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Original Article

Correlative Analysis of Radiological Measurements and 1-year Postoperative SRS-22r in Early and Middle Adolescents with Adolescent Idiopathic Scoliosis: A Retrospective Study

Rieva Ermawan[1*], Bayu Sakti Jiwandono[1], Ibnu Yudistiro[2], Muhammad Abdulhamid[2], Hubertus Corrigan[3], Felicia Renata[3]

[1]Division of Spine Surgery, Department of Orthopedic and Traumatology, Dr. Moewardi General Hospital, Surakarta, Indonesia
[2]Department of Orthopedic and Traumatology, Dr. Moewardi General Hospital, Surakarta, Indonesia
[3]Department of Orthopedic and Traumatology, Sebelas Maret University Faculty of Medicine, Surakarta, Indonesia

Correspondence should be addressed to Rieva Ermawan. Division of Spine Surgery, Department of Orthopedic and Traumatology, Dr. Moewardi General Hospital, Kolonel Sutarto No.132, Jebres, Surakarta 57126, Indonesia. e-mail: rievaortho1611@gmail.com

ABSTRACT

Background: Patient-reported outcomes are increasingly valuable for assessing the effectiveness of clinical interventions from the patient's perspective. This study aimed to investigate the differences in the correlation between radiological measurements and 1-year postoperative Scoliosis Research Society-22 revised (SRS-22r) domain scores in early (EA) and middle adolescence (MA) patients with adolescent idiopathic scoliosis (AIS), as well as analyze the correlation of these outcomes across different Lenke curve types.
Methods: We reviewed the records of 87 female AIS patients who underwent scoliosis corrective surgery, collecting data on age, body mass index, preoperative and postoperative radiographic measurements, and 1-year postoperative quality of life assessments, including function, pain, self-image, and satisfaction scores from the SRS-22r questionnaire. Patients were categorized into subgroups based on age and number of curves. The Spearman correlation test was used to evaluate correlations between radiographic measures and SRS-22r domain scores across these subgroups.
Results: Significant correlations were found between self-image and preoperative main apical vertebral translation (AVT), Cobb angle, and trunk shift, with stronger associations in EA than in MA. Pain had a weak inverse correlation with the postoperative main Cobb angle, notably in the one-curve group and more strongly in the EA group. Satisfaction scores decreased with age and were lower in the two-curve and EA groups.
Conclusions: Cobb angle correction in patients with AIS strongly correlates with postoperative self-image, particularly in Lenke types 2, 3, and 6. In Lenke types 1 and 5, greater correction of the Cobb angle is associated with increased postoperative pain.

Keywords: Adolescent idiopathic scoliosis; Lenke curve type; Scoliosis research society-22 revised; Human and health

INTRODUCTION

In light of the trend toward value-based healthcare, patient-reported outcomes are increasingly valuable for assessing the effectiveness of clinical interventions from the patient's perspective.[1] There is a well-known distinction of physical and psychological development between early (EA) versus middle adolescence (MA), as during this age significant change due to transition from childhood to adulthood occurs.[2,3] Studies have shown that different age groups have different perceptions of surgical results measured by patient-reported outcomes.[4,5] Scoliosis Research Society-22 revised (SRS-22r) is proven to be effective in assessing multidimensional aspects for patients with scoliosis.[6] Prior studies also have confirmed the correlation between preoperative radiological measurements and adolescent quality of life measured by SRS-22r.[6–8]

However, the difference between post-surgical quality of life measured by the SRS-22r in EA versus MA in AIS has not been described. Our study aimed to investigate the difference in the correlation between radiological measurements and 1-year SRS-22r domain scores in EA and MA.

Previous studies found that there is a difference in SRS-22r scores between curve types in AIS; however, the result is still controversial.[7,9] Preoperative and postoperative radiological measurements and 1-year SRS-22r domain score correlation between Lenke curve types were analyzed.

MATERIAL AND METHODS

Patient selection

This retrospective study was conducted at a single tertiary hospital. The data of all patients who underwent corrective surgery for scoliosis between 2017 and 2023 were analyzed. Inclusion criteria were: female, diagnosed with AIS at 10 to 17 years and 11 months of age, and less than 18 years of age at the time of undergoing corrective surgery for scoliosis. We applied the following exclusion criteria: incomplete medical records, incomplete pre/postoperative standing full-spine digital imaging and communications in medicine (DICOM) file, incomplete 1-year SRS-22r response, male, combined with kyphotic or lordotic deformity, other spinal diseases, history of trauma, and previous spinal surgery.

Data collection involved a thorough review of the medical records of surgeries performed by four spine surgeons. Ethical clearance was obtained from the local health ethics committee (683/III/HREC/2024).

Measurements

All measurements were based on standing full-spine radiographs. Preoperative and postoperative Cobb angles of all curves, apical vertebral translation (AVT), trunk shift, Cobb angle change, and trunk shift change were obtained. The definition of parameters follows the Scoliosis Research Society (SRS) Working Group terminology. The term apical vertebral translation follows the definition of apical vertebral lateral deviation. Trunk shift is defined by the lateral horizontal distance of the C-7 midpoint from lateral edges of the rib margins in the mid-thoracic level in the coronal plane of the radiograph.[10]

The SRS-22r questionnaire was translated and validity and reliability testing performed for the current population.[11] The 1-year follow-up postoperative SRS-22r assessment was used. The questionnaire contained five domains; in this study, only four were analyzed: function, pain, self-image, and satisfaction.

All AIS diagnoses are categorized by Lenke classification and agreed upon by at least two spine surgeons. Curve(s) must be structural, either major or minor, with at least 25°. We divided the patients into one-curve (Lenke 1 and 5), two-curve (Lenke 2, 3, and 6), and three-curve groups (Lenke 4).[12] The correlation of pain, function, self-image, and satisfaction was calculated to assess the correlation of each group. We considered the data for three-curve groups insufficient for correlation analysis; hence, only the one-curve and two-curve groups were analyzed.

By age group, we divided the participants into two groups: early adolescents aged 10-14 years, and middle adolescents aged 15-18 years, which coincides with the age group of junior and senior high school, respectively. To assess the differences in response to corrective surgery related to different age groups, the same four domain correlations were analyzed.

Statistics

The mean and standard deviation were calculated for age, body mass index (BMI), radiographic measurement, and SRS-22r domains. Curve numbers are presented as frequencies and percentages. Mean differences between one-curve, two-curve, and three-curve groups were analyzed using ANOVA. The mean difference between the

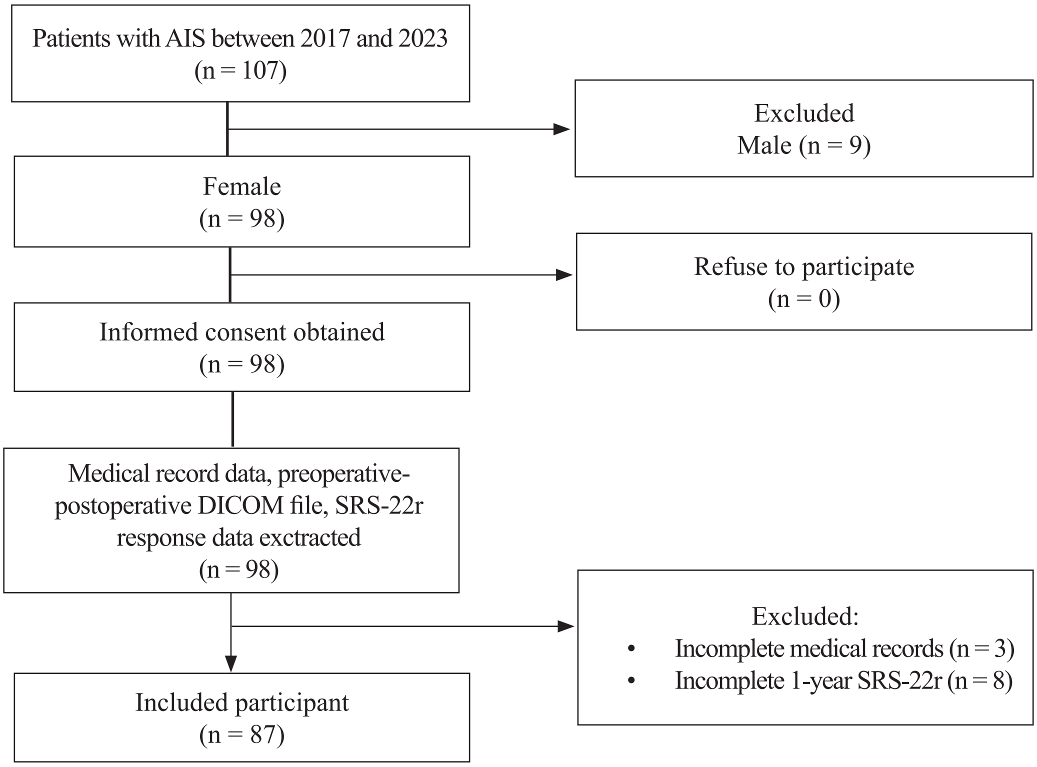

Figure 1. Study participant selection

Table 1. Demographic, SRS-22r response, and radiographic parameters of all cases

	All cases (n = 87)	One-curve group (n = 43)	Two-curve group (n = 31)	Three-curve group (n = 13)
Age (year)	14.46 ± 1.81	14.81 ± 1.75	14.24 ± 1.51	14.11 ± 2.15
BMI (kg/m^2)	18.18 ± 2.46	18.42 ± 2.18	17.72 ± 3.02	18.46 ± 1.76
Number of Curves				
One-curve	43 (49.43%)			
Two-curves	31 (35.63%)			
Three-curves	13 (14.94%)			
1-year postoperative SRS-22r scores				
Pain domain	18.44 ± 3.01	18.42 ± 3.25	18.29 ± 2.78	18.92 ± 3.01
Function domain	18.98 ± 3.09	19.20 ± 3.06	18.77 ± 3.13	18.77 ± 2.90
Self-image domain	19.93 ± 2.56	19.79 ± 2.68	19.96 ± 2.71	20.31 ± 1.75
Satisfaction domain	7.49 ± 1.28	7.53 ± 1.24	7.48 ± 1.23	7.38 ± 1.61
Cobb Angle (°)				
Preoperative	53.03 ± 14.81	52.27 ± 15.37	53.53 ± 14.87	54.31 ± 13.65
Postoperative	14.93 ± 7.65	15.39 ± 7.96	14.53 ± 7.68	14.31 ± 6.91
Change	38.10 ± 11.20	36.88 ± 11.89	39.00 ± 11.24	40.00 ± 8.72
AVT (cm)				
Preoperative	5.01 ± 1.83	5.03 ± 1.65	4.90 ± 1.53	5.33 ± 2.16
Postoperative	1.65 ± 0.69	1.56 ± 0.66	1.68 ± 0.62	1.84 ± 0.91
Trunk Shift (cm)				
Preoperative	3.26 ± 1.80	2.87 ± 1.89	3.51 ± 1.32	3.91 ± 2.23
Postoperative	1.11 ± 0.84	0.97 ± 0.83	1.09 ± 0.81	1.26 ± 0.90
Change	2.15 ± 1.44	1.77 ± 1.31	2.46 ± 1.13	2.65 ± 2.16

EA and MA groups was determined using a t-test. Spearman correlation coefficients were used to determine correlations. Statistical significance was set at $p \leq 0.05$. Correlations were considered weak (r = 0.20-0.39), moderate (r = 0.40-0.59), strong (r = 0.60-0.79), and very strong (r = >0.80).

For the satisfaction domain, a subdomain analysis was conducted after suspicion of ceiling effect interference. Percentages of maximum participant scores were used. We consider 0-10%, 11-20%, and >20% as weak, moderate, and strong ceiling effects, respectively. Data analyses were conducted using the Statistical Package for the Social Sciences 26.0 (SPSS, IBM Corp, Armonk, NY).

RESULTS

All patients

The mean and standard deviation of age, BMI, 1-year SRS-22r response, and preoperative and postoperative radiological measurements are reported in Table 1. No significant differences were found in radiological measurement, SRS-22r score, age, and BMI among the one-curve, two-curve, and three-curve analyses (ANOVA, all $p > 0.05$). Independent t-tests for EA and MA revealed significant differences in self-image ($p = 0.04$), satisfaction ($p < 0.001$), and age ($p < 0.001$), but no differences in radiological measures, BMI, and other SRS-22r scores (all $p > 0.05$). BMI showed no significant correlation with age, radiological measures, or SRS-22r score in any subgroup.

We assessed whether missing data could interfere with the results (i.e., excluded, n = 11, Figure 1). T-test comparing the included and excluded available radiological measurements and/or SRS-22r response showed no significance (all $p > 0.10$).

A strong correlation was observed between the preoperative main Cobb angle and Cobb angle change (r = 0.822; $p < 0.001$). A moderate correlation was found between the preoperative main AVT and preoperative main Cobb angle (r = 0.590; $p < 0.001$), preoperative main AVT and Cobb angle change (r = 0.422; $p < 0.001$), trunk shift change and Cobb angle change (r = 0.4.18; $p < 0.001$), and preoperative trunk shift and Cobb angle change (r = 0.522; $p < 0.001$).

Function

We found no correlation between the 1-year follow-up function score in SRS-22r and preoperative and postoperative radiological measures. No correlation was observed in any of the curves (Table 2) or age subgroups (Table 3).

Pain

The postoperative main Cobb angle and pain have a weak inverse correlation. Cobb angle change and pain were correlated in the one-curve group (Table 2). No significant correlation was found between age and pain score ($p > 0.05$). Both EA and MA experienced more pain with a greater Cobb angle change and a stronger correlation with EA. A negative correlation between the postoperative Cobb angle and postoperative pain was observed only in the EA group (Table 3).

Self-image

Positive correlations between preoperative main AVT, main Cobb angle, and trunk shift and 1-year postoperative self-image were found (Table 4). The positive correlation between the preoperative Cobb angle and postoperative self-image is consistent among the one-curve and two-curve subgroups, as well as in EA and MA. Postoperative self-image and radiological parameters are more strongly correlated in EA than in MA. Postoperative self-image in the EA group was significantly greater than that in the MA group ($p = 0.04$), but there was no direct correlation between age and self-image (Table 5).

Satisfaction

A significant negative correlation was found in the two-curve group (r = -3.78; $p = 0.018$), but not in the one-curve group. The difference in the satisfaction domain between the two- and

Table 2. Spearman correlation between postoperative SRS-22r questionnaire scores in the function and pain domains and radiographic parameters across all cases, one-curve, and two-curve groups

			All cases (n = 87)		One-curve group (n = 43)		Two-curve group (n = 31)	
			Function	**Pain**	**Function**	**Pain**	**Function**	**Pain**
Preoperative	Main AVT	rho	-0.032	-0.045	0.056	0.019	-0.063	-0.097
		p	0.384	0.339	0.360	0.452	0.369	0.302
	Main Cobb angle	rho	0.105	0.081	0.194	0.127	0.102	0.100
		p	0.166	0.227	0.107	0.208	0.293	0.297
	Trunk shift	rho	-0.036	0.197	-0.042	0.105	0.109	0.249
		p	0.370	0.087	0.394	0.251	0.280	0.089
Postoperative	Main AVT	rho	0.001	0.048	0.078	0.216	-0.043	-0.188
		p	0.495	0.328	0.311	0.082	0.408	0.155
	Main Cobb angle	rho	-0.068	-0.244*	0.040	-0.249	-0.148	-0.195
		p	0.267	0.009	0.399	0.054	0.213	0.147
	Cobb angle change	rho	0.091	0.278*	0.121	0.323*	0.153	0.270
		p	0.200	0.005	0.219	0.017	0.206	0.071
	Trunk shift	rho	-0.020	-0.006	0.010	0.054	0.084	0.080
		p	0.426	0.478	0.474	0.365	0.327	0.334
	Trunk shift change	rho	-0.040	0.187	-0.108	0.036	0.248	0.223
		p	0.356	0.311	0.245	0.409	0.090	0.060

rho = Spearman correlation coefficient; *p* = probability value, *considered as significant at *p-value* ≤ 0.05

Table 3. Spearman correlation of postoperative SRS-22r questionnaire scores in the function and pain domains and radiographic parameters in early and middle adolescents

			Early adolescent (n = 38)		Middle adolescent (n = 49)	
			Function	**Pain**	**Function**	**Pain**
Preoperative	Main AVT	rho	-0.154	0.082	0.052	-0.079
		p	0.178	0.312	0.360	0.295
	Main Cobb angle	rho	-0.042	0.138	0.032	0.049
		p	0.400	0.204	0.399	0.370
	Trunk shift	rho	0.181	-0.258	0.081	-0.134
		p	0.210	0.059	0.262	0.211
Postoperative	Main AVT	rho	-0.134	-0.203	-0.075	0.207
		p	0.211	0.111	0.303	0.076
	Main Cobb angle	rho	-0.069	-0.314*	0.032	-0.139
		p	0.288	0.027	0.399	0.170
	Cobb angle change	rho	0.175	0.390*	-0.119	0.243*
		p	0.147	0.008	0.208	0.046
	Trunk shift	rho	-0.066	0.205	-0.045	-0.048
		p	0.348	0.108	0.378	0.372
	Trunk shift change	rho	-0.162	-0.201	0.159	-0.164
		p	0.166	0.113	0.112	0.131

rho = Spearman correlation coefficient; *p* = probability value, *considered as significant at *p-value* ≤ 0.05

Table 4. Spearman correlation between postoperative SRS-22r questionnaire scores in the self-image and satisfaction domains and radiographic parameters across all cases, one-curve, and two-curve groups

			All cases (n = 87)		One-curve group (n = 43)		Two-curve group (n = 31)	
			Self-Image	**Satisfcation**	**Self-Image**	**Satisfcation**	**Self-Image**	**Satisfcation**
Preoperative	Main AVT	rho	0.267*	-0.002	0.142	0.078	0.356*	-0.064
		p	0.006	0.493	0.183	0.309	0.025	0.366
	Main Cobb angle	rho	0.365*	-0.071	0.292*	-0.034	0.471*	-0.016
		p	<0.001	0.256	0.029	0.414	0.004	0.466
	Trunk shift	rho	0.223*	-0.087	0.140	0.036	0.335*	-0.130
		p	0.019	0.212	0.185	0.409	0.025	0.243
Postoperative	Main AVT	rho	0.390*	0.083	0.256*	0.044	0.473*	0.295
		p	<0.001	0.221	0.049	0.391	0.004	0.054
	Main Cobb angle	rho	0.020	-0.108	-0.045	-0.017	0.075	-0.192
		p	0.426	0.159	0.386	0.456	0.345	0.151
	Cobb angle change	rho	0.444*	0.004	0.366*	-0.014	0.598*	0.149
		p	<0.001	0.484	0.008	0.465	<0.001	0.212
	Trunk shift	rho	0.156	-0.422*	0.253	-0.175	0.098	-0.378*
		p	0.074	<0.001	0.051	0.131	0.301	0.018
	Trunk shift change	rho	0.237*	0.076	0.100	0.177	0.321*	0.142
		p	0.014	0.242	0.500	0.129	0.039	0.223

rho = Spearman correlation coefficient; *p* = probability value, *considered as significant at *p-value* ≤ 0.05

Table 5. Spearman correlation of postoperative SRS-22r questionnaire scores in the self-image and satisfaction domains and radiographic parameters in early and middle adolescents

			Early adolescent (n = 38)		Middle adolescent (n = 49)	
			Function	**Pain**	**Function**	**Pain**
Preoperative	Main AVT	rho	0.365*	-0.216	0.189	0.199
		p	0.005	0.068	0.128	0.116
	Main Cobb angle	rho	0.344*	-0.222	0.300*	-0.055
		p	0.018	0.063	0.017	0.370
	Trunk shift	rho	0.321*	-0.388*	0.184	0.068
		p	0.025	0.008	0.103	0.321
Postoperative	Main AVT	rho	0.395*	0.158	0.357*	-0.152
		p	0.003	0.139	0.014	0.181
	Main Cobb angle	rho	0.151	-0.048	-0.196	-0.186
		p	0.150	0.372	0.120	0.132
	Cobb angle change	rho	0.574*	-0.335*	0.371*	0.106
		p	<0.001	0.009	0.010	0.264
	Trunk shift	rho	0.112	-0.511*	0.192	-0.148
		p	0.252	0.001	0.101	0.155
	Trunk shift change	rho	0.309*	-0.042	0.019	0.198
		p	0.030	0.400	0.449	0.086

rho = Spearman correlation coefficient; *p* = probability value, *considered as significant at *p-value* ≤ 0.05

one-curve groups was not significant. The two-curve group and EA had worse perceptions of the procedure (Table 4).

Satisfaction scores declined with age (r = -0.279; p = 0.04), with a significant mean difference in satisfaction scores between EA and MA (p < 0.001). Trunk shift was significantly correlated with postoperative satisfaction with EA (preoperative, r = -0.388, p = 0.008; postoperative, r = -0.422, p < 0.001). EA with greater Cobb angle change was less satisfactory (r = -0.335; p = 0.009), and no correlation was observed in the MA group (Table 5).

Strong ceiling effect observed in the satisfaction domain

The satisfaction domain includes two final questions; (Q.21) 'Are you satisfied with the results of your back management?' and (Q.22) 'Would you have the same management again if you had the same condition?', and each score ranged from 1 to 5. The majority of the patients (93.1%) were satisfied (Q.21 score 4 or 5), but only 35.6% of patients would undergo the same surgery (Q.22 score 4 or 5). A strong ceiling effect was observed, with the majority answering Q.21 with 3 or more (98.8%) and 4 or more (94.3%). Moreover, 85 of 87 patients (97.7%) had a Q.21 score > Q.22 score. One patient answered 'Unsatisfied' (score 2) for Q.21 and 'Not sure' (score 3) for Q.22. The other patient answered 'Neither satisfied nor unsatisfied' (score 3) for Q.21 and 'Probably yes' (score 4) for Q.22. This indicates that the willingness to undergo the same surgery (Q.22) is influenced by satisfaction (Q.21).

Satisfaction subdomain analysis

We hypothesized that the ceiling effect might contribute to the difference in the correlation of the satisfaction domain with radiologic measurements. Subdomain analysis by age group showed; EA: Q.21 mean = 4.32±1.3, Q.22 mean = 3.5±1.9; MA: Q.21 mean = 4.37±1.3, Q.22 mean = 2.91±1.4. In EA, 94.5% were satisfied (Q.21, scores 4 and 5) and 60.5% would undergo the same surgery (Q.22, scores 4 and 5). In MA, 91.8% were satisfied (Q.21, scores 4 and 5); however, only 16.3% would repeat the same procedure (Q.22, scores 4 and 5).

No significant difference was found between Q.21 of the EA and MA groups (p = 0.357), while Q.22 was significant (p = 0.0012). Spearman rank revealed no correlation between Q.21 and Q.22 scores and radiological measures in either group (all p > 0.05).

In one curve, Q.21 mean = 4.34±1.3 and Q.22 mean = 3.23±1.8. In two-curve, Q.21 mean = 4.58±1.0 and Q.22 mean = 3.94±1.3. There was no statistical difference between the corresponding scores (all p > 0.05). No correlation was found between Q.21 and Q.22 scores and radiological measurements (all p > 0.05).

The subdomain analysis could not explain the difference in correlation results of the satisfaction domain with preoperative and postoperative radiologic measures in the MA group or between the one-curve and two-curve groups, but further revealed that the Q.21 subscore had a stronger ceiling effect than the Q.22 subscore. The possibility of ceiling effect interference remains.

DISCUSSION

Previous studies have consistently revealed correlations between Cobb angle and AVT, with self-image.[13,14] Wang et al. found that preoperative main Cobb angle and AVT were inversely correlated with preoperative self-image in 202 female patients with AIS.[13] Asher et al. revealed that the preoperative Cobb angle significantly influences preoperative self-image in addition to transverse plane trunk deformity.[6]

We found positive correlations between preoperative main AVT, main Cobb angle, and trunk shift and 1-year postoperative self-image, providing weak predictive values. This can be explained by the fact that patients with greater deformities receive greater correction. A strong correlation between preoperative main Cobb angle and main Cobb angle change was observed (r = 0.822; p < 0.001), along with a moderate correlation between preoperative main AVT Cobb angle change and preoperative trunk shift and Cobb angle change.

Our findings suggest that the extent of curve correction (Cobb angle change) achieved by surgery in AIS patients has a greater impact on the patient's postoperative self-image. These correlations were stronger in the two-curve group than in the one-curve group and between the EA and MA groups. Regarding the number of curves, in common sense, the two-curve group has greater deformity than the one-curve group; hence, more corrections can be made.

Interestingly, trunk shift change showed a weaker correlation with postoperative self-image than Cobb angle change, despite being more directly observable by patients. Belli et al. found that SRS-22r self-image correlate weakly with external measurement of trunk deformity and also trunk deformity score.15 Wang et al. found that preoperative trunk shift does not correlate with preoperative self-image in single or multiple curves.[13]

Surgical intervention in scoliosis is associated with improvement in self-image.[16] Previous studies indicated age-related differences in self-image. Elsamadicy et al. found that younger age reported better postsurgical self-image after complex spinal surgery.[17] Zebracki et al. revealed greater self-image improvement after surgery in juvenile (8–12 years) compared to adolescent (13–21 years) patients.[18] Analogous to our study, while no direct correlation with age, self-image score is significantly higher in EA than MA, and preoperative and postoperative radiological measurement correlated more strongly with postoperative self-image in EA.

This may be explained by a change in physical awareness. Clay et al. observed a general decline in physical satisfaction in 136 female adolescents aged 11-16.[19] During this period, an increase in awareness and internalization of sociocultural attitudes toward appearance and comparison to unrealistic media models was observed, which lowered physical satisfaction.[19,20] Furthermore, comparing behavior is pronounced in girls and rural populations; which later diminishes in early adulthood.[20]

An inverse correlation between postoperative pain and postoperative Cobb angle was found but was not consistent across subgroups. We considered this correlation to be very weak. Cirrincione et al. and Asher et al. found no correlation between trunk deformity and pain.[21] Similarly, we found no correlation between pain and trunk shift.

Sanders et al. reviewed 477 AIS patients from multicenter databases. The amount of correction with two years postoperative pain was correlated, but the coefficient was only r=0.139.[9] Moreover, Watanabe et al. found that postoperative pain is correlated with the amount of rotational correction (r = 0.27; $p < 0.05$).[22] We found that postoperative pain is correlated with Cobb angle change. This could be attributed to patients with larger Cobb angle changes experiencing more substantial alterations in spinal biomechanics and muscle strain, contributing to increased postoperative pain.[23]

These findings suggest that postoperative pain is contributed to (but not limited to) the magnitude of spinal alteration during surgery. Consistently, postoperative pain was never found to correlate strongly to a single factor and was found to be correlated with a variety of patient factors, beyond what the surgeon can do.[8]

Sanders et al. found differences in 2 years of postsurgical pain among Lenke curve types.[9] Théroux et al. revealed that back pain correlates with curve severity in the main-thoracic and lumbar curves but not the proximal thoracic or thoracolumbar curves.[24] We found that postoperative pain correlates with Cobb angle change in the one-curve group that has a main curve on the main-thoracic and thoracolumbar/lumbar, Lenke 1 and 5, respectively. However, this was not observed in the two-curve groups (Lenke 2, 3, and 6). In contrast, Fekte et al. reviewed 85 female AIS patients and found no correlation of pain between curve-type groups.[7]

Age- and gender-specific pain perception differences are well-observed. While adolescents demonstrate a reduction in pain sensitivity as they mature, girls generally have higher sensitivity.[25] Wang et al. found no direct correlation between age and pain in AIS patients,[13] while Fekete et al. found a weak correlation ($r = 0.31$).[7] We found no direct correlation between age and pain with no significant difference between groups. However, we observed that differences in pain associated with Cobb angle change are stronger in EA, although further studies are needed to corroborate these findings.

The correlation of the satisfaction domain in SRS-22r was inconsistent. While preoperative and postoperative trunk shifts and Cobb angle changes correlated with satisfaction in the EA and two-curve groups, subdomain analysis showed no clear correlation. Prior studies also show inconsistent results, as some revealed correlation while others did not.[9,22] The ceiling effect observed in the satisfaction domain is consistent between studies, which suggests the inability to classify higher satisfaction scores and it may be unable to accurately reflect satisfaction.[6] While a significant correlation is found in this domain, we opt to not conclude as the result might be misleading.

This study had some limitations. This study was conducted retrospectively, which limits its ability to determine causal relationships. The analysis only included female patients, which reduces the generalizability to the broader AIS population. The three-curve group had a small number of subjects; therefore, no valid statistical correlation could be drawn for that subgroup. The satisfaction domain showed a ceiling effect, which may have affected the ability to detect differences between the groups. The use of a single-center sample may also have limited external validity. Prospective multicenter studies including both sexes are recommended for future research. A larger sample size, especially for the three-curve group, would allow for a more comprehensive analysis. The development or use of alternative satisfaction measurement tools may also help reduce the ceiling effect and better reflect patient-reported outcomes.

CONCLUSION

The current study found that the extent of curve correction (Cobb angle change) achieved by surgery in patients has a greater correlation with the patient's postoperative self-image and was more pronounced in Lenke 2, 3, and 6. Furthermore, surgical intervention for AIS has a greater impact on postoperative self-image in early adolescence. Greater curve correction (Cobb angle change) was associated with greater postoperative pain in Lenke 1 and 5. Moreover, early adolescents have a greater correlation of curve correction with pain than middle adolescents, possibly related to the difference in pain tolerance. Factors that influence postoperative satisfaction in AIS are beyond surgical correction, and the satisfaction domain in SRS-22r might not truly represent postoperative satisfaction in AIS patients. Therefore, a new reliable multifactorial scoring system for satisfaction is required.

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DATA AVAILABILITY

Due to privacy restrictions, raw data cannot be made publicly available. However, aggregated and anonymized data are available from the corresponding author upon request.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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