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Divergence Insufficiency Esotropia: Surgical Treatment

Stacy L. Pineles, M.D., M.S.

Jules Stein Eye Institute, University of California—Los Angeles, Los Angeles, California

Abstract

Divergence insufficiency esotropia, or acquired comitant esotropia that is at least 10° larger at distance than at near, is most often seen in older adults, and may also be known as “age-related distance esotropia.” Surgical treatment is often indicated for patients who do not tolerate prism therapy, or for those with large angles of esotropia. Surgical treatments have evolved with our understanding of the disease-state. Currently, accepted treatments include lateral rectus resection and medial rectus recession. These surgeries can be performed unilaterally or bilaterally. New surgical techniques such as lateral rectus equatorial myopexy are under investigation and may hold promise as future therapies.

Keywords

esotropia; age-related distance esotropia; diplopia; strabismus

INTRODUCTION

Divergence insufficiency esotropia is most commonly defined as an acquired comitant esotropia that is at least 10° larger at distance than at near.¹ Recently, the term “divergence insufficiency” has been challenged, since alternate etiologies have been introduced that do not necessarily imply insufficient divergence amplitudes as the cause of this disease-state. Additionally, the pattern of divergence insufficiency esotropia can be seen in a wide range of ages, and likely has a differing underlying etiology in young patients compared with older adults.² Given that the pattern of divergence insufficiency esotropia is more often related to a neurological problem when it occurs in young children, the focus of this discussion will be on divergence insufficiency pattern esotropia in older adults, also known as “age-related distance esotropia.”

TYPICAL PRESENTATION

Divergence insufficiency esotropia typically presents in older individuals. In a study of the Rochester Epidemiology Project, divergence insufficiency esotropia was present in 10.6% of adult strabismus cases, at a median age of 74 years (range 19–92 years).³ In the same

Requests for reprints should be addressed to: Stacy L. Pineles, M.D., M.S., Jules Stein Eye Institute, UCLA, 100 Stein Plaza, Los Angeles, CA 90095.

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population, as age increased, the proportion of adult strabismus patients with divergence insufficiency also increased, with a significant age trend for both men and women.³

The typical presentation in an older individual is one of gradual or subacute onset of horizontal diplopia. Initially, most patients only notice intermittent horizontal binocular diplopia at long distances, such as in the theater or while driving. Over a period of several months, the diplopia becomes more constant and is noticed while driving, watching television, and in other long-distance vision situations. Typically, patients note that they do not have any diplopia at near. The deviation at distance is most often in the range of 10–20 and at near, patients are often orthotropic or may have a controlled esophoria.⁴ The esotropia at distance is horizontally comitant and may be associated with either normal or reduced divergence amplitudes.⁴ The remainder of the neurological examination should be normal, without any cranial neuropathies or abduction deficits. It is important to rule out a neurological cause of esotropia, as unilateral and bilateral abducens palsies can present with a similar pattern. The presence of lateral incomitance or other associated cranial neuropathies should prompt a work-up for neurological abnormalities.^{2,5} In addition, one should consider ruling out thyroid eye disease and myasthenia gravis when making this diagnosis.

ETIOLOGY

Our understanding of the underlying pathogenesis of this disorder is currently in evolution. Historically, divergence insufficiency was thought to be due to inadequate functioning of a “divergence center” in the brain.⁶ Several investigators in the past have attempted to localize this “divergence center” to various locations in the pons, midbrain, or cranio-vertebral junction.^{7–11} This theory was never fully accepted, and new theories were later introduced. In 2006, Guyton introduced the idea that increased convergence tonus over time may lead to medial rectus muscle shortening, thereby causing esotropia to be worse at distance.¹² Recently, a paradigm shift has been suggested by Chaudhuri and Demer¹³ in which they assert that the underlying etiology of “divergence insufficiency esotropia” (which they and Mittleman¹⁴ also call “adult onset age-related distance esotropia”) may be due to mechanical changes in the orbital connective tissues. As they describe, orbital connective tissues degenerate with age similarly to other periocular structures. In 2013, Chaudhuri and Demer presented a series of twenty-eight elderly patients with acquired diplopia suspected to be due to orbital connective tissue degeneration, or “sagging eye syndrome.”¹³ Magnetic resonance imaging of these patients revealed significant lateral rectus pulley displacement inferiorly due to degeneration of the lateral rectus-superior rectus band. With inferior displacement of both lateral rectus muscles, patients are left with diminished abducting power in the lateral rectus, and a divergence insufficiency pattern of esotropia.

SURGICAL TREATMENT

Patients with divergence insufficiency pattern of esotropia can be treated surgically if they do not respond to or do not desire prism therapy. The surgical treatment of divergence insufficiency esotropia can be approached by several differing techniques, all of which have

satisfactory results. As the etiology of divergence insufficiency is further elucidated, surgical treatments may evolve as well, in order to target the underlying pathological features.

Lateral Rectus Resection

Lateral rectus muscle resection has been advocated by many authors.^{6, 15–18} Proponents of lateral rectus muscle resection claim that this surgical approach is more likely to improve the distance esotropia without causing convergence insufficiency at near. One of the earliest case series was in 1982 by Krohel et al.¹⁹ This series included eleven patients undergoing bilateral lateral rectus resection. Their success rate could be considered low, with only 4 of 11 patients achieving satisfactory results. In 1995, Lim et al. reported five patients undergoing bilateral lateral rectus resection, with satisfactory results of no over-corrections at near.¹⁶ Thacker et al. described the largest series of patients with long-term follow-up who underwent lateral rectus resection.¹⁵ In their group of twenty-nine patients, twenty-four underwent bilateral lateral rectus resection and five underwent unilateral lateral rectus resection. The amount of resection ranged from 4.5 to 7.5 mm for unilateral surgery for deviations of 6–18° and 3–7 mm for bilateral surgery for deviations of 10–30°. Their patients all had satisfactory results, with no patients initially over-corrected or requiring additional prisms. However, they had a recurrence rate of almost 7% over their mean follow-up period of 39 months.¹⁵

Various authors have also reported results for unilateral lateral rectus resection only. Hoover et al. reported the results of six patients undergoing a single lateral rectus resection for deviations of 12–20°. ¹⁷ Their results were deemed satisfactory and there were no over-corrections reported. In 2013, Stager et al. reported a series of fifty-seven patients aged 54–89 years undergoing unilateral lateral rectus resection for distance esotropia deviations of 5–30°. ²⁰ Surgery was performed using local anesthesia on the non-dominant eye with the amount of resection ranging from 5 to 9 mm. Of the fifty-seven patients, 86% of them had a satisfactory result with no diplopia and no residual esotropia. Four patients required prism treatment to achieve diplopia-free vision, and two patients required additional surgery for recurrent esotropia.

Medial Rectus Recession

As the understanding of divergence insufficiency advanced, some surgeons began to advocate the use of medial rectus recession as an alternative treatment. In 2000, Thomas reported seven patients with divergence insufficiency pattern esotropia, albeit a younger population (aged 7–41 years).²¹

Prompted by questions related to the collapse of distance-near deviations, Archer studied the effect of medial vs. lateral rectus muscle surgery for strabismic deviations with distance-near incomitance.²² Evaluating 267 patients who underwent medial rectus recessions for esotropia, he found an exoshift of only 9% at near overall. Interestingly, he reported that a larger preoperative distance-near incomitance was associated with greater reduction in the incomitance irrespective of which muscles underwent surgery. He concluded that distance-near incomitance might not be an important indicator of which muscles should be operated. This study was preceded by Archer's group's report²³ of a series of eight patients aged 44–

77 years who underwent bilateral medial rectus recessions ranging from 3 to 4.25 mm for distance esotropias of 12–35°. Of their eight patients, three required prisms postoperatively, but the remaining five patients had satisfactory results. Although they did not report symptomatic convergence insufficiency, the mean near deviation postoperatively was 1.8° of exophoria (range 8° exophoria to 10° esotropia at near). They also reported a collapse of the distance-near deviation from 15° pre-operatively to 5° postoperatively.

Most recently, Chaudhuri and Demer²⁴ reported twenty-four patients with divergence paralysis pattern of esotropia and compared the results of those undergoing lateral rectus resection (n = 8) to those undergoing medial rectus recession (n = 16). Patients undergoing medial rectus recession had their surgery performed mostly under topical anesthesia. In both groups, there was no postoperative diplopia or convergence insufficiency, with follow-up time ranging from 8.5 to 40 months. The authors concluded that medial rectus recession is as effective as lateral rectus resection in this population of patients. However, they did note larger amounts of recession were required in this population, and suggested that double the distance angle of esotropia should be used as the surgical target.

Future Directions

Given the advancements in our understanding of this pattern of esotropia, new surgical techniques will likely be explored and reported. Chaudhuri and Demer's elucidation of the inferiorly displaced lateral rectus muscle pulley in patients with lateral rectus-superior rectus band degeneration will likely lead to new techniques addressing this mechanical problem. At the 2014 Jules Stein Eye Institute Apt Meeting, Dr. Robert Clark presented a series of patients undergoing lateral rectus equatorial myopexy for sagging eye syndrome/age-related distance esotropia.²⁵ Although this technique shows promise, it is still under active investigation.

CONCLUSIONS

Divergence insufficiency esotropia may be better described as "age-related distance esotropia." The underlying pathogenesis of this disease entity is still under active investigation, but may be related to mechanical factors such as degeneration of the lateral rectus-superior rectus band leading to lateral rectus muscle pulley displacement. Surgical treatment is often successful and may include unilateral or bilateral medial rectus recession or lateral rectus resection. Complications such as recurrence of distance esotropia or new-onset convergence insufficiency are rare, and patients are generally satisfied. Lateral rectus equatorial myopexy may be used in the future for this category of patients, but this technique is still under investigation.

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