Vertical Rectus Surgery for Knapp Class II Superior Oblique Muscle Paresis

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Objective: To evaluate the efficacy of treating Knapp class II superior oblique muscle palsy with 7-mm nasal transposition of the ipsilateral inferior rectus muscle combined with recession of the contralateral inferior rectus muscle when the primary position hypertropia is 10 prism diopters (PD) or less.

Method: A retrospective review of 8 consecutive patients with superior oblique muscle paresis who had nasal transposition of the inferior rectus muscle in the paretic eye and recession of the inferior rectus muscle in the nonparetic eye. Ocular motility, including objective and subjective torsion, were evaluated before and after surgery.

Results: The mean (SD) preoperative hypertropia was 5 PD (1.5) and 13.1 (3.6) PD in the primary position and downgaze, respectively. After surgery the mean (SD) hypertropia was 1.25 (1.0) and 3.25 (1.3) PD in the primary position and downgaze, respectively. The mean (SD) subjective excyclotropia decreased from 6.8° (1.3°) preoperatively to 0.5° (0.9°) after surgery, and there was a mean (SD) objective decrease in the excyclotorsion of the paretic eye by 7.8° (1.4°). All patients were diplopic before surgery and asymptomatic after surgery.

Conclusion: Treatment with 7-mm nasal transposition of the ipsilateral inferior rectus muscle combined with recession of the contralateral inferior rectus muscle can effectively treat Knapp class II superior oblique muscle palsy when the primary position hypertropia is 10 PD or less.


IN THE FIRST ANNUAL SCOBEE LECTURE, Knapp presented a classification and treatment schema for superior oblique muscle palsy that has become a classic in the field of strabismus.1 Though subsequent advances in our understanding of superior oblique tendon anatomy2-3 and the popularization of adjustable sutures4,5 have made some of his treatment recommendations outdated, the underlying concepts behind his recommendations are quite useful. Specifically, Knapp recommended that the magnitude of the deviation determine how many muscles should be operated on, and the incomittance pattern should determine which muscles should have surgery. He chose to operate on muscles that would have the greatest effect in the field of gaze with greatest vertical misalignment and that also address any torsional abnormality. Subsequent authors have incorporated these principles into newer schemas for treating superior oblique muscle paresis, though they deviated from Knapp’s recommendations.6-12

Knapp classified a deviation that was greatest in the field of the paretic superior oblique muscle (adduction in downgaze) as being class II, for which he recommended tucking the tendon of the paretic superior oblique muscle. However, many strabismologists tend to avoid tucking the superior oblique tendon whenever possible.10,13 Others prefer to limit that procedure to patients in whom the tendon is lax. Thus, they would not perform a superior oblique tendon tuck in patients with a Knapp class II superior oblique muscle paresis if it was an acquired problem, and in which a lax tendon is typically not found.5,14,15 When the deviation in the primary position is large enough that surgery to weaken 2 vertical muscles is safe, there are good alternatives to tucking the superior oblique tendon. These include ipsilateral inferior oblique muscle weakening combined with either contralateral inferior rectus muscle recession or ipsilateral superior rectus muscle recession. However, for patients in whom the deviation in the primary position is relatively small, an effective alternative to tucking the superior oblique tendon would thus be useful for treating Knapp class II superior oblique muscle paresis. One possible alternative in this setting would be to recess the inferior rectus muscle in the...
A paresis was presumed to be congenital if there was documentation of it dating back to childhood and there was no antecedent head trauma or other neurologic cause for an acquired problem. Testing for subjective torsion was done with the double Maddox rod test before and after surgery using a white and red Maddox rod. Because almost all of the patients had surgery before it was known that the use of a white Maddox rod caused a color dissociation artifact in which the eye perceiving the white line will tend to be viewed as having no torsion,20 the subjective torsion was analyzed as the total torsional disparity between the 2 eyes without attention to which eye was subjectively torted. Objective torsion was determined by comparing the preoperative and postoperative fundus torsion in each eye separately before and after surgery using fundus photography and analyzed using a template overlay in the manner previously described.21 This technique has been shown to be accurate within 2°. The change in objective torsion at the outcome examination was determined by comparing the preoperative and postoperative fundus torsion in each eye separately from the photographs.

The final outcome determination was approximately 3 months after surgery; however, many patients were followed up for much longer and long-term trends were noted.

This study was approved by the institutional review board of the University of Wisconsin and was compliant with the Health Insurance Portability and Accountability Act.
Ipsilateral nasal transposition of the inferior rectus muscle combined with contralateral inferior rectus muscle recession is effective in treating superior oblique muscle paresis when the deviation is 10 PD or less in the primary position, is greatest in the field of the affected superior oblique muscle, and is not accompanied by substantial ipsilateral inferior oblique muscle overaction (eg, does not have a larger hypertropia in the field of the inferior oblique muscle).

In theory, simply recessing the contralateral inferior rectus muscle might be a simpler alternative for these patients. It will give maximum correction in the field of the paretic superior oblique muscle. Good results have been reported with this approach in patients with very small amounts of subjective torsion. However, inferior rectus recession of the relatively small amount needed in this patient group will have a small effect on decreasing the excyclotropia. In this series, the decrease in objective torsion in the eye treated with inferior rectus recession only had a mean of 2.75°. This may be inadequate in a patient who has more than 5° of objective excyclotropia. In fact, the initial attempt to combine ipsilateral inferior rectus muscle transposition with contralateral inferior rectus muscle recession was owing to an experienced perior oblique muscle transposition with contralateral in tropia. In fact, the initial attempt to combine ipsilateral inferior rectus muscle recession with the contralateral superior oblique muscle, as seen in the Table. The 3 patients with a presumed congenital paresis who had exaggerated forced traction testing had lax superior oblique tendons, and the 3 with an acquired paresis who had testing did not have lax tendons.

Five patients had postoperative suture adjustment of 0.5 to 1 mm. In 4 patients, the adjustment was to decrease the recession, and in 1, to increase it.

**COMMENT**

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When the primary position hypertropia is relatively large, there are more treatment options available that may allow the surgeon to avoid tucking the superior oblique tendon. These typically involve operating on 2 vertical muscles that are directed toward decreasing the hypertropia. Although authors have different thresholds for when to operate on a second vertical muscle to decrease a hypertropia that ranges from 10 to 17 PD, many appear to follow the concept that the size of the primary position deviation dictates the number of muscles to weaken or strengthen. These approaches include varying combinations of either weakening the ipsilateral inferior oblique muscle or performing a tuck or Harada-Ito procedure on the ipsilateral superior oblique tendon, combined with contralateral inferior rectus muscle recession. In cases in which there is ipsilateral superior rectus muscle overaction and/or contracture, the plan may involve recessing the superior rectus muscle.

Ipsilateral tucking of the superior oblique tendon, as recommended by Knapp, addresses all aspects of the motility disturbance in patients with a Knapp class II superior oblique muscle paresis. However, tucking the superior oblique tendon remains controversial in some situations. Plager, Helveston, and colleagues have reported that many patients with congenital superior oblique muscle paresis have a lax or redundant tendon. They advise that patients with tendon laxity should have a tucking procedure and those without should not. Although this recommendation is becoming an often-repeated dogma, it has never been clinically tested. The teaching is predicated on the belief that the primary anomaly in these patients is a lax tendon, and if the laxity is taken up with a tucking procedure, the muscle will function more normally. However, Sato has shown that patients with a lax tendon typically have an atrophic superior oblique muscle, as seen on imaging studies, and hence the tendon laxity may be secondary. If that is the case, the rationale for only tucking lax tendons is less compelling. One could argue that tucking tendons that are not lax might be more likely to result in improved function, as the muscle itself may only be paretic and still have some function. This is similar to the principle that a mildly paretic lateral rectus muscle may be strengthened by a resection but a completely flaccid one will not. In fact, there are multiple reports of good results with tucking the superior oblique tendon to treat superior oblique muscle paresis without limiting the indication to patients with...
lax tendons. Irrespective of this argument, there are many clinicians who always avoid tucking the superior oblique tendon and others who avoid it if laxity is not found. For these surgeons, an alternative procedure would be useful.

This study has obvious limitations. Being retrospective in nature, it is subject to all of the measurement and interpretation errors that can accompany a retrospective study. Because it was not carried out according to a predetermined protocol, there may have been selection bias in choosing patients for this surgical procedure.

It appears, however, that ipsilateral nasal transposition of the inferior rectus combined with contralateral inferior rectus recession is an effective treatment for Knapp class II superior oblique muscle palsy when the deviation in the primary position is 10 PD or less.

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REFERENCES