Major Article

Stereoacuity outcomes following surgical correction of the nonaccommodative component in partially accommodative esotropia

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BACKGROUND Previous studies of partially accommodative esotropia (PAET) have assessed factors requiring surgery and alignment outcomes. The purpose of the present study was to additionally evaluate stereoacuity in patients who required surgery for their nonaccommodative component.

METHODS The medical records of consecutive patients with PAET who underwent bilateral medial rectus recession from April 1990 to July 2010 to treat the nonaccommodative component were reviewed retrospectively. Preoperative data included visual acuity, stereoacuity, cycloplegic refraction, deviation at distance and near, and age at surgery. The primary outcomes were stereoacuity and alignment.

RESULTS A total of 84 patients were included. Stereopsis by the Titmus StereoTest was demonstrated in 51 (61%) by the final visit. The average follow-up time was 4.4 ± 2.8 years (range, 0.8-11.0 years). Fine stereopsis (100 arcsec or better) was appreciated in 29 patients (35%, 57% of those with stereopsis). Of those with residual esotropia, 11 (50%) demonstrated stereopsis, and 7 (32%) appreciated fine stereoacuity. No exotropic patient had stereopsis. There was a statistically significant correlation between age at time of surgery and stereopsis at 1 year ($\rho = 0.233$; $P = 0.033$) but not at the final visit ($\rho = 0.106$, $P = 0.34$). Of the 84 patients, 56 (67%) had a favorable alignment (within 10^{Δ} of orthotropia) at the final visit; 22 (26%) had residual esotropia; and 6 (7%) had consecutive exotropia.

CONCLUSIONS In this subset of esotropic patients who required surgery for their nonaccommodative component, favorable sensory outcomes can be achieved. Furthermore, favorable stereoacuity can be found even when there is a residual esodeviation. (J AAPOS 2018;■:1-5)

Partially accommodative esotropia (PAET), where a convergent misalignment of the visual axes is associated with high hypermetropia, is typically diagnosed at 18-48 months of age. Initial therapy for PAET is spectacle correction, which may be followed by surgical management of any persistent, nonaccommodative component.[1,2]

The period of stereopsis development has been well studied. Initiating at 3 months of age, there is significant maturation within the 8-18 month age range, followed by continued development until 36 months of age.[3] Although PAET generally presents later than this critical period, there is evidence that up to 75% of patients with PAET have abnormal binocularity.[4] Even those with orthotropic or microtropic alignment from refractive correction alone may achieve merely gross stereoacuity (≥1,980 arcsec); Tomaç[5] found this to be true in up to 45% of the cases. Patients who lacked stereopsis also had a 17 times higher risk of requiring surgical correction of their PAET, whereas those obtaining earlier rehabilitation of stereopsis through optical correction and surgical management had better long-term alignment stability.[6] The current study aimed to evaluate the stereoacuity outcomes of patients with PAET; specifically, we investigated consecutive patients who required surgical correction of their nonaccommodative component to explore the relationship between stereoacuity and alignment.

Subjects and Methods

Institutional Review Board approval for this study was obtained through Ann & Robert H. Lurie Children's Hospital of Chicago (formerly Children's Memorial Hospital). The medical records of consecutive patients who underwent bilateral medial rectus

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recession by a single surgeon (MBM) over the 10-year period from April 1990 to July 2010 were reviewed retrospectively. The study complied with US Health Insurance Portability and Accountability Act of 1996 and adhered to tenets of the Declaration of Helsinki.

Patients were included if they had a diagnosis of PAET, hypermetropic spherical equivalent of ≥ +2.25 D, and at least 1 year ± 2 months of postoperative follow-up. Exclusion criteria consisted of preoperative amblyopia (defined as having a > 2-line visual acuity difference, because this may interfere with appropriate stereoacuity testing), anisometropia >1.75 D, underlying neurologic disorder, previous surgery, insufficient follow-up, and lack of stereoacuity documentation at the final postoperative visit. Preoperative data included visual acuity, stereoacuity (Titmus StereoTest, Stereo Optical Co Inc, Chicago, IL), cycloplegic refraction, ocular alignment measurements at near (0.33 m) and distance (6 m), and age at time of surgery. All measurements were performed by trained orthoptists or ophthalmic technicians via the alternate prism-cover test or the Krimsky method, depending on patient age and cooperation, in habitual spectacle correction.

Patients underwent bilateral medial rectus recession via fornix-based incision and fixed-suture technique. The amount of recession followed Parks,[7] with measurements taken from the muscle insertion, and was based on the distance deviation with best-corrected spectacle use.

Postoperatively, data were extracted at the 6-week visit (±2 weeks), 1-year visit (±2 months), and final recorded visit to assess visual acuity, stereoacuity, and alignment measurements. Distance alignment data were subdivided into "favorable" (within 10^{Δ} of orthotropia), "residual" (residual esotropia $>10^{\Delta}$), and "consecutive" (consecutive exotropia $>10^{\Delta}$). Because alignment measurements were made using alternate prism-cover test when possible, these groups include underlying phoria, too. Stereoacuity was measured as fine (40–100 arcsec) or gross (101–3600 arcsec).

Statistical Analysis

Variables at different follow-up points were compared using multivariate analysis of repeated measures while controlling for follow-up time. The Kruskal-Wallis test was used to determine statistical significance between groups. Pearson correlation coefficient was used to determine correlation between parameters. Data were analyzed using SAS 9.3 (SAS Institute Inc, Cary, NC).

Results

Of the 695 consecutive patients who underwent bilateral medial rectus recession during the study period, 84 patients (44 females [52%]) met inclusion criteria. The mean age (with standard deviation) at the first clinic visit was 3.7 ± 2.1 years; at time of surgery, 4.5 ± 2.5 years. The average difference between the ages at time of surgery and the first visit was 0.9 years (ie, on average, there was a 10.8-month span between the first visit and the time of surgery). The mean preoperative esotropia at distance was 28.2^{Δ} ± 10.5^{Δ}; at near, 35.3^{Δ} ± 12.5^{Δ} (Table 1). All patients had a preoperative esotropia $>10^{\Delta}$ except for a 3-year-old girl with a preoperative esotropia of 5^{Δ} at distance and 8^{Δ} at near, +3.00 D of hypermetropia, and V pattern of 0^{Δ} in upgaze and 35^{Δ} of esotropia in downgaze. Surgery was performed in this case given the significant V pattern.

By the 6-week postoperative visit, the mean distance deviation was 4.3^{Δ} ± 6.7^{Δ} of esotropia (range, 10^{Δ} exotropia to 30^{Δ} esotropia), and the mean near deviation was 8.2^{Δ} ± 7.5^{Δ} of esotropia (range, 6^{Δ} exotropia to 25^{Δ} esotropia). Overall, there were no significant overcorrections noted initially, although 1 patient had 10^{Δ} XT at distance on the 6-week visit (while the near deviation was 8^{Δ} esotropia). At the 1-year postoperative visit, the mean distance deviation was 5.1^{Δ} ± 10.5^{Δ} of esotropia (range, 35^{Δ} extropia to 25^{Δ} of esotropia), and the mean near deviation was 11.5^{Δ} ± 10.2^{Δ} esotropia (range, 25^{Δ} exotropia to 37^{Δ} esotropia). The average follow-up from surgery to the final recorded postoperative visit was 4.4 ± 2.8 years (range, 0.8-11.0 years). At the final visit, 67% were in favorable group; 26%, in the residual esotropia group; and 7.1%, in the consecutive exotropia group (Table 1). There was no statistically significant difference between the postoperative alignments at the 1-year visit and at the final visit (P = 0.23), nor between the stereoacuity results at the 1-year and final postoperative visits (P = 0.76).

Given the statistical similarity in postoperative data at 1-year and final visits, our study focused on the stereoacuity at the final visit. Of the 84 patients, 51 (61%) had quantifiable stereoacuity at their final postoperative visit. Of these 51, 40 (78.4%) were in favorable group, with 22 (43% of total and 55% of favorable group) having fine stereoacuity and 18 (35% of total and 45% of favorable group) having gross stereoacuity (Figure 1). The remaining 11 patients (22%) were in the residual esotropia group with 7 (14% of total and 64% of residual esotropia group) showing fine stereoacuity and 4 (8% of total and 36% of residual) having gross stereoacuity. None of the 6 patients with consecutive exotropia showed measureable stereopsis. Therefore, 11 of the 84 patients (13%) demonstrated quantifiable stereoacuity despite having a poor motor outcome (specifically residual esotropia). Only 2 of those patients had gross stereoacuity of 3600 arcsec, but the remaining perceived 400 arcsec or better.

We also investigated whether preoperative refractive error played a role in surgical outcomes. Because those with significant preoperative anisometropia were excluded, the right and left eye spherical equivalent (SE) was averaged and then statistically analyzed in the three groups. The median preoperative SE with 95% confidence intervals was +3.56 D (95% CI, 2.59-5.59 D) in the favorable group (n = 56), +3.19 D (2.38–4.31 D) in the residual esotropia group (n = 22), and +4.00 D (2.50–5.50 D) in the consecutive group (n = 6). There was no statistically significant difference among the three outcome groups (P = 0.34). At the final postoperative visit, there were 21 patients (25.0%) with high hypermetropia (>+5.00 D SE). The majority (n = 15 [71%]) were in the favorable group, of whom 9 (43% of all hyperopic patients and 60% of favorable-group high hyperopic patients) had measurable