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CLINICAL INVESTIGATIONS

Outcome of Surgery for Bilateral Third Nerve Palsy

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Purpose: To review the outcome of surgery for bilateral third nerve palsy.

Methods: The series comprised 16 cases. The eye deviation in the primary position averaged −27.0° horizontally. Surgery was aimed at bringing both eyes into alignment in the primary position by recession-resection of horizontal muscles. Transposition of the superior oblique was performed for complete third nerve palsy. Surgery was initially performed on the nonfixating eye. The fellow eye underwent further surgery for residual disorders.

Results: Within 6 months after surgery, the eye deviation in the primary position averaged −0.7° horizontally. After longer follow-up, the eye deviation averaged −4.7° horizontally. Postoperatively, diplopia in the primary position was absent in 11 and remained in 5 cases.

Conclusion: Surgery for bilateral third nerve paresis or palsy achieved lasting cosmetic or functional improvements in the majority of cases. **Jpn J Ophthalmol 2002;46:540–547** © 2002 Japanese Ophthalmological Society

Key Words: Blepharoptosis, paralytic exotropia, third nerve palsy, transposition of superior oblique muscle.

Introduction

Of paralytic strabismus disorders, the surgical treatment of third cranial nerve palsy is the most difficult. The difficulty is greater in bilateral than in unilateral cases. There are numerous reports regarding the surgical techniques and outcomes for paralytic exotropia in unilateral third nerve palsy, but there is not a large number of bilateral palsy case reports.

Reinecke[1] and Young et al[2] reported favorable motor alignment in a few cases of bilateral third nerve palsy, Saunders and Rogers[3] reported poor results in cases of bilateral complete third nerve palsy. Schumacher-Feero et al[4] recommended repeated surgery to achieve satisfactory results. Because of a limited number of operated cases in these reports, there is as yet no consensus of opinion concerning surgery for bilateral third nerve palsy.

In the present paper, we studied the surgical approach and its results by reviewing a relatively large number of bilateral third nerve palsy cases with a long follow-up time after surgery.

Materials and Methods

Eighteen patients were operated on during the 27-year period since September 1971 when our Department was established. All the 18 cases had bilateral third nerve palsy or paresis. We reviewed 16 of the 18 cases who could be followed up after surgery. They were aged from 19 to 81 years, average 46 years, at the time of the initial surgery. The series comprised 13 men and 3 women. All cases were acquired palsy. The causative lesions comprised head trauma, 6 cases; intracranial lesions including cerebral hemorrhage, 5 cases; and idiopathic, 5 cases. One case had been operated on previously elsewhere.

Third nerve palsy was diagnosed based on the following criteria. The affected eye had to show complete or incomplete eye movements by medial rectus, superior rectus, inferior rectus, and inferior oblique muscles. We also took into consideration the presence of blepharoptosis, pupil anomaly, the Bell's phenomenon, findings by forced duction test, and diagnostic imaging. The objective angle of ocular devi-

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ation was measured by prism and cover test. For measurement of the subjective angle of deviation and assessment of simultaneous perception, major amblyoscopy was used. The fixating eye was evaluated by comprehensive study of visual acuity, severity of blepharoptosis, and limitation of eye movement. The severity of third nerve palsy was classified based on the severity of the effect on the medial rectus muscle. Patients showing an inability to adduct past midline were classified as having complete palsy of the medial rectus muscle, and those showing slightly defective adduction were defined as having incomplete palsy.

The major aim of surgery was to bring both eyes into alignment in the primary position and to eliminate diplopia. Correction of blepharoptosis was also attempted if the ptosis was severe.

The surgical procedure for bilateral third nerve palsy was similar to that for unilateral third nerve palsy case.[5–7] Surgery was performed more than 6 months after the onset under local or general anesthesia. Different approaches were used depending on the clinical manifestations of individual cases. In cases of complete palsy of the medial rectus muscle, transposition of the superior oblique muscle combined with recession of the lateral rectus muscle was performed, in which case the superior rectus muscle was recessed simultaneously to correct hypertropia. In case of incomplete paresis of the medial rectus muscle, resection-recession of the horizontal muscles was carried out. For residual vertical deviation, resection-recession of the vertical rectus muscles was conducted 3 months after the initial surgery. Levator resection was performed to correct blepharoptosis. Surgery was performed on the nonfixating eye, and the fellow eye received additional surgery when the outcome of initial surgery proved to be insufficient.

Patients with paralytic strabismus generally report satisfaction with results within ±4° of horizontal and 2° of vertical deviation. Consequently, we defined the result as a cure when diplopia was not present in the primary position. Patients showing deviation within ±7° horizontally and 5° vertically were defined as cosmetically satisfactory, which conforms with the standards for cure of the Japanese Association of Strabismus and Amblyopia.[8]

Results

The outcomes of the 16 cases in the present series are shown in Table 1.

The series comprised 11 cases of bilateral paresis of the medial rectus muscle, and 5 cases of paresis in 1 eye and complete palsy of the medial rectus muscle in the fellow eye. There was no case of bilateral complete palsy of the medial rectus muscle.

The number of surgeries averaged 2.7 per case in the whole series. Surgery was repeated 2.8 times for 11 cases of bilateral paresis of the medial rectus muscle, and 2.4 times for 5 cases of paresis in 1 eye and complete palsy of the medial rectus muscle in the other. The follow-up period ranged from 2 to 183 months, with the average at 61 months. Thirteen patients were followed up for 6 months or longer, including 7 cases that were followed up for 4 years or longer after surgery.

The mean preoperative horizontal deviation of 27.0° of exotropia, ranging from 7° to 46° was reduced to 0.7° of exotropia, ranging from 0° to 11°, with a follow-up duration of 6 months. Cases with vertical deviation of 9.3° of hypertropia, ranging from 1–40° were reduced to 3.2°, ranging from 0–12° (Table 2).

The effectiveness of surgery was assessed according to the criteria described in Table 3.

Cure was obtained in 9 cases, cosmetically satisfactory results in 4 cases, and improvement in 3 cases. Cure or cosmetically satisfactory results were thus obtained in 13 of 16 cases (Table 4).

In the 13 cases who were followed up for 6 months or longer, the mean horizontal deviation was 4.7° of exotropia, ranging from 0–17°. The mean vertical deviation was 3.1° of hypertropia, ranging from 0–9°. The surgical outcome was evaluated as a cure in 5 cases, cosmetically satisfactory in 3 cases, and improved in 5 cases. Cure or cosmetically satisfactory results were thus obtained in 8 of 13 cases (Table 4).

There was a tendency for horizontal deviation to shift toward the initial state, but vertical deviation tended to remain constant after surgery.

The incidence of cure was higher in cases of bilateral paresis of the medial rectus muscle than in cases of paresis in 1 eye and complete palsy of the medial rectus muscle in the other. Of the 16 cases, diplopia in the primary position disappeared in 11 cases and decreased in 5 cases. Single binocular vision was obtained by compensatory head posture in all the 11 cases of bilateral paresis of the medial rectus muscle, and in 4 of 5 cases of paresis in 1 eye and complete palsy of the medial rectus muscle in the other.

Two Representative Cases

Case 1. A 43-year-old man had noted blepharoptosis in his left eye for 20 years. Exotropia with diplopia had been present for 10 years. He had re-

Table 1. Surgical Method and Outcome

Case No.	Type of MRP		Ptosis		Strabismus Sx		No. of Sx		Sx for Ptosis		Deviations (°)*				Follow-up (m)	Diplopia*	Single Binocular Vision
												Postop					
	RE	LE	RE	LE	RE	LE	RE	LE	RE	LE	Preop	≤6m	≤4y	>4y			
1	Par	Par	−	+	MRs, LRc, IRs	MRs, LRc	2	1	−	+	−45 R/L 7 in 5	R/L 5 in 5	**	0	95	−	+
2	Par	Par	−	−	MRs, LRc, SRc, IRs, IOt	SRs, IRc	3	1	−	−	−19 R/L 40 in 5	R/L 2	R/L 2	R/L 5	126	−	+
3	Par	Par	+	+	−	MRs, LRc	0	1	+	+	−26	R/L 2	0	**	15	−	+
4	Par	Par	+	+	MRs, LRc	MRs, LRc, IRs	3	3	+	+	−38 L/R 11 in 17	−11 L/R 12 in 25	−17 L/R 9 in 25	**	18	+	+
5	Par	Par	+	+	MRs, LRc	MRs	1	1	−	−	−23 L/R 4 in 10	in 13	**	**	2	−	+
6	Comp	Par	+	+	SO, LRc, SRc	−	1	0	−	−	−22 R/L 3 in 6	L/R 6 ex 6	L/R 2 ex 6	**	13	−	+
7	Par	Comp	+	+	SRs	SO, MRs, LRc, SRc, IRs	1	2	+	+	−25 L/R 17	L/R 7	−3 L/R 7	**	45	+	+
8	Par	Par	+	+	MRs, LRc, SRc, IRs	MRs, LRc	2	1	+	+	−33 R/L 14 in 2	0	**	−14 R/L 5 in 5	183	+	+
9	Par	Comp	+	+	MRs, LRc	SO, MRs, LRc, LRm	1	2	+	+	−46 L/R 10 in 19	0	−12 L/R 4 in 26	−17 L/R 3 in 20	128	+	−
10	Par	Par	+	+	−	MRs, SRc, IRs	0	2	+	+	−7 R/L 14	L/R 7	0	0	142	−	+
11	Par	Par	+	+	MRs, LRc	MRs, LRc, IRs, IOa	1	1	−	−	−32 L/R 8 in 19	in 15	0	−10 in 18	100	−	+

(*continued*)

Table 1. *Continued*

Case No.	Type of MRP		Ptosis		Strabismus Sx		No. of Sx		Sx for Ptosis		Deviations (°)*				Follow-up (m)	Diplopia*	Single Binocular Vision
												Postop					
	RE	LE	RE	LE	RE	LE	RE	LE	RE	LE	Preop	≤6m	≤4y	>4y			
12	Comp	Par	+	+	SO, LRc	MRs	1	1	−	−	−24 L/R 10 in 5	0	R/L 4	**	41	−	+
13	Par	Par	−	−	−	MRs, LRc	0	1	−	−	−9 L/R 2 ex 9	R/L 2 ex 8	**	**	6	−	+
14	Par	Par	−	−	−	MRs, LRc	0	1	−	−	−19 R/L 4 in 9	R/L 2 in 5	0	**	48	−	+
15	Par	Comp	+	+	MRs, LRc	SO, MRs, LRc, SRc, IRs	1	2	−	−	−45	L/R 3 in 9	L/R 5 in 6	**	11	+	+
16	Par	Par	−	−	SRc, IRs, LRc	MRs, LRc	3	2	−	−	−19 R/L 5	R/L 5	**	**	6	−	+

MRP: palsy of medial rectus muscle, Sx: surgery, No. of sx: number of surgeries, RE: right eye, LE: left eye, Comp: complete palsy of the medial rectus, Par: paresis of the medial rectus, M: month, Y: year, MRs: medial rectus resection, LRc: lateral rectus recession, IOt: inferior oblique tenotomy, LRm: lateral rectus myectomy, SO: transposition of superior oblique, IRs: inferior rectus resection, SRc: superior rectus recession, IOa: inferior oblique advancement, R/L: right hypertropia, L/R: left hypertropia, in: incyclotorsion, ex: excyclotorsion.

*Measured in the primary gaze.

**Drop out.

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Table 2. Pre- and Postoperative Deviation (°)*

	Preop Deviation (n = 16)		Short-term Postop Deviation (n = 16)		Long-term Postop Deviation (n = 13)	
Type	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Par-Par	−24.5 ± 11.7	9.9 ± 11.0	−1.0 ± 3.3	3.4 ± 3.7	−4.6 ± 7.1	2.4 ± 3.5
Comp-Par	−32.4 ± 12.0	8.0 ± 6.7	0	2.8 ± 2.8	−5.0 ± 8.1	4.2 ± 1.9
Total	−27.0 ± 12.0	9.3 ± 9.7	−0.7 ± 2.8	3.2 ± 3.3	−4.7 ± 7.1	3.1 ± 3.0

* Values are mean ± SD.
†Par-Par: bilateral paresis of the medial rectus muscle, Comp-Par: paresis in one eye and complete palsy of the medial rectus muscle in the other.

ceived no treatment before visiting us. No causative lesion was identified after thorough examinations.

His uncorrected visual acuity was 0.4 in the right eye and 0.08 in the left. After correction for myopia, the visual acuity was 1.2 in the right eye and 1.0 in the left. His left eye showed blepharoptosis. In the primary position he had 45° of exotropia with 7° of right hypertropia. Both eyes showed marked limitation of adduction and impaired up- and downward gaze. The left eye was mydriatic. Bell's phenomenon was absent in both eyes. No abnormal findings were present in the media or the fundus (Figure 1) of either eye.

Forced duction test was positive for the medial rectus muscle of both eyes. Two-millimeter resection of the medial rectus muscle, 5-mm recession of the lateral rectus muscle, and levator resection were carried out on the left eye. Nineteen days later, 10-mm resection of the medial rectus muscle and 5-mm recession of the lateral rectus muscle were performed on the left eye. Because of the presence of right hypertropia associated with the restriction of upward movement in the left eye, 4-mm resection of the inferior rectus muscle was performed on the right eye 11 months after the initial surgery. Orthophoria in the primary position was observed after the final surgery. Blepharoptosis and diplopia disappeared. The clinical findings have been stable for the ensuing 8 years (Figure 2).

Case 2. A 19-year-old man suffered from head trauma after being involved in a traffic accident. While recovering from unconsciousness lasting for 2 months, he noted diplopia and abnormal ocular position. His corrected visual acuity was 0.7 in the right eye and 1.2 in the left. He had 25° of exotropia with 38° of right hypertropia. Both eyes showed up- or downward gaze palsy. The right eye was mydriatic. Bell's phenomenon was absent in both eyes. There was no abnormal finding in the transparent media or the fundus of either eye (Figure 3).

Four-millimeter recession of the superior rectus muscle and 4-mm resection of the inferior rectus muscle were performed on the right eye. The right eye had additional surgery 5 months later by 10-mm resection of the medial rectus muscle, 7-mm recession of the lateral rectus muscle, and tenotomy of the inferior oblique muscle. Ten months later, 4-mm resection of the superior rectus muscle and 4-mm recession of the inferior rectus muscle were performed on the left eye. Orthophoria in the primary position was attained after the last surgery. Diplopia was not present in either the primary position or in the lateral gaze position. Clinical findings have been stable for 10 years after the last surgery (Figure 4).

Table 3. Criteria for Determining the Effect of Surgery

Effect	Horizontal Degree of Deviation (°)	Vertical Degree of Deviation (°)
Cure	≤4	≤2
Cosmetically satisfactory	≤7	≤5
Improved	≥8	≥6
Not improved	≥20	≥11

Discussion

The primary objective of surgery for bilateral third cranial nerve palsy is to eliminate diplopia in the primary position. The surgical approach may differ depending on the degree of involvement of the medial rectus muscle, which may be paretic or paralytic. Combined resection-recession of the horizontal muscles may be sufficient to correct exotropia secondary to paretic medial rectus muscle. Additional transposition of the superior oblique muscle is, however, necessary for complete palsy of the medial rectus muscle.[5–7] Transposition of the superior oblique muscle by manipulating the trochlea was reported by Peter[9] but surgery without touching the trochlea has become the accepted method after the report by Scott.[10] We have used the non-touch technique throughout because of the ease of surgery.

Table 4. Short- and Long-term Outcome of Surgery in This Study

	Short-term Postop Deviation (N= 16)				Long-term Postop Deviation (n = 13)			
Type*	Cure	Cosmetically Satisfactory	Improved	Not Improved	Cure	Cosmetically Satisfactory	Improved	Not Improved
Par-Par	7	2	2	0	4	1	3	0
Comp-Par	2	2	1	0	1	2	2	0
Total	9	4	3	0	5	3	5	0

*Par-Par: bilateral paresis of the medial rectus muscle, Comp-Par: paresis in one eye and complete palsy of the medial rectus muscle in the other.

We have treated bilateral third nerve palsy on the same principle as for the unilateral type. This principle was also advocated by Simons.[11] He described two different approaches. In acquired bilateral third nerve palsy, surgery may be performed on 1 eye only to achieve orthophoria. Alternatively, surgery may be performed bilaterally to bring both eyes into alignment. The latter approach involves a higher risk of postoperative diplopia. In our present series of 16 cases, surgery was performed unilaterally in 5 cases and bilaterally in 11 cases. No patient who received bilateral surgery developed problems in daily life due to postoperative diplopia.

There has been no report regarding the long-term effect after surgery for bilateral third nerve palsy. In our present series, 7 patients were followed up for more than 4 years, including 4 cases that were observed for over 10 years. Both eyes remained aligned for 6 months after the last surgery in the majority of the 16 cases in our series. After 6 months, some cases showed a tendency for exotropia to recur. This tendency was more obvious in cases that manifested exotropia of 30° prior to surgery. Generally, the primary eye position remained well-aligned in cases who received maximum resection-recession of horizontal muscles, resulting in limited abduction.

It was observed by Sato et al[12] that the eyes remained well aligned following resection-recession of the horizontal muscles in a case of large-angle unilateral third nerve palsy. It may appear that planned limitation of abduction is effective to prevent postsurgical exotropia on a long-term basis. The history of Case 9 in our series supports this view. This patient initially showed weakening of the superior oblique and recession of the lateral rectus muscle in the paralytic eye. Because insufficient outcome had

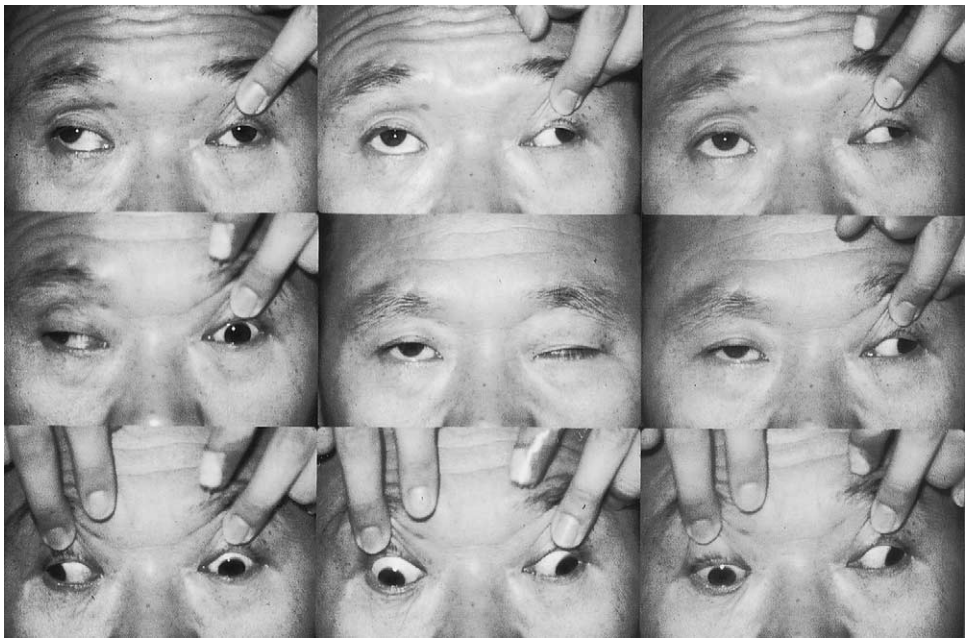

Figure 1. Case 1: Findings before surgery. The patient has blepharoptosis in the left eye and exotropia in the primary position. Both eyes show limitation in adduction, elevation, and depression.

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Figure 2. Case 1: Findings 8 years after surgery. Both eyes are orthophoric without diplopia in the primary position.

been attained, tenotomy of the lateral rectus was added. Both eyes were well-aligned up to 6 months after surgery, but a gradual tendency to exotropia followed.

Favorable long-term motor alignment was obtained in 8 of the 13 cases (61.5%) because 11 of the 16 cases (68.8%) comprised bilateral incomplete palsy. On the other hand, cases of complete palsy in 1 eye tended to respond poorly even to repeated surgery. However, various grades of lasting postsurgical improvements were observed both in complete and incomplete palsy cases.

Multiple surgeries are usually necessary for bilateral third nerve palsy. Four rectus muscles were operated on in 4 of our patients (Cases 2, 7, 8, and 15), but no patient developed severe complications, including anterior segment ischemia.

Blepharoptosis is one of the major manifestations of third nerve palsy. Simons[11] advocated either tuck-

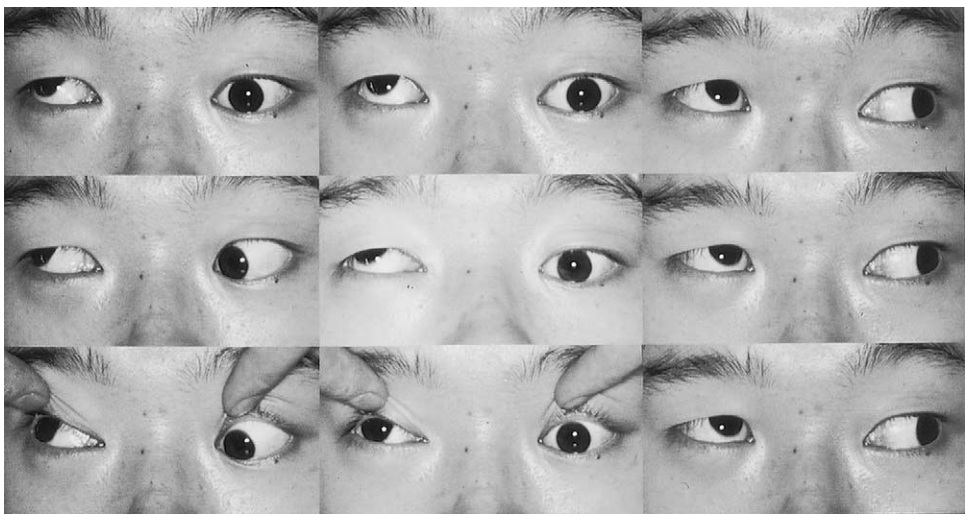

Figure 3. Case 2: Findings before surgery. The nonfixation right eye is exotropic/hypertropic. Both eyes show limitation in up- and downward gazes.

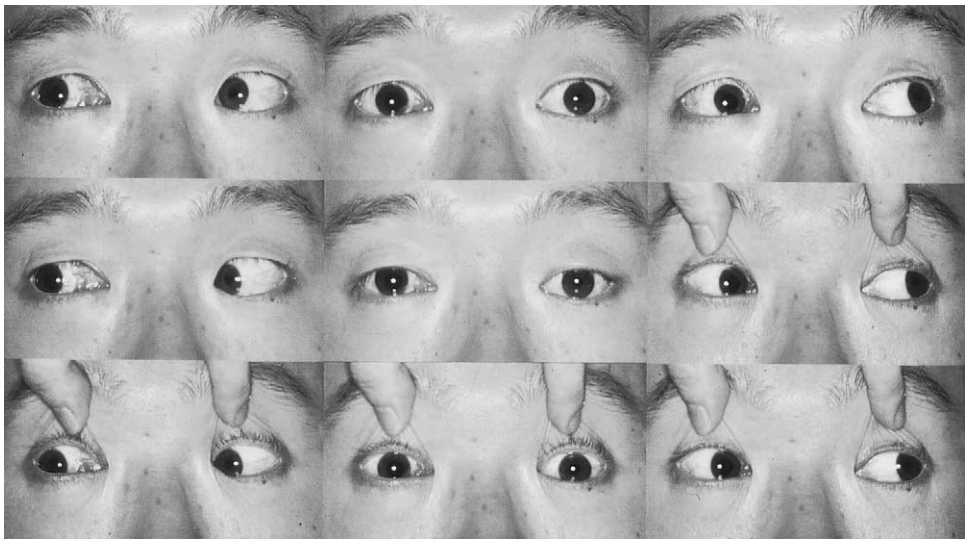

Figure 4. Case 2: Findings 10 years after surgery. Both eyes are orthophoric without diplopia in the primary position.

ing or levator resection, and recommended the tucking procedure for acquired cases. In our series, 7 cases underwent levator resection. It is necessary to avoid overcorrection, which may result in lagophthalmos and corneal damage, particularly because the Bell's phenomenon is often absent in third nerve palsy. There was no case in our series that showed corneal damage after surgery.

The present study revealed that the primary eye position improved following surgery for bilateral third nerve palsy or paresis. Surgery either decreased or eliminated diplopia. The surgical effect lasted during long-term observations. Surgery for bilateral third nerve palsy or paresis is much more difficult than for the unilateral type. Still, we advocate surgery as the primary choice for bilateral cases. Surgery may induce improvements in eye position, diplopia, and blepharoptosis, resulting in a better quality of life for the patients.

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