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Superior oblique surgery: when and how?

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Background: The purpose of this paper is to review different types of superior oblique muscle surgeries, to describe the main areas in clinical practice where superior oblique surgery is required or preferred, and to discuss the preferred types of superior oblique surgery with respect to their clinical outcomes.

Methods: A consecutive nonrandomized retrospective series of patients who had undergone superior oblique muscle surgery as a single procedure were enrolled in the study. The diagnosis, clinical features, preoperative and postoperative vertical deviations in primary position, type of surgery, complications, and clinical outcomes were reviewed. The primary outcome measures were the type of strabismus and the type of superior oblique muscle surgery. The secondary outcome measure was the results of the surgeries.

Results: The review identified 40 (20 male, 20 female) patients with a median age of 6 (2–45) years. Nineteen patients (47.5%) had Brown syndrome, eleven (27.5%) had fourth nerve palsy, and ten (25.0%) had horizontal deviations with A pattern. The most commonly performed surgery was superior oblique tenotomy in 29 (72.5%) patients followed by superior oblique tuck in eleven (27.5%) patients. The amount of vertical deviation in the fourth nerve palsy and Brown syndrome groups ($P = 0.01$ for both) and the amount of A pattern in the A pattern group were significantly reduced postoperatively ($P = 0.02$).

Conclusion: Surgery for the superior oblique muscle requires experience and appropriate preoperative evaluation in view of its challenging nature. The main indications are Brown syndrome, fourth nerve palsy, and A pattern deviations. Superior oblique surgery may be effective in terms of pattern collapse and correction of vertical deviations in primary position.

Keywords: A pattern, Brown syndrome, fourth nerve palsy, superior oblique muscle tuck, tenotomy

Introduction

Superior oblique surgery is one of the most challenging surgeries and requires a thorough knowledge of anatomy, extensive experience, and appropriate preoperative decision-making in view of possible complications and unpredictable outcomes. It includes various types, such as tucking, split tendon elongation, the Harada-Ito procedure, tendon plication, tenotomy, tenectomy, silicone tendon expander, and adjustable sutures.[1–3] We aimed to identify the clinical scenarios in which surgery for the superior oblique muscle was preferred or required, to define our surgical preference for strabismus cases in which the superior oblique muscle was involved, and to analyze the surgical results.

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Materials and methods

This retrospective study included patients who had undergone superior oblique muscle surgery to either weaken or strengthen the muscle between January 2007 and May 2012 at Hacettepe University School of Medicine Department of Ophthalmology, Strabismus Section. The study was carried out in full accord with the principles laid out in the Declaration of Helsinki, and approval of the institutional review board was obtained. The patients were enrolled in the study according to the following inclusion criteria: having undergone superior oblique muscle surgery as a sole procedure, reliable orthoptic measurements, and a postoperative visit six months after the operation.

The clinical characteristics of the patients, including presence of patterns, amount of vertical deviation (Δ), subjective torsions, and the main diagnosis leading to surgery, were recorded, as well as the type of surgery and postoperative measurements. Visual acuity was assessed using the Snellen or Lea chart. Vertical deviations were measured by prism cover test or Krimsky test.

Diagnosis of superior oblique palsy was made on the basis of a positive three-step test, subjective ocular torsion measurement, Hess chart and synoptophore measurements. All of the surgeries were performed in theater under general anesthesia after a forced duction test had been performed for both eyes. The abnormal head position was measured using an orthopedic goniometer.

The surgical choice made by the surgeons for Brown syndrome was intrasheath nasal tenotomy. The superior oblique tendon was identified and cut in its sheath after opening of the conjunctiva nasally to the superior rectus muscle without damaging the neighboring tissue, whereas it was identified and cut temporally in patients with A pattern. An exaggerated forced duction test was performed for all patients to rule out the presence of any remnant of superior oblique muscle.

In the event of fourth nerve palsy, the amount of superior oblique tendon tuck was set after performing a forced duction test to prevent iatrogenic Brown syndrome. The final visit was at six months after superior oblique muscle surgery for all patients.

Among patients with fourth nerve palsy, only those eligible for superior oblique surgery in terms of the main surgical indication (clinically significant superior oblique muscle underaction) were enrolled in the study. The primary outcome measures were the type of strabismus and the type of superior oblique muscle surgery. The secondary outcome measure was the result of surgery.

Statistical analyses

Statistical analyses were performed using Statistical Package for the Social Sciences Windows version 15.0 software (SPSS Inc, Chicago, IL, USA). The arithmetic mean, standard deviation, median, range, frequency, and percentage were used as descriptive statistics. The Wilcoxon signed-rank test was used to compare quantitative variables in the matched samples. Results are accepted as statistically significant when $P < 0.05$.

Results

Review of medical records identified a total of 40 patients (20 male, 20 female) with a median age of 6 (2–45) years. There were 19 patients (47.5%) with Brown syndrome, 11 (27.5%) with fourth nerve palsy, and ten with A pattern (25.0%).

Of the 19 Brown syndrome patients (six males and 13 female), 17 (89.4%) patients were unilateral and unilaterally operated, and two (10.6%) were bilateral and bilaterally operated. The mean age of these patients was 8.2 ± 7.1 (2–27) years. The median preoperative vertical deviation was 12 (10–30) Δ and this was significantly decreased after surgery (median postoperative vertical deviation was 0 [0–10] Δ, $P = 0.01$). The degree of abnormal head position trended towards a decrease after surgery (median 20 [10–25] degrees versus 0 [0–10] degrees, $P = 0.04$).

Of eleven patients (seven male, four female) with fourth nerve palsy, nine had unilateral and two had bilateral involvement. Of nine unilateral cases, two were traumatic palsy and the rest were congenital. The mean age of these patients was 17.2 ± 14.8 (2–45) years. The sole surgery was superior oblique tendon tuck for all eleven patients. The amount of tuck was 8 mm. Median preoperative vertical deviation was 14 (8–30) Δ whereas the median postoperative vertical deviation was 4 (0–25) Δ in primary position ($P = 0.01$). The amount of torsion (median 6 [0–8] degrees versus 2 [0–4] degrees, $P = 0.02$, in nine of eleven patients) and abnormal head position (median 25 [0–30] degrees versus 10 [0–15] degrees, $P = 0.03$) was found to be significantly decreased after superior oblique surgery.

Of the ten patients (six male, four female) with A pattern, six (60.0%) were unilaterally and four (40.0%) were bilaterally operated. The mean age of these patients was 4.2 ± 1.3 (3–43) years. The procedure was temporal tenotomy. The parameter which was decreased postoperatively in a significant manner was the amount of A pattern (18.23 ± 2.14 Δ and 8.32 ± 3.45 Δ respectively, $P = 0.02$) The change in vertical deviation after surgery was insignificant (median 4 [0–4] Δ versus 4 [0–4] Δ,

$P = 0.31$) There was no surgery-related complication in any of the groups, except for mild-to-moderate but asymptomatic limitation of elevation in adduction in patients who underwent superior oblique tuck surgery.

Discussion

Our data show that several techniques for superior oblique surgery may be preferred for selected cases, including fourth nerve palsy, Brown syndrome, and superior oblique overaction. In this study, we aimed to identify the most common surgical techniques used and indications for surgery at our clinic.

Superior oblique palsy is one of the most common extraocular muscle palsies.[4] The decision of the surgical technique for superior oblique palsy is very difficult because of the complicated clinical picture. The critical surgical step for patients with fourth nerve palsy is to decide whether to perform a single-muscle or two-muscle surgery. The decision depends on the magnitude of hypertropia in primary position and side gaze, and the presence of torsion.[5,6] In our study, we preferred superior oblique tuck for patients with superior oblique muscle underaction (≥ -2), torsional diplopia, and complaints mainly in the field of action of the superior oblique muscle, and for children, the indications were mainly based on orthoptic evaluation.

In their retrospective series, Kaeser et al[7] compared the surgical results of inferior oblique recession alone, with those of inferior oblique recession combined with superior oblique tuck in patients with congenital superior oblique palsy. They examined the effects of surgery on binocularity and found that inferior oblique recession alone is an appropriate procedure with a low incidence of iatrogenic Brown syndrome. They also suggested that superior oblique muscle surgery may be considered as a second surgical step after weakening of the inferior oblique muscle, in view of evaluation of the residual deviations and manifest concerns. On the basis of a comparative study, Bhola et al[8] recommended isolated superior oblique tendon tuck for patients with unilateral superior oblique palsy and less than 15 Δ deviation in primary position.

However, Saunders[5] emphasized that he had needed to perform tuck takedown for only one patient during his 30 years of clinical practice. Saunders and Tomlinson[9] described a technique to produce the desired tuck by definition of the first resistance at the limbus crossed imaginary line. Arici and Oguz[10] compared the effect of superior oblique tuck and inferior oblique weakening, including anterior transposition, recession, and myectomy, on ocular torsion in cases of superior oblique palsy. They showed that superior oblique tuck had a more corrective effect on ocular torsion. In our study, there was also a significant reduction of torsion after superior oblique tuck surgery.

Durnian et al[11] evaluated the effect of superior oblique muscle tuck as a single-muscle surgery for selected cases with fourth nerve palsy by retrospectively reviewing the medical records of 75 cases. They reported successful outcomes in 71% of cases, no intraoperative complications, 10 cases of subclinical Brown syndrome, and 29.3% additional surgeries.

Many types of surgery, including tenotomy, tenectomy, Z-tenotomy, recession, split-lengthening procedures, and spacer tenotomy, can be performed to reduce the power of the superior oblique muscle gradually. Our surgical preference for Brown syndrome is intrasheath nasal tenotomy. However, the main potential complication is still secondary inferior oblique overaction which may require a second operation in order to weaken the ipsilateral inferior oblique muscle.[12] To prevent iatrogenic superior oblique palsy, Velez et al[13] stated that 15 mm posterior tenectomy was an effective procedure for patients with Brown syndrome who had fusion, small vertical deviation, and marked downshoot. Wright[14] suggested a silicone tendon expander for well controlled superior oblique muscle weakening, and recommended this procedure for Brown syndrome, with a high success rate.

Ung et al[15] determined that weakening of the superior oblique muscle was effective in collapsing of A pattern, but was inadequate to provide ocular alignment in primary position and to reduce vertical incomitance. In the present study, we found a significant reduction of A pattern after superior oblique temporal tenotomy. Superior oblique tendon lengthening was used in addition to tenotomy or tenectomy for management of superior oblique overaction and was found to be effective.[16,17] Adjustable surgery for the superior oblique muscle was used by Goldenberg-Cohen et al[3] and was also found to be effective, but was not used in the present study.

The present study should be considered in the context of some limitations, ie, its retrospective and noncomparative design and the small number of patients included. Further, the variety of operations and etiologies, as well as additional surgeries, may affect the surgical outcomes at a later date. Although the results of the present study reflect outcomes at a single center, our aim was to present the most commonly performed types of superior oblique muscle surgery for different indications in our clinical practice in view of its rarity, to analyze and report the surgical results in different clinical situations, to discuss the preferred choices in terms

of success, and to encourage further discussion about the need for different approaches.

In conclusion, superior oblique muscle surgery may result in good clinical outcomes when performed with appropriate clinical indications and for selected cases. The choice of surgical method should be individualized in order to avoid complications.

Disclosure

The authors report no conflict of interest in this work.

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