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Original Article

Comparable satisfaction and clinical outcomes after surgery for adolescent idiopathic scoliosis in the adult (AISA) between the US and Japan

Mitsuru Yagi [a, b], Christopher P. Ames [c], Naobumi Hosogane [d], Justin S. Smith [e], Christopher I. Shaffrey [f], Frank J. Schwab [g], Virginie Lafage [g], Shay Bess [h], Morio Matsumoto [a], Kota Watanabe [a, *], International Spine Study Group (ISSG)

[a] Department of Orthopedic Surgery, Keio University School of Medicine, Tokyo, Japan
[b] Department of Orthopedic Surgery, National Hospital Organization, Murayama Medical Center, Tokyo, Japan
[c] Department of Neurological Surgery, University of California, San Francisco, CA, USA
[d] Department of Orthopedic Surgery, Kyorin University School of Medicine, Tokyo, Japan
[e] Department of Neurosurgery, University of Virginia Medical Center, Charlottesville, VA, USA
[f] Department of Orthopedic Surgery, Duke University, NC, USA
[g] Spine Service, Hospital for Special Surgery, New York, NY, USA
[h] Department of Orthopedic Surgery, Denver International Spine Center, Denver, CO, USA

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ABSTRACT

Background: The impact of ethnicity on the surgery outcomes of adolescent idiopathic scoliosis in the adult (AISA) is poorly understood. This study aimed to compare the surgery outcomes for AISA between the United States (US) and Japan (JP).

Methods: 171 surgically treated AISA (20-40y) were consecutively collected from 2 separate multicenter databases. Patients were propensity-score matched for age, gender, curve type, levels fused, and 2y postop spinal alignment. Demographic and radiographic parameters were compared between the US and JP at baseline and 2y post-op.

Results: A total of 108 patients were matched by propensity score (age; US vs. JP: 29 ± 6 vs. 29 ± 7y, females: 76 vs. 76%, curve type [Schwab-SRS TypeT; TypeD; TypeL; TypeN]: 35; 35; 30; 0 vs. 37; 33; 30; 0%)] levels fused: 10 ± 4 vs. 10 ± 4, 2y thoracic curve:17 ± 13 vs. 17 ± 12°, 2y CSVL: 10 ± 8 vs. 11 ± 9 mm). Similar clinical improvement was achieved between US and JP (function; 4.2 ± 0.9 vs 4.3 ± 0.6, p = 0.60, pain; 3.8 ± 0.9 vs 4.1 ± 0.8, p = 0.13, satisfaction; 4.3 ± 0.9 vs 4.2 ± 0.7, p = 0.61, total; 4.0 ± 0.8 vs 4.1 ± 0.5, p = 0.60). The correlation analyzes indicated that postoperative SRS-22 subdomains correlated differently with satisfaction (all subdomains moderately correlated with satisfaction in the US while only pain and mental health correlated moderately with satisfaction in JP ([function: r = 0.61 vs 0.29, pain: r = . 72 vs 0.54, self-image: r = 0.72 vs 0.37, mental health: r = 0.64 vs 0.55]).

Conclusions: Surgery for AISA was similarly effective in the US and JP. Satisfaction for spinal surgery among patients in different countries may not be different unless the procedure limits an individual's unique lifestyle that the patient expected to resume.

This study was approved by the institutional review board.

The submitted manuscript does not contain information about medical device(s) or drug(s). No benefits in any form have been or will be received from a commercial party related directly or indirectly to the subject of this manuscript.

* Corresponding author. 35 Shinanomachi, Shinjyuku-ku, Tokyo, Japan. Fax: +81 3 3353 6470.
E-mail address: kw197251@keio.jp (K. Watanabe).

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1. Introduction

Recent studies have reported that corrective spine surgeries for adolescent idiopathic scoliosis in adults (AISA) are similarly effective as those performed in adolescents [1,2]. Patient outcomes and satisfaction of surgery can vary significantly across different countries due to different cultural factors, including lifestyle, religion, and genetics [3–5]. Yagi et al. have reported that spinopelvic fusion for adult thoracolumbar spinal deformity is similarly effective in patients in the United States (US) and in Japan (JP), although satisfaction domain were lower in JP compared to those in the US [6]. Yagi et al. postulated that differences in lifestyle and cultural expectations may impact patient satisfaction following ASD surgery. For example, extension of posterior instrumentation to include the pelvis, which is common in adult deformity surgery, may prove more impactful in a culture such as JP in which sitting directly on the floor is traditional for activities such as dining. Theoretically, both selective thoracic fusion and lumbar fusion, which are common surgical strategies for AISA, have less impact on the trunk range of motion compared with corrective spine surgery that extends to and includes the pelvis. Therefore, corrective spine surgery for mature AIS may provide similar satisfaction in the US and JP. However, the impact of ethnicity on patient satisfaction and clinical outcomes in the setting of operative treatment of AISA remains poorly understood. The present study sought to compare the clinical outcomes, potential factors affecting clinical outcomes, and patient satisfaction of surgical treatment for AISA between the US and JP.

2. Materials and methods

2.1. Patient population

This study was approved from the institutional review board of our hospitals (The IRB approval number #20110142). We attest that the oral and written informed consents were obtained from all these patients. The all methods were performed in accordance with the relevant guidelines and regulations. This study used data from 2 multicenter ASD databases representing 171 consecutive primary AISA patients (61 patients in the US and 110 patients in JP) who had undergone corrective spine surgery (US vs. JP; age: 28.1 ± 6.4 years vs 30 0.2 ± 7.9 years, female: 72% vs. 84%, BMI: 24.6 ± 7.3 vs. 19.3 ± 2.8 kg/m^2, p < 0.01, Table 1). The US group had approximately 1 vertebral level longer fusion when compared to those in the JP group (US vs. JP; 10.1 ± 4.3 vs. 8.8 ± 3.3, p < 0.01).

Table 1
Comparisons of demographics and surgical descriptions between the US and JP groups.

	US ($n = 54$)	JP ($n = 54$)	*P* value
Age (*y*)	28.9 ± 6.2	29.2 ± 6.9	0.88
Gender (*female*)	41 (76%)	41 (76%)	>0.99
Height (*cm*)	165.9 ± 12.1	159.2 ± 6.9	<0.01*
Weight (*kg*)	66.3 ± 16.3	48.8 ± 6.6	<0.01*
BMI (*kg/m^2*)	24.4 ± 7.2	19.5 ± 2.9	<0.01*
BSA (*m^2*)	1.74 ± 0.26	1.47 ± 0.11	<0.01*
Schwab-SRS curve type			0.98
Type T	19 (35%)	20 (37%)	
Type D	19 (35%)	18 (33%)	
Type L	16 (30%)	16 (30%)	
Type N	0 (0%)	0 (0%)	
Levels fused	10.1 ± 4.3	9.9 ± 3.9	0.86
3 column osteotomy	0 (0%)	0 (0%)	>0.99
Level of LIV (*pelvis*)	0 (0%)	0 (0%)	>0.99
Time of surgery (*min.*)	306.1 ± 111.4	187.9 ± 70.9	<0.01*
EBL (*mL*)	991.2 ± 713.4	486.6 ± 341.1	<0.01*
EBL/BSA (*mL/m^2*)	574.7 ± 450.6	340.2 ± 239.3	<0.01*
Complications			
Major complications	16 (30%)	12 (22%)	0.38
Perioperative complications	11 (21%)	10 (16%)	0.81
Implant-related complications	5 (8%)	6 (10%)	0.75
Neurological complications	5 (8%)	6 (10%)	0.75
Surgical site infections	3 (5%)	0 (0%)	0.24
Reoperations	8 (15%)	3 (4%)	0.11

Means and standard deviations. Percentages in parenthesis. * indicates statistically significant.

2.2. Inclusion and exclusion criteria

Patients included in our study were young adults (age 20 years–40 years) diagnosed with idiopathic scoliosis defined by a Cobb angle ≥20°. The patients selected for analysis had a minimum of five fused vertebral levels and complete 2-year follow-up data. Patients were excluded if they did not have appropriate radiographs or had syndromic, neuromuscular, other pathological conditions, history of spine surgery, or those who had fusion extended to sacrum. 8 patients in the US group and 9 patients in Japan group did not achieve 2-year follow-up.

2.3. Data collection and radiographic assessment

Charts were reviewed to extract patient age, gender, and body mass index (BMI). Collected surgical data included Scoliosis Research Society (SRS)-Schwab classification, use of three-column osteotomy, number of vertebral levels fused, estimated blood loss (EBL), and length of surgery (LOS) [7]. Full-length standing spine radiographs at baseline and 2-year follow-up were analyzed. Radiographic measurements included Cobb angle of thoracic and lumbar curve, C7-center sacral vertical line (CSVL), thoracic kyphosis (TK, T4-T12), lumbar lordosis (LL), C7 sagittal vertical axis (SVA), pelvic tilt (PT), and the mismatch between pelvic incidence (PI) and lumbar lordosis (PI-LL). All data were collected prospectively and analyzed retrospectively. Body surface area (BSA) was calculated based on the previously described formula [8]: BSA (m^2) = square root (weight (cm) × height (kg))/60.

2.4. Inclusion of postoperative complications

Major complications included all intra-, peri-, and postoperative complications recorded in the charts or identified on radiographic imaging within 2 years following surgery. Complications were categorized as a neurologic, implant-related, surgical site infection, other type of infection, excessive bleeding (>2000 mL), delirium, cardiopulmonary, gastrointestinal, or renal.

2.5. Clinical outcomes

Patient outcomes were evaluated using the Scoliosis Research Society patient questionnaire (SRS-22r). Baseline and 2-year postoperative SRS-22r scores were determined.

2.6. Propensity-score matching of the patient cohort

To account for the potential confounding factors for postoperative HRQOL, patients from the databases were propensity-score matched for age, gender, curve type, levels fused, and 2y postoperative spinal alignment (major curve magnitude and CSVL). There were 108 patients (54 patients in each group) who were matched by propensity score (Table 1, Supplemental Table 1). The chi-square of the Hosmer–Lemeshow test for this propensity-score matching was 14.49, and the p value was 0.68, indicating good model adaptation.

2.7. Statistical analysis

Differences between the US and JP groups were compared by unpaired t-tests, and chi-square tests as appropriate. Differences between the baseline and 2-year postoperative values were compared by paired t-tests. Pearson's correlation was used to analyze the correlations of 2-year postoperative SRS-22r satisfaction domain scores with baseline and 2-year postoperative demographic and radiographic variables of each group. A p value < 0.05 with a confidence interval of 95% was considered statistically significant. All analyses were performed using the Statistical Package for the Social Sciences (SPSS version 26.0. IBM Corp., Armonk, NY).

3. Results

3.1. Baseline and postoperative radiographic comparisons between the US and Japan

The baseline and 2-year postoperative thoracic curve and lumbar were similar between the US and JP (US vs. JP; baseline 56.6 ± 11.8° vs. 60.1 ± 14.3°, p = 0.34, 2-year postoperative 16.6 ± 13.1° vs. 16.9 ± 12.4°, p = 0.92). The 2-year postoperative coronal balance was also not different between the US and JP (9.9 ± 7.7 mm vs. 11.3 ± 8.7 mm, p = 0.33). Similarly, the lumbar curve was not different between the US and JP (baseline 52.5 ± 14.5° vs. 49.4 ± 14.4°, p = 0.69, 2-year postoperative 19.0 ± 13.8° vs. 20.0 ± 9.9°, p = 0.76). The sagittal alignment was well maintained in both groups (C7SVA; −6.6 ± 41.3 vs. −13.7 ± 30.6 mm, PI−LL; −6.9 ± 10.9° vs. 5.4 ± 13.1°, and PT; 10.4 ± 8.8° vs. 16.1 ± 6.7°) at 2-year follow-up (Supplemental Table 1).

3.2. Comparisons of clinical outcomes and complications between the US and Japan

Baseline SRS-22r pain domain and total score were inferior in the US compared with those in JP, while self-image domain was inferior in JP (pain; 3.1 ± 0.9 vs. 3.6 ± 0.8, p < 0.01, self-image; 2.6 ± 0.7 vs. 2.9 ± 0.7, p = 0.04, total; 3.3 ± 0.6 vs. 3.5 ± 0.5, p = 0.03, Table 2). The US group had a significantly greater improvement in the pain domain (2-year follow-up versus baseline) compared with the JP group; otherwise, similar improvements were achieved in both groups (delta pain domain; 0.8 ± 0.9 vs. 0.5 ± 1.0, p = 0.05, Table 2). Assessment of surgical parameters showed that US patients had significantly longer surgical time and greater EBL/BSA.

Between the patient cohorts, a similar number of patients experienced major complications (US vs. JP: 30% [n = 16] vs. 22% [n = 12], p = 0.38, Table 1). The most common type was implant-related in both groups (8% [n = 5] in the US and 10% [n = 6] in JP, p = 0.75). Among the patients with complications, a higher number of patients required unplanned surgery within 2 years after index surgery in the US group though not significant (US vs. JP: 15% [n = 8] vs. 4% [n = 3], p = 11, Table 1). This difference primarily resulted from the greater number of irrigation and debridement surgeries required in the US group (US vs. JP; 5% [n = 3] vs. 0% [n = 0]).

3.3. Correlation between the 2-year postoperative SRS-22r satisfaction and demographic and baseline radiographic variables

Correlation coefficient analyses between the postoperative SRS-22r satisfaction domain and the baseline variables revealed that none of the baseline and postoperative demographic and radiographic variables were correlated with postoperative SRS-22r satisfaction in either group (Table 3).

3.4. Correlation between the 2-year postoperative SRS-22r satisfaction and other SRS-22r domains

The baseline SRS22r function and mental health domains were both correlated with the postoperative SRS22r satisfaction domain in the US group whereas, none of the baseline SRS-22r domains were correlated with the postoperative SRS-22r satisfaction domain in the JP group (Table 3). The correlation coefficient analyses showed that all postoperative SRS-22r domains were moderately correlated with the satisfaction domain in the US group. Nevertheless, moderate correlation was seen only between pain domain and satisfaction domain and only a weak correlation was seen between postoperative SRS-22r satisfaction, self-image and function domain and mental health domain in the JP group (Table 3).

Table 3
Pearson correlation coefficients between 2-year postoperative satisfaction and variables in the US and JP.

Correlation coefficient (*r*)	Baseline		2-year	
	US	JP	US	JP
Age	n.s.	n.s.		
BMI	n.s.	n.s.		
Coronal alignment				
Cobb angle (Thoracic)	n.s.	n.s.	n.s.	n.s.
Cobb angle (Lumbar)	n.s.	n.s.	n.s.	n.s.
C7CSVL (*mm*)	n.s.	n.s.	n.s.	n.s.
Sagittal alignment				
Thoracic kyphosis	n.s.	n.s.	n.s.	n.s.
PT	n.s.	n.s.	n.s.	n.s.
PI-LL	n.s.	n.s.	n.s.	n.s.
C7SVA	n.s.	n.s.	n.s.	n.s.
HRQOL				
SRS-22 Function	0.34*	n.s.	0.61**	0.29**
SRS-22 Pain	n.s.	n.s.	0.72**	0.54**
SRS-22 Self-image	n.s.	n.s.	0.72**	0.37**
SRS-22 Mental health	0.53*	n.s.	0.64**	0.55**

* indicates *p* value < 0.05. ** indicates *p* value < 0.01.

Table 2
Comparisons of baseline and 2-year postoperative measures of HRQOL between the US and JP groups.

SRS-22	Baseline			2-year follow-up			Delta value		
	US	JP	*P* value	US	JP	*P* value	US	JP	*P* value
Function	3.7 ± 0.9	4.0 ± 0.7	0.07	4.2 ± 0.9	4.3 ± 0.6	0.60	0.4 ± 0.7	0.2 ± 1.0	0.19
Pain	3.1 ± 0.9	3.6 ± 0.8	<0.01*	3.8 ± 0.9	4.1 ± 0.8	0.13	0.8 ± 0.9	0.5 ± 1.0	0.05*
Self-image	2.9 ± 0.7	2.6 ± 0.7	0.04*	4.1 ± 0.8	4.0 ± 0.6	0.39	1.2 ± 0.8	1.3 ± 1.0	0.77
Mental health	3.5 ± 0.9	3.5 ± 0.9	0.92	4.0 ± 0.9	4.0 ± 0.6	0.52	0.4 ± 0.6	0.4 ± 0.9	0.75
Satisfaction				4.3 ± 0.9	4.2 ± 0.7	0.61			
Total	3.3 ± 0.6	3.5 ± 0.5	0.03*	4.0 ± 0.8	4.1 ± 0.5	0.60	0.8 ± 0.5	0.7 ± 0.8	0.44

Means and standard deviations. * indicates statistically significant.

3.5. Correlation between the 2-year postoperative SRS-22r satisfaction and each of the questions of postoperative SRS22r questionnaire

Detailed correlation analyses between the 2-year postoperative SRS-22r satisfaction domain and each of the questions from the postoperative SRS-22r questionnaire revealed the answers to Question 1 (self-image), Question 2 (pain), Question 4 (pain), Question 13 (mental health), and Question 20 (mental health) correlated most with the satisfaction domain in the US group ($r = 0.86$ to 0.63), and the answers for these 5 questions were also ranked among the top 6 questions that correlated most with satisfaction domain in the JP group ($r = 0.70$ to 0.48, Table 4). Interestingly, the answer to Question 3 (mental health) was correlated moderately with the satisfaction domain only in the JP group ($r = 0.466$), while Question 3 was the only question which was not correlated with postoperative satisfaction among 20 questions in the US group (Supplemental Table 2). Additionally, the answer to Question 6 (self-image), Question 8 (pain), Question 10 (self-image), Question 14 (self-image), Question 16 (mental health), and Question 17 (pain) were correlated (range from 0.54 to 0.62) only in the US group (Supplemental Table 2).

4. Discussion

Previous literatures have described the influence of ethnicity on clinical outcomes in AIS [3–5]. Watanabe et al. described that Japanese AIS patients had less baseline pain and negative self-image compared with those of US AIS patients [3]. Morse et al. noted that US whites reported more pain than native Japanese, though the latter had lower self-image scores as was seen in the present study [4]. In the present study, the baseline SRS-22r pain domain was lower in the US AISA patients but the self-image domain was lower in JP among AISA patients whose age, gender, curve type, and postoperative spinal alignment were propensity-score matched. However, none of these differences remained postoperatively. These results clearly show that surgical treatment for AISA can be similarly effective for those who live in geographically different areas and whose genetic background, culture, and ethnicity may be very different. Previous literature has shown that surgery for AISA is similarly effective as those for AIS, despite slightly higher complication rates [1,2]. Goshi et al. described that surgery for AIS and AISA was similarly effective in clinical outcomes and radiographic outcomes [1]. Lonner et al. also reported that corrective spine surgery for AISA resulted in good clinical outcomes despite an increased number of vertebral levels fused, greater operative time, and higher complication rates compared to AIS [2].

There is much to be understood regarding patient expectations of care and outcomes in scoliosis surgery. Few studies have evaluated the factors affecting patient satisfaction after corrective spine surgery for AISA [8–15]. Hayashi et al. reviewed the correlation between the demographics, complications, HRQOLs, and radiographic parameters in ASD patients who live in Europe with the SRS-22r satisfaction domain at 2-year follow-up [16]. They found that the satisfaction domain was moderately correlated with the self-image ($r = 0.64$) and function ($r = 0.55$) domains. Since Hayashi et al. included a wide range of age groups, it cannot be directly compared with the present study. However, their results are similar to those of the US patients in the present study. Yagi et al. previously compared clinical outcomes and satisfaction after spinopelvic fusion in elderly ASD patients in propensity-score matched Japanese and US cohorts and concluded that surgical treatment for ASD was similarly effective in patients in the US and in Japan, although the satisfaction scores were lower in Japan, possibly due to differing cultural expectations [6]. In contrast, in the present study, the clinical outcomes and the satisfaction after corrective spine surgery for AISA were similar between the US and Japan in the propensity-score matched patient cohort. This difference with the previous study may come from the patient age distribution and the lack of inclusion of the sacropelvic in the current study. In the present propensity-score matched study we compared surgical outcomes in young AISA patients (mean age: 29 years-old) who had a thoracic or thoracolumbar fusion between the US and Japan, while Yagi et al. previously compared elderly ASD patients (mean age: 66 years-old) who had a spinopelvic fusion in a propensity-score matched study. Compared to spinopelvic fusions in elderly ASD patients, thoracic or isolated lumbar fusions in young AISA patients may have less impact on lifestyle after surgery because of less limitation of trunk range of motion. In the previous study, Yagi et al. postulated that spinopelvic fusion may impact the Eastern lifestyle in Asian ASD patients and resulted in the observed inferior satisfaction in JP patients compared with US patients [6]. The present study supports this speculation, as the satisfaction of patients with thoracic or isolated lumbar fusion did not differ in AISA patients between the US and Japan. Therefore, we suggest that corrective spine surgery for ASD may be similarly effective unless the procedure limits an individual's unique lifestyle that the patient expects to resume.

In the present study, patient satisfaction was similar between the AISA patients in the US and Japan including the top 5 of 6 most correlated questions from the SRS-22r questionnaire (Question 1 [pain domain: Which one of the following best describes the amount of pain you have experienced during the past 6 months?], 2 [pain domain: Which one of the following best describes the amount of pain you have experienced over the last month?], 4 [self-image domain: If you had to spend the rest of your life with your back shape as it is right now, how would you feel about it?], 13 [mental health domain: Have you felt calm and peaceful during the

Table 4
Pearson correlation coefficients between the SRS-22 2-year postoperative satisfaction domain score and variables in the US and JP.

US			JP		
SRS-22	*r*	Category	SRS-22	*r*	Category
Q4	0.86**	A	**Q1**	0.70**	P
Q2	0.74**	P	**Q2**	0.55**	P
Q1	0.70**	P	**Q4**	0.51**	A
Q13	0.64**	M	**Q11**	0.48**	P
Q20	0.63**	M	**Q13**	0.48**	M
Q16	0.62**	A	**Q20**	0.46**	M
Q10	0.61**	M	**Q3**	0.46**	M
Q17	0.56**	P	**Q18**	0.41*	F
Q6	0.54**	A	**Q7**	0.39*	M
Q8	0.54**	P	**Q19**	0.38*	A

P: pain, M: meatal health, A: Self-image, F: function, * Indicates p value < 0.05. ** indicates p value < 0.01.

past 6 months?], and 20 [mental health domain: Have you been a happy person during the past 6 months?]). Additionally, the postoperative pain and mental health domain scores were moderately correlated with satisfaction domain score range from r = 0.54 to 0.72 in both groups.

These results are consistent with previous reports. Hayashi et al. described that bodily pain was moderately correlated with postoperative satisfaction in ASD patients [16]. Chan et al. performed a survey on their fears and concerns about surgery for AIS and their family members and described that pain was the greatest concern for both patients and parents but was rarely listed as a concern by surgeons [11]. These results clearly indicated that improvement of perioperative and postoperative pain intensity and dedication to the postoperative comfort may further improve patient satisfaction in both countries.

However, interesting differences were found for factors affecting patient satisfaction between the US and Japan. Three of the 5 questions (Question 6, 10, 14) in the self-image domain were not correlated with the satisfaction domain in Japanese AISA, whereas all of them were moderately correlated with the satisfaction domain in the US cohort (r = 0.51 to 0.64). Theologis et al. described that ethnicity influenced the self-image concerns in 1977 AIS patients differently among Caucasian, Hispanic, and Asian patients, and concluded that Asians were least likely to be concerned about self-image [12]. In contrast, question 3 (During the past 6 months have you been a very nervous person?) was 7th most correlated question with the postoperative satisfaction domain in JP group, while question 3 was the only question which was not correlated with the satisfaction domain in the US among 20 questions in the SRS-22r questionnaire. Question 3 evaluates the patient's anxiety about treatment. Several studies found that Japanese are more anxious than people in the US [17,18]. Krieg et al. performed latent mean comparisons based on the scalar invariant measures between European Americans and Asian Americans and revealed higher social anxiety for Asian Americans than European Americans [17]. Similarly, Lynn et al. described that Japanese students were much more anxious than those in the US [18]. Several studies reported that this difference may come from both cultural difference and different genetic backgrounds between Americans and Japanese. Moriyasu et al. compared the behavior of Japanese Americans and Japanese residents who live in the US and concluded that Japanese Americans and Japanese residents have differences in the expression of anxiety due to the cultural differences [19].

Collectively, it appears that overall satisfaction for spinal surgery among AISA patients in different countries was not significantly different. However, factors affecting patient satisfaction after surgery in AISA differed between the JP and US cohorts and may be due to the genetic, cultural, and ethnic differences.

Some limitations must be acknowledged. There was a lack of questionnaire items representing the lifestyle of individuals in Asian countries. Therefore, we could not fully identify the reason for different correlation between the satisfaction of patient background and HRQOLs between the US and JP who underwent the surgery for AISA. Additionally, there is a lack of validation study for the SRS22 in other languages including Japanese. Although, several previous studies have described the validity of Japanese SRS22 for AIS patients and healthy volunteers, careful consideration is needed for accurate interpretation of the results. The linguistic validation process needs to obtain a translation of an original instrument in a target language that is both conceptually equivalent to the original and easily understood by the people to whom the translated questionnaire is administered. Therefore, further large sample validation study include test, re-test reliability. However, the SRS22 is the standard disease specific questionnaire for the evaluation of HRQOLs in scoliosis, therefore we strongly believe it to be beneficial to translate and adapt for other languages for the cross-cultural comparison of the HRQOL in patient with spinal deformity.

5. Conclusion

In this propensity-score matched study, we first described that corrective spine surgery for AISA was similarly effective for improvement of HRQOLs with similarly high satisfaction in the US and JP patients. Satisfaction for spinal surgery among patients in different countries may not be different unless the procedure limits an individual's unique lifestyle that the patient expects to resume. Patient counseling based on the cultural and ethnic differences may further improve patient satisfaction in scoliosis surgery.

Author contributions

Writing – original draft: MY and NH.
Writing – review and editing: SB, JS, FS, VL, MM, and KW.
Data curation – CA, CS, and MM.
KW was responsible for all work related to this submission as the corresponding author. Also, all authors approved the final version manuscript and agreed to be accountable for all aspects of the work.

Declaration of competing interest

The authors declare that they have no relevant conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jos.2021.08.014.

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