representation of the superior rectus transposition (SRT) plus sutures. A, The MRc with adjustable suture. B, The SRT technique with augmentation suture. The amount of muscle included in the augmentation suture appears in the rendering to be less than one-quarter of the muscle width after tying the knot.
5. Temporal pole of muscle reattached adjacent to the superior pole of lateral rectus

6. Nasal pole reattached to the superior pole of the lateral rectus insertion following the spiral of Tillaux

7. Most cases also used an augmentation suture – double armed polyester suture placed through the lateral ¼ of SR, and superior ¼ of medial rectus; 8-12mm posterior to muscle insertion
Results

- Good stuff
- Bad stuff

Table 1. Patient Demographics and Distribution

<table>
<thead>
<tr>
<th>Patient Groups</th>
<th>Duane Syndrome (n = 10)</th>
<th>Sixth Nerve Palsy (n = 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range, mo</td>
<td>1 to 33</td>
<td>6 to 60</td>
</tr>
<tr>
<td>Sex, No. of patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Follow-up, mo</td>
<td>2 to 32</td>
<td>2 to 16</td>
</tr>
<tr>
<td>Abduction deficit, U</td>
<td>−3 to −5</td>
<td>−4 to −5</td>
</tr>
<tr>
<td>Head turn &gt;20°, No. (%)a</td>
<td>10/10 (100)</td>
<td>7/7 (100)</td>
</tr>
</tbody>
</table>

*Abbreviation: MRc, medial rectus muscle contracture.*
the superior rectus muscle in our procedure, we were comfortable performing routine MRc to reduce any potential abduction limitation. By making this recession adjustable, we were able to fine-tune the horizontal alignment in the postoperative period, an added benefit considering that a transposition procedure might have a less predictable result on horizontal alignment than a recession or resection. The addition of an abducting force to the eye has a theoretical advantage of preventing recurrence of esotropia over time, but the duration of follow-up in the present study is not sufficient to address this question. Because only 1 muscle is transposed, even patients who have had a prior recession or resection may be considered candidates for the SRT (or the SRT/H11001 MRc) procedure.

The results of SRT/H11001 MRc in our hands appear to be comparable to the results of VRT (Table 2 and Table 3)10,20-23. However, in one patient with undercorrection (with a sixth nerve palsy secondary to pilocytic astrocytoma), the subsequent transposition of the inferior rectus muscle improved the ocular alignment. In our experience, SRT/H11001 MRc and VRT are superior to ipsilateral MRc alone for patients with severe abduction limitations because the amount of MRc required alone tends to cause a new adduction limitation and MRc contributes no chronic abducting force to prevent recurrence. One patient experienced overcorrection, but we do not believe it was a result of the transposition because, after fully reversing the transposition, the overcorrection persisted until the previously recessed medial rectus muscle was advanced (and the lateral rectus muscle was recessed). None of the patients with Duane syndrome developed a hypotropia after surgery, but 2 patients with sixth nerve palsy did; we believe these two were anomalous cases because one had orbital fractures requiring surgery and the other had the augmentation suture attached to the sclera. Torsional diplopia was not a problem, except in one unusual case in which the patient (treated

Figure 2. Surgical results. A, Change in alignment in primary gaze position (n=17). Positive values represent esotropia. B, Change in head turn (n=16). Head turn was not assessed in 1 patient who did not demonstrate fusion. Final postoperative visit represents a mean follow-up of 8 (range, 2-32) months. The bottom and top of each box represent the 25th and 75th percentiles (the lower and upper quartiles, respectively); the band near the middle of the box is the 50th percentile (the median). The ends of the whiskers represent the minimum and maximum of all the data. Any data not included within the whisker are plotted as outliers (dots). For preoperative vs final findings, P<.001 (paired t test). Δ indicates prism diopters.
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Figure 3. Ductions before and after surgery (n=17). A, Abduction limitation ($P<.001$ for preoperative vs final values [paired $t$ test]). B, Adduction limitation ($P=.01$ for preoperative vs final values [paired $t$ test]). Final postoperative visit represents a mean follow-up of 8 (range, 2-32) months. To prevent the measurements of 1 patient with overcorrection from confounding postoperative averages, we reanalyzed the values after excluding that patient and found no substantive change in the calculated means or $P$ values. The bottom and top of each box represent the 25th and 75th percentiles (the lower and upper quartiles, respectively); the band near the middle of the box is the 50th percentile (the median). The ends of the whiskers represent the minimum and maximum of all the data. Any data not included within the whisker are plotted as outliers (dots).
Operatively (correction occurred in a 1-year-old girl with Duane syndrome (with a 14 astrocytoma (after irradiation) who developed a recurrence). The second was a 16-year-old boy with a sixth nerve palsy secondary to pilocytic astrocytoma.

Residual esotropia of 20° at the immediate postoperative period; however, at the first follow-up examination, there were minor variations from the surgical technique noted in the "Methods" section. One patient, the first in the series, did not have an augmentation suture placed. In 3 patients, the polyester augmentation suture was secured to the sclera; 1 of these patients also underwent a recession of more than 6 mm. In 6 patients, the recession was limited to 6 mm (mean [SD], 4.7 [1.7] mm).

There was no new-onset, symptomatic vertical strabismus. Vertical recession was performed in 7 patients (41%). In an additional 9 patients (52%), the recession was combined with the transposition of the medial rectus muscle to correct globe retraction. Three patients, all with Duane syndrome, also underwent a recession of the lateral rectus muscle to reduce head turn and to improve the esotropia. Improvement was noted in 9 of 17 patients (53%) after surgery (Table 1).

Mean (SD) esotropia in the primary position improved from 44° (76%) after surgery (Table 1; Figure 2). Torsion was assessed postoperatively in 6 patients using the double Maddox rod test (3 patients) or anatomic torsion technique noted in the "Methods" section. In all cases, there were minor variations from the surgical technique noted in the "Methods" section.
Bad stuff

No torsional diplopia induced except 1 case

- Unusual - Scleral fixation of augmentation suture
- Suture removed due to distressing torsional diplopia
New-onset vertical deviation

- 2 out of 17
- Mean, SD = 10 PD, 2.8 PD
- Both had chronic 6th
- No new-onset symptomatic hypotropia
Repeat procedure - 3 cases

• 2 undercorrections
  • 4-year-old boy with a residual esotropia of 20 who responded to full hyperopic correction and a 7.5-mm recession of the contralateral medial rectus muscle.
  • 16-year-old boy with a 6th secondary to irradiation for pilocytic astrocytoma who developed a recurrence (with a 14 hypotropia).
    • Retreated with an augmented inferior rectus transposition which reduced the head turn and improved the esotropia from 25 to 10 but with a persistent hypotropia

• 1 overcorrection
  • 1 year old girl with Duane’s who developed a consecutive XT and adduction limitation
  • treated with reversal of the transposition, recession of the lateral rectus muscle, and advancement of the medial rectus muscle
Limitations

• Retrospective
• Limited follow-up [<6 months for 8 patients (47%)]
• No comparison
Conclusion

• Authors recommend SRT + MRc for patients with profound abduction limitation in which there is no reasonable chance that a horizontal rectus muscle procedure alone will be satisfactory

• Results - markedly reduced esotropia in the primary position, increased abduction, and improved head position with minimal effect on adduction

• Theoretically less risk of anterior segment ischaemia