

**ORIGINAL ARTICLE**

**ANTERIOR TRANSPOSITION OF THE INFERIOR OBLIQUE MUSCLE FOR TREATMENT OF SUPERIOR OBLIQUE PALSY WITH 10 TO 25 PRISM DIOPTERS HYPERDEVIATION IN PRIMARY POSITION**

Majid Farvardin MD<sup>\*</sup>, Shahin Nazerpoor MD, Mohsen Farvardin MD

*Department of Ophthalmology, Shiraz University of Medical Sciences, Shiraz, Iran*

**Background** – Weakening of the inferior oblique muscle is the procedure of primary importance in the treatment of patients with superior oblique palsy, Knapp's classes I and III. In this study, the effectiveness of anterior transposition of the inferior oblique muscle in the treatment of these patients was evaluated.

**Methods** – Twenty three patients with superior oblique palsy, Knapp's classes I and III underwent anterior transposition of the inferior oblique muscle. These patients had 10 to 25 prism diopters (PD) hyperdeviation in primary position. The tip of the disinserted muscle was sutured to the sclera parallel and adjacent to the lateral border of the inferior rectus muscle insertion. The prism and alternate cover test measurements were performed in all cardinal positions of gaze before and six months after surgery.

**Results** – The mean reduction of hyperdeviation measured 14.9 PD in the primary position, 23 PD in adduction, 25.2 PD in elevation and adduction, and 18.1 PD in depression and adduction. There was no hypotropia in the primary position or limitation of upgaze. Postoperative hyperdeviation in the primary position was 5 PD or less in 21 out of 23 patients.

**Conclusion** – The anterior transposition of the inferior oblique muscle is very effective in eliminating hyperdeviation in patients with superior oblique palsy, Knapp's classes I and III. Up to 25 PD of hyperdeviation reduction in the primary position can be achieved. If this type of anterior transposition is used, hypotropia in the primary position or limitation of upgaze will possibly not occur.

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**Keywords** • anterior transposition • inferior oblique muscle • superior oblique palsy

**Introduction**

**S**uperior oblique palsy is the most common form of paralytic strabismus. It may be unilateral or bilateral. The diagnosis of superior oblique palsy is based on the presence of hypertropia, usually greatest in the nasal field of the involved eye.<sup>1</sup>

In 1974, Knapp classified superior oblique palsy according to the pattern of vertical deviation measured in nine cardinal positions of gaze.<sup>2</sup> Classes I, II, and III are the most common types.<sup>3</sup>

Surgical treatment of superior oblique palsy is still a controversial issue. Because the majority of patients with unilateral superior oblique palsy present with significant overaction of the ipsilateral inferior oblique, weakening of this muscle is the procedure of primary importance. The methods commonly employed include recession, myectomy, and disinsertion. Resolution of 10 prism diopters (PD) of hyperdeviation in primary position is common after such procedures.<sup>4</sup> Anterior transposition of the inferior oblique muscle has recently been introduced as a means for weakening of overacting inferior oblique muscles.<sup>5</sup> Anterior transposition may work in part by converting the inferior oblique muscle from an elevator to a

**•Correspondence:** M. Farvardin MD, Department of Ophthalmology, Shiraz University of Medical Sciences, Shiraz, Iran. Fax: +98-711-6279374, E-mail: farvardin@sums.ac.ir.

**Table 1.** Characteristics of the patients.

No. of patients	Age at the time of surgery (yr)	Sex	Knapp's class	Preoperative deviation in primary position (PD)
1	13	F	I	20LH
2	20	M	I	20RH-25ET
3	2	M	I	20RH-5ET
4	14	M	III	25LH-10ET
5	4	F	I	15RH-20ET
6	10	M	I	14LH-25ET
7	5	F	III	12RH
8	11	F	I	12LH-5ET
9	15	F	III	15LH-25ET
10	13	F	III	20RH-25XT
11	18	F	III	15RH-25XT
12	21	F	III	20LH-10XT
13	28	M	III	20RH-30ET
14	16	M	III	14LH
15	20	F	III	23LH
16	6	F	I	10RH-20ET
17	39	M	III	22RH
18	12	M	I	20LH-25XT
19	11	F	I	16RH
20	5	M	III	15RH-30XT
21	8	F	III	16LH
22	4	M	I	15LH-12ET
23	10	F	III	15RH

PD = prism diopters; F = female; M = male; ET = esotropia; XT = exotropia; LH = left hypertropia; RH = right hypertropia; yr = year.

depressor of the globe. In theory, this would be useful in treating the inferior oblique overaction, associated with superior oblique palsy.<sup>6</sup> There are few reports with unclear results on using anterior transposition of the inferior oblique muscle for the treatment of patients with superior oblique palsy. In this study, the effectiveness of this procedure in the treatment of patients with superior oblique palsy, Knapp's classes I and III and 10 to 25 PD hyperdeviation in primary position was evaluated.

### Patients and Methods

The subjects of this prospective study consisted of 23 patients with unilateral superior oblique palsy in Khalili Hospital, Shiraz University of Medical Sciences, Shiraz, Iran. The criteria for the diagnosis of unilateral superior oblique palsy

included hypertropia in the primary position, increase in the nasal field of the involved eye, and positive Bielschowsky head tilt test.

Ocular deviation was measured in the nine cardinal positions at distance while, the best corrected vision and accommodative targets were used to control fixation. The prism and alternate cover test method were used.

The surgical technique of Elliott and Nankin for anterior transposition of the inferior oblique muscle was used. The tip of the disinserted inferior oblique muscle was sutured to the sclera, just anterior to the temporal insertion of the inferior rectus muscle. In the case of associated horizontal deviation, appropriate horizontal surgery was done in combination with anterior transposition of the inferior oblique muscle.

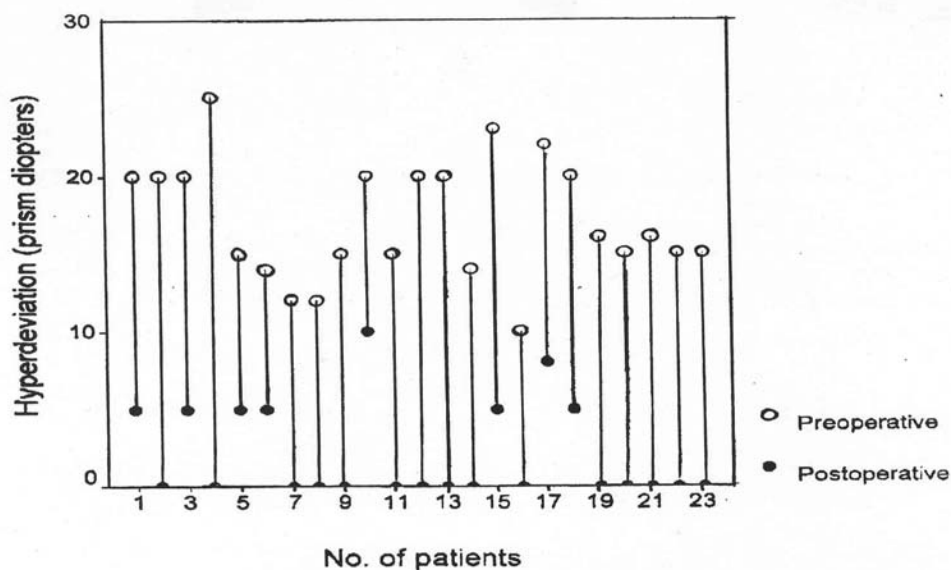
Six months after the surgery, ocular deviation

**Table 2.** Postoperative results.

Gaze position	Preoperative hyperdeviation (PD)	No. of patients	Mean reduction of hyperdeviation (PD)
Primary	0 - 15	11	12.9
	16 - 25	12	16.8
Adduction	0 - 15	1	15
	16 - 25	11	21
	26 - 45	11	25.5
Elevation/adduction	0 - 15	1	15
	16 - 25	8	19.5
	26 - 45	14	29.2
Depression/adduction	0 - 15	4	13.1
	16 - 25	15	17.8
	26 - 45	4	24

PD = prism diopters.

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**Figure.** Hyperdeviation in the primary position before (open circle) and after (closed circle) surgery.

was measured again. A patient was considered to have a successful surgical outcome if the postoperative hyperdeviation in the primary position was 5 PD or less and the maximum postoperative hyperdeviation in an oblique diagnostic position of gaze was 10 PD or less.

### Results

The twenty three studied patients consisted of thirteen females and ten males. The average age at the time of surgery was 13.3 years (age range, 2 to 39 years). Thirteen patients had their palsy from birth or early infancy. In three cases, the palsy was associated with previous head trauma and was considered traumatic in origin. In seven cases, the cause of the palsy was unknown. Twelve patients had right-sided palsy while the other eleven had left-sided palsy. There were ten patients with Knapp's class I and thirteen with Knapp's class III palsy. Table 1 shows age, sex, Knapp's class, preoperative deviation in the primary position, and side of palsy in each patient.

The average of preoperative hyperdeviation was 17.1 PD (10 to 25 PD) in the primary position, 25.2 PD (14 to 35 PD) in adduction, 29.3 PD (20 to 45 PD) in elevation and adduction, and 21.1 PD (10 to 30 PD) in depression and adduction.

Preoperative and postoperative hyperdeviations in the primary position for each patient are shown

in Figure. The mean reduction of hyperdeviation in the four primary positions of gaze was calculated to determine the effectiveness of the anterior transposition of the inferior oblique muscle (shown in Table 2). The average reduction of 14.9 PD in the primary position, 23 PD in adduction, 25.2 PD in elevation and adduction, and 18.1 PD in depression and adduction were achieved. The average reduction of hyperdeviation in all positions of gaze was 14.4 PD.

Anterior transposition of the inferior oblique muscle was considered successful in 21 out of 23 patients (91% success rate). No surgical complication was seen. There was no hypotropia in the primary position or limitation of upgaze.

### Discussion

The anterior transposition of the inferior oblique muscle was highly effective in eliminating hyperdeviation in patients with superior oblique palsy, Knapp's classes I and III. In our patients, the average reduction of hyperdeviation in all positions of gaze was 14.4 PD. In a comparable study using inferior oblique myectomy, this quantity was shown to be 11.91 PD.<sup>7</sup> In our study, only two patients (9%) needed a second surgery for hyperdeviation. In a comparable study, using recession of the inferior oblique muscle, the need for a second surgery was near 20%.<sup>8</sup>

In our patients, the extent of vertical correction was roughly proportional to preoperative hyperdeviation. The average reduction of hyperdeviation in the primary position was 12.9 PD in patients with 10 to 15 PD of preoperative hyperdeviation and 16.8 PD in those with 16 to 25 PD of preoperative hyperdeviation. In two other reports, 12 and 17 PD reduction of hyperdeviation in the primary position were achieved with anterior transposition of the inferior oblique muscle.<sup>6,9</sup> This difference could be due to the difference in preoperative hyperdeviations in these two studies.

The most important complications reported for the anterior transposition of the inferior oblique muscle are hypotropia in the primary position and limitation of upgaze. Bremer et al have reported hypotropia in the primary position and limitation of upgaze in three patients with superior oblique palsy, following anterior transposition of the inferior oblique muscle.<sup>10</sup> However, May et al found that no hypotropia occurred after unilateral anterior transposition surgery in patients with superior oblique palsy.<sup>9</sup> Ziffer et al found that anterior transposition surgery may lead to limitation of upgaze, but this limitation is not a cosmetically noticeable or functionally unacceptable result.<sup>11</sup> Primary-position hypotropia and marked limitation of upgaze may be due to overanteriorization of the inferior oblique muscle. Kushner noted that the transposition of the inferior oblique muscle to more than 1 mm anterior to the insertion point of the inferior rectus muscle may cause limitation of upgaze.<sup>12</sup> Hypotropia in the primary position and the limitation of upgaze were not observed in our study. In our patients the tip of the disinserted inferior oblique muscle was sutured to the sclera, at a point less than 1 mm anterior to the temporal insertion of the inferior rectus muscle.

Using this type of anterior transposition of the inferior oblique muscle, primary-position hypotropia or limitation of upgaze will possibly not occur.

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