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The Diagnosis and Surgical Management of Acquired Bilateral Superior Oblique Palsy

N. C. PRICE, S. VICKERS, J. P. LEE and P. FELLS
London

Summary

Thirty-four patients with surgically treated bilateral superior oblique palsy are presented.

The patients are divided into three groups:

(1) Symmetrical palsies,
(2) Asymmetrical palsies,
(3) A group in whom the bilaterality was initially masked.

Bilaterality should be suspected in all cases of traumatic IVth nerve paresis, and particularly in cases with a large 'V' pattern, excyclo deviation of more than 10 degrees on down-gaze and when right hypertropia switches to left hypertropia on lateral down-gaze.

Bilateral Harada-Ito procedures alone 'cured' 11 of 17 patients (65 per cent) in groups 1 and 2, and is the operation of choice in acute bilateral superior oblique palsy. Cyclo deviation was reduced by a mean of 5.5° degrees in the primary position and by 6–10° in down-gaze.

Patients initially managed with other surgery had a more complicated surgical course and required more operations. Seven patients who initially demonstrated only gross fusion recovered good fusion after Harada-Ito surgery.

Bilateral superior oblique palsy has been discussed in several papers in recent years.[1–3,5,6]

It has been found to follow severe head trauma in many cases, and usually presents with troublesome torsional diplopia worse in down gaze.

The palsy may be symmetrical or asymmetrical but sometimes the diagnosis of bilaterality is difficult, and Hermann[7] has described 9 cases of 'masked' bilateral palsy.

About two-thirds of patients with bilateral IVth nerve palsies come to surgery,[5] but there has been no large series reported which allows us to assess the effects of surgery in the 3 groups described above. Fells and Waddell[2] reported that 10 of 17 patients had good results following bilateral superior oblique surgery as described by Harada and Ito[8] and modified by Fells[9] (Fig. 1). Mitchell and Parks,[3] reported good results in 9 patients with symmetrical pareses following the same procedure. We report a retrospective series of 34 cases of acquired bilateral superior oblique palsy treated surgically at Moorfields Eye Hospital. The series includes all patients with this pathology identified by a search of the orthoptic records and operating books for the past 15 years.

Results

Of the 34 patients, 14 were described as having symmetrical palsies on orthoptic

From: Moorfields Eye Hospital, High Holborn, London.
Correspondence to: J. P. Lee, FRCS, Moorfields Eye Hospital, High Holborn, London WC1V 7AN.

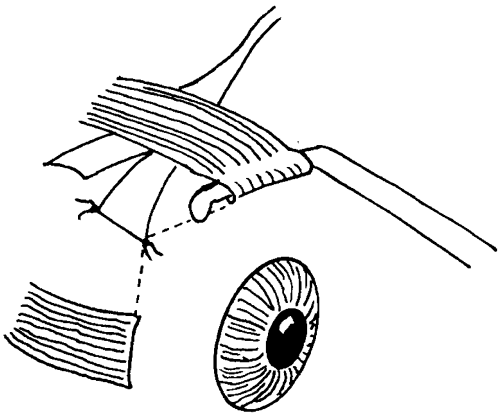

Fig. 1. *Fells modification of Harada-Ito procedure.*

examination, 11 were said to be asymmetrical and 9 were 'masked'.

Twenty-four had been involved in road traffic accidents and another 5 had fallen; down stairs, from a horse or from a ladder. One patient developed bilateral IVth nerve paresis secondary to an astrocytoma, and 4 were spontaneous in onset and probably represent late-presenting 'congenital' palsies (Table I).

Twenty patients had been rendered unconscious by the accident, 7 for more than one week. Seven patients described pre-trauma amnesia. The patients were mainly young (Fig. 2), with a peak incidence in the third decade. All but three of the patients complained of torsional and/or vertical diplopia, worse on down-gaze, and 17 adopted a chin-down head posture.

Five patients had their initial surgery at other hospitals and their pre-operative records are not available. A significant 'V' pattern was noted on orthoptic examination in 12 of the remaining 29 patients (Table II) but was not measurable using the synoptophore with ocular rotations of 20° up and down. It was more common in the symmetrical group than in the other patients.

Pre-operative cyclo deviation was 10° or more in the primary position in 10 out of 27 patients (37 per cent) but was 10° or more in 21 of 24 patients (88 per cent) on lateral down-gaze.

The vertical deviation in the primary position was less than 10 prism dioptres in 23 of 28 patients (82 per cent), and remained so on lateral down-gaze in 14 of 26 (54 per cent). Using the synoptophore 12 out of 24 showed the classic left over right changing to right over left on dextro and laevo depression, this sign being much more common in the presence of a symmetrical paresis (Table II).

The horizontal deviation was only significant (greater than 6°) in two patients.

All patients were observed for at least eight months after the onset of symptoms for signs of spontaneous recovery, before surgery was considered. Most underwent their first operation within 18 months, and those waiting longer did so because of delayed presentation.

Twenty-five patients with recognised bilateral pareses were admitted for surgery, and of these 21 had bilateral modified Harada-Ito procedures with or without other surgery as their first operation (Table III). If we ignore those patients with insurmountable neurological problems, 11 out of 17 were said to be cured (they had minor or no symptoms) by one operation and only one has required 3

Table I *Aetiology and injuries*

	Symmetrical	*Asymmetrical*	*Masked*
Aetiology			
RTA	12	7	5
Fall	1	3	1
Others	1 (Astrocytoma)	1 (Spontaneous)	3 (Spontaneous)
Unconscious			
No	5 (1)	3	6 (1)
<1/7	2	3 (1)	0
1/7–1/52	2	3	3 (1)
>1/52	5 (4)	2 (2)	0

() = Other significant neurological injury.

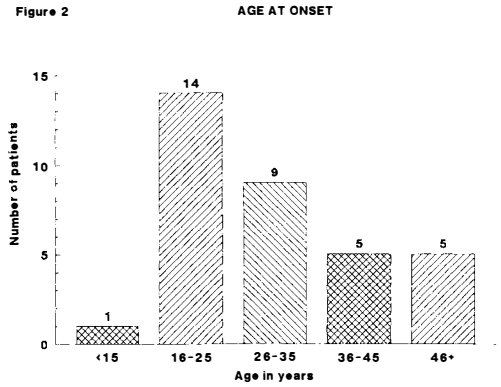

Fig. 2. *Age at onset.*

procedures to date. (Three patients are awaiting further surgery.)

In contrast, of the patients treated initially with other surgical procedures, 3 were 'cured' by two operations and 4 by three or more procedures. Three remain symptomatic and 3 await further surgery. Of the four cases originally diagnosed as bilateral but not treated by modified Harada-Ito surgery, two remain symptomatic, and two have been 'cured' by multiple procedures.

The effects of modified Harada-Ito operations on cyclo deviation and vertical strabismus are documented in Table IV. Cyclo deviation in the primary position was reduced by about 5.5° in both the symmetrical and asymmetrical groups, leaving a torsional strabismus of about 2°. In down-gaze, between 6–10° of cyclo deviation were relieved, leaving a mean of 7° uncorrected in both groups. Vertical strabismus in the primary position was reduced by 1.95 p.d. in the symmetrical patients and 2.5 p.d. in the asymmetrical group. The maximum recorded height was reduced by 5.5 to 6.1 p.d.

There was no significant change in horizontal alignment of the eyes after modified Harada-Ito surgery.

Twenty patients have no significant residual symptoms and another 6 are awaiting further surgery (Table V).

Eight patients remained symptomatic, but four of these have insurmountable neuro-

Table II *Pre-operative measurements*

	Symmetrical	*Asymmetrical*	*Masked*
'V' Pattern			
Yes	7	3	2
No	6	7	4
1° position cyclo			
<10°	7	8	2
10°+	6	2	2
No record	0	0	2
Maximum cyclo			
<10°	1	1	1
10°+	11	7	3
No record	1	2	2
1° position height			
$<10^{\Delta}$	11	9	3
10^{Δ}+	2	1	2
No record	0	0	1
Maximum height			
$<10^{\Delta}$	6	5	3
11^{Δ}+	6	4	2
No record	1	1	1
R/L → L/R on lateral downgaze			
Yes	8	3	1
No	3	5	4
No record	2	2	1

Table III

	Symmetrical	*Asymmetrical*	*Masked*
Time to surgery			
8–18 months	9	8	7
19–30 months	3	0	0
31+ months	2	3	2
First operation			
'Bilateral HI' ± others	12	9	0
Other surgery	2	2	9
Number of operations to 'cure' if 'bilateral HI' first			
1	6	5	0
2	1	0	0
3+	1	0	0
Waiting surgery	0	3	0
Intractible neurological disorder	3	1	0
Symptoms but no surgery	1	0	0
Number of operations to 'cure' if other surgery first			
1	0	0	0
2	0	1	2
3+	1	0	3
Waiting surgery	0	0	3
Symptoms but no surgery	1	1	1

logical problems (3 no fusion, 1 psychiatric disorder).

Three patients were found to have no fusion, but 7 who initially only demonstrated gross fusion regained detailed fusion after correction of their cyclo deviation (Table VI). Horizontal muscle surgery was carried out as part of the primary procedure in 3 cases, and was required in 4 cases later (Table VII).

The mean time since last operation in the 28 patients who have completed surgery is 62.6 months, ranging from 6 months to 185 months.

Discussion

Bilateral superior oblique palsy is uncommon, and usually follows head injury.[1–3,5,6,10–12] All of our cases of true acquired paresis followed head injury except the case secondary to an astrocytoma. The young age of the patients may reflect the distribution of people involved in road traffic accidents. The other four cases, who presented with symptoms of gradual onset of diplopia or blurring were probably congenital pareses. They are of particular interest since three were initially diagnosed as unilateral. This is in accord with the series of 9 patients with masked bilateral superior oblique palsy described by Hermann,[7] who had longstanding, and in many cases congenital palsies.

Table IV *Effects of 'bilateral Harada-Ito' procedure*

	1° height (no pts)	*Max height*	*1° cyclo°*	*Max cyclo°*
Change in				
Symmetrical	1.95 (10)	6.1 (7)	5.6 (9)	6.3 (8)
Asymmetrical	2.5 (4)	5.5 (2)	5.4 (5)	10.0 (3)
Residual after 'bilateral HI'				
Symmetrical	1.75 (10)	3.0 (8)	2.0 (9)	7.1 (8)
Asymmetrical	0.8 (5)	8.6 (3)	1.6 (5)	6.8 (4)

Table V *Symptoms*

	Symmetrical	*Asymmetrical*	*Masked*
None/minor after			
1 op	6	5	0
2 op	1	1	2
3+ op	2	0	3
Awaiting surgery after			
1 op	0	1	2
2 op	0	2	1
3+ op	0	0	0
Symptomatic with no surgery planned	5 3 no fusion 1 corrected by Fresnel after 7 ops 1 V eso + torsion after 1 op. Declined R_x	2 1 psychiatric disorder 1 diplopia after 3 ops	1 Diplopia after 9 ops

Almost all of our patients have a history of significant head injury, many of them suffered prolonged periods of unconsciousness and other neurological complications. Several authors[2,5,6] have associated bilaterality of IVth nerve paresis with severe head injury.

Torsional diplopia, worse on down-gaze, with or without a vertical element was universal in the acute group. The vertical component of the diplopia was in most cases negligible in the primary position: Mitchell and Parks[3] point out that the symptoms in a patient with symmetrical palsies appear out of proportion to the tiny vertical and horizontal strabismus present in the primary position.

The suspicion of bilaterality is vital in all cases of superior oblique palsy as it changes surgical management. Diagnostic criteria have been described which should alert one to the possibility of bilaterality: a history of head injury; a large 'V' pattern; cyclo torsion of more than 10° and right hypertropia on left gaze switching to left hypertropia on right gaze.

Since this study is retrospective, the methods of documentation cannot be controlled. Thus, while nearly half the patients were found to have a significant 'V' pattern on examination of the eye movements in free space, none were recorded as having large 'V' patterns using the synoptophore. The ocular rotations performed on synoptophore testing are necessarily limited, and it would be better to document the 'V' pattern using prism bars or the Lees screen. It is interesting to note that the finding of the 'V' was more common in symmetrical than asymmetric or masked pareses, and may therefore be of only limited value in diagnosing the difficult cases.

Table VI *Fusion*

3 patients	None → None
7 patients	Gross → Good
24 patients	Good → Good

All authors agree that significant excyclo deviation is a cardinal sign of bilateral IVth nerve palsy. Sydnor[5] suggested that excyclotorsion of more than 10° suggests bilaterality. Using synoptophore measurements, only 37 per cent of our patients showed 10° or more cyclo deviation in the primary position, but on lateral down-gaze, again using the synoptophore, only 3 patients failed to show 10° or more torsion. This may be the single most useful indicator of bilaterality as 3 of the 4 masked patients in whom the measurements were made, and 7 of 8 in the asymmetrical group had more than 10° of cyclo deviation on down-gaze. Since torsion increases on down-gaze, using the Lees screen and the T-piece wand described by Dulley and Harden[13] with greater ocular rotations may allow higher degrees of torsion to be recorded.

The finding of right hypertropia on left gaze and left hypertropia on right gaze is commonest in symmetrical palsies, and unusual in

Table VII *Surgical history and outcome*

Symmetrical	
Bilateral 'HI'	None
Bilateral 'HI'	None
Bilateral 'HI'	Minor
Bilateral 'HI'	Minor
Bilateral 'HI'	Minor
Bilateral 'HI'	Minor
Bilateral 'HI'/Bilateral IO−, LMR−adj	None
Bilateral 'HI'/LIR−adj/LIR+, RIR−adj	Minor
Bilateral 'HI'	V Eso Declined R_x
Bilateral 'HI', LIO−	No fusion
Bilateral 'HI', LLR− ↓, LMR+ ↓	No fusion
Bilateral 'HI', LMR− ↑, LR+ ↑/RSR−LMR tenotomy, LIR−adj	No fusion
LIR−, LSR−/LIR−adj/RSO tenot, RIO−, RIR+	Minor
Bilateral IO−/RSO Plicn/LSO plicn/LIR−/LSO plicn/RIR−LHI	Fresnels
Asymmetrical	
Bilateral 'HI'	None
Bilateral 'HI'	None
Bilateral 'HI'	None
Bilateral 'HI'	Minor
Bilateral 'HI', LMR−, LLR+	Minor
Bilateral 'HI'	For surgery
Bilateral 'HI'/LIO−, RIO−adj	For surgery
Bilateral 'HI', LLR−/RIR−	For surgery
Bilateral 'HI', Bilateral IO−, LSO lat tenotomy	Psychiatric disorder
RIO−, LIR−/LIO−, LIR−	None
Bilat IR−/Bilat HI/LIR Faden	Diplopia
Masked	
RHI/LHI, LIR Medial tenotomy	Minor
RIR−/Bilat 'HI'/LIR−/RIR−	Minor
LIO−, RIR−/Bilat 'HI'	Minor
RIR−/LIR−/Bilat 'HI'	Minor
LSO Plicn, RIR−/LSO adhesions divided/RIR−, RSR−/RIR+/RIR--	Minor
RIR−adj, LIO−	For surgery
RIO−, LIR−	For surgery
LIO−, RIR−adj/RIO−, RIR+adj	For surgery
RIR−/LIR−/Bilat 'HI', LIR+/LIO−, LLR+/Bilat post ½ SO adv/ Bilat MR− ↓/RIO−, LIR−adj/RIR−adj/LSE tuch/RSO tuck	Diplopia

asymmetric and masked pareses. This sign is a useful indicator of bilaterality if present, but its absence cannot exclude the presence of a bilateral palsy.

A history of head injury and significant cyclo deviation are the most useful diagnostic criteria for bilaterality in those patients with asymmetric and masked pareses.

There have been several alternative surgical strategies described in the literature. Lyle[14] described inferior oblique myectomy and repositioning of the inferior rectus in such patients. Knapp[15] suggested superior oblique tucks, graded, depending on the hypertropia.

Bilateral Harada-Ito surgery is very effective in relieving symptoms, regardless of the symmetry of the paresis: six of 9 symmetrical patients and 5 of 8 with asymmetric palsies were relieved of symptoms by this operation alone (Table III). In their discussion of Mitchell and Parks paper, Guyton and Crawford[4] postulate that different amounts of surgery may be necessary in different patients and that 'the usual undercorrection in down-gaze is not addressed'. In this series no attempt was made to vary the standard Fells modification of the Harada-Ito procedure regardless of torsion or symmetry, and while on average 7° of cyclodeviation remained in down-gaze, only 3 patients were left with more than 10°[11,12,20] and only 1 (20°) was symptomatic.

Ruttum and Van Noorden[16] have shown that patients with acquired cyclotropia often show retinal sensory reorientation to help them overome significant degrees of torsion, which only becomes subjectively apparent under conditions of dissociation, so it is not surprising that many of our patients have no symptoms in the presence of residual excyclotropia.

Metz[17] described an adjustable Harada-Ito procedure carried out on four patients, one of whom had bilateral superior oblique palsy. This patient was cured of symptoms, but left with 5 degrees of measurable cyclodeviation in the primary position, and 7 degrees on down gaze. These figures are very similar to those achieved in our series (Table IV) without the complication of an adjustable suture, and we feel that this unnecessarily complicates the procedure.

Five patients had modified bilateral Harada-Ito surgery with other surgery at the same time; in 4 cases on the horizontal recti and in one on the inferior oblique (Table VII). Of these patients, three were subsequently found to have no fusion, one is waiting further surgery, and only one was relieved of symptoms by a single operation. The effect of modified Harada-Ito surgery alone is encouraging, and patients with apparently poor fusion often regain good function after such surgery.[2] It may be prudent to carry out superior oblique surgery alone in the first instance, as this will 'cure' many patients, and may help define the small group of patients with no fusion, and prevent them from having unnecessarily complicated surgery with no hope of benefit.

The 'masked' group have done well overall, with 5 patients having only minor symptoms. Four of these 5 have had bilateral Harada-Ito procedures at some stage to relieve the torsion unmasked after unilateral surgery. All have required more than one operation.

Of the 4 patients diagnosed as bilateral, but who had other surgery first, 2 remained symptomatic and 2 are symptom-free. As a group they seem to do least well.

The mean time since last surgery is 62.6 months. Many patients have been discharged from follow-up at Moorfields during that time, so we cannot claim total follow-up. Nevertheless, there has been no evidence of the effects of surgery wearing off in any patient.

In conclusion, from our series it appears that:

(a) About 38 per cent of bilateral IVth nerve pareses are masked. Bilaterality should be suspected and vigorously searched for in all cases of superior oblique palsy.
(b) The modified Harada-Ito procedure is effective in reducing cyclodeviation and vertical diplopia in down gaze in these patients. In many cases, this procedure is all that is required to relieve all symptoms.
(c) Patients managed with other surgical techniques have a much more complicated course and require more operations.

We would like to thank the various surgeons at Moorfields who allowed us to include their patients in this series.

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