



# IS QUALITY OF LIFE WORSE IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS WHO UNDERGO LONGER FUSIONS? 2 YEARS OF FOLLOW-UP

A QUALIDADE DE VIDA É PIOR EM PACIENTES COM ESCOLIOSE IDIOPÁTICA DO ADOLESCENTE SUBMETIDOS A FUSÕES MAIS LONGAS? ACOMPANHAMENTO DE DOIS ANOS

¿ES PEOR LA CALIDAD DE VIDA DE PACIENTES CON ESCOLIOSIS IDIOPÁTICA DEL ADOLESCENTE SOMETIDOS A FUSIONES MÁS LARGAS? 2 AÑOS DE SEGUIMIENTO

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## ABSTRACT

**Objective:** To compare quality of life in patients with longer fusions with that of those who have short fusions 2 years of after surgery. **Methods:** This is a retrospective comparative cohort study (Level of Evidence III) involving patients with adolescent idiopathic scoliosis who underwent posterior spinal fusion with pedicle screws with a 2-year follow-up. The primary outcome was quality of life assessed using the SRS-30 questionnaire. Participants were divided according to Lenke and stratified into those with major (Lenke 3 and Lenke 6) and minor (Lenke 1 and Lenke 5) fusions. **Results:** Forty-one patients, 34 of whom were women, were evaluated: Lenke 1 (17 patients), Lenke 3 (15 patients), Lenke 5 (3 patients), and Lenke 6 (6 patients). The mean age was 13.8 years, the mean preoperative and postoperative Cobb angles were 56.48 degrees and 10.49 degrees, respectively, and the mean surgical Cobb reduction was 45.54 degrees. All patients in the sample showed an overall improvement in quality of life after surgery ( $p < 0.0001$ ). There was no difference between groups A (long fusions) and B (short fusions) in relation to the domains in general ( $p > 0.05$ ). Although pain was improved in the overall sample, this was not the case for the group with structured double curves and longer fusions ( $p = 0.03$ ). **Conclusion:** There was no difference in quality of life between patients with long and short fusions with a 2-year follow-up. **Level of Evidence III; Retrospective cohort.**

**Keywords:** Quality of Life; Scoliosis; Arthrodesis; Spinal Fusion.

## RESUMO

**Objetivo:** Comparar a qualidade de vida de pacientes com fusões mais longas com a dos que têm fusões curtas após dois anos de cirurgia. **Métodos:** Estudo retrospectivo do tipo coorte (Nível de evidência III) que envolveu pacientes com escoliose idiopática do adolescente submetidos à fusão espinhal posterior com parafusos pediculares com acompanhamento de dois anos. O desfecho primário foi a qualidade de vida avaliada pelo questionário SRS-30. Os participantes foram divididos de acordo com Lenke e estratificados em fusões maiores (Lenke 3 e Lenke 6) e menores (Lenke 1 e Lenke 5). **Resultados:** Foram avaliados 41 pacientes: Lenke 1 (17 pacientes), Lenke 3 (15 pacientes), Lenke 5 (três pacientes) e Lenke 6 (seis pacientes), sendo 34 mulheres, com média de idade de 13,8 anos e médias dos ângulos de Cobb pré-operatório de 56,48 graus, pós-operatório de 10,49 graus e diminuição cirúrgica do Cobb de 45,54 graus. Todos os pacientes da amostra apresentaram melhora global da qualidade de vida depois da cirurgia ( $p < 0,0001$ ). Não houve diferença entre os grupos A (fusões longas) e B (fusões curtas) com relação aos domínios em geral ( $p > 0,05$ ). Apesar da melhora da dor na amostra geral, observou-se que isso ocorreu em detrimento do grupo com curvas duplas estruturadas e fusões mais longas ( $p = 0,03$ ). **Conclusões:** Não foi observada diferença na qualidade de vida entre pacientes com fusões longas e curtas em dois anos de acompanhamento. **Nível de Evidência III; Coorte retrospectiva.**

**Descritores:** Qualidade de Vida; Escoliose; Artrodese; Fusão Vertebral.

## RESUMEN

**Objetivo:** Comparar la calidad de vida en pacientes con fusiones más largas con las de aquellos con fusiones cortas después de 2 años de cirugía. **Métodos:** Estudio de cohorte retrospectivo (nivel de evidencia III) que incluye a pacientes con escoliosis idiopática del adolescente sometidos a fusión vertebral posterior con tornillos pediculares con un seguimiento de 2 años. El resultado primario fue la calidad de vida evaluada por el cuestionario SRS-30. Los participantes fueron divididos según Lenke y estratificados en fusiones mayores

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(Lenke 3 y Lenke 6) y menores (Lenke 1 y Lenke 5). Resultados: Se evaluaron 41 pacientes: Lenke 1 (17 pacientes), Lenke 3 (15 pacientes), Lenke 5 (3 pacientes) y Lenke 6 (6 pacientes), un total de 34 mujeres con edad media de 13,8 años y media de ángulos de Cobb preoperatorio de 56,48 grados, postoperatorio de 10,49 grados y disminución quirúrgica de Cobb de 45,54 grados. Todos los pacientes de la muestra presentaron una mejoría global de la calidad de vida tras la cirugía ( $p < 0,0001$ ). No hubo diferencias entre los grupos A (fusiones largas) y B (fusiones cortas) respecto a los dominios en general ( $p > 0,05$ ). A pesar de la mejora del dolor en la muestra general, se observó que ésta se produjo en detrimento del grupo con curvas dobles estructuradas y fusiones más largas ( $p = 0,03$ ). Conclusiones: No se observaron diferencias en la calidad de vida entre los pacientes con fusiones largas y cortas tras 2 años de seguimiento. **Nivel de Evidencia III; Cohorte retrospectiva.**

**Descriptor:** Calidad de Vida; Escoliosis; Artrodesis; Fusión Vertebral.

## INTRODUCTION

Adolescent idiopathic scoliosis is defined as a three-dimensional deformity in adolescents between 10 and 18 years of age with lateral curvature of the spine greater than  $10^\circ$  in the coronal plane. It is the most common form of scoliosis and occurs more often in girls.<sup>1,2</sup> Although the cause is still unknown, the diagnosis is often present in several members of the family, suggesting a strong genetic etiological factor.<sup>1</sup> These patients tend to experience psychosocial difficulties with their body image.<sup>1</sup>

Among the challenges in treating adolescent idiopathic scoliosis surgically are determining the correct fusion levels, achieving balance and alignment in the coronal and sagittal planes, and promoting the quality of life of the patient.<sup>1</sup> Longer fusions provide greater curve correction force but leave fewer levels free, which are consequently more overloaded. On the other hand, short fusions have less correction power, more free levels, and tend to have less vertebral overload, although due to the lower correction force there may be disequilibrium and imbalance.<sup>2-6</sup> The objective of this study was to compare the quality of life in adolescent idiopathic scoliosis patients submitted to long fusion with that of patients who underwent short fusion over a two-year period.

## METHODS

This was a retrospective cohort study with a convenience sample of 41 patients who underwent surgery to treat adolescent idiopathic scoliosis (AIS). The sample was comprised of patients diagnosed with AIS with an angle greater than  $45^\circ$  (measured using panoramic radiographs with inclinations) who underwent surgical treatment at the Hospital da Santa Casa de Misericórdia de Vitória during the period from 2015 to 2019. This sample was selected through searches of the data system of the Spine Study Group of the Santa Casa de Misericórdia de Vitória. Patients whose age was outside of the proposed 10- to 18-years-of-age range, patients with other types of scoliosis (neuromuscular, congenital, syndromic, early onset), patients who had undergone previous surgical spinal interventions, and patients with previous infections or neoplasms of the spine were excluded.

The categorical variables analyzed were obtained through analysis of the study patients' medical records and included sex, age at the time of surgery, current age, Cobb angle of the highest magnitude curve observed on the day of and following the surgery, Lenke classification at the time of the surgical indication, and postoperative complications. The patients were stratified into groups according to the respective categories for each variable. All surgical procedures were performed by three experienced spine surgeons.

The instrument applied to measure quality of life was the SRS-30 questionnaire, which was created by the Scoliosis Research Society (SRS) and validated for the Portuguese language, which makes it possible to evaluate the quality of life of patients with AIS undergoing surgical treatment. The questionnaire has 30 questions covering 5 domains: Function/Activity (preoperative questions 5, 9, 12, 15, and 18; postoperative questions 25 and 26), Pain (preoperative questions 1, 2, 8, 11, and 17; postoperative question 27), Self-image (preoperative question 4, 6, 10, 14, 19, and 23; postoperative questions 28, 29, and 30), Mental Health (preoperative questions 3, 7, 13, 16, and 20); and Satisfaction with Management (preoperative

questions 21 and 22; postoperative question 24). Each item is scored on a scale from 1 (worst) to 5 (best). The total score for each domain varies from 5 to 45, except for the satisfaction with management domain score, which ranges from 3 to 15. The sum of the first 4 domains yields a maximum possible subtotal of 135 points, which when added to the satisfaction domain score gives a maximum possible overall total of 150 points. The results are expressed as the mean (total score for the domain divided by the number of items answered) for each domain and the total score is the sum of these mean domain values.

It is known that the SRS-22r is the most suitable questionnaire for conducting research, as recommended by the Scoliosis Research Society, but it has not yet been validated for the Portuguese language. Therefore, we opted for the SRS-30. During the collection of preoperative and postoperative data, only questions 1 to 23 were answered, excluding questions 24 to 30, directed towards the postoperative period, in order to obtain equal measurements for the preoperative and postoperative comparisons, thus presenting a homogeneous sample.

The patients were divided into groups A and B according to the Lenke classification. Group A included patients classified as Lenke 3 and 6, those submitted to long fusions. Group B included patients classified as Lenke 1 and 5, those submitted to short fusions.

This study was approved by the Institutional Review Board of the institution where the work was conducted (CAAE: 55656521.1.0000.5065) and the data were collected after the study participants had assigned the Informed Consent Form.

## RESULTS

Forty-one patients, 34 (82.9%) of whom were female and 7 (17.1%) of whom were male, were evaluated. The mean age on the date of surgery was 13.8 years of age (ranging from 10 to 18 years), with mean female and male ages of 13.3 and 16.1 years, respectively.

The sample was also stratified according to Lenke classifications 1, 3, 5, and 6, with 17 (41.5%), 15 (36.6%), 3 (7.3%), and 6 (14.6%) patients, respectively, and also grouped by Lenke 1 and 5 (Group B – surgeries with fewer instrumented levels, greater mobility) and Lenke 3 and 6 (Group A – surgeries with more instrumented levels, less mobility), with 20 (48.8%) and 21 (51.2%) patients, respectively. All frequencies and proportions for the factors described above can be seen in Table 1.

The mean overall quality of life score of patients is separated by domain in accordance with the answers to the SRS-30 questionnaire administered in the preoperative (Table 2) and postoperative (Table 3) periods. In Tables 2, 3, and 4 the differences in the overall sample are shown for all domains following surgery, except for mental health ( $p = 0.9642$ ).

Improvement in quality of life in the postoperative period was evaluated using the Wilcoxon test, which conducts the analysis by pairing data from different periods (pairing of the mean pre- and postoperative responses for the same patient). A significance level of 5% was used for all tests. It is worth mentioning that the above-mentioned test does not quantify the improvement in the patient's quality of life, but only determines whether there was improvement for that question.

From the overall perspective (Figure 1), the upward trend of the

**Table 1.** Sample characterization: frequencies and proportions in each category.

Variable	Category	N	%
Sex	Female	34	82.9%
	Male	7	17.1%
Age	12	14	34.1%
	13 to 14	12	29.3%
	15 to 17	15	36.6%
Mobility	Greater (Lenke 1 and 5)	20	48.8%
	Lesser (Lenke 3 and 6)	21	51.2%
Lenke	1	17	41.5 %
	3	15	36.6 %
	5	3	7.3 %
	6	6	14.6 %

**Table 2.** Mean overall patient quality of life score separated by domain according to the preoperative answers to the SRS-30 questionnaire.

Domain	Minimum	Median	Maximum	Mean	SD
Overall	1.20	2.77	4.33	2.80	0.73
Function/Activity	-0.20	0.20	0.20	0.13	0.11
Pain	-0.60	0.20	1.20	0.26	0.41
Self-image	0.17	0.83	1.67	0.89	0.37
Mental Health	-0.80	0.00	0.60	-0.08	0.32
Satisfaction with Management	1.00	1.50	2.50	1.61	0.49

**Table 3.** Mean overall patient quality of life score separated by domain according to the postoperative answers to the SRS-30 questionnaire.

Domain	Minimum	Median	Maximum	Mean	SD
Overall	18.17	19.67	20.87	19.66	0.61
Function/Activity	4.40	4.40	4.60	4.45	0.09
Pain	3.80	4.60	5.00	4.60	0.32
Self-image	2.17	2.83	3.33	2.76	0.31
Mental Health	4.40	4.80	5.00	4.81	0.21
Satisfaction with Management	2.50	3.00	3.50	3.04	0.36

**Table 4.** Descriptive measurements of improved quality of life (postoperative minus preoperative score) for all patients and Wilcoxon test results.

Domain	Minimum	Median	Maximum	Mean	SD	Wilcoxon (P-Value)
Overall	1.20	2.77	4.33	2.80	0.73	< 0.0001
Function/Activity	-0.20	0.20	0.20	0.13	0.11	< 0.0001
Pain	-0.60	0.20	1.20	0.26	0.41	0.0003
Self-image	0.17	0.83	1.67	0.89	0.37	< 0.0001
Mental Health	-0.80	0.00	0.60	-0.08	0.32	0.9642
Satisfaction with Management	1.00	1.50	2.50	1.61	0.49	< 0.0001

lines illustrates the quality-of-life improvement, with patients presenting a mean postoperative score greater than the preoperative score. For this analysis, a p-value < 0.001 was obtained. (Table 4)

In our analysis of the function/activity parameter, we observed a marginal improvement (postoperative score only 0.2 points above that observed in the preoperative period in cases where there was an improvement). Even though the numeric difference was small, the results of this domain were statistically significant (p-value < 0.0001) due to the limitations of the Wilcoxon test already mentioned.

Unlike the previous domain, the patients' responses presented different levels of improvement in the pain domain, with the same median value but greater mean and maximum values. (Table 4) The Wilcoxon test confirmed the interpretation of the statistical analysis that indicated improved patient quality of life in the pain domain (p-value = 0.0003).

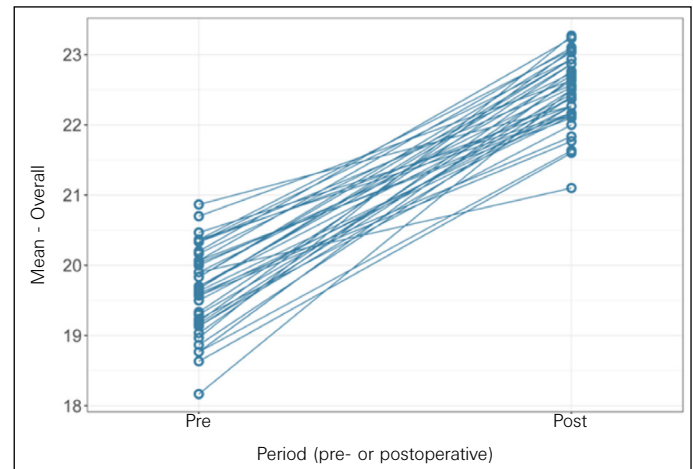
In the analysis of self-image and satisfaction with management, we observed characteristics like those of the pain domain, as they both present different variations in the mean quality of life scores with all patients showing improvement (p-value = 0.0001).

Finally, the means for the mental health domain did not indicate an improved quality of life, but rather they remained constant or worsened (median equal to zero and mean less than zero according to the measurements shown in Table 4 and the predominance of horizontal or descending lines in Figure 2). The Wilcoxon test indicated that there was no improvement in quality of life in this domain (p-value = 0.9642), in line with what was observed in the descriptive analysis.

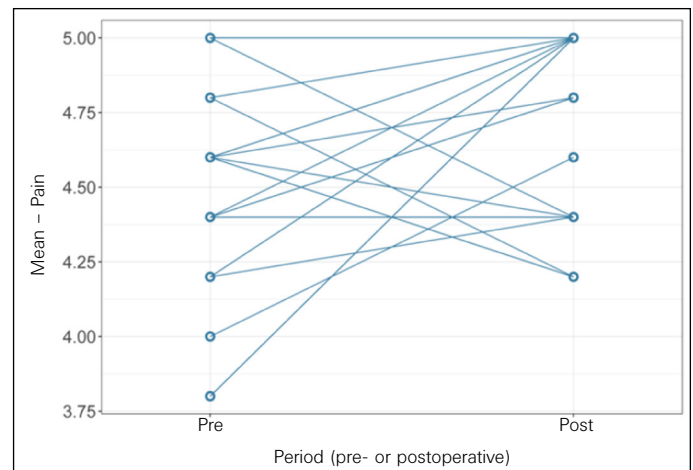
The Kruskal-Wallis test was used to assess the postoperative improvement in the patients' quality of life correlated with their Lenke classification. A significance level of 5% was used for all tests (results in Table 5).

Overall, all patients of all Lenke types indicated an improved quality of life following surgery. (Figure 3) The Kruskal-Wallis test showed that the quality-of-life improvement observed was not dependent on the Lenke classification of the patient (p-value = 0.6127).

All the domains were evaluated separately and compared to the patient Lenke type. In the function/activity domain, we observed little variation in improvement in patient quality of life among Lenke types (p-value = 0.9994). In the pain, self-image, and satisfaction with management domains, we noted that improvement in quality of life was similar for all Lenke types (p-values of 0.11471, 0.4986, and 0.6457, respectively). As observed in the overall analysis, there was no improvement in the mental health domain (p-value = 0.6468).



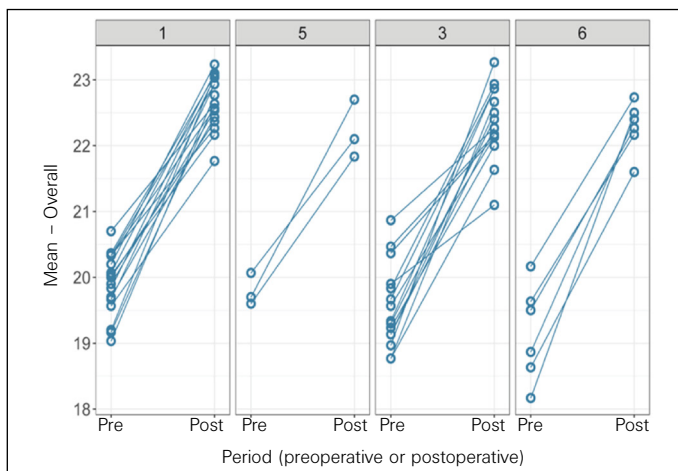
**Figure 1.** Comparison of pre- and postoperative quality of life by the respective mean scores.



**Figure 2.** Comparison of mean scores in the Mental Health domain.

**Table 5.** Descriptive measurements for the improvement of quality of life (postoperative minus preoperative) by Lenke classification and Kruskal-Wallis test results.

Domain	Lenke	Minimum	Median	Maximum	Mean	SD	Kruskal-Wallis (P-Value)
Overall	1	1.93	2.70	3.87	2.77	0.60	0.6127
	5	2.03	2.23	3.00	2.42	0.51	
	3	1.20	3.10	4.30	2.79	0.91	
	6	2.53	2.87	4.33	3.12	0.70	
Function / Activity	1	-0.20	0.20	0.20	0.13	0.12	0.9994
	5	0.00	0.20	0.20	0.13	0.12	
	3	0.00	0.20	0.20	0.13	0.10	
	6	0.00	0.20	0.20	0.13	0.10	
Pain	1	-0.60	0.20	1.20	0.16	0.46	0.1471
	5	0.00	0.00	0.20	0.07	0.12	
	3	-0.60	0.40	1.20	0.33	0.40	
	6	0.20	0.40	0.80	0.43	0.23	
Self-image	1	0.33	0.83	1.67	1.01	0.38	0.4986
	5	0.33	0.83	1.00	0.72	0.35	
	3	0.17	0.67	1.33	0.80	0.36	
	6	0.33	0.83	1.17	0.83	0.32	
Mental Health	1	-0.80	0.00	0.60	-0.04	0.36	0.6468
	5	-0.20	0.00	0.20	0.00	0.20	
	3	-0.80	-0.20	0.20	-0.17	0.29	
	6	-0.60	0.00	0.40	-0.03	0.32	
Satisfaction with Management	1	1.00	1.50	2.00	1.50	0.43	0.6457
	5	1.00	1.50	2.00	1.50	0.50	
	3	1.00	1.50	2.50	1.70	0.56	
	6	1.00	1.75	2.50	1.75	0.52	



**Figure 3.** Comparison of the overall mean pre- and postoperative quality of life scores for patients stratified by Lenke type

While the analysis without the Lenke stratification (Table 4) indicated improvement in overall patient quality of life, as well as by domain (except mental health), the analysis stratified by Lenke did not reveal that this improvement (or worsening as in the case of mental health) differed by Lenke. (Table 4)

The overall patient quality of life was compared after separating the patients into two groups: patients with greater curve mobility (Lenke 1 and 5) and patients with lesser curve mobility (Lenke 3 and 6). The Wilcoxon-Mann-Whitney (W-MW) test with a significance level of 5% was used for this comparison. (results in Table 6)

In general, there were no significant differences in the improvement of quality of life between the greater and lesser mobility groups (p-value = 0.3617), nor did we observe any influence from the curvature on the improvement of the overall quality of life of the sample.

In the function/activity domain, there was little difference in the improvement of the quality of life between the greater and lesser mobility groups (p-value = 1.000).

For the self-image and satisfaction with management domains, the improvement in the quality of life was similar in the two mobility groups based on the median and mean metrics observed, which were confirmed by the tests (p-values = 0.2543 and 0.2098, respectively).

The non-improvement of quality of life in the mental health domain indicated in the previous scenarios persisted in the two mobility groups (p-value = 0.3766).

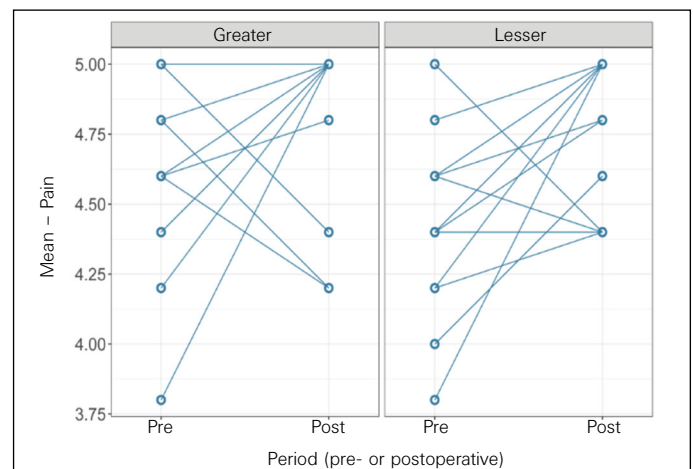
As can be seen in Figure 4, improvement in the quality of life in the pain domain was more intense in the lesser mobility group (Lenke 3 and 6) than in the greater mobility group (Lenke 1 and 5). The Wilcoxon-Mann-Whitney test confirmed this difference (p-value = 0.0359), that is, while patients had an overall improvement in the quality of life, this improvement occurred differently in the two mobility groups, being greater in the Lenke 3 and 6 patients.

Finally, we also noted that, in the study sample, the Cobb delta (preoperative Cobb – postoperative Cobb) was greater in the lesser mobility group (Lenke 3 and 6), that is, the group with lesser mobility had a greater reduction in the Cobb value than the group with greater mobility. Table 7 shows this difference, with the lesser mobility group having lower median and mean values, and Figure 5 shows the greater reductions in the lesser mobility group occurred (in part) because the patients in this group had greater preoperative Cobb angle values.

Despite the differences pointed out in the descriptive analysis, the statistical test used for the analysis (W-MW) did not identify any

**Table 6.** Descriptive quality of life improvement measurements (postoperative minus preoperative) by mobility group and Wilcoxon-Mann-Whitney (M-MW) test results.

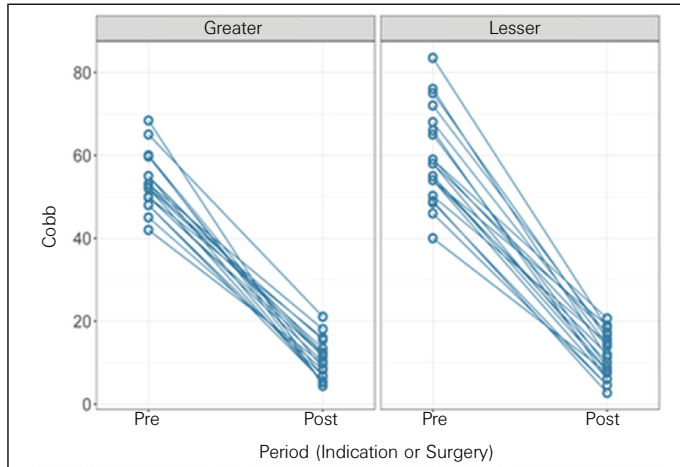
Domain	Lenke	Minimum	Median	Maximum	Mean	SD	Exact W-MW (P-Value)
Overall	1 and 5	1.93	2.67	3.87	2.72	0.59	0.3617
	3 and 6	1.20	2.97	4.33	2.89	0.85	
Function/ Activity	1 and 5	-0.20	0.20	0.20	0.13	0.12	1
	3 and 6	0.00	0.20	0.20	0.13	0.10	
Pain	1 and 5	-0.60	0.10	1.20	0.15	0.43	0.0359
	3 and 6	-0.60	0.40	1.20	0.36	0.36	
Self-image	1 and 5	0.33	0.83	1.67	0.97	0.38	0.2543
	3 and 6	0.17	0.83	1.33	0.81	0.34	
Mental Health	1 and 5	-0.80	0.00	0.60	-0.03	0.34	0.3766
	3 and 6	-0.80	0.00	0.40	-0.13	0.30	
Satisfaction with Management	1 and 5	1.00	1.50	2.00	1.50	0.43	0.2098
	3 and 6	1.00	1.50	2.50	1.71	0.54	



**Figure 4.** Comparison of pre- and postoperative quality of life in the pain domain by mean score with the patients grouped by Lenke classification.

**Table 7.** Descriptive Cobb delta (postoperative minus preoperative) measurements for the mobility groups.

Factor	Lenke	Minimum	Median	Maximum	Mean	SD	Exact W-MW (P-Value)
Cobb (Post – Pre)	1 and 5	-64.00	-41.80	-32.20	-43.27	7.98	0.0839
	3 and 6	-65.10	-46.30	-32.40	-47.81	9.57	

**Figure 5.** Comparison of pre- and postoperative Cobb angles for the greater and lesser mobility groups.

statistical significance ( $p$ -value = 0.0839). Therefore, the distributions of the Cobb delta in the two mobility groups are not different.

No postoperative complications (infection, non-fusion, implant breakage, spinal cord injury, nerve root injury, dural injury, neurological deficit, or death) were observed in the study sample.

## DISCUSSION

The results of this study indicate that, in terms of the domains in general ( $p > 0.05$ ), there were no significant differences in

improvement of the quality of life between the Lenke 3 and 6 group and the Lenke 1 and 5 group, with the exception of the pain domain, where the Lenke 3 and 6 group had better performance.

Studies have reported overall improvement in mean pain domain scores during the first two years following surgery, as measured by the SRS-30 quality of life questionnaire.<sup>7,8</sup>

Bastrom et al. conducted the first study associating an increase in pain in relation to the magnitude of the curve (even after fusion) and reported an increased prevalence of pain during 10 years of follow-up in patients with a residual curve greater than 26 degrees in the coronal plane. Bastrom et al. could not confirm the reasons behind their findings.<sup>9,10</sup>

Up until the time of the literature review for this study, we found no studies correlating a decrease in the arc of motion and an increase in the number of fused levels with quality of life.

Despite the small sample (41 patients), a difference between the groups in the pain domain can be observed as compared to the other SRS-30 domains. A study with serial assessments (not only at two moments, as is the case in the article in question) and over a longer period, such as 5, 10, or 15 years, could enable better analysis and quantify the progression of improvement in the quality of life of the sample patients. Another important point to be explored in further studies is that the Sars-Cov-2 pandemic was in effect during the study and the end of the two-year follow-up for cases operated in 2018 and 2019 occurred in the 2020 and 2021 timeframe, during the pandemic. We believe that this could have been a bias.

Among the positive aspects of the study, the fact that homogeneity was observed in Groups A and B in relation to age, sex, pre- and postoperative Cobb angles, and complications stands out.

## CONCLUSION

There was no difference in the quality of life between patients who underwent long fusions compared to patients who underwent short fusions in 2 years of follow-up.

All authors declare no potential conflict of interest related to this article.

**CONTRIBUTIONS OF THE AUTHORS:** Each author made significant individual contributions to this manuscript. JZQ, ACF, IBZ: study concept and design; ACF: data acquisition and CEP approval; JZQ, ACF, and IBZ: data analysis and interpretation; JZQ and ACF: article development; IBZ: critical review of the article; CJJ and IBZ: review of the final version for submission; IMC, JLB, IBZ, and CJJ: execution of the surgeries.

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