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**Surgery to Treat Residual Acquired Excyclotropia without Changing the Primary Position**  
**Vertical Deviation - A Case Report**

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## **Surgery to Treat Residual Acquired Excyclotropia without Changing the Primary Position**

### **Vertical Deviation - A Case Report**

#### Abstract

*Aim:* To describe the surgical management and long term outcome of a case of symptomatic residual acquired primary position excyclotropia, without changing the vertical deviation.

*Methods:* This case report describes ipsilateral half tendon width transpositions of the left superior rectus temporally and inferior rectus nasally, combined with right inferior rectus posterior fixation suture at 11mm.

*Results:* Three days postoperatively the transposition procedure produced a 10° cyclotorsional change in primary position, resulting in 5° of incyclotorsion. Six weeks postoperatively the incyclotorsion regressed to 1° and a central field of BSV was demonstrated. Fifteen months postoperatively 1° incyclotorsion and the field of BSV remained stable. The vertical deviation was changed by 1 prism dioptre.

*Conclusion:* In our case ipsilateral half tendon width horizontal transpositions of the vertical recti achieved satisfactory correction of excyclotorsion and restored BSV without changing the primary position vertical deviation. The result was stable fifteen months post-operatively.

Keywords: excyclotropia, fourth nerve palsy, torsion, transposition surgery, vertical rectus muscles

#### Introduction

Following primary surgical treatment for bilateral asymmetric fourth nerve paresis, residual strabismus can still occur. Further treatment is indicated when the residual defect is symptom producing, particularly in primary position and/or downgaze. Excyclotropia is more common in acquired bilateral fourth nerve paresis and can act as a barrier to fusion and binocular single vision (BSV) when there is a minimal horizontal or vertical deviation in primary position. Prisms are unlikely to be helpful in such a case and occlusion would be required unless an abnormal head posture (AHP) could be adopted to achieve BSV.

Surgical management options of symptomatic residual excyclotropia include a superior oblique (SO) tuck (Knapp and Moore, 1976; Morris et al, 1992) or a Harada-Ito procedure (Harada and Ito, 1964) which is commonly modified (Fells, 1974). Horizontal transposition procedures of the vertical rectus muscles have been described as an alternative surgical option for cyclotropia (Okamoto et al, 2015; von Noorden et al, 1996; Ohmi et al, 1997).

We report the longer term successful outcome of a complex case of symptomatic residual acquired primary position excyclotropia with subnormal motor fusion and saccades secondary to a severe head injury. Following 1/2 tendon width transpositions of the SR rectus temporally and IR nasally, her excyclotropia resolved without significantly modifying the primary position vertical deviation and without inducing incomitance on eccentric gaze.

Case report

A 14 year old girl was referred for a second opinion with diplopia related to residual acquired primary position excyclotropia. At age 12 she sustained a severe head injury and bilateral asymmetrical fourth cranial nerve pareses in a road traffic accident. Following a period of observation without full recovery, she underwent a left inferior oblique (IO) myectomy at age 13. This reduced her vertical deviation, but she continued to experience constant torsional diplopia and was referred to our service for further management; unfortunately preoperative measurements were not available.

Unaided visual acuity (ETDRS) was right -0.08 (20/16-1) and left 0.02 (20/20-1) LogMAR. Her deviation measured 1Δ left hypertropia (LHT) in primary position and 8Δ LHT in depression; no horizontal deviation was present (alternate cover and prism test at 6m) (Figure 1). The patient complained of torsional diplopia, which she could not fuse, even with vertical prisms in free space. BSV could only be achieved with a 30–40° right head tilt. Excyclotorsion of 2° in primary position and 5° at 20 degrees in depression was measured, however gross BSV was demonstrable only when 5° excyclotorsion was corrected in primary position (synoptophore); suggesting that the true amount of torsion present was larger than subjectively reported and that fusion may be impaired following the severe head injury. The patient relied on occlusion to eliminate torsional diplopia, as the AHP was impractical to maintain. A residual, but markedly asymmetrical,

bilateral fourth nerve paresis was confirmed by the presence of an esotropia on extreme downgaze at near ( $1-2\Delta$ ), reversal of the vertical deviation on dextro-depression and laevo-depression, and on plotting a Hess chart.

At surgery, a forced duction test revealed no SO tendon laxity. To reduce the excyclotorsion without affecting the vertical deviation in primary position, ipsilateral 1/2 width transpositions of the left SR temporally and IR nasally were performed (Ohmi et al, 1997). A right IR posterior fixation suture was placed at 11mm from its insertion to reduce the residual LHT in depression (Buckley and Meekins, 1988). Three days postoperatively the procedures produced a  $10^\circ$  cyclotorsional change in primary position, resulting in  $5^\circ$  of incyclotorsion (double Maddox rod), with no vertical or horizontal deviation. In downgaze a  $1\Delta$  LHT and  $2\Delta$  exotropia was measured. At 6 weeks postoperatively the primary position incyclotorsion had regressed to  $1^\circ$  (synoptophore), no vertical deviation was present and a central field of BSV, without prisms or an AHP, was demonstrated. In downgaze  $1\Delta$  left hyperphoria and  $2\Delta$  esophoria was measured. At 15 months postoperatively the field of BSV remained stable and there was  $1^\circ$  incyclotorsion (Torsionometer), in both primary position and depression. A  $2\Delta$  exophoria was measured in primary position and a  $1\Delta$  LHT was measured in downgaze (Figure 2). The patient continued to have poor quality

saccades, smooth pursuits and fusion following her severe head injury, yet achieved BSV without prisms or an AHP.

## Discussion

Unilateral horizontal transposition of the SR temporally and IR nasally by one half tendon width was successful in reducing 5° of primary position excyclotorsion in a case of residual bilateral asymmetrical fourth nerve pareses without primary position vertical diplopia, following a severe head injury and a previous left IO myectomy. The initial postoperative 5° incyclotorsion reduced to 1° within six weeks and BSV was achieved. We postulated that for a patient whose motor fusion was impaired this choice of transposition may be less likely to induce incomitance on eccentric gaze, compared to a less symmetrical single muscle full tendon width transposition. Information on eccentric gaze findings are not otherwise available in the literature. A range of tests were used to measure the torsional deviation including the synoptophore, double Maddox rod and Torsionometer. They were selected on the basis of the information required, each torsion test was performed according to the manufacturer's instructions as described in Ansons and Davis (2014). We acknowledge that using the same clinical torsion test at each visit would have been desirable in our case.

The surgical management of torsional diplopia in primary position is challenging, especially in a patient with compromised motor fusion following a severe head injury. The traditional surgical approaches to reduce excyclotorsion in the presence of a primary position vertical tropia is a SO

tuck (Knapp and Moore, 1976; Morris et al, 1992). No change in the primary position vertical deviation was reported as a feature of the Harada Ito procedure (Harada and Ito, 1964) or Fells modification thereof (Fells, 1974), yet primary position hypotropia can occur, leading some to prefer an adjustable modified Harada-Ito procedure (Elsas, 1988). Reported outcomes of modified Harada-Ito procedures focus on its torsional effect, with little detail about the effect on the horizontal or vertical deviations (Bradfield et al, 2012; Younis et al, 1995).

Whilst a unilateral modified Harada-Ito procedure is likely to have corrected 5° of primary position excyclotropia (Bradfield et al, 2012) the impaired fusion and saccadic eye movements caused by the severe head injury in our case was of key concern, as recognised by Elsas (1988) and Fells (1976). Specific treatment of the excyclotropia was needed without changing the vertical deviation in primary position and risk inducing a symptomatic vertical deviation on sidegaze or upgaze (Morris et al, 1992) or a mild iatrogenic Brown syndrome (Bradfield et al, 2012). For these reasons an alternative procedure was considered.

Horizontal transposition of the vertical recti has been described to reduce abnormal head tilts in nystagmus (von Noorden et al, 1993) and improve torticollis and lateropulsion in ocular tilt reaction (Brodsky and Holmes, 2012). von Noorden et al (1996) described 11 cases of cyclotropia that underwent unilateral IR nasal transposition of one muscle width, which corrected a mean of 7.2° excyclotropia (range 2-10°) in primary position. Ohmi et al (1997) used a unilateral transposition of the SR temporally and IR nasally by one-half tendon with acquired

excyclotropia in primary position. Three months postoperatively a mean of  $7.8^\circ$  excyclotorsion (range  $6-10^\circ$ ) was corrected with no induced primary position vertical deviation, resolving the diplopia in all 3 cases.

Okamoto et al (2015) described 11 of 135 cases of acquired or decompensated SO palsy that had a one muscle width IR nasal transposition where the excyclodeviation was reduced by a mean of  $5.9^\circ$ , however the effect on the primary position and downgaze vertical and horizontal deviations were not described. For those cases with an accompanying small primary position hypertropia (**less than  $8\Delta$** ), Kushner (2010) performed an ipsilateral 7 mm IR nasal transposition with contralateral adjustable IR recession in 8 patients (Knapp Class II SO paresis). The outcome in primary position was a decrease in mean subjective excyclotropia of  $6.1^\circ$  (SD 0.99, range  $5-8^\circ$ ) **with a residual mean hypertropia of  $1.25\Delta$  (range  $0-2\Delta$ )**. Nemoto et al (2000) instead performed a diagonal half to full tendon-width transposition of a vertical muscle (“skew transposition”), often in the unaffected eye coupled to a contralateral vertical muscle resection or recession in 10 patients with SO palsy. At 4 weeks postoperatively this reduced the torsional deviation by  $6.4^\circ$  and reduced the vertical deviation by  $8.4^\circ$ .

In our case, and other transposition technique modifications, satisfactory correction of excyclotorsion was achieved without changing the primary position vertical deviation (Ohmi et al, 1997; von Noorden et al, 1996). We chose an ipsilateral half tendon width transposition of the SR and IR (Ohmi et al, 1997) as our case was complicated by a severe head injury that caused

impaired motor fusion, saccadic and smooth pursuit eye movements. It resulted in stable BSV through 15 months without prisms or an AHP and with 1° residual incyclotorsion and no vertical deviation. This is a much longer follow up period than previously reported in the literature. This procedure caused minimal or no change to the horizontal and vertical deviation in primary position and eccentric gaze (Figures 1 and 2). Further knowledge relating to the applications of these infrequent procedures will help establish their effectiveness, limitations, and the relative merits of transposing a single or both vertical recti in one or both eyes, via full or partial tendon width transpositions.

## Conclusion

For the small but specific subgroup of patients with symptomatic excyclotropia with little or no primary position vertical deviation, up to 10° of primary position excyclotorsion can be corrected by transposing vertical recti without new complications arising.

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