Correlation of monocular grating acuity at age 12 months with recognition acuity at age 4.5 years: findings from the Infant Aphakia Treatment Study

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PURPOSE To determine whether grating acuity at age 12 months can be used to predict recognition acuity at age 4.5 years in children treated for unilateral congenital cataract enrolled in the Infant Aphakia Treatment Study (IATS).

METHODS Traveling testers assessed monocular grating acuity at 12 months of age (Teller Acuity Card Test [TACT]) and recognition acuity at 4.5 years of age (Amblyopia Treatment Study Electronic Visual Acuity Testing, HOTV) in children treated for visually significant monocular cataract in the IATS. Spearman rank correlation was used to evaluate the relationship between visual acuities at the two ages in the treated eyes.

RESULTS Visual acuity data at both ages were available for 109 of 114 children (96%). Grating acuity at 12 months of age and recognition acuity at 4.5 years of age were significantly correlated for the treated eyes ($r_{spearman} = 0.45$; $P = 0.001$). At age 4.5 years, 67% of the subjects who had grating acuity at 12 months of age within the 95% predictive limits in their treated eye demonstrated recognition acuity better than 20/200. Similarly, at age 4.5 years 67% of the subjects who had grating acuity at age 12 months below the 95% predictive limits in their treated eye demonstrated recognition acuity of 20/200 or worse.

CONCLUSIONS A single grating acuity assessment at age 12 months predicts recognition acuity in a child treated for unilateral congenital cataract in only two-thirds of cases. Clinicians should consider other factors, such as patching compliance and age at surgery, when using an early grating acuity assessment to modify treatment. (J AAPOS 2018;22:299-303)

Grating acuity assessments in infants and young children have evolved from a rigorous laboratory-based protocol to a relatively simple procedure that has been used extensively in clinical populations.[1,2] The Teller Acuity Card procedure was developed to determine an infant's visual acuity at the time of the test; however, application of this procedure with clinical populations has led to studies evaluating the extent to which early grating acuities can predict later recognition acuities. Research with preterm infants has demonstrated significant, albeit modest, correlations between grating acuity at 12 months corrected age and recognition acuity at 4 and 5.5 years of age.[3,4] Two studies of infants who had been treated for congenital cataracts demonstrated significant correlations between early grating acuity and later recognition acuity that were higher than those reported for preterm populations (Maurer D, Lewis T & Brent HP, IOVS 1989;30:ARVO Abstract 408,69).[5] The greater range of both grating and recognition acuities in these cataract patients compared with a more optically uniform group of preterm infants likely allowed for a stronger correlation between these two measures. The longitudinal nature as well as the large range of visual acuities in IATS affords an opportunity to assess the ability of grating acuity at 12 months of age to identify children treated for unilateral congenital cataract whose visual outcome was better than 20/200 using recognition acuity in the treated eye at 4.5 years of age.

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Subjects and Methods

The IATS is a multicenter, randomized clinical trial funded by the National Eye Institute designed to assess the benefits as well as the risks of implanting an IOL at the time of initial cataract surgery compared with leaving the patient aphakic. This study followed the tenets of the Declaration of Helsinki, received approval from the institutional review boards of the participating institutions, and complied with the US Health Insurance Portability and Accountability Act of 1996. The off-label research use of the Acrysof SN60AT and MA60AC IOLs (Alcon Laboratories, Fort Worth, TX) for infants was covered by US Food and Drug Administration investigational device exemption G020021.

Previous publications have reported the study design and methodology[6] as well as the primary outcome results at 12 months and 4.5 years of age.[7,8] (See eAppendix A for a brief summary.)

Statistical Procedures

Measures of monocular grating acuity and recognition acuity were converted to logMAR values for calculation purposes. Statistical analyses demonstrated no significant difference between median visual acuity for the two treatment groups at either age. Given the lack of significant difference between the two treatment groups and the fact that the current analysis relates to prediction of visual acuity, data from all participants were pooled for the present analyses. The relationship between acuities at 12 months and 4.5 years was determined using Spearman rank correlation.

Predictive values were determined by dichotomizing the grating acuity results based on the lower 95% predictive limit from normative monocular data at 12 months of age: 4.21 cy/deg.[9] Grating acuity values above the lower 95% predictive limits were considered to be within normal limits and represent good vision, while grating acuities below this level were judged to represent poor vision. Recognition acuity values were categorized into good visual acuity (better than 20/200) and poor visual acuity (equal to or worse than 20/200). This cut-off was based on the legal definition of blindness used in the United States: visual acuity that cannot be corrected to better than 20/200.[10] Negative predictive value (NPV) was defined as the proportion of children with grating acuity within 95% prediction limits (4.21 cycles/degree or better) who had recognition acuity better than 20/200. Positive predictive value (PPV) was estimated as the proportion of eyes with poor grating acuity (worse than 4.21 cycles/degree, 95% predictive limits) who had poor recognition acuity (20/200 or worse). We also estimated the sensitivity and specificity of grating acuity within the 95% predictive limits in identifying those children who will have a good recognition acuity (better than 20/200) at age 4.5 years.

Additional analyses grouped patients by factors that might contribute to and improve predictive values, specifically: (1) grouping patients by age at surgery; and (2) grouping patients according to (a) reported decreases in patching between 12 months and 4.5 years of age, (b) the occurrence of a sight-threatening adverse event after 12 months of age, or both (a) and (b). Comparison of the slopes of the regression lines (logMAR at 12 months vs logMAR at 4.5 years) and analysis of covariance were performed for these supplemental analyses, respectively.

Results

A total of 114 infants were enrolled in the IATS; 57 were randomized to each treatment condition. At age 12 months, monocular grating acuity data were obtained on all 114 participants. At age 4.5 years monocular recognition acuity data were obtained on 112 participants: one child was lost to follow-up around 18 months of age and a second was unable to complete the HOTV testing because of a developmental disorder diagnosed at 9 months of age. Additionally, for the present analyses, we excluded 3 patients: one child had endophthalmitis in the early postoperative period that limited visual potential and resulted in a visual acuity of LP at 4.5 years; another developed a retinal detachment and the eye, subsequently, became phthisical, leaving the child with NLP at 4.5 years of age; the third patient was ultimately diagnosed with Stickler's syndrome. Thus, data on 109 children were available for analysis.

Comparison of logMAR Visual Acuity at 12 Months and 4.5 Years

The correlation between grating and recognition acuities for the 109 treated eyes was statistically significant ($r_{spearman} = 0.45$, $P < 0.001$). That is, eyes with better grating acuity at 12 months of age tended to have better recognition acuity at 4.5 years. However, as shown in Figure 1, there is a considerable amount of variability in logMAR values of the treated eye at both ages. It is also apparent that the number of patients whose vision improved (n = 60) between the two ages is almost the same as the number whose vision decreased (n = 49).

In order to assess the contribution of age at surgery on these predictive values, we grouped our patients into the following three categories: (1) surgery at 4-6 weeks of age (n = 49); (2) surgery at 7-12 weeks of age (n = 28); and (3) surgery after 12 weeks (n = 34). We compared the slopes of the regression lines (logMAR at 12 months vs logMAR at 4.5 years) across these three age groups and determined that there was no statistically significant difference among the groups ($P = 0.218$).

Exploring intervening events that might influence long-term recognition acuity, we considered the effects of changes in reported patching and the occurrence of one or more sight-threatening adverse events between 12 months and 4.5 years on the ability of grating acuity at 12 months to predict recognition acuity at 4.5 years. We divided patients into four groups based on specific experiences between 12 months and 4.5 years: (1) reported patching on average ≤30 minutes per day between