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McBain, H., MacKenzie, KA., Hancox, J., Ezra, DG., Adams, GGW. & Newman, S. Does strabismus surgery improve quality and mood, and what factors influence this? Eye (accepted).

Title: Does strabismus surgery improve quality and mood, and what factors influence this?

Running Title: Does strabismus surgery improve psychosocial well-being?

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1 **Aims**

2 To establish the impact of adult strabismus surgery on clinical and psychosocial well-being  
3 and determine who experiences the greatest benefit from surgery and how one could  
4 intervene to improve quality of life post-surgery.

5 **Methods**

6 A longitudinal study, with measurements taken pre-surgery and at 3 and 6 months post-  
7 surgery. All participants completed the AS-20 a disease specific quality of life scale, along  
8 with measures of mood, strabismus and appearance-related beliefs and cognitions and  
9 perceived social support. Participants also underwent a full orthoptic assessment at their  
10 preoperative visit and again 3 months postoperatively. Clinical outcomes of surgery were  
11 classified as success, partial success or failure, using the largest angle of deviation, diplopia  
12 and requirement for further therapy.

13 **Results**

14 210 participants took part in the study. Strabismus surgery led to statistically significant  
15 improvements in psychosocial and functional quality of life. Those whose surgery was  
16 deemed a partial success did however experience a deterioration in quality of life. A  
17 combination of clinical variables, high expectations, and negative beliefs about the illness  
18 and appearance pre-surgery were significant predictors of change in quality of life from pre-  
19 to post-surgery.

20 **Conclusions**

21 Strabismus surgery leads to significant improvements in quality of life up to 6 months  
22 postoperatively. There are however a group of patients who do not experience these

23 benefits. A series of clinical and psychosocial factors have now been identified, which will  
24 enable clinicians to identify patients who may be vulnerable to poorer outcomes post-  
25 surgery and allow for the development of interventions to improve quality of life after  
26 surgery.

## 27 INTRODUCTION

28 Strabismus can have debilitating effects on patient's self-esteem, quality of life and mood  
29 (1). Surgery to realign the eyes is associated with eliminating diplopia, expanding the visual  
30 field and reducing torticollis, as well as overall improvements in quality of life, patient  
31 satisfaction and confidence (2-7). However, this is not the case for everyone. Whilst 95% of  
32 patients achieve clinical success 6 weeks following surgery, only 60% of patients experience  
33 a meaningful improvement in quality of life (8). This suggests that other factors may act as  
34 cofounders to successful improvements in quality of life. Cross-sectional studies suggest  
35 that depression (1;9), beliefs the patient holds about their appearance, strabismus and its  
36 treatment (1), and the expectations patients have about post-surgical outcomes (10) are all  
37 factors associated with quality of life in this population, as opposed to clinical variables.  
38 There has however, been no exploration of how these factors may impact upon surgical  
39 success, or who experiences the optimal quality of life post-surgery.

40 The studies so far conducted are often flawed by small samples, retrospective designs or  
41 short follow-ups. Hence, larger studies with longer follow-up assessments are needed  
42 (2;11). This study therefore aims to assess how strabismus surgery impacts upon quality of  
43 life and mood in a larger population over a 6 month follow-up period. In order to  
44 understand who may benefit most from surgery and what factors could be targeted in an  
45 intervention to improve the impact of strabismus surgery on quality of life, this study will  
46 also identify the characteristics of patients who experience the greatest improvements in  
47 quality of life.

## 48 MATERIALS AND METHODS

### 49 Participants

50 This study presents the follow-up of participants who took part in a previous study (1).  
51 Between November 2010 and April 2012 consecutive adult strabismus patients listed for  
52 surgery at Moorfields Eye Hospital NHS Foundation Trust, London were prospectively  
53 identified. Patients were consented either on the day of being added to the waiting list or at  
54 their pre-operative assessment. Patients were excluded if they had significant co-  
55 morbidities, other facial or ocular abnormalities, or identifiable psychosis, dementia, or  
56 other cognitive impairment. Approval was obtained from the North London Research Ethics  
57 Committee.

## 58 **Measures**

59 All self-report questionnaires were completed prior to surgery and again 3 and 6 months  
60 post-surgery.

### 61 Demographic and clinical

62 Data were collected on age, gender, ethnicity, previous ocular and treatment history at  
63 baseline. All participants underwent a full orthoptic assessment at their preoperative visit  
64 and again at 2 weeks and 3 months postoperatively. Examination included the assessment  
65 of the direction and size of deviation at near (1/3m) and distance (6m) using the alternate  
66 prism cover test (PCAT) and assessment of binocular functions. For multiplanar deviations,  
67 the largest angles, targeted for surgical correction, be that at near or distance, were  
68 recorded for analysis. Diplopia/visual confusion when present was categorised into two  
69 groups based on the position of gaze in which it was present. Diplopia experienced in either  
70 primary position (straight ahead) and or downgaze (reading position), or diplopia  
71 experienced in another tertiary gaze position during ocular motility assessment. Self-

72 reported levels of pain, swelling, scaring and redness, as a result of surgery, were recorded  
73 on a 10-point Likert scale from 0 (no experience) to 10 (severe).

74 Classification of 3 month postoperative outcome

75 Three categories were defined: success, partial success or failure based on the surgical  
76 outcome 3 months following strabismus surgery. For success, all of the following categories  
77 had to be met (i) the largest angle of deviation for esotropia, exotropia or hypertropia <12  
78 prism dioptres (PD) and hypotropia <20PD (12) (ii) diplopia/visual confusion either absent or  
79 rarely appreciated in primary position and reading (iii) no requirement for prism or  
80 bangerter foil therapy. For partial success at least one of the above categories should not be  
81 met and failure none of the above criteria met.

82 Primary outcome measure

83 The AS-20(13) is a validated, strabismus-specific quality of life instrument. The measure  
84 consists of two subscales; functional and psychosocial quality of life. Scores range from 0 to  
85 100, with higher scores indicating better quality of life. Successful surgery has been defined  
86 as an increase in the psychosocial subscale of 17.7 points and 19.5 points for the function  
87 subscale, these are 95% limits of agreement (LOA) (14).

88 Psychosocial measures

89 Participants also completed a series of psychosocial measures taken from the framework of  
90 adjustment to strabismus (Figure 1) (1). Where possible existing validated measures were  
91 used. A full description of the measures employed can be found elsewhere.<sup>1</sup> In addition to  
92 these measures the following questionnaires were also completed.

93 Expectations of, and reasons for seeking surgery



94 Patients' reasons for seeking surgery and their expectations about the benefits of surgery  
95 were measured pre-operatively using the Reasons for Strabismus Surgery Questionnaire  
96 (RSSQ) and Expectations of Strabismus Surgery Questionnaire (ESSQ) (10). Each consists of 3  
97 subscales (i) intimacy and appearance-related issues, (ii) social relationships, (iii) visual  
98 functioning. Total subscale scores range from 1-5 for subscales i and ii, and 1-7 for subscale  
99 iii. Higher scores indicate stronger reasons for seeking surgery or higher expectations about  
100 the outcome of surgery.

#### 101 Satisfaction

102 Participants were asked if they regretted having surgery, with responses on a 4-point Likert  
103 scale from 1 (yes definitely) to 4 (not at all). Participants also reported on a 4 point Likert  
104 scale from 1 (no hesitation at all) to 4 (certainly not) whether they would go through the  
105 surgery again.

#### 106 Power calculation

107 The sample size was powered to look at differences in quality of life overtime. As data were  
108 hierarchically structured multi-level modelling was performed. This requires a sample size of  
109 at least 60, when there are fewer than 5 parameters to be estimated (15). However, in  
110 order to perform a hierarchical regression with the independent variables (IV) outlined in  
111 Figure 1, with an effect size of 0.15 and  $\alpha=0.05$ , GPower 3.1.6 indicated a sample size of 217.

#### 112 Statistical methods

113 Little's Missing Completely at Random (MCAR) test indicated no systematic differences  
114 between the observed and missing values ( $p>0.05$ ). Ten scale-level imputation iterations  
115 were used to eliminate bias. All analyses, except for the multilevel models, were performed

116 on each of these 10 datasets and then pooled for multiple imputation to give a final  
117 combined result (16). Differences in quality of life between levels of surgical success were  
118 explored using one-way between-groups ANOVA. Multilevel modelling was used to explore  
119 changes over time. As clinical variables were measured at only two time points differences  
120 over time were assessed using either a Wilcoxon Signed Rank test or McNemar's test.  
121 Hierarchical multiple regression were performed to identify the baseline predictors of  
122 changes in quality of life and which changes in the intervening psychological processes  
123 predicted changes in quality of life. The variables were added into the regression based on  
124 the framework (Figure 1). Statistical significance was set at  $p<0.05$ .

## 125 **RESULTS**

### 126 **Participants**

127 Of the 335 patients who consented, 81.49% completed a baseline questionnaire. Of these  
128 210 completed either a 3 (n=41) or 6 month (n=25) follow-up questionnaire, or both  
129 (n=144). Baseline characteristics of the sample can be found in Table 1.

### 130 **Impact of surgery**

#### 131 Clinical variables

132 The angle of deviation decreased significantly from baseline (Mean difference (Md)=30,  
133 range 2-90) to 6 months (Md=10, range 0-90;  $z=-11.81$ ,  $p<0.001$ ,  $r=-0.57$ ). There was a  
134 statistically significant reduction in the proportion of participants who experienced diplopia  
135 from prior (58.57%) to 6 months post-surgery (40%;  $p<0.001$ ). A small proportion (5.85%)  
136 experienced surgery induced diplopia at 3 months, 11 in the primary and downgaze position  
137 and 1 in another gaze. Low levels of pain, swelling, scarring and redness were reported at

138 both 3 and 6 months post-surgery, with no significant changes in pain, swelling or scarring  
139 between these two follow-ups. Improvements in redness from 3 (Md=1, range 0-10) to 6  
140 months (Md=0, range 0-10) post-surgery were significant ( $z=-3.51$ ,  $p=0.001$ ,  $r=-0.24$ ).

#### 141 Psychosocial variables

142 Statistically significant improvements in psychosocial and functional quality of life, anxiety  
143 and depression, social anxiety and social avoidance, illness and treatment beliefs, fear of  
144 negative evaluation, perceived visibility and, salience and valance of appearance (Table 2)  
145 were found from pre-surgery to 3 months and pre-surgery to 6 months. There were no  
146 significant changes from 3 to 6 months. Overtime the number of participants who were  
147 meeting moderate or 'caseness' levels of anxiety or depression, or scoring below normal in  
148 quality of life, reduced significantly from pre-surgery to 6 months post-surgery, whilst the  
149 proportion of patients in the normal classification for mood and above normal in quality of  
150 life increased. There was no statistically significant difference in the proportion of  
151 participants who exceeded the 95% LOAs at 3 and 6 months post-surgery (psychosocial  
152 quality of life:  $p=0.33$ ; functional quality of life  $p=0.12$ ).

#### 153 **Relationship between clinical success and quality of life**

154 According to clinical criteria, 110 (52.38%) participants experienced successful surgery, 20  
155 (9.52%) failed and 80 (38.09%) were partial successes. Of these 80 partial successes, 10  
156 (12.5%) were scheduled for further surgery, 43 (53.75%) had been discharged from the  
157 service, 13 (16.25%) had a scheduled follow-up appointment, 9 (11.25%) were receiving  
158 prism therapy and 5 (6.25%) botulinum toxin therapy. Whilst there were no statistically  
159 significant differences between these three groups of patients on changes in functional  
160 quality of life from baseline to 6 months ( $F_{2, 207}= 0.89$ ,  $p=0.42$ ), there were differences in

161 changes in psychosocial quality of life ( $F_{2, 207}=4.22, p=0.02, \eta^2=0.04$ ). Post-hoc comparison  
162 indicated that the mean residualised change score for those who experienced partial  
163 success ( $M=-0.24, SD=0.84$ ) was significantly lower than those who experienced success  
164 ( $M=0.18, SD=1.05$ ).

### 165 **Satisfaction**

166 Over 80% of patients did not regret having surgery, approximately 6% had some regret  
167 either at 3 or 6 months. Between 70 and 80% of the sample would go through the  
168 operation, only 1-4% would not.

### 169 **Who benefits most from surgery?**

170 The final model for changes in psychosocial quality of life explained 85% of the total  
171 variance ( $F_{49, 160}= 18.60, p<0.001$ ). The statistically significant predictors were the IPQ-R  
172 consequences subscale, the intimacy and appearance-related issues subscale of the RSSQ,  
173 the DAS24 and perceived visibility at baseline (Table 3). The final model for changes in  
174 functional quality of life explained 72% of the variance ( $F_{49, 160}=8.60, p<0.001$ ). The  
175 statistically significant predictors were ethnicity, classification, the IPQ-R consequences  
176 subscale, the TRI treatment concern subscale, the visual functioning subscale of the ESSQ  
177 and RSSQ, and DAS24 at baseline (Table 3).

### 178 **Which concepts should be targeted in order to improve the impact of surgery?**

179 The final model for changes in psychosocial quality of life accounted for 78% of the variance  
180 ( $F_{19, 190}=35.78, p<0.001$ ). The statistically significant predictors were changes in; the IPQ-R  
181 consequences subscale, salience, DAS24 and in perceived visibility (Table 4). The final model  
182 for changes in psychosocial quality of life accounted for 51% of the variance ( $F_{19, 190}=10.48,$

183  $p<0.001$ ). The statistically significant predictors were changes in; the IPQ-R consequences  
184 subscale, perceived visibility, social support from significant others and depression (Table 4).

## 185 **DISCUSSION**

186 In line with previous research (17;18) strabismus surgery led to significant improvements in  
187 psychosocial and functional quality of life from preoperative assessment through to 3  
188 months post-surgery. No further improvements in quality of life were found at the 6 month  
189 follow-up, supporting previous research (11). Although improvements in psychosocial, but  
190 not functional quality of life, have been found up to 1 year post-surgery (19) this does not  
191 negate the possibility that quality of life curtails 3 months after surgery. Contrary to what  
192 might be expected, improvements in functional quality of life were not associated with how  
193 successful surgery was from a clinical perspective. However, surgery deemed partially  
194 successful was found to be more detrimental, leading to a reduction in psychosocial quality  
195 of life from pre to post-surgery, than either success or failure, which both led to  
196 improvements in psychosocial quality of life. This contradicts other findings, which suggest  
197 no association between success of surgery and changes in psychosocial quality of life, but  
198 small improvements in functional quality of life were in failed surgery and larger  
199 improvements after successful surgery (20). The criteria used to define success and failure  
200 between these studies did however differ and could explain these differences (20).

201 This study also provides unique evidence that strabismus surgery not only leads to  
202 improvements in quality of life, but other psychosocial domains. The proportion of people  
203 with strabismus living with clinical anxiety or depression is considerably greater than that of  
204 the general population and those with a chronic conditions (1), therefore a reduction in the  
205 number of patients meeting these criteria is an important step towards improving the

206 mental health of this population. As a result of the restorative nature of strabismus surgery,  
207 it is unsurprising that patients perceived their strabismus as being less visible after surgery  
208 and felt more positive about their appearance, this appears to have enabled participants to  
209 feel more confident and less fearful of interacting and socialising with others, leading to  
210 reductions in social anxiety, and consequently improvements in quality of life.

211 Greater improvements in quality of life from pre- to post-surgery was more likely in those  
212 who held more positive beliefs about their strabismus and treatment, experienced less  
213 social anxiety and social avoidance and had lower expectations about the outcome of their  
214 surgery prior to surgery. Although one might expect that targeting surgery towards those  
215 who are less able to cope would be more beneficial, these negative beliefs, high  
216 expectations and inability to socialise may impinge on the success of surgery. Being able to  
217 predict who will benefit most from surgery is clearly more complex than targeting those  
218 who appear more severely affected clinically or psychologically. Careful consideration  
219 therefore needs to be taken when listing patients for surgery who report more distress, as  
220 these patients maybe more likely to request further surgery as a result of not meeting high  
221 expectations for example, and may benefit from additional psychosocial support in order to  
222 optimise the benefits of surgery.

223 This study suggests that quality of life post-surgery could be improved by addressing  
224 people's beliefs about the negative consequences of their strabismus, challenging the value  
225 they place on appearance and how visible they think their squint is, as well as improving  
226 social skills. The evidence for improving the psychosocial well-being of people with a visible  
227 difference is at present weak, with more theoretically driven interventions, evaluated in  
228 RCTs, required (21). This could involve adapting and tailoring CBT-based or social skills

229 interventions that have been developed and evaluated in people with a visible difference  
230 (22) for the specific needs of people with strabismus.

231 The present study is limited by the lack of a randomised control group, which means that  
232 the changes observed from pre- to post-surgery cannot be directly attributed to surgery.  
233 This is however unlikely given the significant psychological impact of living with strabismus,  
234 which is not predicted by disease duration (1).

235 An appearance that differs from the norm can prove challenging in a society which is  
236 focused on appearance. Restorative surgery, such as ocular realignment, which reduces the  
237 perceived visibility and negative perceptions of one's own appearance, may therefore  
238 provide a mechanism via which people feel better able to interact and cope in social  
239 situations, and hence reduces fear of negative reactions and social anxiety. It is however  
240 clear that not all experience these benefits despite successful clinical outcomes, therefore  
241 by intervening both psychologically and clinically the findings of this study may provide a  
242 unique mechanism via which the benefits of strabismus surgery can be optimised.

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#### 249 **CONFLICTS OF INTEREST**

250 The authors have nothing to disclose

251 **REFERENCES**

- 252 1. McBain HB, MacKenzie KA, Au C, Hancox J, Ezra DG, Adams GG et al. Factors associated  
253 with quality of life and mood in adults with strabismus. *Br J Ophthalmol* 2014; **98**: 550-5.
- 254 2. Gunton KB. Impact of strabismus surgery on health-related quality of life in adults. *Curr*  
255 *Opin Ophthalmol* 2014; **25**: 406-10.
- 256 3. Currie ZI, Shipman T, Burke JP. Surgical correction of large-angle exotropia in adults. *Eye*  
257 2003; **17**: 334-9.
- 258 4. Nelson BA, Gunton KB, Lasker JN, Nelson LB, Drohan LA. The psychosocial aspects of  
259 strabismus in teenagers and adults and the impact of surgical correction. *J AAPOS* 2008; **12**:  
260 72-6.
- 261 5. Burke JP, Leach CM, Davis H. Psychosocial implications of strabismus surgery in adults. *J*  
262 *Pediatr Ophthalmol Strabismus* 1996; **34**: 159-64.
- 263 6. Liebermann L, Hatt SR, Leske DA, Holmes JM. Improvement in specific function-related  
264 quality-of-life concerns after strabismus surgery in nondiplopic adults. *J AAPOS* 2014; **18**:  
265 105-9.
- 266 7. Beauchamp GR, Black BC, Coats DK, Enzenauer RW, Hutchinson AK, Saunders RA et al. The  
267 Management of Strabismus in Adults: The Effects on Disability. *J AAPOS* 2005; **9**: 455-9.
- 268 8. Hatt SR, Leske DA, Liebermann L, Holmes JM. Comparing Outcome Criteria Performance  
269 in Adult Strabismus Surgery. *Ophthalmology* 2012; **119**: 1930-6.



- 270 9. Hatt SR, Leske DA, Liebermann L, Philbrick KL, Holmes JM. Depressive Symptoms  
271 Associated with Poor Health-Related Quality of Life in Adults with Strabismus.  
272 *Ophthalmology* 2014; **121**: 2070-1.
- 273 10. McBain, Hayley B., MacKenzie, Kelly A., Hancox, Joanne, Ezra, D. G., Adams, Gillian GW,  
274 and Newman, Stanton P. What do patients with strabismus expect post-surgery? The  
275 development and validation of a questionnaire. *Br J Ophthalmol* 2015; e-pub ahead of print  
276 21 July 2015; doi:10.1136/bjophthalmol-2015-307027
- 277 11. Jackson S, Morris M, Gleeson K. The long-term psychosocial impact of corrective surgery  
278 for adults with strabismus. *Br J Ophthalmol* 2013; **97**: 419-22.
- 279 12. Larson SA, Keech RV, Verdick RE. The threshold for the detection of strabismus. *J*  
280 *AAPOS* 2003; **7**: 418-22.
- 281 13. Hatt SR, Leske DA, Bradley EA, Cole SR, Holmes JM. Development of a Quality-of-Life  
282 Questionnaire for Adults with Strabismus. *Ophthalmology* 2009; **116**: 139-44.
- 283 14. Leske DA, Hatt SR, Holmes JM. Test-Retest Reliability of Health-Related Quality-of-Life  
284 Questionnaires in Adults with Strabismus. *Am J Ophthalmol* 2010; **149**: 672-6.
- 285 15. Eliason SR. *Maximum likelihood estimation: Logic and practice*. Sage Publications, UK,  
286 1993.
- 287 16. Rubin DB. *Multiple imputation for nonresponse in surveys (Vol 81)*. John Wiley & Sons,  
288 UK, 2004.
- 289 17. Glasman P, Cheeseman R, Wong V, Young J, Durnian JM. Improvement in patients'  
290 quality-of-life following strabismus surgery: evaluation of postoperative outcomes using the  
291 Adult Strabismus 20 (AS-20) score. *Eye* 2013; **27**: 1249-53.

- 292 18. Jackson S, Harrad RA, Morris M, Rumsey N. The psychosocial benefits of corrective  
293 surgery for adults with strabismus. *Br J Ophthalmol* 2006; **90**: 883-8.
- 294 19. Hatt SR, Leske DA, Liebermann L, Holmes JM. Changes in Health-Related Quality of Life 1  
295 Year Following Strabismus Surgery. *Am J Ophthalmol* 2012; **153**: 614-9.
- 296 20. Hatt SR, Leske DA, Holmes JM. Responsiveness of Health-Related Quality-of-life  
297 Questionnaires in Adults Undergoing Strabismus Surgery. *Ophthalmology* 2010; **117**: 2322-  
298 8.
- 299 21. Bessell A, Moss TP. Evaluating the effectiveness of psychosocial interventions for  
300 individuals with visible differences: A systematic review of the empirical literature. *Body*  
301 *Image* 2007; **4**: 227-38.
- 302 22. Bessell A, Brough V, Clarke A, Harcourt D, Moss TP, Rumsey N. Evaluation of the  
303 effectiveness of Face IT, a computer-based psychosocial intervention for disfigurement-  
304 related distress. *Psychol Health Med* 2012; **17**: 565-77.

305 Titles and legends to figures

306 Figure 1. Framework outlining the process of psychological adjustment to strabismus

Table 1. Baseline characteristics of the sample

	<b>All n=210</b>
Age (years)	46 (17-88)
Female/Male	118/92
Ethnicity	
<i>White</i>	170
<i>Black African/Caribbean</i>	9
<i>South Asian</i>	19
<i>Other</i>	12
Concomitant/Incomitant	124/86
Classification <sup>a</sup>	
<i>Primary</i>	35
<i>Residual</i>	33
<i>Secondary</i>	10
<i>Secondary (Iatrogenic)</i>	9
<i>Consecutive</i>	39
<i>Neurogenic</i>	47
<i>Mechanical</i>	37
<i>Other</i>	3
Disease duration (years)	24 (0-88)
Age of onset (years)	23 (0-76)
Previous surgery (yes/no)	98/112
Total no. of previous strabismus surgeries	1 (0-6)
Previous Botulinum toxin type A therapy (yes/no)	81/129
Previous prism therapy for diplopia (yes/no)	47/163
Worse eye visual acuity - LogMAR Conversion <sup>b</sup>	0.40 (-0.20 – 2.20)
Best eye visual acuity - LogMAR Conversion <sup>b</sup>	-0.06 (-0.20 – 0.80)
Deviation in primary position	
<i>Esotropia</i>	59
<i>Exotropia</i>	78
<i>Hypotropia &amp; Hypertropia</i>	61
<i>Other</i>	12
Deviation in primary position	33.87 (2-90)
Diplopia/No diplopia	123/87
Mood (Anxiety/Depression)	
<i>Normal</i>	123/172
<i>Moderate</i>	45/21
<i>Caseness</i>	42/18
AS20 Function/Psychosocial	
<i>Below normal threshold</i>	152/179
<i>Above normal threshold</i>	58/31

<sup>a</sup> Secondary refers to a squint occurring following the loss or impairment of vision. Secondary (iatrogenic) refers to squint occurring secondary to sight saving surgery e.g. retinal detachment surgery; <sup>b</sup> Visual acuity. Vision acuity measured as Snellen's acuity but converted into LogMAR scale for statistical analysis. LogMAR values ranged between -0.20 and 2.1. The score of 2.2 LogMAR being assigned to vision of counting fingers, hand movements, perception of light and non-perception of light

Table 2. Changes over time, estimated marginal mean (SE)

	<b>Baseline</b>	<b>3 month</b>	<b>6 month</b>	<b>Statistic</b>
AS20 Psychosocial	<b>56.45 (1.62)</b>	<b>71.94 (1.75)*</b>	<b>74.65 (1.87)*</b>	<b>F<sub>2,273.84</sub> = 82.19, p &lt; 0.001</b>
AS20 Function	<b>56.44 (1.44)</b>	<b>68.29 (1.57)*</b>	<b>69.42 (1.67)*</b>	<b>F<sub>2,280.03</sub> = 53.70, p &lt; 0.001</b>
Depression	<b>4.69 (0.23)</b>	<b>3.52 (0.25)*</b>	<b>3.21 (0.26)*</b>	<b>F<sub>2,286.28</sub> = 24.28, p &lt; 0.001</b>
Anxiety	<b>6.94 (0.26)</b>	<b>5.69 (0.28)*</b>	<b>5.79 (0.30)*</b>	<b>F<sub>2,295.11</sub> = 17.31, p &lt; 0.001</b>
DAS24	<b>39.29 (0.86)</b>	<b>34.66 (0.93)*</b>	<b>34.46 (0.98)*</b>	<b>F<sub>2,242.42</sub> = 24.03, p &lt; 0.001</b>
IPQ-R Personal control	2.51 (0.06)	2.46 (0.06)	2.43 (0.06)	F <sub>2,313.36</sub> = 0.72, p = 0.49
IPQ-R Consequences	<b>2.99 (0.06)</b>	<b>2.35 (0.07)</b>	<b>2.23 (0.07)</b>	<b>F<sub>2,262.84</sub> = 80.64, p &lt; 0.001</b>
IPQ-R Timeline	<b>3.66 (0.07)</b>	<b>3.11 (0.07)</b>	<b>3.04 (0.07)</b>	<b>F<sub>2,283.44</sub> = 41.71, p &lt; 0.001</b>
TRI Treatment value	<b>2.97 (0.04)</b>	<b>2.86 (0.05)</b>	<b>2.83 (0.05)*</b>	<b>F<sub>2,314.04</sub> = 3.99, p = 0.02</b>
TRI Treatment Concerns	<b>2.76 (0.05)</b>	<b>2.33 (0.06)*</b>	<b>2.19 (0.06)*</b>	<b>F<sub>2,282.80</sub> = 52.12, p &lt; 0.001</b>
TRI Decision satisfaction	<b>3.97 (0.04)</b>	<b>4.13 (0.04)*</b>	<b>4.16 (0.04)*</b>	<b>F<sub>2,295.88</sub> = 11.86, p &lt; 0.001</b>
TRI Cure	<b>3.61 (0.04)</b>	<b>3.27 (0.05)*</b>	<b>3.24 (0.05)*</b>	<b>F<sub>2,348.88</sub> = 26.66, p &lt; 0.001</b>
FNE	<b>37.11 (0.57)</b>	<b>35.60 (0.61)*</b>	<b>35.52 (0.64)*</b>	<b>F<sub>2,272.66</sub> = 7.19, p = 0.01</b>
Perceived visibility	<b>4.87 (0.12)</b>	<b>3.06 (0.13)*</b>	<b>2.79 (0.14)*</b>	<b>F<sub>2,333.02</sub> = 120.55, p &lt; 0.001</b>
CARSAL	<b>32.46 (0.42)</b>	<b>30.92 (0.46)*</b>	<b>31.03 (0.48)*</b>	<b>F<sub>2,299.58</sub> = 10.51, p &lt; 0.001</b>
CARVAL	<b>20.38 (0.49)</b>	<b>17.64 (0.54)*</b>	<b>17.41 (0.57)*</b>	<b>F<sub>2,286.99</sub> = 22.65, p &lt; 0.001</b>
Social support - Family	16.19 (0.23)	16.10 (0.25)	16.46 (0.26)	F <sub>2,309.33</sub> = 1.56, p = 0.21
Social support - Friends	16.00 (0.21)	16.02 (0.23)	16.04 (0.24)	F <sub>2,303.20</sub> = 0.02, p = 0.98
Social support - Significant others	16.02 (0.27)	15.73 (0.30)	15.76 (0.31)	F <sub>2,292.73</sub> = 0.87, p = 0.42
Anxiety				
<i>Normal</i>	<b>123 (58.57)</b>	<b>131 (70.81)</b>	<b>115 (68.05)</b>	<b>χ<sup>2</sup> (2, n=210) =20.19, p &lt; 0.001</b>
<i>Moderate</i>	<b>45 (21.43)</b>	<b>33 (17.84)</b>	<b>35 (20.71)</b>	
<i>Caseness</i>	<b>42 (20.00)</b>	<b>21 (11.35)</b>	<b>19 (11.24)</b>	
Depression				
<i>Normal</i>	<b>172 (81.90)</b>	<b>165 (89.19)</b>	<b>151 (89.35)</b>	<b>χ<sup>2</sup> (2, n=210) =13.90, p=0.001</b>
<i>Moderate</i>	<b>21 (10.00)</b>	<b>11 (5.95)</b>	<b>11 (6.51)</b>	
<i>Caseness</i>	<b>18 (8.57)</b>	<b>9 (4.86)</b>	<b>7 (4.14)</b>	

	Baseline	3 month	6 month	Statistic
AS20 Psychosocial				
<i>Below norm</i>	<b>179(85.24)</b>	<b>124(67.03)</b>	<b>116(68.64)</b>	$\chi^2 (2, n=210) = 47.50, p=0.001$
<i>Above norm</i>	<b>31(14.76)</b>	<b>61(32.97)</b>	<b>53(31.36)</b>	
AS20 Function				
<i>Below norm</i>	<b>152(72.38)</b>	<b>87(47.03)</b>	<b>76(44.97)</b>	$\chi^2 (2, n=210) = 55.93, p=0.001$
<i>Above norm</i>	<b>58(27.62)</b>	<b>98(52.97)</b>	<b>93(55.03)</b>	
AS20 Psychosocial	-			-
<i>Exceeded 95% LOAs</i>		68(36.76)	74(43.79)	
<i>Did not exceed 95% LOAs</i>		117(63.24)	95(56.21)	
AS20 Function	-			-
<i>Exceeded 95% LOAs</i>		61(32.97)	64(37.87)	
<i>Did not exceed 95% LOAs</i>		124(67.03)	105(62.13)	

\*significant difference from baseline  $p < 0.01$

Table 3. Baseline predictors of change in psychosocial and functional quality of life

	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper bound
<b>Outcome: Psychosocial quality of life</b>					
<b>(Constant)</b>	<b>0.00</b>	<b>4.50</b>	<b>0.00</b>	<b>1.70</b>	<b>4.34</b>
Age	0.00	-0.01	0.99	-0.01	0.01
Gender	0.03	0.70	0.48	-0.10	0.20
Ethnicity					
<i>Black</i>	0.02	0.48	0.63	-0.28	0.47
<i>South Asian</i>	-0.04	-0.98	0.32	-0.40	0.13
<i>Other ethnicity</i>	0.02	0.49	0.62	-0.23	0.38
Classification					
<i>Primary</i>	0.03	0.62	0.54	-0.17	0.33
<i>Residual</i>	0.02	0.41	0.68	-0.24	0.37
<i>Secondary</i>	-0.03	-0.71	0.48	-0.57	0.27
<i>Secondary iatrogenic</i>	0.05	1.18	0.24	-0.16	0.63
<i>Consecutive</i>	0.00	0.00	1.00	-0.31	0.31
<i>Mechanical</i>	-0.04	-0.90	0.37	-0.35	0.13
<i>Other classification</i>	0.01	0.41	0.68	-0.46	0.71
Disease duration (years)	-0.05	-0.61	0.54	-0.01	0.01
Age of onset (years)	-0.10	-1.24	0.22	-0.01	0.00
Previous surgery (yes/no)	-0.04	-0.61	0.54	-0.31	0.16
Total no. of previous strabismus surgeries	-0.03	-0.50	0.62	-0.13	0.08
Previous Botulinum toxin type A therapy (yes/no)	0.01	0.24	0.81	-0.13	0.17
Previous prism therapy for diplopia (yes/no)	-0.06	-1.32	0.19	-0.34	0.07
Worse eye visual acuity - LogMAR Conversion†	-0.02	-0.43	0.67	-0.15	0.10
Best eye visual acuity - LogMAR Conversion†	0.04	1.14	0.25	-0.24	0.91

	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper bound
Deviation in primary position	0.01	0.31	0.75	0.00	0.01
Deviation in primary position					
<i>Esotropia</i>	-0.01	-0.17	0.87	-0.23	0.19
<i>Hypertropia or hypotropia</i>	0.01	0.13	0.90	-0.25	0.28
<i>Other direction</i>	0.01	0.26	0.79	-0.32	0.43
Diplopia	0.09	1.65	0.10	-0.03	0.38
IQP-R Timeline	-0.01	-0.28	0.78	-0.10	0.07
<b>IQP-R Consequences</b>	<b>-0.18</b>	<b>-3.41</b>	<b>0.00</b>	<b>-0.32</b>	<b>-0.09</b>
IQP-R Personal control	-0.02	-0.51	0.61	-0.10	0.06
TRI Treatment value	0.01	0.30	0.77	-0.13	0.17
TRI Treatment concerns	-0.03	-0.63	0.53	-0.13	0.07
TRI Decision satisfaction	0.00	-0.06	0.95	-0.18	0.17
TRI Cure	-0.02	-0.37	0.71	-0.19	0.13
FNE	-0.06	-1.21	0.23	-0.02	0.00
ESSQ Intimacy and appearance-related issues	-0.05	-0.73	0.46	-0.28	0.13
ESSQ Visual functioning	0.08	1.17	0.25	-0.09	0.36
ESSQ Social functioning	0.02	0.40	0.69	-0.23	0.34
<b>RSSQ Intimacy and appearance-related issues</b>	<b>-0.24</b>	<b>-3.57</b>	<b>0.00</b>	<b>-0.33</b>	<b>-0.09</b>
RSSQ Visual functioning	0.02	0.36	0.72	-0.09	0.13
RSSQ Social functioning	-0.06	-1.11	0.27	-0.19	0.05
<b>DAS24</b>	<b>-0.25</b>	<b>-4.39</b>	<b>0.00</b>	<b>-0.03</b>	<b>-0.01</b>
Appearance concern	-0.08	-1.57	0.12	-0.40	0.04
<b>Perceived visibility</b>	<b>-0.26</b>	<b>-4.43</b>	<b>0.00</b>	<b>-0.19</b>	<b>-0.07</b>
Salience	-0.01	-0.11	0.91	-0.01	0.01
Valence	0.01	0.15	0.88	-0.01	0.01



	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper bound
Social support - Family	-0.05	-1.11	0.27	-0.04	0.01
Social support - Friends	0.04	0.95	0.34	-0.01	0.04
Social support - Significant others	0.05	1.20	0.23	-0.01	0.03
Anxiety	-0.03	-0.60	0.55	-0.03	0.02
Depression	-0.01	-0.10	0.92	-0.03	0.03
<b>Outcome: Functional quality of life</b>					
<b>(Constant)</b>	0.00	4.66	0.00	2.35	5.76
Age	-0.01	-0.12	0.91	-0.01	0.01
Gender	0.05	0.91	0.36	-0.11	0.29
Ethnicity					
<i>Black</i>	0.05	0.97	0.33	-0.23	0.69
<i>South Asian</i>	0.06	1.12	0.26	-0.16	0.57
<b><i>Other ethnicity</i></b>	<b>0.10</b>	<b>2.12</b>	<b>0.03</b>	<b>0.03</b>	<b>0.83</b>
Classification					
<i>Primary</i>	-0.05	-0.73	0.47	-0.45	0.21
<i>Residual</i>	-0.01	-0.18	0.86	-0.44	0.36
<i>Secondary</i>	0.00	0.00	1.00	-0.56	0.56
<b><i>Secondary iatrogenic</i></b>	<b>-0.14</b>	<b>-2.62</b>	<b>0.01</b>	<b>-1.22</b>	<b>-0.17</b>
<i>Consecutive</i>	0.08	0.92	0.36	-0.22	0.61
<i>Mechanical</i>	-0.10	-1.58	0.11	-0.58	0.06
<i>Other classification</i>	-0.06	-1.25	0.21	-1.25	0.28
Disease duration (years)	-0.10	-0.96	0.34	-0.01	0.01
Age of onset (years)	-0.09	-0.79	0.43	-0.01	0.01
Previous surgery (yes/no)	-0.11	-1.34	0.18	-0.52	0.10

	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper bound
Total no. of previous strabismus surgeries	0.07	0.83	0.41	-0.08	0.19
Previous Botulinum toxin type A therapy (yes/no)	0.09	1.76	0.08	-0.02	0.38
Previous prism therapy for diplopia (yes/no)	0.08	1.41	0.16	-0.08	0.46
Worse eye visual acuity - LogMAR Conversion†	0.05	0.78	0.44	-0.10	0.23
Best eye visual acuity - LogMAR Conversion†	0.01	0.28	0.78	-0.65	0.86
Deviation in primary position	0.01	0.10	0.92	-0.01	0.01
Deviation in the primary position					
<i>Esotropia</i>	0.00	0.05	0.96	-0.27	0.29
<i>Hypertropia or hypotropia</i>	0.15	1.85	0.07	-0.02	0.68
<i>Other direction</i>	0.06	1.03	0.30	-0.23	0.75
Diplopia	-0.10	-1.46	0.14	-0.48	0.07
IQP-R Timeline	-0.01	-0.21	0.83	-0.12	0.10
<b>IQP-R Consequences</b>	<b>-0.28</b>	<b>-3.81</b>	<b>0.00</b>	<b>-0.45</b>	<b>-0.14</b>
IQP-R Personal control	0.04	0.88	0.38	-0.06	0.16
TRI Treatment value	-0.03	-0.52	0.60	-0.25	0.15
<b>TRI Treatment concerns</b>	<b>-0.15</b>	<b>-2.49</b>	<b>0.01</b>	<b>-0.30</b>	<b>-0.04</b>
TRI Decision satisfaction	-0.05	-0.78	0.44	-0.31	0.14
TRI Cure	-0.02	-0.26	0.80	-0.24	0.18
FNE	-0.06	-0.85	0.39	-0.02	0.01
ESSQ Intimacy and appearance-related issues	0.15	1.68	0.10	-0.04	0.51
<b>ESSQ Visual functioning</b>	<b>-0.17</b>	<b>-2.04</b>	<b>0.04</b>	<b>-0.54</b>	<b>-0.01</b>
ESSQ Social functioning	-0.02	-0.31	0.76	-0.43	0.31
RSSQ Intimacy and appearance-related issues	0.11	1.26	0.21	-0.05	0.25
<b>RSSQ Visual functioning</b>	<b>-0.20</b>	<b>-2.42</b>	<b>0.02</b>	<b>-0.33</b>	<b>-0.03</b>
RSSQ Social functioning	0.00	-0.06	0.96	-0.16	0.15

	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper bound
<b>DAS24</b>	<b>-0.21</b>	<b>-2.78</b>	<b>0.01</b>	<b>-0.03</b>	<b>0.00</b>
Appearance concern	0.00	0.01	0.99	-0.29	0.29
Perceived visibility	0.05	0.60	0.55	-0.05	0.10
Saliency	-0.07	-1.09	0.27	-0.03	0.01
Valence	0.00	-0.06	0.95	-0.02	0.02
Social support - Family	-0.06	-0.85	0.40	-0.05	0.02
Social support - Friends	0.05	0.72	0.47	-0.02	0.05
Social support - Significant others	-0.08	-1.32	0.19	-0.04	0.01
Anxiety	-0.06	-0.92	0.36	-0.04	0.02
Depression	-0.14	-1.94	0.05	-0.07	0.00

Table 4. Changes in clinical and psychosocial variables that predict change in psychosocial and functional quality of life

	$\beta$	t	p	95% CI for $\beta$	
				Lower Bound	Upper Bound
<b>Outcome: Psychosocial quality of life</b>					
(Constant)	0.00	0.39	0.69	-0.08	0.12
Success					
<i>Partial success</i>	-0.03	-0.78	0.44	-0.22	0.09
<i>Unsuccessful</i>	0.00	-0.13	0.90	-0.27	0.24
Change in IPQ-R Timeline	0.00	0.04	0.97	-0.08	0.08
<b>Change in IPQ-R Consequences</b>	<b>-0.16</b>	<b>-3.09</b>	<b>0.00</b>	<b>-0.26</b>	<b>-0.06</b>
Change in IPQ-R Personal control	-0.01	-0.15	0.88	-0.08	0.07
Change in TRI Treatment value	0.02	0.48	0.63	-0.07	0.12
Change in TRI Treatment concerns	-0.03	-0.78	0.43	-0.11	0.05
Change in TRI Decision satisfaction	-0.02	-0.40	0.69	-0.10	0.07
Change in TRI Cure	-0.04	-0.77	0.44	-0.14	0.06
Change in FNE	-0.04	-0.85	0.39	-0.14	0.06
<b>Change in Salience</b>	<b>-0.11</b>	<b>-2.33</b>	<b>0.02</b>	<b>-0.20</b>	<b>-0.02</b>
<b>Change in DAS24</b>	<b>-0.31</b>	<b>-5.42</b>	<b>0.00</b>	<b>-0.41</b>	<b>-0.19</b>
Change in Valence	-0.05	-0.93	0.35	-0.14	0.05
<b>Change in Perceived visibility</b>	<b>-0.42</b>	<b>-8.68</b>	<b>0.00</b>	<b>-0.51</b>	<b>-0.32</b>
Change in Social support - Significant others	0.07	1.53	0.13	-0.02	0.16
Change in Social support - Family	-0.06	-1.20	0.23	-0.16	0.04
Change in Social support - Friends	0.02	0.38	0.70	-0.07	0.11
Change in Anxiety	-0.06	-1.13	0.26	-0.16	0.04
Change in Depression	0.04	0.73	0.47	-0.07	0.14
<b>Outcome: Functional quality of life</b>					

(Constant)	0.00	-0.36	0.72	-0.17	0.12
Success					
<i>Partial success</i>	0.01	0.22	0.83	-0.21	0.26
<i>Unsuccessful</i>	0.00	0.01	0.99	-0.36	0.36
Change in IPQ-R Timeline	0.01	0.15	0.88	-0.11	0.13
<b>Change in IPQ-R Consequences</b>	<b>-0.38</b>	<b>-4.83</b>	<b>0.00</b>	<b>-0.51</b>	<b>-0.22</b>
Change in IPQ-R Personal control	0.06	1.06	0.29	-0.05	0.16
Change in TRI Treatment value	-0.09	-1.20	0.23	-0.22	0.05
Change in TRI Treatment concerns	-0.12	-1.97	0.05	-0.24	0.00
Change in TRI Decision satisfaction	-0.06	-0.94	0.35	-0.19	0.07
Change in TRI Cure	0.05	0.64	0.52	-0.10	0.19
Change in FNE	0.02	0.29	0.77	-0.12	0.16
Change in DAS24	-0.07	-0.82	0.41	-0.22	0.09
Change in Salience	0.01	0.08	0.94	-0.13	0.14
Change in Valence	-0.02	-0.26	0.79	-0.16	0.12
<b>Change in Perceived visibility</b>	<b>0.23</b>	<b>3.28</b>	<b>0.00</b>	<b>0.09</b>	<b>0.36</b>
<b>Change in Social support - Significant others</b>	<b>-0.13</b>	<b>-2.07</b>	<b>0.04</b>	<b>-0.26</b>	<b>-0.01</b>
Change in Social support - Family	-0.02	-0.29	0.77	-0.16	0.12
Change in Social support - Friends	0.09	1.30	0.19	-0.04	0.22
Change in Anxiety	-0.05	-0.60	0.55	-0.19	0.10
<b>Change in Depression</b>	<b>-0.34</b>	<b>-4.39</b>	<b>0.00</b>	<b>-0.49</b>	<b>-0.19</b>