Surgical Management of Strabismus for Dysthyroid Ophthalmopathy

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Background: The study reports our 8-year experience in the surgical treatment of restrictive myopathy resulting from dysthyroid ophthalmopathy. We tried to determine the factors that contributed to favorable surgical outcomes.

Methods: The charts of patients who had surgical treatment for strabismus related to dysthyroid ophthalmopathy at Chang Gung Memorial Hospital between January 1995 and December 2002 (n=25) were retrospectively reviewed, and factors that possibly influenced the outcome were statistically analyzed for significance.

Results: The mean pre-operative vertical deviation of the 25 patients was 23.3 prism diopters and the pre-operative horizontal deviation was 11.3 prism diopters. The mean follow-up time was 29.7 months. Each patient had strabismus surgery an average of 1.5 times. The majority of patients (84%) were satisfied with the result. No significant difference in the success rate was evident between patients who waited less than 3 months before the surgery and those who waited for a longer period. The repeat surgery rate was significantly higher in the latter group. A shorter duration of diplopia and smaller angle of pre-operative horizontal deviation were contributors towards a favorable outcome.

Conclusions: A waiting time of less than 3 months prior to treatment of strabismus associated with dysthyroid ophthalmopathy produced a favorable outcome. The duration of diplopia and the pre-operative angle of horizontal deviation were the most important prognostic factors.

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Key words: dysthyroid ophthalmopathy, restrictive strabismus, diplopia, orbital decompression.

Dysthyroid ophthalmopathy can produce a complex of orbital abnormalities resulting from lymphocytic infiltration and congestion of the extraocular muscles, orbital fat and other orbital tissues. Over intervening months or years, the progressive development of a chronic fibrotic process of extraocular muscles may result in permanent change in ocular motility.

Motility related problems in patients with dysthyroid ophthalmopathy include restriction of ocular duction, diplopia, and the need for a compensatory head posture. Treatment for these ocular motility problems is complicated. Most strabismologists recommend waiting at least 6 months before conducting a stabilized motility examination as a prelude to corrective strabismus surgery. [(1)]Indeed, our typical

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experience had been to follow this timetable. However, a shorter waiting period has been advocated.[2] Our positive experience with a waiting period of less than 3 months prior to surgery on a select number of patients led us to modify our typical strategy of treatment after 1997.

Presently, we document our experience in treating strabismus associated with dysthyroid ophthalmopathy.

METHODS

Twenty-five patients with dysthyroid ophthalmopathy underwent their first extraocular muscle surgery between January 1995 and 2002 at Chang Gung Memorial Hospital (CGMH), Taoyuan, Taiwan. This population excluded patients with a history of orbital decompression surgery or steroid treatment prior to muscle surgery, lack of appropriate postoperative follow-up data, or poor vision in one eye.

The diagnosis of dysthyroid ophthalmopathy was based on patient history, results from a clinical examination, laboratory findings, forced duction testing, and radiographic results. The duration of strabismus caused by dysthyorid orbitomyopathy was determined using the time of onset of diplopia, restricted eye movement or abnormal head posture. Each patient underwent a comprehensive ophthalmic examination, including best-corrected visual acuity, external eye examination, slit-lamp examination, fundus examination, tonometry, visual field testing, and exophthalmometry. Regular follow-up examinations were conducted. Ocular deviations were determined by alternate cover testing using prisms with fixation at both 6 meters and 30 centimeters. Stable ocular motility was defined as a change of deviation less than 5 prism diopters or no change of the patient's head posture. Patients with stable measurements in two sequential follow-up visits within 3 months were indicated for strabismus correcting surgery, in keeping with the 1997 decision to do the strabismus surgery after a shorter waiting period.

The operations were performed by three ophthalmologists. Operations were intended to simultaneously or separately correct vertical and horizontal deviations. The most common procedures used were recession with sclera fixation suture or adjustable suture of the involved rectus muscles. Disinsertion of the fibrotic rectus muscles was occasionally reserved for severe restricted cases. For the second surgeries, adjustable recessions, re-recessions, or advancements of previously recessed muscles were performed as necessary. If the alignment changed during the follow up, identification of the restrictive muscle responsible for the new deviation and recession was performed. The result was defined as "successful" in patients whose residual deviation was less than 10 prism diopters and who were free from diplopia in the primary position. The result was termed "unsuccessful" in patients who had residual deviation more than 10 prism diopters and had persisting diplopia in the primary position.

The clinical data were analyzed utilizing the Student's test and $p < 0.05$ was considered to be a statistically significant level of difference.

RESULTS

Twenty-five patients were included in this study. The average age of the 15 men and 10 women at the time of their first strabismus surgery was 53.0 years (36-74 years). The duration of diplopia, limited eye movement or abnormal head posture ranged from 2 to 120 months, and averaged 15.0 months. Preoperatively, 60 percent of patients had vertical deviation only, 16 percent had horizontal deviation only, and 24 percent had mixed vertical and horizontal deviations. The mean vertical deviation was 23.3 prism diopters, and the mean horizontal deviation was 11.3 prism diopters. At the time of extraocular muscle surgery, 23 patients were euthyroid and 2 patients were still hyperthyroid.

There were 36 strabismus surgeries during the period between 1995 and 2002. Four patients required a second operation to correct the residual deviation. In these patients, an adjustable suture technique was used within 3 months of the first operation. Two patients experienced late overcorrection, a single patient experienced recurrence, and 4 patients developed new horizontal deviation. For these 7 patients, another correcting operation was required. The onset of deterioration of the ocular motility appeared from 2 to 28 months after the initial operation. Overall, 10 of the 25 patients (40%) required more than one strabismus surgery. Two patients required a third operations. On average, 1.5 strabismus surgeries were performed per patient.

The follow-up period after the last strabismus surgery ranged from 3 to 95 months (average: 29.7 months). At the last visit, the measurement of ocular alignment in 84.0 percent of patients was less than 10 prism diopters and these patients were free of diplopia in the primary position. There were no significant differences in the age, waiting period before surgery, follow-up time, or number of operations between those with successful and those with unsuccessful outcomes. (Table 1). However, the duration of diplopia, limited eye movement, or abnormal head posture and the pre-operative horizontal deviation angle were significantly higher in those patients with an unsuccessful result.

Seven patients had orbital decompression procedures after their strabismus surgery. The duration between the two operations ranged from 2 to 48 months (average 12 months). The indications for orbital decompression were severe exposure keratopathy, compressive optic neuropathy and cosmetically unacceptable proptosis. Four of the 7 patients had another strabismus surgery at 8, 8, 11 and 24 months after the decompression surgery.

To investigate the influence of the shorter waiting period on the outcome of strabismus treatment, we compared the patients who had their first strabismus surgery before 1997 (group 1) with those whose initial surgery came after 1997 (group 2). Table 2 summarizes the gender, age, pre-operative deviation and duration of follow-up of the two groups. There was a preponderance of menin group 2 (76.9%) compared with 46.2 percent in group 1. The average peri-

Table 1. Comparison of Contributing Factors in Successful and Unsuccessful Outcomes

Group	Successful	Unsuccessful	*p*
Age (y/o)	53.3 ±10.8	51.5 ±10.7	0.759
Duration of diplopia (months)	8.1 ± 4.1	50.8 ±46.4	0.000
Duration of waiting (months)	4.2 ± 3.2	8.3 ± 5.5	0.050
Pre-operative angle of vertical deviation (PD)	20.7 ±20.2	36.3 ±38.2	0.240
Pre-operative angle of horizontal deviation (PD)	7.0 ±12.2	33.0 ±43.9	0.025
Number of operations	1.5 ± 0.7	2.0 ± 0.8	0.159
Follow-up (months)	34.5 ±30.0	4.8 ± 2.9	0.056

Abbreviations: PD: prism diopters
Values expressed in mean ±standard deviation; *p* values by independent samples T test.

Table 2. Comparison of Study Populations

	Group 1 (before 1997)	Group 2 (after 1997)	*p*
Female/Male ratio	7:5	3:10	0.0691*
Age (y/o)	53.8 ±12.5	51.5 ± 8.8	0.450
Duration of diplopia (months)	20.4 ±32.1	9.9 ± 8.7	0.267
Duration of waiting (months)	8.1 ± 3.1	1.8 ± 0.7	0.000
Pre-operative vertical deviation (PD)	24.4 ±29.2	22.2 ±18.0	0.822
Pre-operative horizontal deviation (PD)	17.8 ±29.6	5.9 ±10.1	0.184
Number of operations	1.8 ± 0.7	1.2 ± 0.4	0.006
Repeat surgery rate	(66.7%)	(15.4%)	
Successful cases	9 (75.0%)	12 (92.3%)	
Follow-up (months)	33.1 ±29.5	6.6 ±28.9	0.585

Abbreviation: PD: prism diopters
Values expressed in mean ±standard deviation; *p* values by independent samples T test and * by Chi-Square test.
* Place this value under the *p* column.

od of stabilized motility for patients was 8.4 months in group 1 and 1.8 months in group 2. The average number of strabismus surgeries per patient was 1.8 in group 1 and 1.2 in group 2. The repeat surgery rate was 66.7 percent in group 1 and 15.4 percent in group 2. Otherwise, there were no statistically significant differences between the two populations for the parameters examined.

Seventy-five percent of those in group 1 and 92.3 percent of those in group 2 had successful results at the last visit. No systemic or acute vision-threatening problems were present after surgery in either group. Two patients who were not euthyroid at the time of extraocular muscle surgery achieved fusion and long-term stability.

DISCUSSION

Strabismus associated with dysthyroid ophthalmopathy is the most common cause of acquired diplopia in middle and old age. These ocular motility problems are often complicated, and challenge the skills of the strabismologist.

The aim of corrective treatment is typically to obtain a field of single binocular vision comprising infraversion and primary position of gaze. Although there can be multiple extraocular muscles involved, the recession of the fibrotic and restrictive muscles, which produce the deviation in the primary position, is the primary surgical approach. Published normograms based on the deviation between the two eyes are highly effective for predicting surgical success in cases of general strabismus, but are much less effective for adult patients with dysthyroid ophthalmopathy. To improve the surgical results, an adjustable suture technique is commonly recommended.[3,4] Surgery tailored to address the restriction of ductions, instead of adjustable suture aimed primarily at the correction of deviation, has been reported to confer improved initial realignment, and therefore a lower rate of repeat surgery.[5,6] The results of surgery are highly variable, however, with reported repeat surgery rates ranging from 17 to 45 percent.[6-9] The response rates of diplopia to surgical treatment range from 44 to 88 percent.[5,10-13] In our series of 25 patients, the repeat surgery rate was 40.0 percent and the success rate was 84.0 percent. These rates are consistent with other reports.

The outcome of surgical treatment of strabismus related to dysthyroid ophthalmopathy is probably influenced by the pre-operative duration of orbitopathy, angle of deviation, and prior treatment (radiotherapy, corticosteroids or orbital decompression).[15-17] Previous reports that have concluded that the angle of deviation does not influence the surgical outcome only addressed vertical deviation. The present results are consistent with the suggestion that the preopertive angle of horizontal deviation, instead of vertical deviation, is one of the main predictors of surgical outcome. The inferior rectus is most commonly affected in dysthyroid ophthalmopathy, followed by the medial, superior and lateral rectus.[18] The resultant deviation in the primary position depends not only on the severity of muscle restriction but also on the degree of asymmetry of muscle involvement. The presence of horizontal deviation may indicate that more muscles are affected, producing a more severe orbitopathy. This could in turn influence the surgical outcome.

The duration of the orbitomyopathy did not influence the surgical outcome in one report.[17] The researchers determined the duration using the time of onset of infiltration in a modified Werner's classification (Class 2-6). However, the eyelid retraction, soft tissue periorbital swelling or proptosis of eyes that form the basis of this classification might not correspondingly reflect the severity of myopathy. Our present observations are rather more consistent with the notion that the duration of subjective symptoms, including diplopia, limitation of eye movement, and compensating head posture may reflect the true condition of the myopathy and thus be a predictive factor of the surgical outcome.

Seven of our 25 patients (28.0%) needed orbital decompression surgery after the muscle surgeries. Most of them had the decompression surgery because of unacceptable proptosis. It has also been reported that conventional recessions of two muscles in the same eye can induce as much as 3-4 mm of proptosis in patients with Graves' myopathy.[1] The possibility of sequential decompression surgery should be clearly explained to patients with dysthyroid ophthalmopathy prior to strabismus surgery.

The optimal time to initiate the surgical treatment for strabismus associated with dysthyroid ophthalmopathy can be hard to determine. Ocular motility problems tend to progress in the active phase and surgical treatment may carry the risk of instability of

both the systemic disease and the orbitopathy.[19] The use of magnetic resonance imaging (MRI) may help to determine if there is edema in the extraocular muscles.[20-22] Still, there is no effective and reliable parameter to clinically demonstrate the fibrotic phase of the disease. Many authors recommend proceeding with surgery only after a 6-month waiting time, especially after active congestive ophthalmopathy or decompression surgery. The rationale for waiting has generally been that stable post-surgical alignment is more likely to occur after a long period of stable preoperative alignment, minimizing the need for more surgery. Patients have to suffer from diplopia and abnormal head posture during a long waiting time. In a recent study, surgery was performed in a group of selected patients in the active phase of thyroid ophthalmopathy, without waiting for stable alignment. No complications were reported and long-term success was obtained.[23] Other studies have reduced the waiting period from between 6 and 12 months to 3 months.[2] For our patients there was no significant difference in the success rate after multiple surgeries between those who had relatively early surgery and those who waited the conventional period of time. However, the incidence of multiple surgeries was significantly higher in the group of patients who waited more than 6 months. Long-term stability of the patients in the early surgery group may be attributable to the myopathy having achieved maximum restriction. Alternately, the disease process may have entered a quiescent phase before surgery. A third explanation is that muscle recession during the active stage may allow the muscle to continue its infiltrative/fibrotic processes through circumferential enlargement alone, thus preventing further anteroposterior contracture and changes in alignment.[19] Because of the nature of the disease, fibrosis and contracture of the orbital tissue may become more and more severe after long-standing deviation. That might in turn influence the results of a single procedure. We propose that realignment of the eye in the early stage would make the results more predictable and the orbital tissue ongoing fibrosis in situ would be helpful in maintaining long term stability.

Since this study was not a prospective case series and bias could not be excluded, the suggestion that early surgery is a prudent strategy for patients with strabismus related to dysthyroid ophthalmopathy is premature. However, no one in our study had systemic or acute vision-threatening complications. Further studies are needed to confirm that there may be little reason to wait 6 to 12 months to perform strabismus surgery for patients with dysthyroid ophthalmopathy.

In our 8-year experience with surgical treatment for strabismus related to dysthyroid ophthalmopathy, 84.0 percent of patients experienced a successful post-operative outcome. The duration of diplopia, limited eye movement or abnormal head posture, and the pre-operative horizontal deviation were the most important prognostic factors. Initiating surgical treatment for strabismus with a waiting time of less than 3 months is a reasonable approach for patients with dysthyroid ophthalmopathy.

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甲狀腺眼病變之斜視手術治療

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背 景： 甲狀腺眼病變造成的斜視在治療上往往較爲複雜和困難。病患須忍受一段時間等待症狀穩定後才能手術，並常須接受多次手術才能消除複視的症狀。

方 法： 我們收集1995至2002年間接受斜視手術的甲狀腺眼病變病例，分析影響癒後的可能因素。

結 果： 8年來共有25名病人平均追蹤29.7個月。每人平均手術次數爲1.5次。84%的病人術後得到滿意的結果。症狀出現3個月內就手術的成功率與等待3個月以上相同，且後者須多次手術的機會反而較高。複視時間短和水平方向斜視角度小的病人較易得到滿意的結果。

結 論： 症狀出現3個月內就進行手術可以得到滿意的結果。術前複視時間的長短和水平方向的斜視角度是影響癒後的重要因素。

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關鍵字：甲狀腺眼症，限制性斜視，複視，眼窩減壓術。

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