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Postoperative drift is less in pattern than concomitant intermittent exotropia

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Abstract

Introduction—There is little data concerning postoperative drift in patients with intermittent exotropia who have coexistent A or V patterns. In addition, the impacts of pattern collapse and surgical method on postoperative drift have not been well addressed.

Methods—We retrospectively reviewed the records of 132 patients who had surgery for intermittent exotropia and had ≥ 6 months follow-up. Mean postoperative drift in 66 patients with pattern exotropia was compared to a nonpattern (comitant) group matched for surgeon, age, surgical method, and initial deviation. Postoperative drift was calculated by subtracting the deviation at postoperative day 1 from that at approximately 6 weeks, 6 months, 9 months, and >1 year.

Results—Pattern and comitant groups were similar in mean $\pm$ SD age (15 ± 17 years), follow-up (2.3 ± 2 years), preoperative exotropia ($23^\Delta \pm 11^\Delta$), initial postoperative deviation ($1^\Delta \pm 5^\Delta$ esotropia), and surgical technique. Patients with pattern intermittent exotropia showed significantly ($p < 0.02$) less exotropic drift postoperatively at all times than did patients without a pattern. In contrast to undercorrected patients, in those who were sufficiently overcorrected the effect of pattern became statistically insignificant after 6 months. Patients with persisting postoperative patterns had a significantly less postoperative drift ($p < 0.01$).

Discussion—Postoperative drift in patients with A- or V-pattern intermittent exotropia is consistently less than in comitant exotropia, particularly if the pattern persists postoperatively and if the exotropia is undercorrected. Therefore, surgeons should consider smaller early overcorrections in pattern than comitant intermittent exotropia. Lesser postoperative drift in pattern exotropia may suggest differing underlying causes of pattern vs nonpattern exotropia.

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Introduction

Postoperative drift in intermittent exotropia has been studied in several retrospective reviews.¹⁻⁸ Most strabismus surgeons agree that surgical interventions in intermittent exotropia should be targeted for an initial postoperative overcorrection to account for postoperative drift. However, many of the studies which have quantified postoperative drift have excluded patients with A or V patterns,^{3,4,7,8} or intermittent exotropia which is characterized by a greater deviation in sursumversion (V) or deorsumversion (A) relative to the opposite direction. In addition, in a small pilot study, our group reported that patients with A or V patterns show less drift than those with vertically comitant intermittent exotropia.⁹ The underlying mechanisms responsible for pattern deviations are still not clearly understood; thus, information describing the postoperative response to surgery for such patients may be informative.

Given our previous findings and the lack of data in this population, we undertook a retrospective, case-controlled review of patients with pattern and comitant intermittent exotropia from our surgical practices to determine the postoperative drift characteristics of a larger cohort of A- and V-pattern intermittent exotropia patients.

Methods

Patients

This retrospective chart review was approved by the University of California, Los Angeles, Institutional Review Board and complied with relevant privacy laws. Intermittent exotropia was generally defined as a divergent deviation intermittently controlled by fusional mechanisms, and intermittently breaking down into a manifest exotropia. Records were reviewed of all patients who underwent surgery for intermittent exotropia by one of two surgeons (ALR or JLD) with at least 6 months of follow-up between January 1996 and December 2006. Information extracted included the patients' age at diagnosis, age at surgery, preoperative visual acuity, stereo-acuity, cycloplegic refraction, spectacle correction, follow-up length, presence of amblyopia, prior surgery, use of preoperative patching, and amount of exotropia in primary position, as well as up and down gaze at distance (10 meters), and in central gaze at near (approximately 14 inches) at each visit. Patients were excluded if they had a constant exotropia, if they had prior surgery for any form of strabismus other than intermittent exotropia, if they had any cranial nerve palsy, anomalous retinal correspondence, central nervous system defects, or demonstrated lack of fusional capacity (<400 arcsec on standard Titmus testing). In addition, patients were excluded if they had coexistent vertical deviations exceeding 5^{Δ} , or if they did not have preoperative measurements in sursumversion and deorsumversion. Patients were defined as having an A pattern if the amount of exotropia in deorsumversion exceeded that in sursumversion by at least 10^{Δ} ; a V pattern was defined as an exotropia in sursumversion exceeding that in deorsumversion by at least 15^{Δ} . In addition, patients were only included if they had some control of their exotropia; thus all patients with constant exotropia were excluded. Patients were not excluded based on degree of control. After identification of patients with pattern intermittent exotropia, a control group was created by selecting matched individuals from the nonpattern (comitant) group. Matched controls for each patient with pattern exotropia were chosen with the following priority: surgeon (same surgeon was required for matching), age at surgery, surgical method of exotropia correction, and amount of preoperative intermittent exotropia. The control group was chosen to maximize similarity of potentially confounding factors. In order to avoid possible differences in case mix or outcomes between two different surgeons, the first priority in selection of the control group was to choose patients operated by the same surgeon. After this, we sought to match age and type of surgery.

Initial postoperative deviation (within 1 week of surgery) was recorded for each patient. Postoperative drift was then calculated for each patient at four nominal time points: 6 weeks (4-8 weeks), 6 months (5-7 months), 9 months (8-11 months), and >1 year.

Statistical Analysis

The primary outcome analysis was mean postoperative drift calculated for patients with pattern intermittent exotropia compared with patients having comitant intermittent exotropia. Drift was then calculated for several subgroups selected post hoc in an exploratory attempt to explain our findings (Table 1). Sufficient overcorrection was defined as at least 4^{Δ} of esotropia within one week following surgery. Pattern collapse was defined as reduction to less than 5^{Δ} difference in deviation between supraversion and infraversion. Surgical success was defined as a deviation between 4^{Δ} of esotropia and 8^{Δ} of exotropia at the last postoperative visit. Mean postoperative drift at each time-point was compared amongst groups using a paired Student's *t*-test (two-tailed, $\alpha = 0.05$). Two-tailed power calculations for each subgroup were done with $\alpha = 0.05$ and $\beta = 0.20$ to evaluate sample size.

Results

Subjects

Inclusion criteria for the study were met by 212 cases, including 66 with pattern-intermittent exotropia. Of the remaining cases, 66 cases of comitant intermittent exotropia were selected to serve as controls matched for (in order of importance) surgeon, age, surgical method, and initial deviation. Subjects' baseline characteristics are summarized in Table 2. Fifty-five of the patients with pattern-intermittent exotropia and 46 with comitant deviations had follow-up for at least one year. Sixty (91%) cases with pattern strabismus underwent rectus transposition (27), oblique surgery (28), or both (5) to collapse their patterns. Twenty-three cases exhibited clinical A patterns, while 43 exhibited V patterns. Of those patients old enough to undergo Titmus testing, all had measurable stereopsis, and 47/60 (78%) of the patients with comitant and 42/53 (79%) of the patients with pattern intermittent exotropia had stereopsis better than 100 arcsec. Preoperatively, the mean deviation in central gaze for the pattern and comitant intermittent exotropia groups were $21.0^{\Delta} \pm 12^{\Delta}$ and $24.3^{\Delta} \pm 11^{\Delta}$, respectively ($p = 0.1$).

Postoperative Drift

Mean overall drift was toward exotropia, and is illustrated graphically in Figure 1. Patients with a comitant intermittent exotropia drifted 5.2^{Δ} at approximately 6 weeks, 7.4^{Δ} at approximately 6 months, 8.2^{Δ} at approximately 9 months, and 8.8^{Δ} at >1 year. Patients with pattern intermittent exotropia drifted less: 2.6^{Δ} at approximately 6 weeks, 4.3^{Δ} at approximately 6 months, 3.8^{Δ} at approximately 9 months, and 4.9^{Δ} at >1 year ($p < 0.02$ for all comparisons between groups).

Several subgroups were analyzed post hoc (e-Supplement 1, available at jaapos.org). Of patients undergoing primary surgery (51 comitant, 44 pattern), the drift was significantly lower at most time points in patients with pattern compared to comitant intermittent exotropia ($p = 0.04, 0.07, 0.01, 0.01$, for the respective time points). The difference in drift was also significant at the later time points in those patients undergoing bilateral lateral rectus recessions ($p = 0.06, <0.01, <0.01, <0.01$). This difference was not significant in the smaller subgroups undergoing medial rectus resection and combined recess/resect procedures. Similarly, patients with smaller ($<20^{\Delta}$) and larger ($\geq 20^{\Delta}$) amounts of intermittent exotropia demonstrated similar trends. Patients with pattern intermittent exotropia who were sufficiently overcorrected postoperatively (at least 4^{Δ} of esotropia on the first postoperative day) appeared to drift less than patients with comitant intermittent exotropia ($p = 0.02$ and 0.03 , at 6 weeks and 6 months); however, this trend was not significant at one year. Conversely, patients who were

undercorrected (exotropia, orthotropia, or $<4^{\Delta}$ of esotropia on postoperative day 1) had significantly less drift beginning at 9 months ($p = 0.01$ at 9 months and one year). Among patients having pattern intermittent exotropia, the early postoperative drift was 0.6^{Δ} in those whose patterns were collapsed by surgery—significantly less than the mean drift of 3.7^{Δ} in patients whose patterns were not collapsed ($p < 0.01$); however, this trend was insignificant after the first time point. No significant difference in postoperative drift could be detected between patients with A vs V pattern. There was no statistically significant difference in postoperative drift between pattern patients who underwent rectus transposition compared to those who underwent oblique surgery until the final time point (7.4^{Δ} vs 3^{Δ} , respectively; $p = 0.05$). In addition, there was significantly greater drift in patients whose surgery was deemed unsuccessful in both comitant and pattern groups (data not shown).

Since some apparently insignificant differences between some groups in these analyses might simply have been due to insufficient sample size, retrospective power calculations were performed for each comparison in Table 1. At both time points, there were sufficient numbers of patients in the overall pattern and comitant groups, as well as those patients who had undergone primary surgery and bilateral lateral rectus recession. The remaining subgroups had insufficient numbers in at least one time point; failure to demonstrate significant differences in these subgroups may therefore not indicate absence of possible differences.

Discussion

Postoperative drift after surgery for comitant intermittent exotropia has been widely studied, resulting in recommendations for degrees of initial overcorrection depending on patient population and surgical approach. Early studies employing bilateral lateral rectus recessions suggested that initial overcorrection of up to 10^{Δ} - 20^{Δ} gave the best long-term results.⁴ Later, other studies compared various 2-muscle horizontal surgical techniques, and found drifts that varied from 0^{Δ} - 10^{Δ} in patients undergoing unilateral recession-resection procedures to 0^{Δ} - 20^{Δ} in those undergoing bilateral lateral rectus recessions.^{3,5,10,11} Studies have also suggested that there may be less postoperative drift in these groups after unilateral than bilateral surgery for intermittent exotropia.⁸ Other patient groups that have been evaluated include those with large angle intermittent exotropia, consecutive intermittent exotropia, and those undergoing adjustable suture surgery.^{1,6,12} As demonstrated by the foregoing studies, postoperative drift has been well characterized in presumably comitant cases; but many of these studies excluded or did not differentiate patients with A or V patterns or evidence of oblique dysfunction.

Although the question of postoperative drift in pattern intermittent exotropia has not been evaluated in a large study, reported surgical success in pattern intermittent exotropia has ranged between 60% and 91%.¹³⁻¹⁶ Our study chose not to arbitrarily define surgical “success,” but instead attempted to characterize the amount of postoperative drift in our population of patients with pattern intermittent exotropia.

Our findings indicate that patients with a significant A or V patterns drift less after surgical correction of intermittent exotropia than patients with comitant intermittent exotropia. We did not detect a difference in the postoperative drift when patients were subdivided into subgroups based on amount of initial deviation ($>20^{\Delta}$ or $<20^{\Delta}$); this may reflect real absence of such a difference, or inadequate power to detect a difference since there were too few patients in both subgroups. Interestingly, when we analyzed subgroups based on the amount of initial overcorrection at one year, patients who were sufficiently overcorrected ($>4^{\Delta}$ esotropia) appeared to behave similarly to those patients with comitant intermittent exotropia, and those who were undercorrected drifted less. In addition, patients with pattern intermittent exotropia whose patterns were sufficiently collapsed ($<5^{\Delta}$ difference) appeared to drift more than those

whose patterns were not collapsed (although the difference was not statistically significant after the first time point). While there was a trend toward less drift in those pattern patients undergoing oblique surgery compared to rectus transposition, the effect was not found to be statistically significant. Finally, the presence of an A vs V pattern did not significantly correlate with postoperative drift.

Several potential explanations may underlie these findings. First, differing mechanisms may be responsible for pattern versus comitant strabismus. If pattern strabismus is based on mechanical and orbital factors, as proposed by Nakamura et al¹⁷ and Oh et al,¹⁸ but comitant exotropia is due to a central disorder of the vergence control, then one should not expect the two forms of exotropia to respond similarly to surgery. Presumably, the putative mechanical problem in pattern strabismus would be more directly addressed by surgery, which mechanically alters extraocular muscles. Alternatively, the observed effect might be due to central fusional mechanisms since patients with pattern strabismus might intermittently fuse more preoperatively by using head positioning. It is possible that patients with pattern intermittent exotropia more frequently adopt a head position postoperatively to maintain fusion. This theory might also explain decreased exotropic drift in patients whose patterns were insufficiently collapsed by surgery, since these patients may have maintained a head position to achieve fusion. This theory could not be tested in our study, as head position was not consistently recorded. Finally, an alternative explanation for our observation is the effect of the oblique weakening surgery on those patients who underwent it. Since oblique muscles are abductors, oblique weakening might reduce postoperative drift. Although the trend was insignificant, there was a larger exotropic drift in those patients who underwent rectus transposition. Evidence to the contrary has been provided by Minguini et al,¹⁹ who observed no difference in surgical outcomes between strabismic patients undergoing combined oblique surgery and horizontal rectus surgery, compared with those undergoing horizontal rectus surgery alone.

Limitations of this study must be understood, including its retrospective nature, relatively small number of patients in various subgroups, contribution of two separate surgeons, nonrandom control group, and nonuniform follow-up. In addition, this study was conducted in a tertiary care setting, and thus included a substantial number of reoperations. Finally, the absolute differences among time points and patient groups are small, and are within the range of test-retest variability of cover testing in individual patients. However, even small differences consistently observed in large samples can be important, and the statistical significance of the difference between pattern and comitant intermittent exotropia was so robust across so many subgroups and at nearly all postoperative time points that it likely represents a true biologic effect of clinical significance. A prospective study of exotropic drift in patients with pattern intermittent exotropia would be useful to confirm our findings, but would constitute a large and resource-intensive endeavor.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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FIG 1. Postoperative drift in patients with pattern and comitant intermittent exotropia. Drift was significantly greater in comitant than with pattern intermittent exotropia at all time points.