

## Improvement in specific function-related quality-of-life concerns after strabismus surgery in nondiplopic adults

Laura Liebermann, CO, Sarah R. Hatt, DBO, David A. Leske, MS, and Jonathan M. Holmes, BM, BCh

### BACKGROUND

We have previously reported improvement in psychosocial scores after strabismus surgery on the patient-derived health-related quality of life (HRQOL) Adult Strabismus 20 (AS-20) questionnaire in adults with nondiplopic strabismus. Unexpectedly, we also found improvement in the function domain. The aim of the present study was to identify which specific aspects of function-related quality of life improved postoperatively.

### METHODS

We retrospectively identified non diplopic adult patients with a history of childhood onset strabismus who underwent surgery and who had preoperative and 1-year postoperative AS-20 questionnaires (scored from 0 [worst] to 100 [best]). Change in scores for each item was evaluated using signed-rank tests.

### RESULTS

A total of 20 patients were included. Of the 10 function-related AS-20 items, 9 showed significant mean improvement postoperatively (improvement ranged from 12.5 to 32.5 points, all  $P < 0.05$ ). Rasch-derived mean scores improved in both reading function and general function domains (71.0 to 86.5 and 66.4 to 87.5, respectively; both  $P < 0.0001$ ). Specific areas of function-related benefit were concentration, depth perception, hobbies, strain, reading, stress, and worry.

### CONCLUSIONS

We found specific function-related quality of life benefits after strabismus surgery in nondiplopic adult patients, particularly those with childhood onset strabismus. (J AAPOS 2014;18:105-109)

Improvement in health-related quality of life (HRQOL) in adult strabismic patients after strabismus surgery has been previously reported.<sup>1-5</sup> In previous studies we have quantified this improvement in HRQOL using the Adult Strabismus 20 (AS-20) questionnaire.<sup>6,7</sup> As expected, we found improvement in the function domain for diplopic patients<sup>7</sup> and in the psychosocial domain for nondiplopic patients,<sup>7</sup> but unexpectedly, we also found improvement in function domain scores for nondiplopic patients.<sup>7</sup> Other investigators have also reported function-related improvement in nondiplopic patients.<sup>1,2,8-10</sup> The aim of the present study was

to identify which specific aspects of function-related quality of life reported on the AS-20 improve postoperatively in nondiplopic patients with childhood-onset strabismus.

### Subjects and Methods

Mayo Clinic Institutional Review Board approval was obtained for this study. All procedures and data collection were conducted in a manner compliant with the Health Insurance Portability and Accountability Act of 1996.

We retrospectively identified nondiplopic adult patients presenting with a history of childhood onset strabismus who underwent surgery for strabismus and completed the AS-20 questionnaire at both their preoperative and 1-year postoperative visits (median, 12 months; range, 6-19 months). If a patient had more than one surgery performed at our institution, only the first surgery and associated examinations were analyzed in this study. Patients with intermittent strabismus or oculomotor, trochlear, or abducens nerve palsies were excluded. For inclusion, absence of diplopia was required at both the pre- and postoperative visits and was either recorded by the patient using the diplopia questionnaire<sup>11</sup> (diplopia rated as “never” or “rarely” in all gaze positions), or taken from the history documented in the patient’s medical record.

The AS-20 questionnaire is a patient-derived, strabismus-specific, health-related quality of life questionnaire.<sup>12</sup> It contains

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Author affiliations: Department of Ophthalmology, Mayo Clinic, Rochester, Minnesota  
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Correspondence: Dr. Jonathan M. Holmes, BM, BCh, Ophthalmology W77, Mayo Clinic, Rochester, Minnesota 55905 (email: holmes.jonathan@mayo.edu).

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Table 1. Adult strabismus 20 questionnaire: 10 function-related items (11-20)<sup>a</sup>

11) I cover or close one eye to see things better
12) I avoid reading because of my eyes
13) I stop doing things because my eyes make it difficult to concentrate
14) I have problems with depth perception
15) My eyes feel strained
16) I have problems reading because of my eyes
17) I feel stressed because of my eyes
18) I worry about my eyes
19) I can't enjoy my hobbies because of my eyes
20) I need to take frequent breaks when reading because of my eyes

<sup>a</sup>Response options: Never, Rarely, Sometimes, Often, Always.

20 questions, 10 referring to psychosocial aspects of HRQOL and 10 to function-related aspects. The frequency response options for each item of the AS-20 are: never, rarely, sometimes, often, or always. The AS-20 is scored from 0 (worst HRQOL) to 100 (best HRQOL) as a mean of all answered items for each domain. The present study focuses on the 10 function-related items (items 11-20; Table 1). The AS-20 has recently undergone refinement using Rasch analysis,<sup>12</sup> resulting in two function-related domains, (the reading function domain, containing items 12, 13, 16, 20, and the general function domain, containing items 11, 15, 17, 18). Additionally, Rasch-derived response scoring for individual items has been reported and is available in lookup tables (available at [www.pedig.net](http://www.pedig.net), accessed November 7, 2013).

Stereoacuity was measured at distance (3 meters) with the Frisby Davis Distance (FD2) stereotest and at near with the near Frisby stereotest (tests described elsewhere<sup>13-15</sup>) pre- and postoperatively for all patients.

For each function-related item of the AS-20, change in score was evaluated using signed-rank tests. Each item was scored on the original 0-100 scale, since 2 of the items (14 and 19) do not have corresponding Rasch measures. For each of the 10 original function-related items, change in response category preoperatively to postoperatively was also analyzed.

As a second possibly confirmatory analysis, for the 8 function-related items retained during refinement of the AS-20 using Rasch analysis,<sup>12</sup> we assigned Rasch-derived response scores to each item (expressed in logits). These Rasch-derived response scores were obtained using Rasch lookup tables of category response thresholds (available at [www.pedig.net](http://www.pedig.net), accessed November 7, 2013). Rasch-derived function domain scores (General Function and Reading Function) were also calculated,<sup>12</sup> and postoperative scores were compared to preoperative scores using signed rank tests.

## Results

### Patient Characteristics

A total of 20 nondiplopic patients with childhood-onset strabismus who underwent surgery were included. Of these, 10 (50%) had strabismus surgery previously performed in their childhood. Median age of included patients was 46.5 years (range, 22-79 years); 15 (75%) were female, and 19 (95%) self-reported their race as white.

Median visual acuity was 20/20 (range, 20/15-20/32) in the better-seeing eye and 20/25 (range, 20/15-20/1000) in the worse-seeing eye. Diagnoses were as follows: 7 had esotropia (infantile, consecutive, or recurrent; 3 also with dissociated vertical deviation [DVD]); 11, exotropia (consecutive, recurrent, or sensory; 5 also with DVD); 1, bilateral Brown syndrome with DVD; and 1, recurrent DVD. The patients' primary reason for surgery was psychosocial concerns ( $n = 15$ ), strain ( $n = 3$ ) and visual confusion regarding object localization ( $n = 2$ , not diplopia).

Alignment before surgery ranged from an exotropia of 55 $^{\Delta}$  to an esotropia of 70 $^{\Delta}$  at distance using the simultaneous prism cover test. Vertical deviations ranged from a hypotropia of 4 $^{\Delta}$  to a hypertropia of 6 $^{\Delta}$ , also using the simultaneous prism cover test. Four patients had surgery specifically for latent DVD and 1 patient for dissociated horizontal deviation. Postoperatively, alignment ranged from orthotropia to an esotropia of 14 $^{\Delta}$  at distance. Based on previously reported motor and diplopia outcome criteria,<sup>16</sup> 18 (90%) would have been classified as successes and 2 (10%) as partial successes; none would have been classified as failures.

### Individual Item Scores

Nine of the 10 AS-20 function-related items showed statistically significant improvement pre- to postoperatively using the original scoring (Figure 1). The greatest improvement in scores was found for the following 5 items: "I feel stressed because of my eyes" (means, 52.50-85.00;  $P < 0.0001$ ); "I worry about my eyes" (45.00-73.75;  $P = 0.0002$ ); "I need to take frequent breaks when reading because of my eyes" (61.25-86.25;  $P = 0.001$ ); "I can't enjoy my hobbies because of my eyes" (60.00-83.75;  $P < 0.0001$ ); and "My eyes feel strained" (46.25-65.79;  $P = 0.0002$ ). The response distribution and change in response category for the 10 individual items of the function-related subscale of the AS-20 are shown in Figure 1.

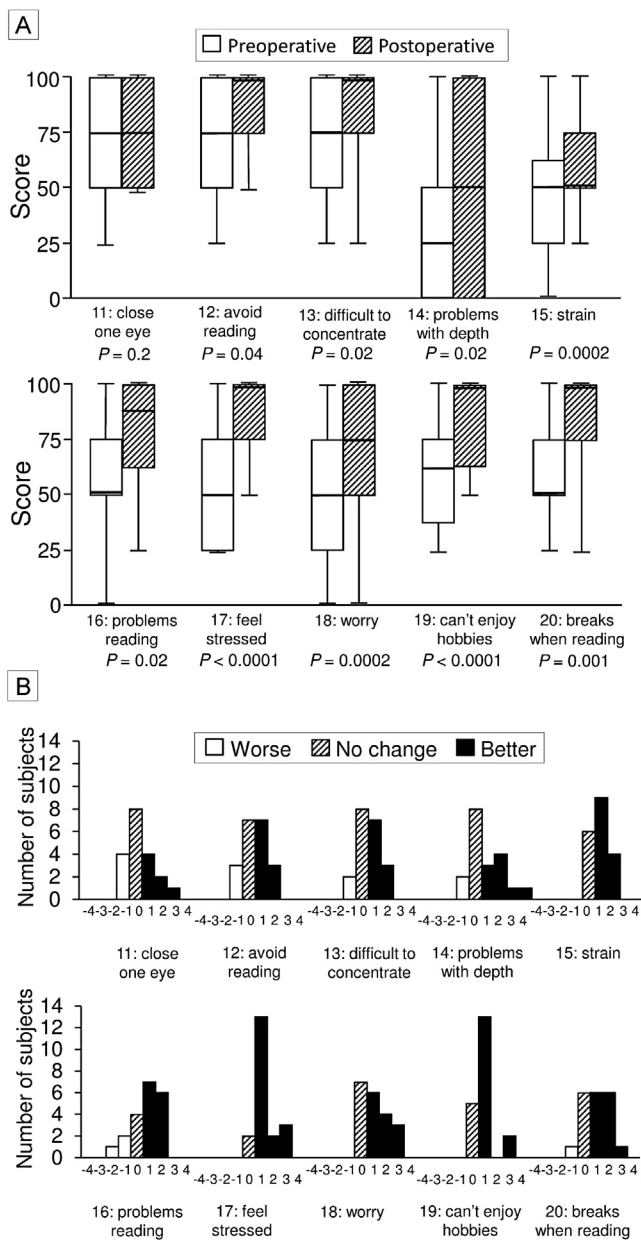
Using Rasch-derived response scores for the 8 Rasch-scored items, 6 items showed statistically significant improvement (data not shown,  $P < 0.04$ ). The two items that did not show significant improvement were "I cover or close one eye to see things better" ( $P = 0.06$ ) and "I stop doing things because my eyes make it difficult to concentrate" ( $P = 0.08$ ).

### Rasch-derived Domain Scores

Rasch-derived scores for both the general function domain and the reading function domain were significantly improved after surgery (mean, 66.4 to 87.5 [ $P < 0.0001$ ] and 71.0 to 86.5 [ $P < 0.0001$ ] respectively; Figure 2).

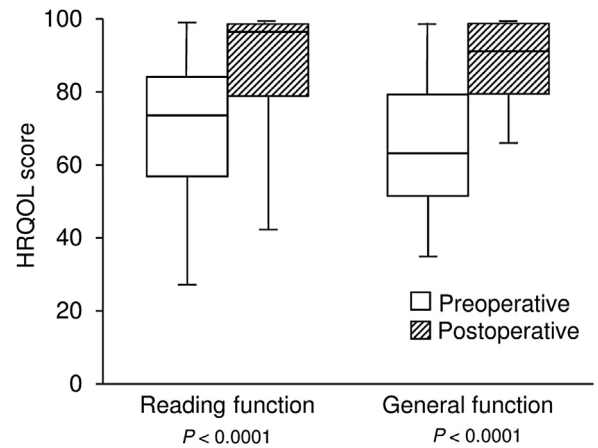
### Stereoacuity

Stereoacuity was nil in all patients preoperatively, both on the FD2 and on the near Frisby. Stereoacuity was measured



**FIG 1.** Improvement in score (A) and change in response category (B) preoperatively to postoperatively for each function-related item of the Adult Strabismus 20 questionnaire. Box-and-whiskers plots show medians, quartiles, and extreme values.

in refractive correction but without neutralizing the deviation with prism. At 1 year postoperatively, a total of 5 patients showed improvement in stereoacuity: 3 patients had stereoacuity of 80 arcsec or better on the FD2 (1 with 40 arcsec and 2 with 80 arcsec) and 3 patients had stereoacuity of 400 arcsec or better on the near Frisby test (1 with 60 arcsec and 2 with 400 arcsec). For the 3 patients who had distance stereoacuity postoperatively, their distance alignment measured by simultaneous prism cover test was 1 $\Delta$ , 2 $\Delta$ , and 2 $\Delta$  of esotropia. For the 3 who had near stereoacuity, the near alignment measured by simultaneous prism cover test was 2 $\Delta$ , 2 $\Delta$  and 4 $\Delta$  of esotropia.



**FIG 2.** Improvement in Rasch-derived scores preoperatively to postoperatively on both reading function (items 12, 13, 16, 20) and general function (items 11, 15, 17, 18) subscales.

## Discussion

In patients with childhood onset strabismus who were not experiencing diplopia, function aspects of health-related quality of life improved significantly following strabismus surgery. When analyzing each item of the AS-20 individually, we found that nearly every aspect of the function-related domain improved.

Very few studies have quantified improvement in function-related HRQOL after strabismus surgery. Beauchamp and colleagues<sup>17</sup> reported improvement in scores on a 6-item disability questionnaire, but in their study, patients were asked to complete both their pre- and postoperative questionnaires *after* surgery. The 6 items of the disability questionnaire used in that study were more general than the AS-20 items used in the present study, making comparison of results difficult. Dickmann and colleagues<sup>18</sup> reported quality-of-life outcomes in 20 adult patients with longstanding childhood-onset constant strabismus, using the Short Form Health Survey (SF-36) and the Amblyopia and Strabismus Questionnaire (A&SQ) preoperatively and 3 months postoperatively. Similar to our study, they found that successful surgery improved quality of life in function-related domains.<sup>18</sup> Using the SF-36, a generic HRQOL questionnaire, patients in the study of Dickman and colleagues<sup>18</sup> showed postoperative improvement in most domains (eg, physical function, vitality). Using the A&SQ, developed specifically for strabismus and amblyopia, Dickman and colleagues found domains such as distance estimation and visual disorientation showed significant improvement, nevertheless, they did not report change on individual questions. In the present study we used the AS-20 questionnaire, specifically designed to measure HRQOL in patients with strabismus,<sup>19</sup> and were able to assess the responsiveness (ability to detect change when it has occurred) of specific questionnaire items in a population of adults for whom function

HRQOL concerns have not previously been well described.

Several studies have discussed and demonstrated the psychosocial benefits of strabismus surgery,<sup>20-25</sup> but very few have analyzed and quantified improvement in binocular function, particularly in nondiplopic patients. Kushner<sup>26</sup> found that 86% of adult patients with longstanding strabismus demonstrated sensory fusion using Bagolini lenses after successful strabismus surgery (defined as <10<sup>Δ</sup> manifest tropia) but did not report more robust measures of binocular function such as stereoacuity. Some studies<sup>27</sup> have reported the presence of stereopsis after strabismus surgery for longstanding strabismus. In our present study of adults with childhood onset strabismus, although we were primarily interested in changes in HRQOL, we also analyzed measures of stereoacuity and found that 5 patients (25%) gained measurable stereoacuity from a baseline of no measurable stereoacuity preoperatively. An additional function-related benefit of strabismus surgery is expansion of the binocular field, reported first by Wortham and Greenwald<sup>8</sup> and later by Kushner.<sup>28</sup> Improvement in stereoacuity and binocular field may underlie some of our findings of improvement in function-related HRQOL after successful strabismus surgery.

The results of the present study have important implications for the management of adult strabismus patients who are not experiencing diplopia. These patients are not typically expected to gain function after strabismus surgery because of the childhood onset and long-standing misalignment. Nevertheless, they showed improvement on almost all function-related items of the AS-20 HRQOL questionnaire. These results suggest that in addition to psychosocial-related benefits, function-related benefits might also be obtained by performing strabismus surgery.

A limitation to our study is that in order to simply answer the question of whether function-related concerns improve in adults with childhood onset strabismus, we limited our cohort to patients who did not have diplopia at both preoperative and postoperative examinations, which resulted in a rather small cohort. We did not measure binocular field of vision in our patients. Another limitation is that due to this small cohort, we did not have any surgical failures so we cannot rule out a placebo effect of surgery on HRQOL, although previous studies<sup>6</sup> have found no such effect.

In nondiplopic patients with childhood onset strabismus, function-related aspects of HRQOL can be significantly improved with strabismus surgery, in particular in the areas of reading, stress, hobbies, strain, worry, concentration and depth perception. These specific function-related concerns should be considered when discussing the benefits of strabismus surgery with nondiplopic adult strabismus patients.

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### First Person

When I was examining an 8-year-old boy with a “reading problem,” I asked him to read the near card. I pointed to a line, which he read fluently. Then I asked him to read the smaller lines underneath. Instead of reading, he pursed his lips and blew on the card repeatedly. I wondered what he was doing and laughed aloud when I realized he had misunderstood me. After he read the larger print I had instructed him with the words “below that.” He was the first child in my 23 years of practice to hear “blow that,” which he did!

*Contributed by Mark Steckel, MD, Fairfield, Connecticut*