Ripcord Adjustable Suture Technique for Use in Strabismus Surgery

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Adjustable sutures in strabismus surgery may be difficult or impossible in poorly cooperative patients. An adjunct suture technique that allows a 1-step, all-or-nothing, preprogrammed adjustment in patients not considered good candidates for standard postoperative adjustable sutures is described. Twelve patients underwent adjustable strabismus surgery using the ripcord technique. Six patients had unacceptable alignment after surgery. In 5 of these, alignment was successfully adjusted. The ripcord adjustable suture technique is effective and is well tolerated by patients.

Postoperative adjustable sutures offer strabismus surgeons the opportunity to alter ocular alignment in the immediate postoperative period. Active patient participation is typically required during the adjustment process, and, therefore, postoperative adjustable sutures are useful only for cooperative patients. Methods to minimize the amount of postoperative manipulation required with adjustable sutures have been reported. Saunders and O’Neil1 described a technique that requires minimal manipulation of the sutures if adjustment is not needed. With their technique, the sutures attached to the extraocular muscle can be cut without tying the suture ends together. Preplaced knots along each suture prevent the muscle from slipping posteriorly through the suture tract. In cases where adjustment is needed, however, good patient cooperation is still required. Intraoperative adjustable techniques have also been described, but have the disadvantage of prolonging operative time and have inaccuracies associated with using corneal light reflection tests to estimate ocular alignment.

The purpose of this article is to describe a technique I have used in selected patients in whom the potential for postoperative adjustment was deemed useful, but the patients were not considered good candidates for the postoperative manipulation required during standard adjustable strabismus surgery. The procedure allows a one-time, single-stage adjustment of a recessed or resected muscle in a predetermined, all-or-nothing step facilitated by releasing an adjunct suture. I refer to the technique as the “ripcord adjustable suture technique” because of its all-or-nothing effect, a feature similar to that of pulling the ripcord to deploy a parachute.

METHODS

I reviewed the medical records of all patients who had undergone placement of a ripcord suture at the time of strabismus surgery between October 1999 and October 2000. Data analyzed included patient age, diagnosis, alignment before and after release of the ripcord suture, and complications. The technique for placement of a ripcord suture for rectus muscle recession and resection are outlined as follows.

RECESSION TECHNIQUE

A rectus muscle recession is performed through a limbal or fornix incision using...
A standard technique. A double-arm 6-0 synthetic absorbable suture is used to secure the muscle to the sclera in the desired recession position. The suture ends are then secured into a knot, but only after suspending the muscle to 1.5 to 2 mm posterior to the desired final position of the muscle (Figure 1). A second suture, which I refer to as the ripcord suture, is placed anteriorly in a position that will be readily accessible postoperatively, if adjustment is needed. After passing the ripcord suture through the sclera, the needle is then loaded backward in the needle driver and is passed under the previously tied muscle suture knot. The posterior end of the needle is advanced first to prevent damage the overlying muscle suture and underlying sclera. The ripcord suture ends are then tied either in a square knot (my preferred method) or in a small bow-knot. As the ripcord suture is tied, tension is exerted on the muscle suture, advancing the muscle to the new scleral insertion.

The ripcord suture must be placed in a manner that allows the muscle suture to be easily distinguished from the ripcord suture to prevent cutting of the wrong suture postoperatively. Although not essential, this can be facilitated by using undyed suture to secure the muscle to the sclera, and using a dyed ripcord suture. The conjunctiva does not need to be recessed if a limbal incision is used. The ripcord suture must, however, be placed in close proximity to the conjunctival incision to facilitate access to it postoperatively. Tenon fascia should be dissected from the area around the ripcord suture to further facilitate access to the ripcord suture. If an undercorrection is noted postoperatively, the ripcord suture can be cut or pulled after instilling topical anesthetic. Upon removal of the ripcord suture, the muscle retracts posteriorly, producing additional recession of the muscle equal to that predetermined as outlined in Figure 1A. The amount of additional recession cannot be titrated, in this all-or-nothing step. If alignment is satisfactory, the ripcord suture is left intact.

**Figure 1.** A. The needles of a double-arm 6-0 polyglactin suture are passed through the sclera at the desired recession position. A space of at least 2 mm should be allowed between the scleral exit sites to facilitate passages of the ripcord suture. The muscle is suspended 1.5 to 2 mm posterior to the needle entry sites and the suture ends are tied together. B. The ripcord suture is placed in an easily accessible area near the conjunctival incision for possible postoperative manipulation. Tenon fascia should be cleared from the area. The needle is then loaded backward in the needle driver and is passed with its blunt end forward between the muscle suture knot and sclera, so that it loops around the muscle suture knot. C. The ripcord suture ends are then tied together with enough tension to pull the knot anteriorly, thus advancing the muscle to the new scleral insertion. Caution should be used to ensure that the ripcord suture can be easily distinguished from the muscle suture postoperatively. D. If adjustment is needed, the ripcord suture can be cut with blunt-tipped scissors and removed postoperatively. This maneuver, like pulling a ripcord, facilitates a preprogrammed all-or-nothing response, increasing the effect of the recession procedure. Alternatively, the loose end of a bowknot ripcord suture can be pulled to release and remove the suture, although this is not my preferred technique.

**RESECTION TECHNIQUE**

A rectus muscle resection is performed through a limbal or fornix incision using a standard technique. Before securing the suture, the muscle is allowed to recess 1.5 to 2.0 mm posterior to the original insertion (Figure 2). The ripcord suture is placed and the conjunctiva closed in exactly the same manner as described for the recession technique. When the ripcord suture is tied, the muscle is advanced to the insertion. If an overcorrection is noted postoperatively, the ripcord suture can be removed, resulting in a reduction of surgical effect.
RESULTS

I have used the ripcord technique on 12 patients who I did not believe were good candidates for standard postoperative adjustment, but in whom I thought having the ability to adjust postoperatively might be beneficial. The mean age at the time of surgery was 32 years (range, 10-60 years), with 4 patients younger than 16 years. Only 1 child, a 15-year-old, required adjustment. A ripcord suture was used on 8 rectus muscles that underwent recession; 6 had ripcord adjustment for undercorrection. A ripcord suture was used on 8 rectus muscles that underwent resection or advancement; 2 had ripcord adjustment for overcorrection (Table).

The ripcord suture was released within 3 hours after surgery in 5 patients and at 24 hours in 1 patient, each resulting in improved ocular alignment. A ripcord suture placed on both medial rectus muscles was released at 48 hours in patient 2. The muscles did not apparent to retract upon removal of the ripcord sutures and there was no resulting change in alignment after adjustment or at follow-up 2 months later. This adjustment failure most likely occurred because the muscle had already become too firmly reattached to the sclera to allow adjustment with this technique. The patient did not tolerate additional attempts to manipulation of the globe and muscle. The ripcord suture was released without the use of a lid speculum in 4 patients and with a lid speculum in 2 patients, and was well tolerated with minimal discomfort by all patients. No sedation or anesthesia, other than topical anesthesia, was required. None of the patients experienced significant ocular discomfort, nausea, or other systemic problems. In 6 patients who did not require adjustment, the ripcord suture was left intact and was well tolerated. None of the patients complained of pain or had consequences beyond those associated with the standard postoperative course, including those in which the ripcord suture was left intact.

COMMENT

Postoperative adjustable sutures have been used in strabismus surgery for decades because strabismus surgeons believe they enhance ability to secure accurate postoperative alignment in selected patients. Patients who are unlikely to tolerate adjustable sutures can usually be identified preoperatively. Unsuitable adjustment candidates typically cannot easily tolerate manipulation of the globe for forced traction testing or for other preoperative testing procedures, such as tonometry. I devised the ripcord adjustable suture technique described herein to allow an opportunity to alter ocular alignment postoperatively in this patient subset. I desired a postoperative adjustment phase that would require minimal manipulation of the globe and limited patient cooperation and that could be done without the use of a lid speculum.

I dubbed the adjunct suture a “ripcord suture” because releasing it produces an all-or-nothing effect, similar to that of pulling the ripcord on a parachute. The technique is potentially more useful in patients who are undergoing a recession/resec-

Figure 2. A, A resection is performed in a standard manner, except that the resected muscle is initially suspended 1.5 to 2.0 mm posterior to the insertion. B, After placement of the ripcord suture, the muscle is advanced to the insertion. C, If adjustment is needed, the ripcord suture can be cut and removed, allowing the muscle to retract and reducing the effect of the resection procedure by a preprogrammed amount. Alternatively, the loose end of a bowknot ripcord suture can be pulled to release and remove the suture, although this is not my preferred technique.
In summary, a ripcord adjustable suture technique that allows a 1-step preprogrammed adjustment of postoperative alignment in patients with small undercorrections or overcorrections after strabismus surgery has been found to be useful in selected patients. The intraoperative technique is relatively simple. Minimal postoperative manipulation and limited patient cooperation are required if adjustment is necessary, and no postoperative manipulation is needed if ocular alignment is satisfactory. The technique may be useful in selected patients when standard adjustable sutures are deemed inappropriate, but the potential to alter alignment in the immediate postoperative period is desired.

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REFERENCES


### Primary Position Alignment in 6 Patients Undergoing Ripcord Suture Adjustment*

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Diagnosis</th>
<th>Procedure</th>
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<tr>
<td>1</td>
<td>ET, lost LLR</td>
<td>Advance LLR (1.5-mm RCS)†</td>
<td>LLR</td>
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<td>ET, TRO</td>
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<td>ET 30</td>
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<tr>
<td>4</td>
<td>ET</td>
<td>Resect LR-OU (2-mm RCS-OU)</td>
<td>LLR</td>
<td>XT 12</td>
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<tr>
<td>5</td>
<td>Right abducens paresis</td>
<td>Recess RMR (1.5-mm RCS); resect RLR (1.5-mm RCS)</td>
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<td>E(T) 3-4</td>
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<tr>
<td>6</td>
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<td>RLR XT 15</td>
<td>XT 5</td>
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</table>

* LLR indicates left lateral rectus muscle; TRO, thyroid-related ophthalmopathy; ET, esotropia; RCS, ripcord suture; MR, medial rectus muscle; OU, both eyes; LR, lateral rectus muscle; RMR, right medial rectus muscle; RLR, right lateral rectus muscle; XT, exotropia; X, exophoria; E, esophoria; and (T), intermittent.
† Size indicates amount of adjustment potential.
‡ Ripcord suture cut more than 48 hours after surgery.
§ Well aligned and fusing with prism 2 months after surgery.