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Rectus muscle plication using an adjustable technique

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Abstract

Background—Rectus muscle plication is an alternative muscle-strengthening procedure to rectus muscle resection. Possible advantages of rectus muscle plication include a lower risk of “lost” muscles and anterior segment ischemia.

Methods—This was a retrospective case series describing a surgical procedure for rectus muscle plication using an adjustable suture technique that can be employed on any of the four rectus muscles.

Results—A total of 5 adult patients underwent adjustable suture plication procedures. Of these, 2 patients required suture adjustment postoperatively. At the final follow-up visit, all of the patients maintained satisfactory ocular alignment within 6° of orthotropia for horizontal deviations and 2° of orthotropia for vertical deviations. Diplopia was eliminated in all cases with preoperative diplopia. There were no postoperative complications or unexpected shifts in ocular alignment.

Conclusions—Rectus muscle plication using this adjustable suture technique may serve as an alternative to rectus muscle resection and may be particularly useful in patients who are at risk for anterior segment ischemia or those in whom a shorter anesthesia time is recommended.

Rectus muscle plication is an alternative muscle-strengthening procedure to the more commonly performed rectus muscle resection. Compared to the latter, rectus muscle plication is less invasive, more easily reversible, may impinge less on anterior segment circulation, and does not require muscle disinsertion, thus minimizing the albeit rare risk of “lost muscles.”^{1–3} Although there has been increasing interest in plication procedures, especially using minimally invasive techniques and topical anesthesia,^{3–6} rectus muscle plication is generally not performed using adjustable techniques. The utility of adjustable sutures has been demonstrated for many types of strabismus surgery.^{7,8} The aim of the present study is to describe a novel technique for rectus muscle plication that uses an adjustable suture. The technique preserves many of the aforementioned advantages of rectus muscle plications as a strengthening technique yet offers the added benefit of postoperative suture adjustment.

Methods

This study was approved by the University of Los California–Los Angeles Institutional Review Board and conformed to the requirements of the US Health Insurance Portability

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and Accountability Act of 1996. The medical records of all patients undergoing rectus muscle plication using adjustable sutures were retrospectively reviewed. Our technique for performing adjustable suture rectus muscle plication is depicted in Figure 1. In brief, the muscle is isolated on a muscle hook and connective tissue is bluntly dissected posteriorly. The desired amount of plication is measured from the muscle insertion using calipers. Two single-armed 6-0 polyglactin 910 or nonabsorbable polyester sutures are passed and secured on the muscle at a distance from the insertion corresponding to the selected amount of plication. The sutures are then fixated using partial scleral thickness passes, adjacent to the corresponding edge of the rectus tendon insertion. These sutures are tied over an iris spatula that folds the anterior tendon posteriorly and flattens it between the globe and the more posterior tendon that is now sutured to the sclera. The suture ends are tied using a slip-knot to place the plication on an adjustable suture. In this manner the adjustable suture may be loosened to reduce the amount of effective shortening by allowing the plication to unfold partially. All patients undergoing this procedure on any of the four rectus muscles for any size deviation were included unless they had a postoperative follow-up time of <6 weeks.

The following preoperative and postoperative characteristics were recorded from the patients' charts: age at surgery, best-corrected visual acuity, preoperative motor alignment at distance and near and in the cardinal positions of gaze, and an assessment of ocular ductions. In addition, details of the surgical procedure, adjustment amount (if required), and postoperative ocular alignment and ductions were recorded. Any postoperative complications were also noted.

Visual acuity was assessed using refractive correction. Binocular alignment was at distance (20 feet) in the cardinal gaze positions and at near (14 inches) using spectacle correction. In general, suture adjustment was performed on postoperative day 1 and targeted similarly with a goal of orthophoria or slight over/under-correction depending on the clinical details. For example, in patients with divergence insufficiency, the target was 5 -10 of exotropia at distance, whereas in patients with Graves disease the target was 2 -6 of undercorrection for vertical deviations.

Results

A total of 5 patients met study inclusion criteria. Mean age at surgery was 49 years (range, 28–65 years). Mean postoperative follow-up was 3.4 months (range, 3–5 months). Table 1 summarizes the clinical diagnosis and features of each patient as well as the surgical procedure, immediate postoperative alignment, alignment after adjustment, and alignment at final visit. In 3 patients the lateral rectus was plicated, and in 2 patients the superior rectus muscle was plicated. One patient (patient 1) was operated on under topical anesthesia; the other 4 under general anesthesia. Plication amounts ranged from 5.5 mm to 7 mm for lateral rectus muscles and 3 mm to 4 mm for superior rectus muscles. Of the 5 patients, 2 (40%) required suture adjustment estimated at 1–2 mm of recession by the surgeon performing the adjustment. Intraoperative bleeding and edema of the plicated muscles were minimal. All of the patients had satisfactory outcomes at the final postoperative visit, with alignment within 6 of orthotropia for horizontal deviations and 2 of orthotropia for vertical deviations and a lack of diplopia. There were no postoperative shifts in alignment to suggest slippage of the plicated muscle. Figure 2 and e-Supplement 1 (available at jaapos.org) depict a typical patient after the adjustable plication procedure on postoperative day 1 and postoperative month 1, respectively. The plication procedure did not result in a lump or other contour irregularity over the operated muscle.

Discussion

Rectus muscle strengthening is a crucial component of many strabismus surgical procedures. The most commonly performed procedure for rectus muscle strengthening, rectus resection, is highly effective and has historically been preferred by North American surgeons. However, rectus muscle plication is an alternative treatment that offers benefits over resection. First, muscle plication does not require extraocular muscle disinsertion from the globe and is thus not subject to the risk of slipped or “lost” muscles in the postoperative period. In addition, muscle plication is reversible in the immediate postoperative period, less invasive, and less technically challenging than resection. Finally, animal studies have shown that plication techniques spare anterior segment circulation^{2,3} and therefore may be preferable in patients at risk for anterior segment ischemia but there are no human studies evaluating this theory.

Our technique for rectus muscle plication is advantageous for surgeons who prefer to use adjustable sutures compared to previously published techniques^{1,4} in that it incorporates the use of an adjustable suture. In our series, 40% of patients required suture adjustment postoperatively, and the alignment was stable in all of patients at the last postoperative visit. Suture adjustment allowed for changes of up to 10° from the immediate surgical result in our cases, although it is possible that larger plications could permit greater postoperative adjustment. Although one might imagine a hypothetical risk of dehiscence of the plication after suture dissolution, we had no cases of postoperative drift toward undercorrection.

In addition to the lack of adjustability, one other common criticism of rectus muscle plication is the possibility of a bulky mass at the muscle insertion due to the presence of the folded anterior rectus tendon. However, with our technique, we did not note any conspicuous conjunctival elevation. Figure 2 depicts a typical postoperative patient, with very little mass effect from the folded rectus muscle. Our technique of folding the plicated segment beneath the muscle (as opposed to anterior to the muscle) may minimize tissue thickness post-plication, especially in the medial rectus muscle. Our experience with reoperation of chronically plicated rectus muscles suggests that plicated portions of muscles thin and become joined in a fibrous union with the overlying muscles in such a secure manner as to defy later surgical separation.

The present study has several limitations. It was not randomized, controlled, or comparative: the purpose of the study was solely to describe a new technique for adjustable rectus muscle plication. The follow-up length of 3–5 months allowed us to analyze immediate postoperative changes but not long-term drifts. Despite these limitations, this study describes a novel approach to rectus muscle plication using adjustable sutures. This technique should be considered in any patient requiring rectus muscle strengthening and especially in those at risk for anterior segment ischemia or those requiring topical anesthesia.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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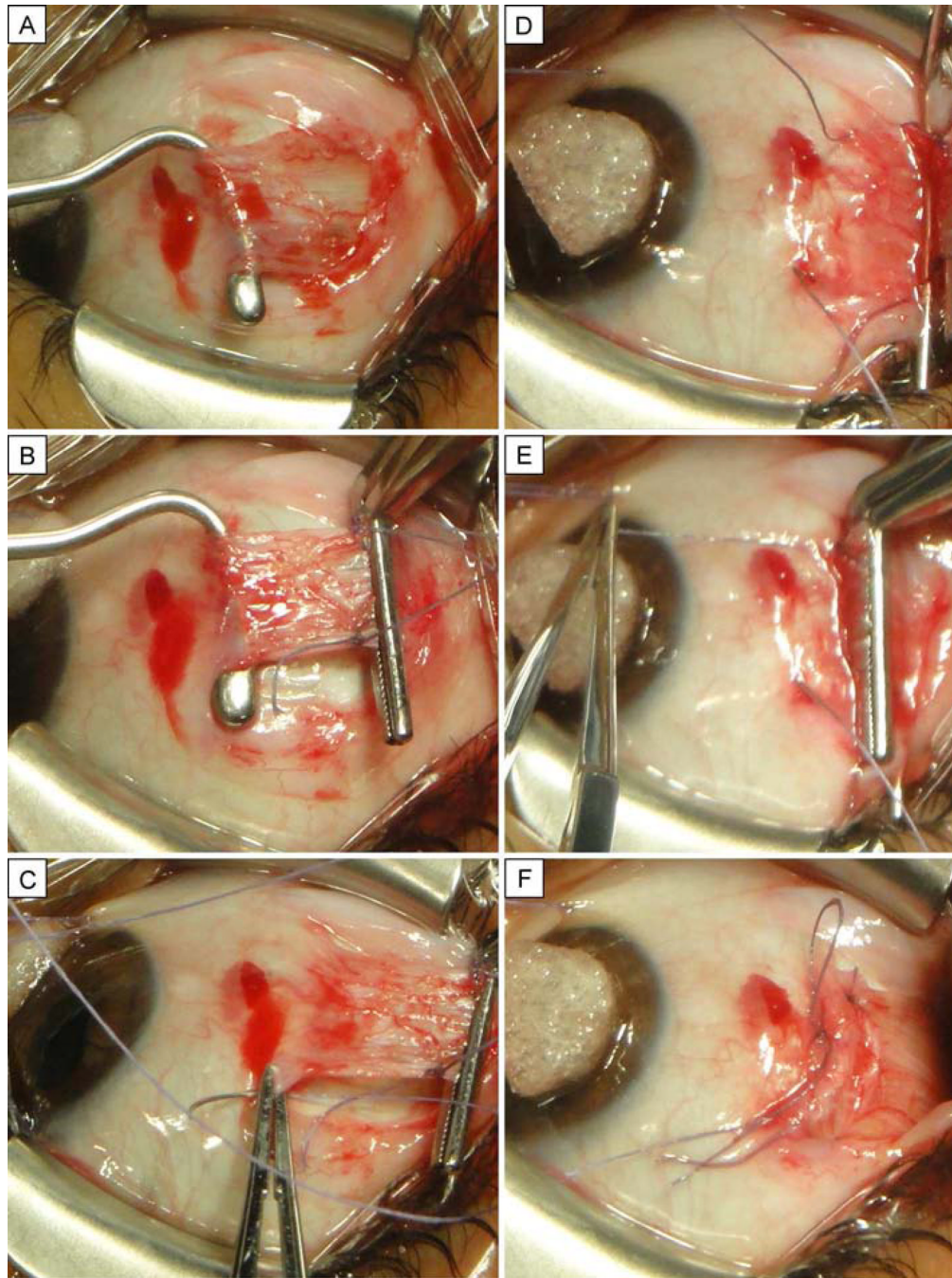


FIG 1.

Procedure for adjustable rectus muscle plication. A, The rectus muscle is isolated on a muscle hook. B, Two 6-0 polyglactin 910 sutures are passed posteriorly to the insertion at the desired plication amount 5.5 mm posteriorly to the insertion C, Sutures are passed using partial scleral thickness passes adjacent to the muscle insertion. D, An iris spatula is used to fold the muscle posteriorly while the sutures pull the muscle anteriorly (the Apt clamp is used in this example, but is not necessary for plication). E, The suture ends are pulled tightly to ensure flat folding of the muscle as the anterior portion of the tendon folds posteriorly. F, The suture ends are tied in a slip-knot fashion.

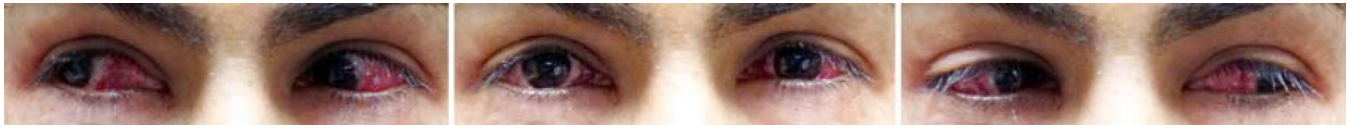


FIG 2.
Patient 1 on postoperative day 1 after adjustable plication procedure on right lateral rectus muscle.

Table 1
Clinical and surgical characteristics of patients undergoing adjustable rectus muscle plication

Patient	Age, years	Strabismus etiology	Previous surgery	Distance deviation, PD	Surgery performed	Immediate post-op distance alignment	Suture adjusted	Final post-op distance alignment	Post-op follow-up, months
1	32	Infantile ET	No	55 ET	BMR recession 5 mm, BLR plication 5.5 mm, adjustable suture on RMR and RLR	2 XT	Yes	Orthotropic	5
2	58	Restrictive secondary to scleral buckle	No	12 LHT	RSR plication 4 mm on adjustable suture, RSO repositioning	2 RHT	No	Orthotropic	3
3	65	Divergence insufficiency	No	25 ET	BLR plication 5.5 mm, adjustable suture	4 XT	No	Orthotropic	3
4	57	Graves disease	BIR/LMR/LIO recession, LLR resection, LSO plication	16 LHT	LSR recession 3 mm, RSR plication 6 mm, adjustable sutures OU	2 LHT	No	Orthotropic	3
5	28	Nystagmus, ET	BMR recession	35 ET	BLR plication 7 mm OS and 8 mm OD, adjustable suture OD	15 XT	Yes	5 XT	3

B, bilateral; *ET*, esotropia; *IR*, inferior rectus muscle; *L*, left; *HT*, hypertropia; *IO*, inferior oblique muscle; *LR*, lateral rectus muscle; *MR*, medial rectus muscle; *OD*, right eye; *OS*, left eye; *OU*, both eyes; *PD*, prism diopter; *Post-op*, postoperative; *Pre-op*, preoperative; *R*, right; *SO*, superior oblique muscle; *SR*, superior rectus muscle; *XT*, exotropia.