Torsion and Pattern Strabismus

Potential Conflicts in Treatment

Burton J. Kushner, MD

Importance: Rectus muscle transposition to treat pattern strabismus or torsion may have an adverse outcome if the surgeon is unaware that it will affect both pattern strabismus and torsion in contradictory ways.

Objective: To highlight the potential adverse affects of rectus muscle transposition on torsion or pattern strabismus.

Design and Participants: A retrospective nonblinded medical record review of patients treated by the author between January 1, 1990, and June 30, 2009, in whom rectus muscle transposition to address pattern strabismus worsened torsion, or in whom transposition to address torsion worsened pattern strabismus. The main outcome was a worsening of either torsion or pattern strabismus.

Setting: A tertiary care university referral center.

Intervention: Rectus muscle transposition surgery to either treat pattern strabismus or torsion.

Main Outcome Measures: The presence of new or worsened pattern strabismus or torsion. The outcome measures were determined before data collection began.

Results: Eight patients were identified by the review, 5 in whom torsion developed because of transposition to address pattern strabismus and 3 in whom pattern strabismus developed after transposition to address torsion. The presence of bifoveal fusion and/or Graves orbitopathy were risk factors for these adverse outcomes.

Conclusions and Relevance: Rectus muscle transposition to address pattern strabismus may cause torsion, and transposition to address torsion may cause pattern strabismus.

Bielschowksy head tilt test was performed. Torsion was as- 
the prism and alternate cover test, as well as at1 
sured in the appropriate diagnostic fields of gaze at6 mw i t h 
pattern resulted in symptomatic torsion. Strabismus was mea-

or rectus muscle transposition to treat or prevent an alphabet 
tified all patients in whom rectus muscle transposition to treat 
ively.14

dus torsion and use of the double Maddox rod test, respec-
mary position and in downgaze at1 

cw i t h 

For reasons outlined herein, these contradictory ef-
rectus muscle transposition for treating torsion or alphabet patterns usually do not cause adverse clini-
cal outcomes. However, in some circumstances, such sur-
gical procedures can lead to unwanted results. The pur-
pose of this study is to present examples of such 
occurrences and suggest guidelines for how to avoid them.

This study complied with the Health Insurance Port-
ability and Accountability Act and the institutional re-
view board of the University of Wisconsin.

METHODS

From my personal database of patients I have examined, I iden-
tified all patients in whom rectus muscle transposition to treat or 
 prevent torsion resulted in a symptomatic alphabet pattern or 
rectus muscle transposition to treat or prevent an alphabet 
pattern resulted in symptomatic torsion. Strabismus was mea-
sured in the appropriate diagnostic fields of gaze at 6 m with 
the prism and alternate cover test, as well as at ½ m in the pri-
mary position and in downgaze at ½ m. When appropriate, the 
Bielschowsky head tilt test was performed.13 Torsion was as-
essed objectively and subjectively through observation of fund-
dus torsion and use of the double Maddox rod test, respec-
tively.14

REPORT OF CASES

The review identified 8 patients who met the inclusion 
criteria, including 5 in whom rectus muscle transposition to 
treat or prevent an alphabet pattern resulted in symptomatic torsion and 3 in whom rectus muscle trans-
position to treat or prevent torsion resulted in a sym-
ptomatic alphabet pattern. Because there are similarities 
among some patients within each of these groups, only 3 patients will be described in detail, with findings in the 
others summarized.

CASE 1

This 48-year-old man, an engineer, sustained bilateral 
fourth cranial nerve palsy in a motor vehicle crash. One 
year later he underwent bilateral superior oblique ten-
don tucks of 10 mm (5 mm on each side of the tuck) com-
bined with bilateral inferior rectus muscle recessions of 
4 mm to treat V pattern esotropia, subjective excyclo-
tropia measuring a total of 15° (combined right and left 
eyes), right hypertropia on left gaze, and left hypertrop-
ia on right gaze. The operation resulted in orthophoria 
and no torsion in the primary position but a residual symp-
tomatic total excyclotropia of 10° and esophoria of 2 prism 
diopters (PD) in the downgaze reading position at ½ m. 
The patient was diplopic in that position, and his diplo-
pia was not relieved with 2 PD base out in his bifocal segment 
because of torsion. Because his diplopia did not resolve, 8 months after his first surgical procedure I nasally 
transposed both inferior rectus muscles 7 mm. This elimi-
nated the torsion but created esotropia of 10 PD in down-
gaze, associated with horizontal diplopia. Base out Fres-
nel prism in his bifocal segment provided some relief, but 
the patient was bothered by the blur from the Fresnel prism. He also had diplopia at an intermediate range in 
slight downgaze (eg, while looking at a computer screen), 
which could not be ameliorated optically through his pro-
gressive bifocal lenses. Six months after his second stra-
bismus operation, I reversed the transposition of the in-
ferior rectus muscles bilaterally and recessed them each 2 
mm further. This eliminated his esotropia in down-
gaze and did not result in a recurrence of his sympto-
matic torsion. Patient 1 requires 2 PD of prism base down 
over his left eye, with which he is diplopia free at dis-
tance and in the near-downgaze reading position.

Two patients were similar to patient 1 in that they had 
an alphabet pattern created by horizontal transposition of 
the vertical rectus muscles to treat torsion. One was a patient with Graves orbitopathy, who underwent bilat-
eral inferior rectus muscle recessions of 4 mm, per-
formed by another ophthalmologist. To prevent postop-
erative incyclotropia, the muscles were simultaneously 
transposed temporally 5 mm; fixed scleral sutures were used, not a suspension (also referred to as a hang-back technique) or adjustable suture technique. After the op-
eration, she had an A pattern with exotropia in down-
gaze. I subsequently treated this patient by performing bilateral tenectomy of the posterior seven-eighths (ap-
proximately) of the superior oblique tendons, which cor-
rected the problem.13

The second patient was another patient with Graves orbitopathy in whom symptomatic incyclotropia of 10° (total right and left eye) developed after bilateral infe-
rior rectus recessions of 5.5 mm in the right eye and 4.5 
mm in the left, performed by another ophthalmologist. 
No horizontal or vertical deviation was described in the 
primary position or in downgaze. To treat the incyclo-
tropia, the same ophthalmologist transposed both infe-
rior rectus muscles temporally 5 mm, using a fixed scleral 
suture technique. This corrected the incyclotropia but 
created exotropia of 7 PD in the primary position and 
15 PD in downgaze. I subsequently examined and treated 
this patient with bilateral tenectomy of the posterior seven-
eighths (approximately) of the superior oblique ten-
dons, which corrected the problem.13

CASE 2

This 55-year-old woman had Graves orbitopathy. She had 
vertical diplopia and a chin-up head posture associated 
with tight inferior rectus muscles bilaterally. She under-
went bilateral inferior rectus muscle recessions, 5 mm
in the right eye and 6.5 mm in the left, performed by another ophthalmologist. After the operation, she was diplopia free in the primary position but had an exotropia of 20 PD in downgaze with horizontal diplopia. Torsion was not measured, and there was no description of superior oblique muscle function in the office records. To treat the exotropia in downgaze, the same ophthalmologist transposed both inferior rectus muscles nasally 5 to 7 mm, using fixed scleral sutures, 4 months after the first operation. This decreased the patient's exotropia in downgaze to 5 PD, but she then complained of a tilting of the images. I examined patient 2 for the first time 3 months after her second surgical procedure and measured 12° of incyclotropia, split approximately equally between her eyes. Three months after my initial examination, I performed bilateral tenectomy of the anterior seven-eighths (approximately) of the superior oblique tendons. This eliminated the patient's torsion. She is diplopia free in the primary position for distance viewing and for reading in the downgaze reading position at 1⁄2 m, where she controls an exophoria of 5 PD.

Two other patients were very similar to patient 2 in that they both had Graves orbitopathy and had undergone bilateral inferior rectus recessions, performed by other ophthalmologists using a fixed scleral suture technique. In both cases, the surgeon transposed the inferior rectus muscles nasally between 5 and 7 mm to prevent the occurrence of an A pattern. Symptomatic intorsion developed in both patients. In 1 patient, I reversed the nasal transposition of the inferior rectus muscles, leaving them in their recessed position. This corrected the problem and did not result in an A pattern. The other patient declined further surgery.

CASE 3

This 48-year-old woman had a history of having undergone multiple prior strabismus surgical procedures for what she thought was intermittent exotropia; prior records were not available. She had been asymptomatic for many years, but when she became presbyopic and needed a bifocal lens for reading, she was bothered by diplopia in downgaze. When I examined her, I found her to be orthophoric in the primary position at 6 m and 1⁄2 m, but she had an exotropia of 12 PD in the downgaze reading position at 1⁄2 m through her +1.50-diopeter bifocal segment, associated with crossed diplopia with normal localization. To treat this A pattern, I transposed both inferior rectus muscles nasally 7 mm. This eliminated the A pattern and the exotropia in downgaze but created 9° to 11° of incyclotropia, split approximately equally between the eyes. The patient was lost to follow-up for 2 years, after which she came to see me again, inquiring whether anything could be done to eliminate her torsion. I performed bilateral tenectomy of the anterior seven-eighths (approximately) of the superior oblique tendons, which eliminated her symptoms. Another patient was very similar to patient 3 in that he also experienced symptomatic incyclotropia after nasal transpositions of the inferior rectus muscles, performed to treat an A pattern. His symptoms were also resolved when I performed anterior tenectomy of the superior oblique tendons.

Transposition of the rectus muscles to treat or prevent torsion may cause or worsen an alphabet pattern, and transposition to treat or prevent an alphabet pattern may cause or worsen torsion. Nevertheless, transposition procedures of these types are frequently performed without adverse consequences for several reasons. Awareness of these reasons can help identify patients who are at risk.

Vertical transposition of the horizontal rectus muscles is a common procedure for treating alphabet patterns. It has been reported that this procedure does not cause any significant torsional change,14,16 but most studies on this subject considered only subjective torsion. Because most patients undergoing a surgical procedure for horizontal strabismus associated with an A or V pattern do not have bilateral fusion or diplopia awareness, a change in subjective torsion is not a good way to assess whether a torsional change has actually occurred after the operation.14 When the change in torsion was studied objectively with fundus photography, however, transposition of the horizontal rectus muscles in the appropriate direction to collapse an A or V pattern always worsened the associated torsion by a mean of 6.4°.14 These patients did not have torsional symptoms in part because they did not have bilateral fusion and because the torsion worsened only slightly.

In all 8 of my patients with symptoms of either torsion or an induced alphabet pattern, symptoms occurred after transposition of the vertical rectus muscles—never after horizontal rectus muscle transposition. Vertical rectus muscle transposition to treat an A or V pattern is now performed infrequently.12 In my prior studies of objective torsion, I have observed that transposition of the vertical rectus muscles has a more profound effect on torsion than transposition of the horizontal rectus muscles.11,14 Although there is no obvious difference between the torque vectors of the vertical and horizontal rectus muscles that would explain their different effects on torsion, this difference in effects is nevertheless an empirical observation, and its causes are unclear.

An A pattern exotropia with incyclotropia commonly occurs after bilateral inferior rectus recessions for Graves orbitopathy.17 Many ophthalmologists describe routinely transposing the inferior rectus muscles nasally to prevent this from happening, and torsional symptoms are usually not reported.18 One possible explanation is that many ophthalmologists use a suspension technique for suturing in this setting, with or without adjustable sutures. I have observed and reported that when rectus muscles are transposed by using a suspension technique, the transposition effect is negated. I have operated on more than a dozen patients who previously underwent rectus muscle recessions with transposition, performed by other ophthalmologists using a suspension technique. Most had undergone bilateral inferior rectus muscle recessions for Graves orbitopathy performed in all patients by the same surgeon, who routinely transposed both muscles nasally one-half to three-fourths tendon width to prevent an A pattern. In all these patients, I found that the muscles were not in a transposed posi-
tion when I performed the surgical procedure, and I concluded that when the muscle actively contracts it will slide to assume the shortest course around the globe and move away from the transposed position. In many patients undergoing a rectus muscle transposition using a suspension technique, I suspect that their muscles are not truly transposed once the operation is complete. In my experience, the best way to prevent an A pattern exotropia after large bilateral inferior rectus recessions for Graves orbitopathy is to simultaneously perform a procedure to weaken the torque of the superior oblique muscles.17

Horizontal transposition of the vertical rectus muscles has been described as an effective procedure for treating torsion, but the occurrence of adverse alphabet patterns has not been considered a problem.9,10 This may be in part because in many cases only a single vertical rectus muscle is operated on. In the current series, all such patients underwent bilateral surgery, so the effects would be additive.

Rectus muscle transposition to treat paralytic strabismus or Duane syndrome should not be expected to cause torsional problems, because the torsional vectors that are created cancel each other. For example, if the vertical rectus muscles are transposed to the lateral rectus insertion, the superior rectus muscle will develop an intorsional vector, and the inferior rectus muscle an extorsional vector; there should be no net torsional change.

Another noteworthy observation is that 5 of the 8 patients in this series had Graves orbitopathy, and thus their relevant muscles were stiffer than normal. This would accentuate the effect of causing torsion or an alphabet pattern when the muscle is in the transposed position. Moreover, all of the patients in this series underwent procedures that involved a fixed scleral suturing technique and not a suspension technique. This is not to imply that a suspension technique is preferable, per se, because it does not produce the desired transposition effect, as described earlier.

This study has some obvious limitations. Because it is a retrospective review of rather uncommon complications, no incidence figures for these complications can be calculated. Although the patients were heterogeneous with respect to presentation and treatment, they did share many findings, from which some common principals can be formulated.

The treatment of prevention of torsion may worsen alphabet patterns, and the treatment or prevention of alphabet patterns may worsen torsion if approached by transposition of the rectus muscles. This problem is more likely in patients with bifoveal fusion potential and in those undergoing bilateral transposition surgery. It is a particular issue in patients with Graves orbitopathy, whose muscles are tight; transposition of the inferior rectus muscles nasally may prevent an A pattern but cause intorsion, and transposition temporally may treat intorsion but cause an A pattern.

Submitted for Publication: July 3, 2012; accepted July 21, 2012.

Correspondence: Burton J. Kushner, MD, Department of Ophthalmology and Visual Sciences, University of Wisconsin, 2870 University Ave, Ste 206, Madison, WI 53705 (bkushner@wisc.edu).

Conflict of Interest Disclosures: None reported.

Funding/Support: This work was supported by an unrestricted grant from Research to Prevent Blindness, New York, New York.

REFERENCES