Artículo Original

The management of vertical deviations in sagging eye syndrome

Manejo de las desviaciones verticales en el sagging eye syndrome

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Abstract

Purpose: This study was conducted to report the findings and surgical management of vertical deviations in patients with sagging eye syndrome (SES).

Methods: Charts were reviewed of patients with acquired vertical deviations associated with SES. Only those with a minimal follow-up of 1 year were included. All patients underwent surgery for esotropia alone or simultaneous combination with inferior rectus muscle recession (IR) or superior rectus muscle tightening (SR) procedure. Preoperative and postoperative alignment, ocular rotations, and torsion were evaluated.

Results: A total of 21 patients were included. Overall, the mean preoperative vertical deviation measured 2 ± 1 prism diopters (PD) and improved to 0.2 ± 0.6 PD postoperatively (p = 0.006). Ten patients underwent simultaneous IR recession: the preoperative vertical deviation improved from 2.8 ± 1.3 PD to 0.2 ± 0.6 PD postoperatively (p = 0.0002). In 3 patients who underwent simultaneous SR tightening procedure, the vertical deviation improved from 2.6 ± 1.1 PD preoperatively to 0 ± 0 PD postoperatively (p = 0.057). Eight patients who were able to fuse the vertical deviation preoperatively on free space testing with horizontal prisms alone underwent horizontal surgery only; the preoperative vertical deviation improved from 1.3 ± 1.7 PD to 0.1 ± 0.3PD postoperatively (p = 0.0001). The overall preoperative torsion measured 5.1 ± 2.2° extorsion improving to 0.7 ± 1.7°extorsion postoperatively (p = 0.006)

Conclusion: SES may be associated with small non-restrictive vertical deviations and extorsion. Simultaneous vertical rectus muscle surgery may be required when patients are unable to fuse with horizontal prisms alone.

Keywords: *Sagging eye syndrome, diplopia, strabismus*

Resumen

Propósito: Este estudio se realizó para publicar los hallazgos y el tratamiento quirúrgico de las desviaciones verticales en pacientes con sagging eye syndrome (SES).

Métodos: Se revisaron las historias clínicas de los pacientes con desviaciones verticales adquiridas asociadas a SES. Sólo se incluyeron aquellos con un seguimiento mínimo de 1 año. Todos los pacientes fueron operados de esotropía o de cirugía combinada con recesión del músculo recto inferior (RI) o refuerzo del músculo recto superior (SR). Se evaluaron la alineación preoperatoria y postoperatoria, las rotaciones oculares y la torsión.

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Resultados: Se incluyeron un total de 21 pacientes. En general, la desviación vertical preoperatoria media fue de 2 ± 1 dioptrías prismáticas (DP) y mejoró a 0,2 ± 0,6 DP después de la cirugía (p = 0,006). Diez pacientes se sometieron a recesión del RI simultánea: la desviación vertical preoperatoria mejoró de 2,8 ± 1,3 DP a 0,2 ± 0,6 DP después de la cirugía (p = 0,0002). De los 3 pacientes que se operaron simultáneamente con refuerzo del RS, la desviación vertical mejoró de 2,6 ± 1,1 PD preoperatoria a 0 ± 0 PD en el postoperatorio (p = 0,057). Ocho pacientes que pudieron fusionar la desviación vertical en la prueba de espacio libre con prismas horizontales se sometieron a cirugía horizontal únicamente. La desviación vertical preoperatoria mejoró de 1,3 ± 1,7 DP a 0,1 ± 0,3 DP después de la operación (p = 0,0001). La torsión global preoperatoria midió 5,1 ± 2,2° de exciclotorsión, mejorando a 0,7 ± 1,7° de exciclotorsión en el postoperatorio (p = 0,006).
Conclusiones: El SES puede asociarse a pequeñas desviaciones verticales no restrictivas y a exciclotorsión. La cirugía simultánea de un músculo recto vertical puede ser necesaria cuando los pacientes no pueden fusionar solo con prismas horizontales.
Palabras clave: *Sagging eye syndrome, diplopia, estrabismo*

INTRODUCTION

Sagging eye syndrome (SES) is a known cause of diplopia in the elderly population secondary to degeneration of the lateral rectus-superior rectus band and subsequent sagging of the lateral rectus muscle (1). The presence of cyclovertical strabismus is attributed to asymmetrical bilateral displacement of the lateral rectus muscles (1-3). Diplopia from SES is typically horizontal, due to an esotropia worse at distance. However, it can also be associated with a small angle hypotropia and extorsion (1-4).

Previous reports indicate that medial rectus muscle recessions and lateral rectus muscle resections or plications are successful in correcting the esotropia associated with sagging eye syndrome (2,4). However limited information has been published for the treatment of the cyclovertical deviation (3). The purpose of our study was to look at the surgical management of SES in those patients with acquired combined vertical and horizontal diplopia.

METHODS

This study was approved by the University of California-Los Angeles (UCLA) Institutional Review Board and was compliant with the US Health Insurance Portability and Accountability Act of 1996. All consecutive records of patients with acquired diplopia in primary position diagnosed with SES who presented with an esotropia worse at distance than near combined with a cyclovertical deviation between January 2015 and October 2017, obtained from 3 different surgeons were retrospectively reviewed. Only those with a minimum follow-up of 1 year were reviewed. Exclusion criteria consisted of previous strabismus surgery, orbital trauma, paralytic strabismus, and those diagnosed with restrictive strabismus, such as thyroid eye disease. Success was defined as no diplopia in primary position and reading position postoperatively in the absence of prisms glasses.

Pre-operative and post-operative motility examinations were recorded for each patient. All patients underwent a complete ocular examination including distance and near visual acuity and a sensory motor examination including ocular rotations measured on a scale 0 to ±4. A 0 was recorded for full excursion, while a -4 was failure to pass midline. A -3 to -1 were used thereafter at 23% increments (4). Ocular alignment was measured in all 5 cardinal positions at 20 feet and in primary reading position at 1 foot. All measurements were obtained using the alternate prism cover test with the patient wearing glasses prescription if

needed for correction of visual acuity and confirmed with the free space prisms test. Torsion was recorded subjectively using the green/red double Maddox rod placed in a trial frame (5). Free space horizontal prism was used to determine if the patient could fuse the vertical diplopia with horizontal prism alone (6). Vertical surgery was indicated in those patients who were not able to fuse the cyclovertical diplopia during the horizontal base out free space prism test.

Patients underwent surgical corrections of strabismus following standard surgical techniques. Patients underwent horizontal surgical correction by either medial rectus recession or lateral rectus resection or plication. For the cyclovertical deviation, patients underwent recessions, resections, plications, or partial tenotomy of the vertical rectus muscles. In general, the selection of the operated muscle depended on the magnitude of the deviation and lateral incomitance. When possible, surgery was performed under topical anesthesia and adjustable sutures were used.

Statistical Analysis

The statistical analysis was done using Microsoft Excel (Microsoft Corp, Washington). Continuous variables were reported using standard summary statistics. Mean values for continuous variables were compared between groups using a Student's t-test.

RESULTS

A total of 21 patients were included in the study. All patients underwent surgery for esotropia. Table 1 depicts the surgical groups with pre-operative measurements, post-operative measurements, and overall improvement percent. The mean overall preoperative vertical deviation improved from 2.1 ± 1.0 PD to 0.2 ± 0.6 PD ($p = 0.006$). Overall, the patients who underwent simultaneous horizontal and vertical muscle surgery had a larger preoperative hypotropia. The mean preoperative vertical deviation measured 2.8PD ± 1.1PD in those undergoing simultaneous horizontal and vertical surgery and only 1.3PD ± 1.5PD in those who underwent strictly horizontal surgery.

Thirteen patients underwent simultaneous surgery on both a horizontal and vertical muscles due to an inability to fuse the vertical deviation in free space with their esotropic deviation neutralized. Ten patients underwent unilateral inferior rectus muscle weakening procedure (most commonly an inferior rectus tenotomy with an average tenotomy of 3.5 mm) associated to a bilateral lateral rectus resection (6 patients) or a bilateral medial recuts muscle recession (4 patients). The average pre-operative deviation did not differ between those undergoing LR surgery and MR surgery (3PD) However those who underwent a MR procedure had a residual of 1PD vertical deviation, while the vertical deviation resolved in all those who underwent a LR procedure (Table 3). Two pa-

Table 1. Pre-operative and Post-operative Motor Alignment

Surgical Procedure	Pre-operative	Post-operative	P value
Overall	2.05±1.0 PD	0.2±0.6 PD	0.006
Inferior rectus weakening	2.8±1.3 PD range: 0.5-4 PD	0.2±0.6 PD range: 0-2 PD	0.0002
Superior rectus tightening	2.6±1.1 PD range: 2-4 PD	0±0 PD range: 0-0 PD	0.057
Horizontal surgery only	1.3±1.7 PD range: 0.5-5 PD	0.1±0.3 PD range: 0-1 PD	0.0001
Torsion	5.1°	0.7°	0.006

tients underwent superior rectus resection and one underwent superior rectus plication.

Eight patients who underwent horizontal surgery alone. Mean vertical correction was 1.04 PD (Table 2). Three patients underwent bilateral lateral rectus plications (mean 4 mm), 3 patients underwent bilateral lateral rectus resections (mean 4.6 mm), and 2 patients underwent bilateral medial rectus muscles recessions (mean 4.2 mm). One patient in this group demonstrated no change in the vertical deviation post-operatively. Preoperative esotropia measured 30 PD associated to a 1 PD vertical deviation. Patient underwent a bilateral LR resection of 5.5 mm. Postoperative horizontal deviation measured 2 PD of exophoria with no change in the preoperative vertical deviation. Patient had no diplopia postoperatively.

All the patients with symptomatic preoperative torsion underwent simultaneous vertical and horizontal muscle surgery (Table 3). Mean preoperative extorsion measured 5.1 ± 2.2°, improving to a mean postoperative extorsion of 0.7 ± 1.7° postoperatively.

DISCUSSION

SES has been well documented in the literature to be a debilitating cause of diplopia in the elderly population (2). The presence of asymmetrical sag causes cyclovertical strabismus in many patients. Pansara *et al*. reported the results of 16 patients with SES and evaluated the position of their vertical rectus muscles (3). There was a significant nasal shift of the superior rectus muscle compared to age-matched controls. The position of the inferior rectus did not differ from normal controls or subjects with heavy eye syndrome. Nasal shift of the SR may result in esotropia, excyclotropia and hypotropia due to a slack on the muscle.

The vertical deviation in our population of SES patients was quite small, ranging up to 5 PD. Potential explanations for the vertical deviation seen in patients with SES include asymmetric inferior sag of the lateral rectus muscle and nasal shift of the superior rectus muscle. Given that SES is typically bilateral, any asymmetry is unlikely to be large.

Acquired vertical deviations may result from other conditions including cyclovertical muscle paresis, trauma, thyroid eye disease, and external ophthalmoplegia, decompensated phoria. An acquired heterotopic or unstable pulleys can present with «A» or «V» pattern horizontal strabismus in association with any size vertical deviation (7,8) Patients with SES present with small vertical deviations, associated to a commitant horizontal deviations, and excyclotropia of the hypotropic eye.

Small angle vertical strabismus traditionally has been treated with prism glasses, as overcorrections are a concern. In patients with an associated large horizontal deviation or in patients with near and distance disparity prisms glasses may not be effective. Also, some patients do not want to be dependent on prisms glasses especially those not requiring

Table 2. Vertical alignment following horizontal rectus surgery.

	Pre-operative vertical deviation	Post-operative vertical deviation
Lateral rectus resection	1.16 PD	0.33 PD
Lateral rectus plication	0.5 PD	0 PD
Medial rectus recession	2.16 PD	0 PD

Table 3. Preoperative and postoperative cyclovertical deviation

	Pre-operative torsion	Post-operative torsion	Pre-operative vertical deviation	Post-operative vertical deviation
SR tightening + LR resection	5°	0°	2.6 PD	0 PD
IR tenotomy + LR resection	5.2°	1.4°	2.2 PD	0.4 PD

glasses for vision. Various surgical procedures have been described to manage small deviations. Scott first reported marginal horizontal rectus muscle tenotomies to manage small angle deviations. Lenhard and Wright described a central plication procedure to correct small angle horizontal and vertical deviations. Chaudhuri and Demer describe the dosing for graded vertical rectus tenotomies (GVRT) in SES (9,10) A 90% tenotomy can correct up to 10D of hypertropia (9). Selective marginal tenotomies and plications can also be used to manage torsional and incomitant vertical deviations (10,11) Singh et al reported 53 patients with a preoperative vertical deviation of 4.3 ± 1.8 PD. They found a mean response correction of 1.5 PD per mm of surgery (12). We did not see any overcorretions postoperatively.

The results of this study should be understood within the context of its limitations. This study was a retrospective chart review with a relatively small sample of patients with limited follow-up. Charts were recorded from three different surgeons and thus there can be variability in surgical techniques. In addition, there was no control group.

Despite its limitations, our study shows that partial tenotomies or plications on the vertical rectus muscles in addition to surgery on the horizontal muscles may be necessary to correct diplopia from small angle vertical strabismus in those patients with SES who are unable to fuse the vertical diplopia with horizontal prism alone.

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