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Assessment of spinal appearance in female patients with adolescent idiopathic scoliosis treated operatively

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A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
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Summary

Background: Body deformities in patients with scoliosis significantly affect appearance perception. The majority of studies on this topic have analyzed the relation between radiological and clinical assessment performed by doctors, and patients' perception of deformity. The object of this study was to adapt the Spinal Appearance Questionnaire (SAQ) to Polish conditions and to explore the perception of trunk deformity by female patients with adolescent idiopathic scoliosis.

Material/Methods: Forty female patients who underwent surgical treatment for adolescent idiopathic scoliosis using the Cotrel-Dubousset method were asked to complete a Polish version of the Spinal Appearance Questionnaire. The mean preoperative Cobb angle of the thoracic curve in the study group was 55.3 degrees (SD 9.7). In the final postoperative examination the Cobb angle was 29.1 degrees (SD 10.1).

Results: The general results of the SAQ demonstrated that the patients achieved a median of 34.48 points, showing a positive assessment of their appearance. Patients rated themselves most critically in the general, chest, surgical scar, symmetry of shoulders and waist domains. The logistic regression model revealed that only the size of the thoracic apical translation, with a model coefficient of –0.9138 (SE=0.350; p=0.013), has a statistically significant (p=0.002) influence on a good general result in the SAQ.

Conclusions: Patients assessed their appearance positively after surgical treatment. A higher thoracic apical translation value is related to a lower probability of achieving a good general result in the Spinal Appearance Questionnaire.

key words: **idiopathic scoliosis • appearance • spinal deformity • adolescence • Spinal Appearance Questionnaire**

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Background

Patient self-report measures are recognized as important tools for assessing patient outcomes. However, only a few studies have focused on the psychological aspects of various trunk deformities such as rib hump, kyphosis, waist asymmetry or asymmetric shoulders in patients with idiopathic scoliosis. These studies analyzed the many ways deformities are perceived by patients and which of these deformities are least acceptable [1–5].

Apart from evident medical indications to surgical treatment, such as correction and limitation of scoliosis progression, this disease also causes psychological problems arising from spinal deformities that significantly affect patients' appearance in cases with a high degree of rib hump [6].

Recent studies indicate that severe scoliosis is often associated with a mental dysfunction [7,8]. Surprisingly, there is often no correlation between radiological and clinical assessment by doctors, and appearance assessment and satisfaction with the treatment by patients and parents [9,10]. Similar conclusions may be derived from studies by D'Andrea et al., White et al., and Koch et al. [11–13].

The available literature on diseases such as idiopathic scoliosis, which significantly affect appearance perception, suggest that deformities concurring with scoliosis, such as rib hump and trunk decompensation, become increasingly important in adolescence [3].

The object of this paper is to define the degree to which trunk deformity arising from scoliosis (e.g., rib hump, degree of scoliosis in a frontal plane, vertebral deformity in a sagittal plane or trunk compensation) affect perception of appearance by patients suffering from idiopathic scoliosis treated with Cotrel-Dubousset method in puberty. This study sought to discover which spine-deforming factor most adversely affects perception of one's appearance.

As there is no Polish version of the Spinal Appearance Questionnaire (SAQ) [3], one of our objectives was to adapt and validate a method that provides specific data on the perception of trunk deformity by patients, such as degree of kyphosis, shoulder asymmetry, waist, chest or appearance of surgical scar.

Material and Methods

Participants

All patients were treated for idiopathic scoliosis by the same orthopaedic surgeon and were selected to surgical treatment consecutively. All patients had their scoliosis corrected with the Cotrel-Dubousset method, using hybrid instrumentation using hooks and screws [14]. Scoliosis correction was the first spine surgery performed in these subjects. In the post-operative period, 2 patients suffered from pneumothoraces. Other diseases leading to deformity of the trunk served as exclusion criteria.

Forty female patients were assessed with the use of questionnaires. The data was collected 2 years postoperatively during routine clinical assessment, according to the method of Bridwell et al. [15].

Average age of the assessed patients during surgery was 15 years (SD 1.5). Average body weight was 52.7 kg (SD 7.6), and average height was 164.3 cm (SD 6.4). The average BMI index was 19.5 (SD 2.3).

The parameters recommended by the Harms Study Group were considered [11]. Average value of the Cobb's angle in the thoracic spine was 55.3 degrees (SD 9.7). The distance between the C7 spinous process to the central sacral vertical line (CSVL) was 1.4 cm (SD 1.0). In the final post-operative assessment, the value of the Cobb's angle was 29.1 degrees (SD 10.1), and the distance between the C7 spinous process to the CSVL was 0.8 cm (SD 0.5) (Table 1).

Methods

We adapted the Spinal Appearance Questionnaire to Polish cultural settings. The process of cultural adaptation of the questionnaire was compliant with the guidelines of the International Quality of Life Assessment (IQOLA) Project [16].

In the first stage, 2 translators working independently translated the English version of the SAQ into Polish; Polish being the native language of these translators. In the second stage, these translations were compared and synthesized into a single version by the 2 translators and authors of the project. In the third stage, 2 native English speakers, who were bilingual, translated the Polish version of the SAQ into English. These translators had no knowledge of the original English version of the SAQ. In the final stage, a committee of translators, 2 orthopedic surgeons, a statistician and a psychologist reviewed all the translations to reach a consensus with regard to all the inconsistencies found in the translations and to create a pre-final version of the SAQ. Then 40 female patients filled out the Polish language version of the Spinal Appearance Questionnaire twice in a 1-week interval.

We performed the reliability tests on the same 40 female patients with adolescent idiopathic scoliosis treated operatively. All patients underwent Cotrel-Dubousset (using hybrid instrumentation) method corrective surgery for scoliosis. Patients were followed-up for a minimum period of 2 years as part of routine clinical assessment according to Bridwell et al. [15].

We conducted the following tests on the psychometric properties of the adapted Spinal Appearance Questionnaire. We analyzed percentage of subjects scoring minimum (floor effect) and maximum (ceiling effect). To assess internal consistency, we used Cronbach's alpha. Cronbach's alpha coefficient values were accepted as follows: ≥ 0.80 as excellent, 0.70–0.79 as adequate, and <0.70 as poor [17]. The assessment of the test-retest reliability was performed using Pearson's correlation coefficient. The Pearson's correlation was accepted as follows: $r \geq 0.75$ as excellent, 0.40–0.74 as adequate, and ≤ 0.40 as poor [17]. Analysis of psychometric properties of the Polish version of the Spinal Appearance Questionnaire was carried out using the Statistica program.

The Cronbach's alpha value of the general result of the Polish version of the SAQ was excellent, and equaled 0.91. Similarly, the test-retest reliability was excellent and equaled 0.98. These values are comparable with the psychometric

Table 1. Description of subjects.

Parameters	Preoperative	Postoperative	After 2 years
Cobb's angle in thoracic and lumbar segments			
Th			
Mean (SD)	55.3 (9.7)	20.8 (11.0)	29.1 (10.1)
L			
Mean (SD)	32.1 (9.0)	14.2 (10.7)	18.2 (10.0)
Th apical translation			
Mean (SD)	4.7 (1.8)	1.5 (1.2)	2.5 (1.3)
L apical translation			
Mean (SD)	1.6 (10.9)	1.5 (1.0)	1.4 (0.9)
Kyphosis angle			
Th2-Th12			
Mean (SD)	25.5 (10.8)	29.3 (9.3)	33.3 (9.5)
Th5-Th12			
Mean (SD)	21.8 (9.9)	23.1 (7.4)	28.8 (8.3)
Th2-Th5			
Mean (SD)	6.7 (4.8)	9.3 (5.4)	9.8 (6.2)
Distance from C7 to CSVL* (cm)			
Mean SD	1.4 (1.0)	1.0 (0.7)	0.8 (0.5)
Rib hump angle			
Mean (SD)	12.8 (5.1)	4.5 (3.2)	7.1 (4.3)
Th1 rib angle			
Mean (SD)	6.6 (5.7)	7.7 (5.4)	7.9 (6.2)

* Central Sacral Vertical Line.

properties of the original English version [3]. The percentage of subjects scoring minimum (floor effect) was 4.9 (2 patients) and there was no ceiling effect.

The Spinal Appearance Questionnaire, a modified version of the Walter Reed Visual Assessment Scale (WRAS), is used to assess the perception of trunk deformity by scoliosis patients [2,3]. It consists of trunk profiles depicting various degrees of trunk deformity caused by scoliosis as included in the WRAS scale. As authors have noted, the application of graphics depicting trunk deformity makes the questionnaire less susceptible to problems arising from translation and cultural adaptation. The Spinal Appearance Questionnaire, contrary to the WRAS, includes open and closed-end questions pertaining to the degree of satisfaction or dissatisfaction of patients with their appearance, such as chest symmetry, chest, waist, length of limbs and arms, and general questions related to appearance, self-perception and surgical scar [3].

The SAQ consists of 20 items which form the following subscales that reflect various forms of body deformity concurrent with scoliosis [3]:
A. General
B. Curve
C. Prominence
D. Trunk shift
E. Waist
F. Shoulders
G. Kyphosis
H. Chest
I. Surgical scar

The items are scored from 1 to 5 points. The higher the score, the worse was the patients' perception of their appearance.

Questions 8, 18 and 20 are open-end questions that focus on which aspect of deformity is the most bothersome to patients.

Structure of the study

All patients were informed in detail on the objective of the study. They understood that their responses would be anonymous and that their personal information would not be disclosed. All patients signed informed consent to participate in the study.

Ethical considerations

The study design was approved by the Bioethics Commission and was carried out following universal ethical principles.

Statistical analysis

In respect to statistical quantitative features, we determined minimal and maximal values, median, and quartiles. In respect to qualitative features, we gave the number of units that belong to described categories of a given feature and respective values. To verify the hypothesis we used non-parametric tests, because the majority of considered features and results were not distributed normally.

To verify the relation between quantitative features we used Spearman's rank correlation coefficient (Spearman's rho

Table 2. Distribution of results of Spinal AppearanceQuestionnaire.

Subscale	Median	95% Confidence interval		Minimal value	Maximum value	Lower quartile	Upper quartile
		From	To				
General	7.23	2.06	2.76	1.00	4.67	4.00	10.00
Curve	1.78	1.56	1.99	1.00	3.00	1.00	2.00
Prominence	3.35	1.48	1.87	1.00	3.00	2.00	4.00
Trunk shift	3.30	1.44	1.86	1.00	3.50	2.00	4.00
Waist	6.08	1.60	2.45	1.00	5.00	3.00	8.00
Shoulders	4.25	1.82	2.43	1.00	3.50	2.00	6.00
Kyphosis	1.70	1.49	1.91	1.00	3.00	1.00	2.00
Chest	4.55	1.79	2.76	1.00	5.00	2.00	7.50
Surgical scar	2.25	1.79	2.71	1.00	5.00	1.00	3.50
General result	34.48	1.78	2.27	1.00	3.65	25.00	42.50

– rS). As the border level of statistical significance we adopted p=0.05; test results whose p value exceeded this level were treated as insignificant.

We used logistic regression analysis to define the degree to which trunk deformity affects perception of appearance by patients with idiopathic scoliosis. By means of logistic regression analysis we evaluated the influence of the parameters, measured in the x-ray performed 2 years postoperatively, on the probability of achieving a "good result" in the SAQ questionnaire. Statistical calculations were performed by means of Statistica software.

Results

Table 2 presents the distribution of the results: the minimal and maximal values, median scores with quartiles and 95% confidence intervals. Tables 3–5 show the interpretation of answers given to open-end questions. In Table 6 we analyzed the correlation matrix for the subscales of the Spinal Appearance Questionnaire.

We used logistic regression analysis to define the degree to which trunk deformity affects perception of appearance by patients suffering from idiopathic scoliosis. The general result of the Spinal Appearance Questionnaire was split into 2 categories: "good result" (from 17 to 34 points) and "poor result" (above 34 points). We used logistic regression analysis to evaluate the influence of the following parameters, measured in the x-ray performed 2 years postoperatively, on the probability of achieving a "good result" in the SAQ questionnaire:

1. Cobb angle in the thoracic spine.
2. Cobb angle in the lumbar spine.
3. Distance from C7 to the central sacral vertical line.
4. Thoracic apical translation according to the Harms Study Group [11].
5. Lumbar apical translation according to the Harms Study Group [11].
6. Kyphosis angle Th2 – Th12.
7. Kyphosis angle Th5 – Th12.
8. Kyphosis angle Th2 – Th5.

Table 3. Distribution of results – question 8.

Which form of deformity bothers you the most out of these 5 categories of images?	Question 8	
	N	%
None	7	17%
Rib prominence	12	29%
Flank prominence	6	15%
Head Chest Hips	2	5%
Shoulder level	10	24%
Spine prominence	4	10%

9. Th1 rib angle.
10. Rib hump angle.

The logistic regression model gained as a result of the calculations revealed that only the value of the thoracic apical translation, of which the coefficient in the model is –0.9138 (SE=0.350; p=0.013), has a statistically significant (p=0.002) influence on the dependent variable. The negative value of the coefficient confirms that a higher thoracic apical translation is related to a lower probability of achieving a good general result in the SAQ. The unit quotient of the odds at 0.40 indicates that an increase of 1 in the value of the thoracic apical translation decreases the probability for a good result by 60%.

Discussion

Only a few studies have attempted to determine which deformities affect mental health of adolescent scoliosis patients to the largest extent. Most studies have focused on the effect of body deformity and performed therapeutic procedures in a general way in respect to patients' functioning. Koch et al. and Nathan et al. pointed out that deformities resulting from scoliosis, such as rib hump, trunk compensation or waist asymmetry that affect appearance, become

Table 4. Distribution of results – question 18.

Of questions 9-17which are the most important to you?	Question 18	
	N	%
None	6	15%
A question on the desire to have a correct trunk shape	13	31%
A question on better appearance in clothing	2	5%
A question on symmetrical hips	1	3%
A question on symmetrical breasts	4	10%
A question on symmetrical shoulders	6	15%
A question on surgical scar	8	20%

Table 5. Distribution of results – question 20.

What would you most like to change about your body's shape?	Question 20	
	N	%
Nothing	25	62%
Trunk shape	13	31%
Asymmetrical shoulders	1	3%
Rib hump	8	19%
Asymmetrical hips	5	13%
Asymmetrical breasts	2	5%
Body weight	2	5%
My body shape in general	1	3%

Table 6. Correlation matrix for the subscales of the Spinal Appearance Questionnaire.

Subscale	General	Curve	Prominence	Trunk shift	Waist	Shoulders	Kyphosis	Chest	Surgical Scar
Curve	rS=0.438 p=0.005	---	---	---	---	---	---	---	---
Prominence	rS=0.476 p=0.002	rS=0.725 p<0.001	---	---	---	---	---	---	---
Trunk shift	rS=0.532 p<0.001	rS=0.726 p<0.001	rS=0.764 p<0.001	---	---	---	---	---	---
Waist	rS=0.605 p<0.001	rS=0.323 p0.042	rS=0.344 p=0.030	rS=0.550 p<0.001	---	---	---	---	---
Shoulders	rS=0.554 p<0.001	rS=0.340 p=0.032	rS=0.371 p=0.018	rS=0.564 p<0.001	rS=0.504 p=0.001	---	---	---	---
Kyphosis	rS=0.476 p=0.002	rS=0.716 p<0.001	rS=0.681 p<0.001	rS=0.636 p<0.001	rS=0.355 p=0.024	rS=0.327 p=0.039	---	---	---
Chest	rS=0.590 p<0.001	rS=0.356 p0.024	rS=0.380 p=0.016	rS=0.589 p<.001	rS=0.788 p<0.001	rS=0.400 p=0.011	rS=0.347 p=0.028	---	---
Surgical scar	rS=0.301 p=0.059	rS=0.207 p0.200	rS=0.104 p=0.524	rS=0.151 p=0.352	rS=0.197 p=0.223	rS=0.289 p=0.071	rS=0.063 p=0.701	rS=0.168 p=0.299	---
General result	rS=0.858 p<0.001	rS=0.611 p<0.001	rS=0.642 p<0.001	rS=0.778 p<0.001	rS=0.807 p<0.001	rS=0.702 p<0.001	rS=0.576 p<0.001	rS=0.795 p<0.001	rS=0.374 p=0.017

particularly important to patients in puberty [11,17]. They emphasize that such deformities, aside from the fact that they are chronic, also constitute a risk factor for developing self-image disturbances such as bulimia and anorexia nervosa [18,19,21,22]. According to studies designed by Fällstrom et al., only 8% of conservatively [23] treated patients and only 27% of surgically treated patients had a positive body image. However, it was found in our studies that, in general, patients perceived their appearance positively. The distribution of answers to question 20 is interesting – as many as 60% of patients would not change anything, which may confirm acceptance of their body appearance following the surgical procedure. Answers to this question do not add to 100%, as some patients indicated more than 1 type of deformity.

As previously stated, until recently there were few studies that examined the perception of body deformities in idiopathic scoliosis patients [2–5]. This is probably due to the fact that it is extremely difficult to objectively assess the self-image perceptions of patients. The majority of studies analyzed the link between radiological and clinical assessment of deformity as performed by doctors, and perception of different aspects of body deformity and satisfaction with the effects of scoliosis correction as indicated by the patients. In such studies general methods were applied, such as SRS-24 or SRS-22, in which patients referred to general issues related to their appearance or improvement of body shape following the treatment [13,24,25].

As Sanders et al. noted, the advantage of the Spinal Appearance Questionnaire is that patients describe in detail

respective aspects of their body deformity, as is the case in SRS-22 or SRS-24. SRS-22 allows gathering data on effectiveness of treatment in respect to appearance improvement, whereas the Spinal Appearance Questionnaire collects precise data on whether improvement of body shape, in the opinion of patients, refers to a reduction of hump, shoulder, waist and breast asymmetry or other parts of the body [3]. We found that patients exhibit the most self-criticism when assessing their shape in general; and then in the following order: general, chest, surgical scar, symmetry of shoulders and waist. Prominence and trunk shift were the elements that are assessed the least critically by females with scoliosis. What is interesting, from the interpretation of answers given to the open-end questions, is that it seems that 29% of patients indicated rib prominence and 24% of patients indicated shoulder level as the elements of trunk deformity which are the most disturbing to them. Moreover, every third patient would rather have a straighter shape, and every fifth patient assessed their post-surgical scar as negative.

Following Sanders et al. [3] it was ascertained that results achieved in respective subscales of the Spinal Appearance Questionnaire correlate with clinical and radiological aspects of deformities prior to surgical intervention.

Pratt et al. discussed, as did our studies, the way in which patients perceive the following elements of body deformity: rib hump, shoulder level, hip, waist and breasts asymmetry. It was concluded that the larger the deformity in the thoracic spine, the more critically the patients' perceived their rib hump or hip and waist asymmetry. Similarly, Pratt found that the higher the value of the Cobb's angle in the thoracic-lumbar spine, the worse the perception of waist, hip and shoulder asymmetry was [5]. Meanwhile, by means of regression analysis we found that only the value of the thoracic apical translation measured 2 years post-surgery is related to a lower probability of achieving a good general result in the Spinal Appearance Questionnaire in the 2-year follow-up. Our results show that an increase of 1 in the thoracic apical translation leads to a 60% decrease in the probability of achieving a good result.

Koch et al. found that factors such as the age, sex, pre- and post-operative values of the Cobb's angle and percent of post-operative correction, do not determine which patients would be satisfied or dissatisfied with the outcome of surgical correction of scoliosis [12]. These results are partly consistent with the results derived from our studies. We found that only the size of the thoracic apical translation influences the general result of the SAQ. On the other hand, Haher et al. indicated that the degree of post-operative correction of scoliosis correlates significantly with satisfaction with treatment, with experiencing pain and perceiving one's attractiveness [25]. In earlier studies, following the analysis of many study results from 11,000 patients, the author found that the degree of post-operative correction significantly correlates with satisfaction with treatment [26].

However, White et al. demonstrated a relation between the pre-operative value of Cobb's angle and the degree of post-surgical correction and self-image of patients following surgical intervention [13]. Following studies by D'Andrea et al., it was determined that, contrary to our findings, with the exception of the pre- and post-operative value of Cobb's angle, other radiological values do not correlate with self-image and the assessment of the degree of deformity assessed by patients in post-operative period [11].

However, Smith et al. found, in agreement with our results, that there is little connection between radiological assessments and the level of satisfaction of patients and their parents. She found that a correlation exists with only post-operative values of Cobb's angle, the degree of post-operative correction, and the value of hump degree. Interestingly, Smith only found relation in satisfaction with results of treatment on objective assessment of specific deformities as evaluated by patients [27].

Buchannan et al. designed an interesting study to compare assessments of shape appearance and level of satisfaction with treatment outcomes by orthopedists and patients following scoliosis correction, finding that in general there is no relation between perception of shape deformity by doctors (surgical scar in particular), shape deformity and post-surgical correction, and satisfaction of patients with treatment outcomes. The only correlation was found in shoulder height evaluated by doctors and general satisfaction with the shape and appearance of the surgical scar [10].

In the studies of Sanders et al., in which a previous version of the Spinal Appearance Questionnaire, the Walter Reed Visual Assessment Scale was used, there was, similar to our findings, a relation between the curve magnitude and critical evaluation by the patient [2]. Results differed between patients who were treated conservatively, surgically and those who were observed. It confirmed his hypothesis that surgical intervention significantly improves perception of appearance [2].

Not much is known about changes in perception of appearance by patients at a longer perspective. Ascani et al. and Edgar et al. focused on how a patient's body shape is perceived by doctors in longer post-operative follow-up [7,28]. It must be noted, however, that assessments made by doctors, to a very little extent, overlap with the assessments made by patients [9,27]. Noonan et al. found that the perception of self-image deteriorates with time. This correlation is especially distinct in operatively treated patients as compared to conservatively treated ones [21].

Conclusions

The Polish version of the Spinal Appearance Questionnaire meets methodological criteria and is a useful instrument for assessment of perception of body deformities in patients with scoliosis. Our results show that patients assessed their body shape positively after surgical treatment. A higher value of the thoracic apical translation is related to a lower probability of achieving a good general result in the Spinal Appearance Questionnaire.

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