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When is isolated inferior oblique muscle surgery an appropriate treatment for superior oblique palsy?

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PURPOSE. *To evaluate the efficacy of isolated inferior oblique muscle weakening in the treatment of superior oblique palsy.*
METHODS. *Forty-seven patients with superior oblique palsy underwent either single-muscle surgery (anteriorization or recession of the inferior oblique muscle) or two-muscle surgery (anteriorization of the inferior oblique muscle combined with recession of the contralateral inferior rectus muscle according to the amount of vertical deviation). In a retrospective noncomparative study the objective surgical effect was calculated as the difference between the deviation at the day before surgery and the deviations 6 weeks and at least 1 year after surgery. Pre- and postoperative sensorimotor status and subjective outcome were evaluated.*
RESULTS. *In patients who underwent isolated inferior oblique muscle surgery the mean preoperative vertical deviation decreased from 15±9 (distance)/16±10 (near) prism diopters (PD) (anteriorization) and 7±5 (distance)/9±8 (near) PD (recession) to 4±4 (distance)/4±6 (near) PD (anteriorization) and 2±2 (distance)/2±3 (near) PD (recession) at the 1-year follow-up. In patients who underwent two-muscle surgery the mean vertical deviation decreased from 20±11 (distance)/21±10 (near) PD preoperatively and 6±7 (distance)/6±6 (near) PD at 1-year follow-up. Subjective assessment showed excellent scores among the patients treated with single-muscle surgery and slightly lower but also favorable scores among the patients treated with combined techniques. A direct comparison of the different outcome scores was not possible because of the more difficult initial situation in patients who underwent combined surgery.*
CONCLUSIONS. *Isolated inferior oblique muscle weakening is an effective treatment option for superior oblique palsy up to 15 PD of vertical deviation in primary position. Two-muscle surgery should be reserved for patients with larger vertical deviations. (Eur J Ophthalmol 2006; 16: 10-6)*

KEY WORDS. *Superior oblique palsy, Inferior oblique muscle, Anteriorization, Recession, Surgical outcome, Patient satisfaction*

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INTRODUCTION

Unilateral superior oblique palsy can be congenital or acquired. Estimating the true incidence of congenital superior oblique palsies is difficult, since many patients compensate the palsy using a head-tilt or large fusional amplitudes for many years until the fusional reserves diminish by a variety of possible causes ([1]).

([1]). Sheik ZA, Hutcheson KA. Trochlear nerve palsy. 2001. Available at: www.emedicine.com.

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Only a few studies have attempted to determine the incidence of acquired and congenital superior oblique palsies (1-3). Patients with superior oblique palsy may report vertical, torsional, or oblique diplopia – which is usually worse in downgaze and gaze away from the side of the affected eye. The treatment of superior oblique palsy is usually surgical. Botulinum toxin treatment has been discouraging (4).

The optimal surgical therapy for superior oblique palsy is controversial. A few surgeons advocate surgery on more than one extraocular muscle while others advocate weakening of the overacting inferior oblique muscle as the initial procedure.

The surgical techniques to correct superior oblique palsy include anterior transposition (anteriorization), recession, disinsertion, myotomy, myectomy, and denervation-extirpation (5-7).

There are early articles, for instance, by Gillies, Urist, and Apt and Call describing procedures for recession of the inferior oblique muscle that appreciated it as an effective weakening procedure in patients with inferior oblique overaction (8-12).

In recent years anterior transposition of the inferior oblique muscle has received more attention. Its principle is to convert the inferior oblique muscle into an antielevator of the globe (13-19). Farvardin and Nazarpoor (13) found anterior transposition of the inferior oblique muscle to be effective in eliminating the overaction of inferior oblique muscle (15, 16). As mentioned, anterior transposition has also been compared with recession of the overacting inferior oblique muscle. These studies showed either similar results in correcting the primary position hyperdeviation or a weaker postoperative inferior oblique muscle action in the anterior transposition group (17-19). A few authors, such as Ziffer et al (17), mentioned postoperative hypotropia in upgaze and therefore suggested performing anterior transposition in both eyes for bilateral inferior oblique muscle overaction and not unilaterally. Three articles recently found anterior transposition to be an effective technique for correction of hypertropia associated with inferior oblique overaction (20-22).

While weakening procedures of the inferior oblique muscle have become an established surgical option for superior oblique palsy, there are other approaches. Maruo et al (23) favor strengthening operations for the underacting superior oblique muscle as the primary choice. Klainguti et al included in their study single muscle surgery as well as combined techniques and found a greater reduction of vertical deviation in the latter ones (24).

The ultimate aim of any strabismus surgery is to have a content asymptomatic or oligosymptomatic patient after treatment rather than a mere reduction of the preoperative deviation. We therefore applied a subjective assessment score to evaluate the outcome of the performed surgical procedures.

METHODS

In this retrospective study the records of patients with superior oblique palsy who underwent eye-muscle surgery by the same surgeon (Dr. Killer) at the Department of Ophthalmology of Kantonsspital Aarau between 1997 and 2002 were reviewed. Patients who underwent prior surgery in other institutions or presented with insufficient diagnostic information were excluded from the study. Thirty-five of the remaining 47 patients were treated with either anteriorization or recession of the inferior oblique muscle (single muscle surgery) – 25 patients with anteriorization of the inferior oblique muscle and 10 patients with recession of the inferior oblique muscle. Twelve patients whose vertical deviation exceeded 20 prism diopters (PD) in primary position underwent two-muscle surgery (anteriorization/recession of the inferior oblique muscle and recession of the contralateral inferior muscle).

Surgical technique

In all patients the conjunctiva and Tenon's capsule were incised inferotemporally and the inferior oblique muscle was isolated with a Steven's hook. After placing a Vicryl 6-0 suture about 4 mm from its insertion the inferior oblique muscle was dissected. Bleeding was controlled by cauterization. In case of a preoperative vertical deviation larger than 15 PD (primary position) the inferior oblique muscle was anteroplaced to the temporal border of the inferior rectus muscle insertion. In cases of a preoperative vertical deviation up to 15 PD (primary position) the muscle was reinserted 5 mm posterior to the temporal border of the inferior rectus muscle. If the preoperative verti-

TABLE I - CLINICAL CHARACTERISTICS OF PATIENTS PREOPERATIVELY

Patient	Age, yr/sex	Vertical deviation		Horizontal deviation		Binocularity	Stereo acuity
		At distance	At near	At distance	At near		
1	65/M	3	4	4	12	x	x
2	27/F	6	30	4	8	x	o
3	23/M	30	30	6	8	x	o
4	8/F	small L/R	small L/R	0	4	x	x
5	5/F	7	6	0	4	x	x
6	23/M	11	25	8	6	x	o
7	41/M	3	5	0	0	x	x
8	5/F	small L/R	small L/R	6	8	x	x
9	20/F	small L/R	7	50	40	x	o
10	14/M	16	18	14	12	x	x
11	44/M	12	30	8	4	x	(x)
12	27/M	16	11	0	6	x	x
13	8/F	4	8	8	8	x	x
14	56/M	10	6	5	0	x	(x)
13	39/F	25	30	14	20	x	x
14	32/F	6	25	0	0	x	x
15	68/F	16	5	12	1	x	x
16	7/F	18	14	5	4	x	x
17	35/M	5	12	4	12	x	x
18	44/M	2	2	4	6	x	x
19	4/F	6	7	0	4	x	x
22	7/M		30	18		x	x
20	12/M	26	30	0	0	x	x
21	28/M	10	10	6	6	x	x
22	48/F	20	8	10	16	x	x
23	3/F	25	20	18	18	(x)	(x)
24	67/M	11	3	0	10	x	x
25	34/F	10	11	14	30	(x)	x
26	53/M	12	10	5	8	x	x
27	35/F	9	9	4	4	x	x
28	7/M	30	30	14	14	(x)	x
29	54/M	40	45	6	12	x	x
30	50/M	8	16	0	0	x	x
31	24/M	23	20	0	6	x	x
32	57/M	25	25	2	4	x	x
33	76/M	7	7	2	8	x	x
34	7/F	7	8	16	12	x	x
35	43/M	20	10	0	0	x	(x)
36	2/M	35	35	0	0	x	o
37	11/M	20	12	0	0	x	x
38	2/M	10	10	0	0	?	x
39	35/F	8	8	2	4	x	x
40	46/F	20	15	0	2	x	x
41	5/M	20	14	14	8	o	o
42	25/M	3	25	0	0	x	x
43	34/M	25	25	0	3	x	x
44	27/M	35	30	0	4	x	(x)
45	41/M	10	10	0	0	x	o
46	50/M	6	4	0	0	x	x
50	69/F	11	12	6	14	x	x
47	5/M	10	14	0	8	x	o

x = Stereo acuity with Lang test; (x) = Partial stereo acuity with Lang test; 0 = No stereo acuity with Lang test

TABLE II - PRE- AND POSTOPERATIVE VERTICAL DEVIATION IN THE THREE DIFFERENT GROUPS

Performed surgery	Number of patients	Age, yr	Preoperative vertical deviation (prism diopters)		Long-term postoperative vertical deviation (prism diopters)	
			At distance	At near	At distance	At near
Anteriorization	25	31+/-21	15+/-9	16+/-10	4+/-4	4+/-6
Recession	10	36+/-24	7+/-5	9+/-8	2+/-2	2+/-3
Combined techniques	12	23+/-14	20+/-11	21+/-10	6+/-7	6+/-6
All together	47	30+/-20	15+/-10	16+/-11	4+/-5	4+/-6

This table makes for the clearness of results - it does not mean a direct comparison of the groups

cal deviation (primary position) exceeded 20 PD above described anteriorization/recession of the inferior oblique muscle was combined with recession of the contralateral inferior rectus muscle. The conjunctiva was closed with Vicryl 7-0.

Patient records were examined, and the following data were retrieved: age at time of surgery, kind of surgery performed, complete sensory and motor status on the day prior to surgery as well as 6 weeks and usually 1 year, but at least 4 months, after surgery, and assessment of the postoperative results by the patients. The motor status included versions and ductions as well as measurements with the alternating prism cover test in all directions of gaze. Sensory functions were evaluated using at least three of the following tests: Worth Four Dot testing, Bagolini lenses, and stereo testing (Lang stereo test) in primary gaze. The subjective results, which were obtained at the time of the long-term follow-up (usually at least 1 year, but at least 4 months, after surgery), were graded between 0 = complaints not at all improved and 3 points = no more complaints (1 = complaints markedly improved, but patient still bothered; 2 = minor complaints that do not noteworthily bother the patient).

RESULTS

Forty-seven patients had been included in this study: 17 female, 30 male. The average age at the time of surgery was 30±20 years (range 2 to 76 years). There were 40 cases of congenital and 7 cases of acquired fourth nerve palsy (6 due to severe head trauma, 1 due to microvascular disease). In case of presence of high vertical fusion amplitudes (usually exceeding 6 PD) and no discernible etiology, the palsy was presumed to be congenital. The mean preoperative vertical deviation was 15±10 PD at distance and 16±11 PD at near; 3 of 47 (at distance) and 2 of 47 patients (at near), respectively, presented with very small vertical deviations which were not measurable. In 45 patients binocularity was present. One patient showed no evidence of binocularity and in one 2-year-old girl these tests could not be reliably performed. Normal stereo acuity was present in 39 patients; reduced stereo acuity was present in 4 patients. In 8 patients stereo acuity could not been demonstrated, but binocular single vision was present. The demographic and preoperative data for all the included patients are given in Table I.

As described above (see Methods) single muscle surgery was carried out in presence of smaller vertical deviation while combined techniques were preferred in case of larger vertical deviation. The vertical deviation in the single-muscle-surgery groups (anteriorization and recession, respectively) was 15±9 PD and 7±5 PD at distance/16±10 PD and 9±8 PD at near, while the vertical deviation in the two-muscle group was 20±11 PD at distance/21±10 PD at near (Tab. II). Differences concerning the age distribution within the three groups (anteriorization, recession, combined techniques) are summarized in Table II. In all groups markedly smaller vertical deviations could be measured after surgery (Tab. II).

In the single-muscle surgery group, in 14% (5/35 at distance)/ 23% (8/35 at near) of the patients (anteriorization 20% at distance/28% at near, recession 0% at distance/10% at near) the remaining hyperdevia-

TABLE III - ASSESSMENT OF THE RESULTS OF PERFORMED SURGERY BY PATIENTS TOGETHER WITH REDUCTION OF DEVIATION

Performed surgery	Reduction of vertical deviation, %		Reduction of horizontal deviation, %		Assessment by patients	Further surgery necessary
	At distance		At nearAt distance		At near	
Anteriorization	79+/-24	74+/-28	70+/-35	53+/-36	2.6+/-0.7	2/25 (8%)
Recession	74+/-35	90+/-14	58+/-39	51+/-38	2.8+/-0.4	0/10 (0%)
Combined techniques	68+/-29	73+/-25	46+/-26	46+/-27	1.9+/-0.9	3/12 (25%)
All together	75+/-27	77+/-25	62+/-34	51+/-34	2.4+/-0.7	5/47 (11%)

This table makes for the clearness of results - it does not mean a direct comparison of the groups

tion was 5 PD or more (primary position); in the combined-surgery group, in 17% (2/12 at distance)/25% (3/12 at near). By anteriorization a reduction of vertical deviation of 79±24% at distance/74±28% at near could be reached, by recession 74±35% (distance)/90±14% (near), and by combined techniques 68±29% (distance)/73±25% (Tab. III). All techniques showed a smaller amount of reduction of horizontal deviation than that of vertical deviation; just in the anteriorization group at distance (70±35%) an amount ranging nearby that of vertical deviation could be found (Tab. III).

As shown in Table III, the subjective assessment of the results by patients showed excellent results in the anteriorization and recession group (2.6±0.7 and 2.8±0.4, respectively). In the combined-techniques group we could with 1.9±0.9 evaluate also a favorable score – particularly considering the more difficult initial situation in this group. A total of 25% of the patients in these groups needed further surgery. Only 6% (anteriorization 8%, recession 0%) of the patients treated with single-muscle surgery needed further surgery (Tab. III).

DISCUSSION

Inferior oblique muscle surgery is a simple procedure that was able to correct the vertical deviation in the primary position as well as in other positions of gaze in the majority of our patients as well as in previous studies (9-22). The remaining vertical deviations after single muscle surgery are usually very small and easy for patients to control. We showed that further surgical treatment is rarely necessary for preoperative deviations not exceeding 15 PD in primary gaze. Furthermore we found no case of marked overcorrection and only a low rate of moderate undercorrection (2 patients of 25 who needed further surgery after anteriorization) indicating that isolated surgery on the inferior oblique muscle appears to be a procedure that produces predictable results in patients with vertical deviations up to 15 PD. We are aware, however, that unilateral anteriorization of the inferior oblique muscle can limit supraduction and lead to diplopia in this position. Kushner (25, 26) reported that anteriorization of the inferior oblique muscles more than 1 mm anterior to the insertions of the inferior rectus muscle may cause a limitation of elevation in abduction and that it causes significant narrowing of the palpebral fissure as a sole procedure. As described above, in our patients the inferior oblique muscle was reinserted just at the temporal border of the inferior rectus muscle, which may have prevented the first problem to some degree. However, as reflected by the subjective assessment by the patients, both problems did not cause a disturbing problem in our study group. Furthermore, there was an excellent overall assessment score of the postoperative results by the patients treated with one-muscle surgery. The lower assessment score in the two-muscle-surgery group may in part reflect the larger initial deviation in these patients.

It should be noted that many patients fit the clinical profile of congenital superior oblique palsy, whereas traumatic cases often predominate in clinical practice (27). Patients with congenital superior oblique palsy tend to present with large vertical deviations (28). However, the success of isolated inferior oblique

surgery in this study population suggests that it should be at least as efficacious as in patients with traumatic superior oblique palsy. Congenital superior oblique palsy is known to be associated with a lax or absent superior oblique tendon (28-30), and superior oblique tuck has been advocated as the initial surgical procedure (31). We did not perform an exaggerated superior oblique forced duction test or explore the superior oblique tendon since, in our experience, superior oblique tuck is unpredictable in patients with congenital superior oblique palsy.

Our surgical results indicate that isolated inferior oblique weakening obviates the need for diagnostic examination of the superior oblique tendon when patients conform to this clinical profile of congenital superior oblique palsy, in accordance with the advice of Jampolsky (32).

Limiting initial surgery to the inferior oblique muscle minimizes the risk of surgical overcorrection and reversal of head tilt, which can simulate superior oblique palsy in the contralateral eye (33). It remains our clinical impression that inferior oblique weakening is a self-titrating procedure, as evidenced by the absence of overcorrections even in those patients who had minimal hyperdeviations in primary gaze. While simultaneous surgery on the ipsilateral inferior oblique and contralateral inferior rectus muscle has been advocated when large vertical deviations were present in downgaze (28), we did not find significant postoperative deviations in downgaze following inferior oblique muscle surgery. Our criteria for the success of our surgical results were the residual vertical deviation in primary position and on the patient's sense of subjective improvement. It could be argued that measurement of residual vertical deviation only indirectly reflects the patient's postoperative degree of fusional control of any residual intermittent hypertropia. While we used the patient's residual vertical deviation as an objective outcome measure that provides an objective quantitative index of mechanical effect, we also relied upon subjective evaluations to further assess the impact of the residual hyperdeviation. Although we recognize that residual torsion can impede fusional vergence, our patients' postoperative fusional control seemed to correspond closely to their residual hyperdeviation on follow-up evaluations. Isolated inferior oblique surgery sometimes leaves a residual hyperdeviation in certain positions of gaze (especially when there is spread of comitance) but our results indicate that restoration of a window of single binocular vision in primary gaze is usually associated with sufficient patient satisfaction to obviate the need for subsequent surgery except when secondary contracture leads to spread of comitance.

We conclude that patients with superior oblique palsy and ≤15 PD hyperdeviation can be managed with isolated inferior oblique muscle surgery, consisting of anteriorization or recession of the inferior oblique, and that two-muscle surgery should be reserved for greater deviations.

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