ORIGINAL ARTICLE

Postoperative perceived health status in adolescent following idiopathic scoliosis surgical treatment: Results using the adapted French version of scoliosis research society outcomes Questionnaire (SRS-22)

Y. Chaib, M. Bachy, S. Zakine, P. Mary, N. Khouri, R. Vialle*

Department of Pediatric Orthopaedics, Paris & Pierre-et-Marie-Curie University, Armand Trousseau Hospital, 26, avenue du Dr-Arnold-Netter, 75571 Paris cedex 12, France

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KEYWORDS
Adolescent idiopathic scoliosis; Surgery; Functional result; SRS questionnaire

Summary
Purpose: Assessing functional outcome from patient-based outcomes questionnaires are essential to the evaluation of adolescent idiopathic scoliosis surgical treatment.

Methods: At the minimum follow-up of 2 years, 45 operated on adolescent idiopathic scoliosis patients were mailed the French version of the Scoliosis Research Society Outcome Instrument (SRS-22) questionnaires containing items on pain, activities of daily living, and satisfaction.

Results: Mean values of the SRS-22 domains were 3.66 for the Pain domain, 3.85 for the Self-perceived image domain, 4.32 for the Function domain, 3.52 for the Mental health domain and 4.12 for the Global satisfaction with management domain. Mean value of the global SRS-22 score was 3.88. We showed no differences in functional SRS-22 health status in patients according to the type of curve (Lenke classification). We showed statistically significant correlations between the gain of Cobb angle and Patients self-image and function domain scores. There was a statistically significant correlation between preoperative Cobb angle and patient satisfaction with management.

Conclusions: Even if Function and Self-image scores in our patients are close to control group values, indicating good short to mid-term outcome of surgical treatment, scores for pain and mental health status were significantly lower in patients than controls. Long-term follow-up studies conducted by multiple surgeons over successive generations are mandatory to assess clinical significance of these differences.

Level of evidence: Level IV. Retrospective study

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* Corresponding author. Tel.: +33 1 44 73 61 25; fax: +33 1 44 73 63 24.
E-mail address: raphael.vialle@trs.aphp.fr (R. Vialle).
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Introduction

Spinal fusions are still the primary means of correcting a scoliosis deformity and thereby halting progression. Many patients to have this kind of surgery are adolescents who have idiopathic scoliosis. Frequently, fusion extends from the thoracic spine into varying portions of the lumbar spine. Although partial or close to complete correction of the deformity is obtained, it is at the expense of removing intervertebral motions that exist in the scoliotic spine [1]. Most surgeries for adolescent idiopathic scoliosis are performed on adolescents or young adults. Thus, functional follow-ups are necessary. In most previous reports, various authors indicated good postoperative results in back pain and activities of daily living [2]. Assessing functional outcome patient-based outcomes questionnaires are essential to the evaluation of disease and the efficacy of treatment [1,3]. Although there are other scoliosis-specific outcome instruments, such as the quality of life profile for spinal deformities [4] and the scoliosis quality of life index [5,6] the Scoliosis Research Society (SRS)-22 is currently the most widely used tool to determine outcomes in patients with scoliosis [7]. The SRS-22 was introduced in 2003 as a simple, disease-specific, practical and patient-based measure of treatment effectiveness for AIS [8–11]. As with most outcome measures, group means or change in group means have been presented as the primary measure of treatment effectiveness [8,12]. The purpose of this study was to determine the clinical outcomes of surgical treatment for adolescent idiopathic scoliosis using the French version of the Scoliosis Research Society Outcome Instrument (SRS-22).

Materials and methods

After approval of the study by our local ethic committee, 70 patients (62 girls, eight boys) with adolescent idiopathic scoliosis diagnosed and surgically treated between 2007 and 2009 were enrolled in the study. At the minimum follow-up of 2 years, all patients were mailed questionnaires containing SRS-22 items on pain, activities of daily living, and satisfaction.

SRS-22 questionnaire

The SRS-22 questionnaire is a scoliosis-specific health-related quality of life questionnaire with 22 items and five domains: Pain, Appearance, Activity, Mental, and Satisfaction; and an SRS total score [8,9]. Each domain score ranges from 1 to 5, with higher scores indicating better outcomes. It is the most widely used outcome instrument to measure changes in health-related quality of life in patients with scoliosis and is available in several languages. It has been found to be reliable and valid for both the pediatric and the adult population. The questionnaire used in the current series was the French version [12] of the Scoliosis Research Society Outcome Instrument (SRS-22). The Questionnaire contains 22 questions, which are grouped to form the following subscales (domains):

(a) intensity of pain (five questions);
(b) self-image (five questions);
(c) function/activity (five questions);
(d) mental health (five questions);
(e) satisfaction from treatment (two questions).

The scores for each answer range from one to five points and in each domain the recipient can score from five to 25 points, except for the satisfaction from treatment subscale where they can score from two to ten points. The overall score can range from 22 to 110 points.

The patients were operated on in the Paediatric Orthopaedics Department of the Armand Trousseau Hospital, Pierre and Marie Curie (Paris 6) University. Four senior surgeons did practice surgeries. All the surgical corrections were made by posterior approach using hybrid constructs (pedicle screws on the deformity area and hooks at the upper part of the construct) (Fig. 1). Patients were operated on using the Xia™ system (Stryker Spine, ZAC Avenue de Satolas Green 69330 Pusignan, France), the Legacy™ spinal system (Medtronic, 710 Medtronic Parkway Minneapolis, MN 55432-5604, USA) and the Pivot Link Universal System-PLUS™ instrumentation (Spinevision SAS, 180, avenue Daumesnil. 75012 Paris, France). Preoperative and postoperative (Follow-up) Cobb angles were noted. Risser sign was noted as being "Mature" for either Risser 4 or 5. In case of combined curves, the main angle was noted. The number of levels fused, lower fused vertebra, Cobb angle gain (difference between preoperative and follow-up Cobb angle values) were noted for each patient.

Statistical analysis

The data was analysed using SPSS 16 software (IBM Corporation, 1 New Orchard Road Armonk, New York 10504-1722 USA). ANOVA variance analysis and Paired comparisons of means were done using a paired T-test. P < 0.05 was considered as being significant. Statistical analysis was performed by a senior author (RV) with the guidance and supervision of our public health department.

Results

A total of 45 fully completed questionnaires (64% response rate) were retrieved from the patients. There were 42 girls and three boys (sex ratio 0.93). Their mean age at surgery was 14.6 years (12–18 years) with a mean Risser sign of 3.4 (range: 2–5). According to the Lenke classification [13], spinal deformity was a Lenke 1 curve in 21 patients (46%), a Lenke 2 curve in two patients (4%), a Lenke 3 curve in 13 cases (30%) and a Lenke 5 curve in nine cases (20%). The mean Cobb angle was 63 degrees preoperatively (from 25° to 110°) and 24 degrees postoperatively (from 5° to 58°). The epidemiological data are presented on Table 1. Mean values of the SRS-22 domains were 3.66 for the Pain domain (range: 1.8–4.8), 3.85 for the Self-perceived image domain (range: 2.2–5.0), 4.32 for the Function domain (range: 2.4–5.0), 3.52 for the Mental health domain (range: 2.4–4.4) and 4.12 for the Global satisfaction with management domain (range: 2.5–5.0). Mean value of the global SRS-22 score was 3.88 (range: 2.55–4.68). Table 2 presents the distribution of the results for the five domains of SRS-22.
Figure 1  Preoperative lateral (A) and frontal (B) radiographs of a 15 years-old girl with a double-major (Lenke 3) right sided thoracic and left-sided lumbar curve. Lateral (C) and frontal (D) radiographs at 5 years follow-up showing stable correction with hybrid construct.
Table 1 Epidemiological data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of female patients</td>
<td>42</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Number of male patients</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Immature Risser sign (0 to 3)</td>
<td>19</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Mature Risser sign (4 and 5)</td>
<td>26</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Preoperative cobb angle (degrees)</td>
<td>45</td>
<td>35</td>
<td>110</td>
<td>62.89</td>
<td>15.35</td>
</tr>
<tr>
<td>Age (years)</td>
<td>45</td>
<td>12</td>
<td>18</td>
<td>14.64</td>
<td>1.58</td>
</tr>
<tr>
<td>Cobb angle gain (degrees)</td>
<td>45</td>
<td>10</td>
<td>75</td>
<td>38.80</td>
<td>11.73</td>
</tr>
<tr>
<td>Number of fused levels</td>
<td>45</td>
<td>5</td>
<td>14</td>
<td>10.18</td>
<td>2.29</td>
</tr>
<tr>
<td>Follow-up (months)</td>
<td>45</td>
<td>24</td>
<td>48</td>
<td>37</td>
<td>7.9</td>
</tr>
<tr>
<td>Follow-up cobb angle (degrees)</td>
<td>45</td>
<td>5</td>
<td>58</td>
<td>24.09</td>
<td>12.22</td>
</tr>
</tbody>
</table>

Table 2 Details of the distribution of SRS-22 items and global score.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>45</td>
<td>1.80</td>
<td>4.80</td>
<td>3.6444</td>
<td>0.72474</td>
<td>0.525</td>
</tr>
<tr>
<td>Self-perceived image</td>
<td>45</td>
<td>2.20</td>
<td>5.00</td>
<td>3.9556</td>
<td>0.58292</td>
<td>0.340</td>
</tr>
<tr>
<td>Function</td>
<td>45</td>
<td>2.40</td>
<td>5.00</td>
<td>4.3200</td>
<td>0.53155</td>
<td>0.283</td>
</tr>
<tr>
<td>Mental health</td>
<td>45</td>
<td>2.00</td>
<td>4.40</td>
<td>3.5200</td>
<td>0.65283</td>
<td>0.426</td>
</tr>
<tr>
<td>Satisfaction with management</td>
<td>45</td>
<td>2.50</td>
<td>5.00</td>
<td>4.1222</td>
<td>0.76986</td>
<td>0.593</td>
</tr>
<tr>
<td>SRS-22 global score</td>
<td>45</td>
<td>2.55</td>
<td>4.68</td>
<td>3.8838</td>
<td>0.52237</td>
<td>0.273</td>
</tr>
</tbody>
</table>

questionnaire, including the mean values for each domain, standard deviations, and variance. The analysis of skewness and kurtosis coefficients were consistent with a normal distribution of these variables.

According to Lenke classification, the ANOVA study showed no statistical difference regarding the Pain domain (F = 1.763 with P = 0.169), the self-perceived image domain (F = 0.221 with P = 0.881), the Function domain (F = 0.089 with P = 0.966), the Mental Health domain (F = 1.199 with P = 0.322) and the Satisfaction with management (F = 1.277 with P = 0.295). The overall SRS-22 global score was also considered as the same regarding each Lenke subtype (F = 0.558 with P = 0.646). The details of the ANOVA study are reported in Table 3. The paired-samples T-test analysis of means showed statistically significant correlations between the gain of Cobb angle and Patients self-image (R = -0.29 with P = 0.04) and function (R = -0.37 with P = 0.01) domain scores. There was a statistically significant correlation between preoperative Cobb angle and patient satisfaction with management (R = 0.308 with P = 0.03). Surprisingly, there was a statistically significant correlation between higher follow-up Cobb angles and better function (R = 0.31 with P = 0.03) and satisfaction with management (R = 0.38 with P = 0.009) domain scores. No other significant correlations were found in the paired-samples study. No statistical correlations were noted between surgeon and SRS-22 results. The details of the relevant paired-samples T-test analysis of means are reported in Table 4.

Discussion

Many reports indicate that patients with adolescent idiopathic scoliosis have good clinical outcomes (improvement in back pain and activities of daily living) after surgery [14]. In AIS as well as in many other diseases, the interest in assessing the patients perceived health status has increased in the recent years [15]. The so-called health-related quality of life (HRQoL) assessments have become a significant outcome parameter in the medical literature and Short Form-36 (SF-36) as well as Short Form-12 (SF-12) is widely accepted as reliable tools in this connection [16–19].

The SRS-22 is nowadays seen as a useful instrument for the periodic assessment of health-related quality of life in adolescent scoliosis patients during their follow-up [20,21]. Since the SRS-22 is widely used in the English-speaking countries and that cross-cultural adaptations were recently made in Italian [22,23], Spanish [24,25], Turkish [26], Japanese [27], Chinese [28,29], and French [12], there was an interest to assess the clinical outcomes of surgical treatment for adolescent idiopathic scoliosis using the French version of the Scoliosis Research Society Outcome Instrument (SRS-22) in our patients.

Table 3 Details of the ANOVA study according to the Lenke classification.

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>1.763</td>
<td>0.169</td>
</tr>
<tr>
<td>Self-perceived image</td>
<td>0.221</td>
<td>0.881</td>
</tr>
<tr>
<td>Function</td>
<td>0.089</td>
<td>0.966</td>
</tr>
<tr>
<td>Mental health</td>
<td>1.199</td>
<td>0.322</td>
</tr>
<tr>
<td>Satisfaction with management</td>
<td>1.277</td>
<td>0.295</td>
</tr>
<tr>
<td>SRS-22 global score</td>
<td>0.558</td>
<td>0.646</td>
</tr>
</tbody>
</table>

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Table 4 Details of relevant paired-samples T-test analysis of means.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Correlation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain on Cobb angle (degrees) &amp; Self Image score</td>
<td>45</td>
<td>-0.2986</td>
<td>0.0463</td>
</tr>
<tr>
<td>Gain on Cobb angle (degrees) &amp; Function score</td>
<td>45</td>
<td>-0.3782</td>
<td>0.0104</td>
</tr>
<tr>
<td>Preoperative Cobb angle (degrees) &amp; Satisfaction with management score</td>
<td>45</td>
<td>0.3080</td>
<td>0.0396</td>
</tr>
<tr>
<td>Postoperative Cobb angle (degrees) &amp; Function score</td>
<td>45</td>
<td>0.3105</td>
<td>0.0379</td>
</tr>
<tr>
<td>Postoperative Cobb angle (degrees) &amp; Satisfaction with management score</td>
<td>45</td>
<td>0.3830</td>
<td>0.0094</td>
</tr>
</tbody>
</table>

In non-operated patients, relationships between SRS-22 scores and clinical variables had been suggested. Asher et al. demonstrated a strong association between the SRS-22 scores and the curve severity as measured by the Cobb angle [30]. These results were significant for Pain, Self-image, Function, Mental Health, and Total scores. Conversely, Glattes et al. [31] and Mehlman et al. [32] proved that patients with an average Cobb of 27° to 32° scored the same as those with an average Cobb less than 11°.

Climent et al. [24] showed that patients treated with a brace were less satisfied with their management and more affected in Self-image than other patients. Curve patterns did not seem to have important consequences on quality of life. Nevertheless, in Climent et al. patients [24] simple curves seemed to be more painful than double or triple curves. Our ANOVA study showed no differences in functional SRS-22 health status according to the type of curve (Lenke classification) or surgeon. Nevertheless, the paired-samples T-test analysis of means showed statistically significant correlations between the gain of Cobb angle and Patients self-image and function domain scores. There was a statistically significant correlation between preoperative Cobb angle and patient satisfaction with management i.e. the most physically impaired patients before the surgery had best satisfaction with management 2 to 4 years after the surgery. The significant correlation between curve size or treatment type and Self-image scores is important to underline since it can provide useful information in the management of spinal deformities in accordance to patient’s perception. There was a statistically significant correlation between higher follow-up Cobb angles and better function and satisfaction with management domain scores. We could not find any logical explanation to this fact that may be due to potential confounders as the preoperative Cobb angle value.

The present study has some limitations. Some factors as BMI and sagittal balance radiographic parameters were not taken into account. Even the follow-up was 2 to 4 years, the response rate was low, as would be expected in a study with very long-term follow-up evaluation. Danielsson et al. reported a high follow-up rate (91%) of surgically treated AIS patients with a minimum of 20 years of follow-up [17]. In contrast, only 64% of our patients had completed the questionnaire. Danielsson et al.’s study included chart reviews, validated questionnaires, clinical examination, and full-length standing frontal and lateral roentgenographs. In our study, because the survey only included a mailed questionnaire, we suggest that patients could be less concerned by the study. One of the main weak points of our study is the lack of a control group (healthy patients). Such control data was studied by Beausejour et al. in 2009 [12] in a group of 64 healthy adolescents recruited from the hospital community, mostly children of hospital employees, in the same age group as AIS patients. Mean values of the SRS-22 domains in control group were 4.65 for the Pain domain, 4.22 for the Self-perceived image domain, 4.78 for the Function domain, 4.07 for the Mental health domain and 4.43 for the SRS-22 subtotal (items 1 to 20). As in Beausejour et al.’s study [12], our work showed a clear gradient in response to the French version of the SRS-22 questionnaires in the participant groups. Differences in scores were obtained between the AIS patients and healthy respondents. This gradient was suggested by other studies investigating relationships between SRS-22 scores and clinical variables. These findings were also demonstrated in adults between healthy adults and adults with scoliosis as in Berven et al.’s study [33]. A recapitulative table including control group values from Beausejour et al.’s study [12] and our values is provided in Table 5.

Although, in the present study, scores for pain and mental health status were significantly lower in patients

Table 5 Recapitulative table including control group values from Beausejour et al. study [12] and our values.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Gender</th>
<th>Age mean (SD) (Range)</th>
<th>Risser n (%)</th>
<th>Pain</th>
<th>Self image</th>
<th>Function</th>
<th>Mental health</th>
<th>SRS-22 Subtotal (items 1–20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>64</td>
<td>41 (64%)</td>
<td>14.1 (2.1) (10.3–17.8)</td>
<td>--</td>
<td>4.65 (0.48)</td>
<td>4.22 (0.46)</td>
<td>4.78 (0.31)</td>
<td>4.07 (0.58)</td>
<td>4.43 (0.35)</td>
</tr>
<tr>
<td>(Beausejour et al. [4])</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Our patients</td>
<td>45</td>
<td>42 (93%)</td>
<td>14.6 (1.8) (12–18)</td>
<td>19 (42%)</td>
<td>3.64 (0.72)</td>
<td>3.95 (0.58)</td>
<td>4.32 (0.53)</td>
<td>3.52 (0.65)</td>
<td>4.06 (0.54)</td>
</tr>
<tr>
<td>(operated AIS)</td>
<td></td>
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</table>

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than controls, the clinical significance of these differences remains unknown and requires further study [14]. In recent years, postoperative correction has markedly improved due to advances in surgical methods and spinal instrumentation. The patients in this study received three-dimensional hybrid constructs, which might have resulted in better outcomes than those expected from older series with hooks constructs.

As a consequence of our population sex-ratio (only three male patients within 45 patients), we did not explore the gender influence on perceived self-image or health status. However, in our study, statistical results were not different if the three male patients were removed from the data.

Even if Function and Self-image scores in our patients are close to control group values, indicating good short to mid-term outcome of surgical treatment, most surgeries for adolescent idiopathic scoliosis are performed on adolescents or young adults. Thus, long-term follow-up studies conducted by multiple surgeons over successive generations are mandatory to determine whether these patients stay healthy.

In other words, surgeons who treat scoliosis should monitor their patients’ health in follow-ups spanning several decades.

Disclosure of interest

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References

Health status in adolescent after idiopathic scoliosis surgical treatment


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