015 A prospective observational study of adult divergence insufficiency esotropia. Eric R. Crouch, Trevano W. Dean, Jonathan M. Holmes, Raymond T. Kraker, Aaron M. Miller, Courtney Kraus, Kammi B. Gunton, Michael X. Repka, Justin D. Marsh, Monte A. Del Monte, Paula A. Luke, Jason H. Peragallo, David K. Wallace

Introduction: This study was designed to assess treatment outcomes for adult onset divergence insufficiency distance esotropia.

Methods: In a nonrandomized observational study, we prospectively enrolled adults with divergence insufficiency (defined as distance esodeviation of 2^{Δ}-30^{Δ} at least 1.25 times larger than near esodeviation by prism and alternate cover test, and distance diplopia with frequency of "sometimes," "often," or "always" in primary gaze by diplopia questionnaire). Participants were enrolled when a new treatment was being initiated (either prism, orthoptic exercises, or surgery). The primary 12-month outcome was "symptom success" defined as diplopia "rarely" or "never" straight ahead in the distance.

Results: A total of 114 participants were enrolled and initiated treatment: surgery (n = 76, 67%), prism (n = 34, 30%), or exercises (n = 4, 4%). Prior treatment was reported primarily in the surgery group (n = 61, 80%). Success criteria were met for 55 (89%; 95% CI, 78%-95%) with surgery and 17 (65%; 95% CI, 44%-83%) with prism. Success rates were high for both major types of surgery (bilateral medial rectus recession: 32 of 35 [91%]; bilateral lateral rectus resection: 10 of 11 [91%]).

Discussion: Although success rates cannot be compared directly in this nonrandomized study because there were important differences in baseline characteristics, success was common.

Conclusions: When assessed 12 months after initiating treatment, strabismus surgery or prism often successfully improves symptoms in divergence insufficiency. These data may be useful for counseling patients and for future RCTs.

016 The medial rectus is the bad actor in intermittent esotropia. Joseph L. Demer, Robert A. Clark

Introduction: Fusional convergence controls exophoria, but failure of fusional divergence in esodeviations has been enigmatic. Magnetic resonance imaging (MRI) can clarify muscle function during divergence.

Methods: Orbital MRI was performed during binocular fusion of centered targets. Nine orthophoric controls fused monocular 4^{Δ} base-in prism at 400 cm and 10 fused 8^{Δ} base-in at 20 cm. Four patients fused acquired, intermittent esotropia averaging $24^{\Delta} \pm 4^{\Delta}$. Changes in compartmental posterior partial volumes of the horizontal rectus muscles quantified contractility.

Results: In patients and controls, both diverging lateral rectus (LR) compartments contracted symmetrically for near and distant targets, although contractility was much larger in patients ($P < 0.002$). At near in controls, only the diverging medial rectus (MR) superior compartment relaxed, while the inferior compartment remained contracted ($P < 0.03$). The normal MR did not relax during far divergence. At near in patients, the MR superior relaxed significantly more than the inferior compartment ($P = 0.005$). For near targets, MR and LR co-relaxed in the aligned eye in both patients and controls.

Discussion: The diverging MR inferior compartment co-contracts against the LR, resisting fusional divergence at near, and the entire MR fails to relax as much as the LR contracts for far targets. The MR and LR co-relax in the aligned eye when its fellow diverges to fuse intermittent esotropia.

Conclusions: The inferior compartment of the MR actively opposes fusional divergence in intermittent esotropia, not reciprocating the LR. Poorer MR relaxation accounts for lower fusional divergence for far than near targets. Selective weakening of the inferior MR compartment may treat acquired intermittent esotropia.

017 How long does gene therapy last? 4-year follow-up of phase 3 voretigene neparvovec trial in *RPE65*-associated LCA/inherited retinal disease. Arlene V. Drack, Jean Bennett, Stephen Russell, Katherine A. High, Zi-fan Yu, Amy Tillman, Daniel Chung, Kathleen Z. Reape, Thomas Ciulla, Albert Maguire

Introduction: Voretigene neparvovec (VN) gene therapy improves ambulatory navigation, light sensitivity, and visual field in subjects with *RPE65*-associated Leber congenital amaurosis /inherited retinal disease. We report Year 4 results for original intervention (OI) subjects, year 3 for delayed intervention (DI), and Y1 results for all subjects stratified by age < 10, 11-17 or >18 years at treatment for the primary endpoint.

Methods: Subjects were randomized to either original intervention (OI:bilateral subretinal VN at baseline) or delayed intervention (DI:VN after 1 year). Primary endpoint was change in bilateral performance on the multi-luminance mobility test (MLMT).

Results: There were no significant differences in MLMT between subjects aged ≤ 10 (n = 13), 11–17 (n = 7), and ≥ 18 years (n = 9) at Year 1. Mean changes in MLMT at Year 1 were maintained at Year 4 for OI and Year 3 for DI (1.7 and 2.4 light levels, respectively). At year 4, 5/20 OI subjects (ages at treatment 4, 6, 11, 11 and 34 years) showed a decrease of one light level. Three of the 5 remained stable compared to year 2 or 3. No subject declined below baseline, and 1/20 (age at treatment 16 years) gained a light level. One subject had a retinal detachment detected at year 4.

Discussion: Amblyopia may not be a major hindrance to gene therapy treatment but loss of photoreceptors in a progressive disease may affect outcome.

Conclusions: Functional vision is stable in 24 of 28 patients (86%) from one year post-treatment through 3-4 years of follow-up.

018 Stepped strabismus surgery. Amr A. Elkamshoushy, Ahmed Kassem

Introduction: To present and evaluate a new intraoperative technique in strabismus surgery that allows further operation on additional extraocular muscles or to be skipped if the immediate intraoperative alignment is satisfactory.

Methods: This is a retrospective chart review of cases of stepped strabismus surgery from 2010 until 2018. In stepped surgery the first muscle is done under propofol IV infusion general anesthesia (GA). The anesthesia technique is modified to allow full recovery within 30 minutes in the OR. Patient is assessed in the OR. If deemed necessary, GA is given again and another muscle is operated. No adjustable sutures were utilized.

Results: A total of 56 cases were included (22 superior oblique palsy [SOP], 29 horizontal deviations and 5 thyroid eye disease). The technique was used in SOP cases with angles ranging 12^{Δ}-25^{Δ}. Inferior oblique myectomy was done as first step in all cases and 5 cases needed additional muscle surgery. Horizontal deviations ranged from 12^{Δ} to 20^{Δ} and all cases underwent a single horizontal rectus recession. Thirteen cases required another muscle surgery. Overall reoperation rate was 9%.

Discussion: The technique was utilized in borderline cases where the decision to operate on one or two muscle was difficult to make. It obviated the need for adjustable sutures in such cases with comparable success rate.