MAEDICA – a Journal of Clinical Medicine
2025; 20(4): 771-778
https://doi.org/10.26574/maedica.2025.20.4.771

MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPER

Long-term Life-Quality Outcomes after Corrective Adolescent Idiopathic Scoliosis Surgery: 10-Year Postoperative Assessment Comparing Lenke Classification and Fused Levels

K. ZYGOGIANNIS[a, b], S. KOMAITIS[b], P. C. CHRISTAKAKIS[a], P. GERASIMIDIS[a], A. KAROUNIAS[a], A. KALAMPOKIS[a], S. MOSCHOS[a], I. CHATZIKOMNINOS[a]

[a]Scoliosis and Spine Department, KAT General Hospital, Athens, Greece, Nikis 2, Kifisia 14561

[b]The Centre for Spinal Studies and Surgery, Queen's Medical Centre, Nottingham University Hospital, UK

ABSTRACT

Background: *Adolescent idiopathic scoliosis (AIS) is a complex spinal deformity often requiring surgical correction in progressive cases. While posterior spinal fusion (PSF) is the standard treatment, long-term outcomes beyond 10 years and the impact of Lenke classification and fusion length on patients' quality of life remain underexplored. This study aims to evaluate the 10-year postoperative outcomes of AIS patients treated with PSF, comparing results across different Lenke curve types and fusion lengths.*

Methods: *This retrospective study with a minimum follow-up of 10 years analyzed a cohort of 98 AIS patients who underwent PSF. Those with neuromuscular, congenital, or syndromic scoliosis were excluded. Outcomes included radiographic parameters and patient-reported metrics: SRS-22, SF-36 and Oswestry disability index (ODI). Subgroup analyses were performed based on Lenke classification and number of vertebrae fused.*

Results: *Patients showed excellent long-term outcomes, with a mean SRS-22 total score of 4.5, SF-36 physical and mental scores above population norms and a mean ODI of 5.6%, indicating minimal disability. Lenke 1 patients (single thoracic curves) had superior outcomes in pain, satisfaction and total SRS-22 scores compared to those with more complex curves. Shorter fusions (≤nine levels) were associated with better function, self-image and lower disability, without compromising satisfaction or pain relief.*

Conclusion: *Posterior spinal fusion in AIS yields durable improvements in function, pain and quality of life after 10 years. Shorter fusion constructs and simpler curve patterns are linked to slightly better outcomes,*

Address for correspondence:
Zygogiannis Konstantinos
Email: zygogianniskonstantinos@gmail.com

Article received on the 25th of October 2025 and accepted for publication on the 9th of December 2025

supporting selective fusion strategies when appropriate. These findings underscore the value of individualized surgical planning based on curve characteristics and motion preservation, while integrating modern technologies and AI models to further improve inter-reliability, decision making and patients' quality of life.

Keywords: scoliosis, long-term outcomes, surgical outcomes, quality of life, Lenke classification and fused levels.

INTRODUCTION

Adolescent idiopathic scoliosis (AIS) is a three-dimensional spinal deformity characterized by lateral curvature and vertebral rotation occurring in otherwise healthy adolescents, typically between 10 and 18 years of age (1). It affects approximately 2–4% of the adolescent population, with a higher prevalence in females, especially for curves that progress and require intervention (2). The natural history of untreated AIS varies – while mild curves often remain stable, moderate to severe deformities can progress during growth and may result in pain, cosmetic deformity and compromised pulmonary function. Surgical correction is indicated primarily for patients with progressive curves exceeding 45–50 degrees or for those with significant deformity and imbalance, where conservative treatments such as bracing are ineffective. Posterior spinal fusion (PSF) with segmental instrumentation has become the gold standard surgical treatment, aiming to halt curve progression, restore spinal balance and improve patients' health-related quality of life (3). Determining optimal fusion levels is critical to maximize deformity correction while preserving as much spinal mobility as possible, particularly in the lumbar spine where motion preservation is essential for long-term function (1, 4).

Long-term follow-up after AIS surgery is essential to evaluate the durability of correction, the development of potential complications such as adjacent segment degeneration, implant-related issues and overall functional outcomes (5). Despite advances in surgical techniques and instrumentation, there remains a relative paucity of studies reporting outcomes beyond 10 years postoperatively, which are necessary to understand the full impact of surgery across a patient's lifespan. The Lenke classification system, widely adopted in clinical practice, assists surgeons in curve assessment and guides fusion strategy by categorizing scoliosis based on curve type, lumbar modifier and sagittal thoracic profile (6). The system helps to tailor fusion length according to curve complexity, aiming to balance sufficient deformity correction and motion preservation. However, there is ongoing debate about the extent of fusion necessary for different curve types, particularly for double or triple curve patterns where longer fusions may affect quality of life (3, 7).

The current literature shows variability in surgical planning and outcomes based on Lenke classification and fusion length, with some studies highlighting inconsistencies in practice and a need for more robust long-term data (7, 8). Moreover, few studies have evaluated large cohorts with long-term follow-up exceeding 10 years to establish the relationship between initial curve characteristics, surgical strategy and sustained clinical outcomes. Therefore, this study aims to retrospectively analyze a cohort of AIS patients treated with PSF, focusing on the impact of curve patterns classified by Lenke, fusion lengths and long-term surgical outcomes with a minimum follow-up of 10 years. We hypothesize that shorter fusion lengths, when appropriately selected based on Lenke classification and curve flexibility, will be associated with favorable long-term radiographic and clinical outcomes, including preserved spinal balance and quality of life. ❑

MATERIALS AND METHODS

This retrospective study evaluated a cohort of 98 consecutive patients who underwent PSF for AIS in a single tertiary referral center. The inclusion criteria consisted of a diagnosis of AIS, an

age between 10 and 18 years at the time of surgery and a minimum postoperative follow-up duration of 10 years. Additionally, all patients underwent posterior spinal instrumentation and fusion using pedicle screw constructs. A consent form was signed by all patients and ethical approval was obtained by KAT General Hospital (358/30-5-2025). The exclusion criteria included all patients with neuromuscular, congenital, or syndromic scoliosis, patients who underwent combined anterior–posterior or isolated anterior scoliosis correction, those with a history of previous infection and patients who underwent removal of instrumentation. Institutional review board approval was obtained prior to data collection and analysis. Demographic and surgical data were collected from medical records and operative reports, while the functional outcomes were collected by re-examination or by phone call. Radiographic parameters were obtained from preoperative and long-term follow-up imaging. Curve classification was performed using the Lenke system based on standard preoperative standing anteroposterior, bending and lateral radiographs. Fusion length was determined based on curve flexibility, structural characteristics and the need to achieve stable balanced correction. Postoperative follow-up was conducted at regular intervals and included clinical evaluations and standardized radiographic assessments. All statistical analyses were performed with the statistical software SPSS, version 17.00 (SPSS Inc.). All data were entered into a secure database and further analyzed using descriptive and comparative statistics where appropriate. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables were summarized as frequencies and percentages. Further subgroup analyses were performed to examine outcomes by Lenke curve type and fusion length. Because the primary objective of this study was to evaluate the effect of surgical treatment, a priori power analysis based on a paired t-test was conducted to ensure that the recruited sample size provided at least 80% statistical power to detect clinically meaningful differences. A p-value of <0.05 was considered to indicate statistical significance. ❑

RESULTS

Demographics and baseline characteristics (10-year follow-up)

The cohort consisted of 98 adolescents who underwent PSF for AIS, with a mean age at surgery of 14.8 years. Consistent with the epidemiology of AIS, the majority of subjects (83.7%) were females. The average preoperative major curve magnitude was 54.2°, indicating that most patients presented with moderate to severe deformities requiring surgical correction. The most common curve pattern, as classified by the Lenke system, was Type 1 (thoracic curves), which accounted for 56.1% of cases, followed by less frequent double and triple curve types (Types 2–6). The average number of fused vertebrae was 10.2, reflecting the surgical need to address both structural curves and adjacent segments to ensure long-term stability and alignment (Table 1).

At a minimum of 10 years postoperatively, the average follow-up duration was 127.4 months, demonstrating a robust long-term surveillance of outcomes. This extended follow-up period is essential for evaluating the durability of surgical correction, the development of any late complications such as adjacent segment degeneration and overall functional recovery. The demographic and surgical characteristics observed in this cohort are consistent with established trends in AIS treatment, providing a representa-

TABLE 1.
Study data

Variable	Mean ± SD	Range	Additional information
Age at surgery (years)	14.8 ± 1.6	11 – 18	Peak incidence: early adolescence
Sex	82 females (83.7%) 16 males (16.3%)	-	Reflects AIS epidemiology
Major curve magnitude (°)	54.2 ± 10.1	40 – 80	Preoperative Cobb angle
Lenke classification	Type 1: 55 (56.1%) Type 2: 14 (14.3%) Type 3: 10 (10.2%) Type 4–6: 19 (19.4%)	-	Type 1 most prevalent
Fusion length (vertebrae)	10.2 ± 2.1	6 – 14	Longer fusions in double/triple curves
Follow-up duration (months)	127.4 ± 8.2	120 – 144	Mean: 10.6 years

SD: standard deviation

tive baseline for further analysis of clinical and radiographic outcomes.

Patient-reported outcome measures at 10 years

At a minimum 10-year follow-up, patients who underwent PSF for adolescent idiopathic scoliosis demonstrated excellent long-term functional and health-related quality of life outcomes (Table 2). The mean SRS-22 total score was 4.5, indicating a high level of overall satisfaction with surgical treatment. All subdomains of the SRS-22 showed favorable results, with the highest scores observed in satisfaction with management (4.7) and pain (4.6), suggesting sustained relief from scoliosis-related discomfort and strong approval of the surgical intervention. Function and self-image scores were also notably high, reflecting the ability of patients to return to normal physical activity and the positive cosmetic outcomes achieved through deformity correction. Mental health scores further supported a favorable psychosocial adjustment following surgery.

Additional outcome measures reinforced the positive impact of long-term surgical correction. The SF-36 scores for both physical (54.3) and mental (52.5) health components were slightly above the population norm (mean ~50), indicating that these patients not only recovered well but maintained a quality of life on par with or better than their peers. The Oswestry disability index (ODI) score averaged 5.6%, placing the majority of patients in the "minimal disability" category. These findings collectively suggest that PSF in AIS provides durable correction, excellent physical and mental function, minimal pain and disability and high satisfaction into early adulthood, supporting its continued role as a definitive treatment for progressive spinal deformity in adolescents.

Comparison by Lenke classification

At 10-year follow-up, patients with Lenke 1 curves – representing single thoracic deformities – demonstrated the most favorable long-term outcomes across multiple domains (Table 3). Their mean SRS-22 total score was the highest (4.6), significantly better than those with more complex curves (Lenke 3–6), who averaged 4.3 ($p = 0.03$). Notably, Lenke 1 patients reported lower levels of pain (4.7 *vs*. 4.4, $p = 0.04$) and greater satisfaction with surgical management (4.8 *vs*. 4.5, $p = 0.05$). Functional scores were also higher in Lenke 1 patients, although the difference was not statistically significant. These findings suggest that single-curve deformities, which generally require shorter fusion lengths and have more predictable correction, result in slightly better long-term physical and psychosocial outcomes.

Patients with more complex curve patterns (Lenke 2 and 3–6), while still showing good outcomes overall, tended to report slightly lower scores in domains related to self-image and satisfaction. These groups often require longer fusions and correction of multiple structural curves, which may influence both the perceived and actual postoperative outcomes. However, even among these more complex subtypes, the SRS-22 scores remained above 4.0 in all domains, and SF-36 physical and mental health scores remained within or above normal population ranges. Oswestry disability index scores remained low across all groups (mean < 7%), indicating minimal long-term disability regardless of curve type. Collectively, the data support

TABLE 2. Long-term functional outcomes

Outcome measure	Mean ± SD	Range	Interpretation
SRS-22 total score	4.5 ± 0.3	4.0–5.0	Excellent overall satisfaction
SRS-22 subdomains			
– Function/activity	4.4 ± 0.4	3.5–5.0	High activity level with minimal limitations
– Pain	4.6 ± 0.4	4.0–5.0	Minimal to no pain at long-term follow-up
– Self-image	4.3 ± 0.5	3.0–5.0	Positive perception of body image
– Mental health	4.5 ± 0.4	3.5–5.0	Strong emotional well-being
– Satisfaction with management	4.7 ± 0.3	4.0–5.0	Very high satisfaction with surgical outcome
SF-36 (PCS – Physical component summary)	54.3 ± 4.9	44–62	Slightly above population norms
SF-36 (MCS – Mental component summary)	52.5 ± 5.2	42–65	Reflects excellent mental health
Oswestry disability index (ODI)	5.6 ± 4.3	0 – 18	Minimal disability

Outcome measure	Lenke 1 (n = 55)	Lenke 2 (n = 14)	Lenke 3–6 (n = 29)	p-value	Interpretation
SRS-22 total	4.6 ± 0.3	4.4 ± 0.3	4.3 ± 0.4	0.03*	Lenke 1 reports highest overall satisfaction
– Function	4.5 ± 0.4	4.3 ± 0.4	4.2 ± 0.5	0.06	Slight trend toward better function in Lenke 1
– Pain	4.7 ± 0.3	4.5 ± 0.4	4.4 ± 0.5	0.04*	Lower long-term pain in Lenke 1 curves
– Self-image	4.4 ± 0.5	4.2 ± 0.5	4.1 ± 0.6	0.12	Cosmetic satisfaction slightly lower in complex curves
– Mental health	4.6 ± 0.4	4.5 ± 0.4	4.4 ± 0.4	0.18	Stable across all types
– Satisfaction	4.8 ± 0.3	4.6 ± 0.3	4.5 ± 0.4	0.05*	Higher satisfaction in single-curve deformities
SF-36 PCS	55.1 ± 4.7	53.6 ± 4.8	52.4 ± 5.1	0.07	Physical scores slightly better in Lenke 1
SF-36 MCS	52.8 ± 5.0	52.3 ± 5.1	51.7 ± 5.6	0.32	No significant differences
ODI (%)	4.9 ± 3.7	6.2 ± 4.1	6.8 ± 5.0	0.08	Disability remains low across all groups

TABLE 3. Comparison of long-term outcomes by Lenke classification

Outcome measure	Shorter fusions (≤nine levels, n = 44)	Longer fusions (≥10 levels, n = 54)	*p*-value	Interpretation
SRS-22 total	4.6 ± 0.3	4.4 ± 0.3	0.04*	Better outcomes in shorter fusions
– Function/activity	4.6 ± 0.3	4.3 ± 0.4	0.02*	Higher function with preserved mobility
– Pain	4.6 ± 0.4	4.5 ± 0.4	0.21	Comparable pain relief
– Self-image	4.4 ± 0.5	4.2 ± 0.5	0.08	Trend toward better self-image in shorter fusions
– Mental health	4.5 ± 0.4	4.5 ± 0.4	0.88	No difference in emotional well-being
– Satisfaction with management	4.7 ± 0.3	4.6 ± 0.3	0.38	High satisfaction across groups
SF-36 PCS	55.6 ± 4.6	53.2 ± 5.0	0.07	Physical health slightly better in shorter fusions
SF-36 MCS	52.9 ± 5.1	52.1 ± 5.2	0.42	No difference in mental health
Oswestry disability index (ODI, %)	4.3 ± 3.8	6.7 ± 4.5	0.05*	Less disability in shorter fusion group

TABLE 4. Influence of fusion length on long-term functional outcomes and quality of life

the effectiveness of PSF in treating AIS across the Lenke spectrum, while highlighting slightly better outcomes in patients with simpler single-curve deformities.

Comparison by fused levels

To evaluate the influence of fusion length on long-term functional outcomes and quality of life, the cohort was stratified into two groups based on the number of vertebrae fused: shorter fusions (≤nine levels, n = 44) and longer fusions (≥10 levels, n = 54). These cutoffs were selected to reflect typical surgical decision-making boundaries between selective and more extensive fusion constructs in AIS (Table 4).

At a mean follow-up of 127.4 months, both groups demonstrated excellent patient-reported outcomes, but subtle differences emerged. Patients with shorter fusions reported slightly higher SRS-22 total scores (4.6 *vs*. 4.4, p = 0.04), primarily driven by better function and self-image subdomains. These patients also had marginally lower ODI scores (4.3% *vs*. 6.7%, p = 0.05), indicating less perceived disability in the long term. Notably, the function/activity score was significantly higher in the shorter fusion group (4.6 *vs*. 4.3, p = 0.02), suggesting a possible benefit of preserving more mobile spinal segments.

In contrast, patients with longer fusions, while still achieving high satisfaction and minimal pain, showed a modest reduction in physical and self-image domains, potentially reflecting the biomechanical limitations of extensive instrumentation and fusion. SF-36 scores for both physical (53.2 *vs*. 55.6, p = 0.07) and mental (52.1 *vs*. 52.9, p = 0.42) components were comparable between groups, and satisfaction with management remained uniformly high across both groups (4.7 *vs*. 4.6, p = 0.38).

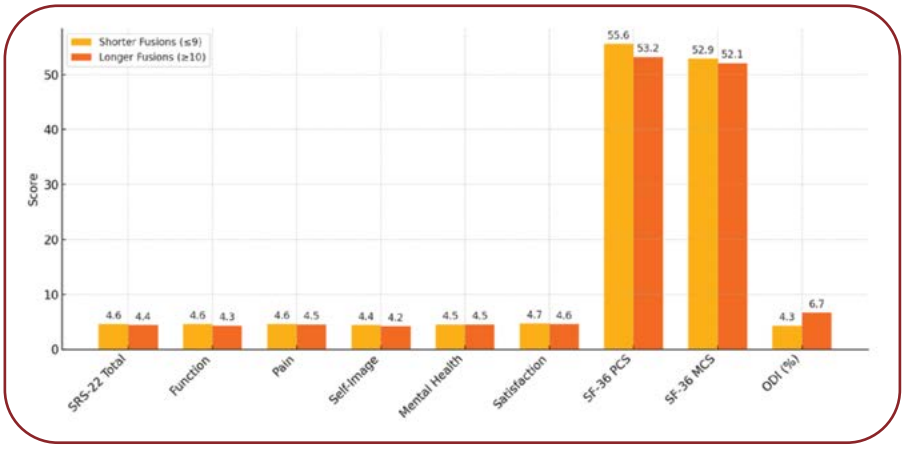

FIGURE 1. Graph with comparison data of long-term outcomes by fusion length

These findings suggest that, while both shorter and longer fusions lead to excellent long-term outcomes, shorter fusions may offer a slight advantage in preserving physical function and self-perception, reinforcing the principle of selective fusion where appropriate (Figure 1). ❑

DISCUSSION

This study demonstrates excellent long-term outcomes in adolescents undergoing PSF for idiopathic scoliosis, with a mean 10.6-year follow-up. The average SRS-22 total score of 4.5 and SF-36 physical and mental component scores (54.3 and 52.5, respectively) indicate sustained functional, psychosocial and health-related quality of life benefits after surgery. Stratification by Lenke classification revealed that patients with Type 1 curves – typically simpler single thoracic deformities – achieved superior outcomes compared to those with more complex curves (Types 3–6). Specifically, Lenke 1 patients had significantly higher SRS-22 total scores (4.6 *vs.* 4.3, p = 0.03), better pain scores (4.7 *vs.* 4.4, p = 0.04) and greater satisfaction with management (4.8 *vs.* 4.5, p = 0.05). These results align with prior studies reporting more favorable outcomes in less extensive deformities due to predictable correction and fewer surgical demands (3, 8-10).

Influence of fusion length

Fusion length also played a role in shaping long-term outcomes. Patients with shorter fusions (≤nine levels) reported higher SRS-22 total (4.6 *vs.* 4.4, p = 0.04), function (4.6 *vs.* 4.3, p = 0.02) and lower ODI scores (4.3% *vs.* 6.7%, p = 0.05) compared to those with longer fusions (≥10 levels). This supports the principle of motion segment preservation where feasible, as maintaining unfused lumbar segments may contribute to improved physical function and reduced mechanical stress on adjacent levels. While both groups achieved high satisfaction and minimal disability, the observed trends suggest that selective fusion may optimize outcomes in appropriately selected cases without compromising deformity correction or patient satisfaction (11, 12).

Shoulder/neck balance and biomechanics

A study by Chan *et al* (2021) examined 111 AIS patients with Lenke 1 curves and stratified them into flexible and stiff subtypes based on the proximal thoracic side-bending Cobb angle (8). Their findings demonstrated that patients with stiff proximal thoracic curves were significantly more likely to exhibit postoperative shoulder and neck imbalance. Specifically, the stiff group had greater preoperative T1 tilt and cervical axis deviation and postoperatively they exhibited a much higher incidence of positive T1 tilt (41.0% *vs.* 2.0%), radiographic shoulder height discrepancy (26.2% *vs.* 12.0%) and clavicle angle asymmetry (24.6% *vs.* 10.0%) compared to those in the flexible group (8). These results emphasize the need for nuanced preoperative assessments to identify patients at risk of residual imbalance, which may have implications for both functional and cosmetic outcomes (13, 14).

The challenging decision of selective fusion

In cases involving more complex double curve patterns such as Lenke type 6C, surgical deci-

sions regarding selective fusion remain challenging. Chang *et al* (2021) reported encouraging results in a preliminary study of patients undergoing selective thoracolumbar-lumbar fusion. Among 13 patients with Lenke 6C curves, they observed spontaneous correction of the unfused thoracic curve from an average of 46.1° preoperatively to 34.2° at the final follow-up. Importantly, no significant differences in patient-reported outcomes, including SRS-22 scores, were noted when comparing Lenke 6C patients with those having Lenke 5C curves (9). These findings suggest that, with appropriate curve flexibility and sagittal balance, selective fusion can be a safe and effective option for managing even more complex deformities, reducing the need for longer fusion constructs (15, 16).

The extent of lumbar fusion has emerged as a key determinant of postoperative health-related quality of life. Frantzén *et al* (2023) examined outcomes across various Lenke curve types and found that patients undergoing more extensive lumbar fusion, particularly those with Lenke 5 and 6 patterns, reported lower scores on quality-of-life metrics. This reinforces the principle that preserving as many mobile segments in the lumbar spine as possible may contribute to better long-term functional outcomes. These findings support a trend toward shorter fusion strategies when biomechanically and radiographically appropriate, balancing deformity correction with motion preservation. Despite advancements in classification and surgical technique, significant variability remains in the application of treatment strategies across different institutions and surgeons. A multicenter survey conducted by Schlager *et al* (2023) revealed considerable discrepancies in the surgical planning for AIS, particularly in Lenke types 1 and 5, which had lower interrater agreement ($\kappa = 0.39$ and $\kappa = 0.32$, respectively). This variability was most pronounced in the choice of fusion levels and highlights the influence of individual surgeon experience and interpretation on treatment planning. While the Lenke system provides a structured framework, its interpretation and implementation continue to vary, especially in more ambiguous curve types (3, 7, 17).

Role of emerging technologies (AI)

Puno *et al* (2003) previously demonstrated the value of adhering to classification-based recommendations, showing that patients whose surgeries followed Lenke-guided strategies experienced superior outcomes in T1 tilt correction and proximal thoracic curve management. This underscores the utility of structured classification in achieving predictable surgical outcomes, although it also suggests that such frameworks must be applied flexibly and in conjunction with clinical judgment (2, 18, 19). The integration of emerging technologies offers new opportunities to improve the precision of preoperative planning. Dong *et al* (2024) introduced an artificial intelligence-based tool using multiple-view semantic segmentation to enhance the accuracy and consistency of radiographic measurements in AIS. Such tools may reduce interobserver variability in classification and assist in identifying optimal surgical strategies based on a more standardized assessment of curve characteristics (20-22). ❑

CONCLUSION

In summary, posterior spinal fusion for adolescent idiopathic scoliosis provides excellent long-term outcomes, with sustained improvements in function, pain relief and health-related quality of life at a mean follow-up of over 10 years. Patients with simpler single thoracic deformities (Lenke 1) achieve the best results, demonstrating higher satisfaction, lower pain and better overall function compared to those with more complex curves. Shorter fusion constructs, when anatomically and biomechanically feasible, are associated with improved physical function, lower disability and preservation of motion, supporting the principle of selective fusion. Careful preoperative assessment of curve flexibility and thoracic/shoulder biomechanics is essential to minimize the risk of postoperative shoulder or neck imbalance and optimize cosmetic and functional outcomes. Despite the structured guidance of classification systems, variability in surgical planning persists, highlighting the importance of individualized clinical judgment. ❑

Conflicts of interest: none declared.
Financial support: none declared.

References

1. **Alzakri A, et al.** Global sagittal alignment and proximal junctional kyphosis in adolescent idiopathic scoliosis. *Spine Deform* 2019;7:236-244. doi: 10.1016/j.jspd.2018.06.014.
2. **Avendano JP, Tis JE, Parent S, et al.** AIS patients have improved total SRS-22R self-image and satisfaction scores relative to pre-op at 10-year follow-up regardless of Lenke type. *Spine Deform* 2025;13:561-568. doi: 10.1007/s43390-024-01006-7.
3. **Baghdadi S, Baldwin K.** Selection of fusion levels in adolescent idiopathic scoliosis. *Curr Rev Musculoskelet Med* 2023;17:23-36. doi: 10.1007/s12178-023-09876-6.
4. **Baroncini A, Cecchinato R, Pellisé F, et al.** Adolescent idiopathic scoliosis with concomitant spondylolysis: Choice of fusion levels and evaluation of the outcomes obtained leaving the lytic level not instrumented. *Spine Deform* 2023;11:1453-1460. doi: 10.1007/s43390-023-00715-9.
5. **Chang SY, Song HR, Moon HJ, et al.** Clinical outcomes of selective fusion for the Thoracolumbar-lumbar curve in patients with Lenke Type 6C adolescent idiopathic scoliosis: A preliminary study. *J Pediatr Orthop B* 2021;30:211-217. doi: 10.1097/bpb.0000000000000771.
6. **Dong Y, Zhang J, Liu H, et al.** Artificial intelligence measurement of preoperative radiographs in adolescent idiopathic scoliosis based on multiple-view semantic segmentation. *Global Spine J* 2024;15:1924-1931. doi: 10.1177/21925682241270036.
7. **Fischer CR, Kim Y.** Selective Fusion for adolescent idiopathic scoliosis: A review of current operative strategy. *Eur Spine J* 2011;20:1048-1057. doi: 10.1007/s00586-011-1730-9.
8. **Frantzén A, Kalén R, Salomonsson B, et al.** Association between Lenke classification, the extent of Lumbar Spinal Fusion, and health-related quality of life after instrumented spinal fusion for adolescent idiopathic scoliosis. *Spine* 2023;48:1216-1223. doi: 10.1097/brs.0000000000004760.
9. **Garg B, Mehta N, Mukherjee RN.** Choosing the distal fusion levels in Lenke Type 1 adolescent idiopathic scoliosis: How do the existing classifications and recommendations guide us? *Global Spine J* 2020;11:465-471. doi: 10.1177/2192568220910712.
10. **Ghandhari H, Ameri E, Nikouei F, et al.** Selective Thoracolumbar/Lumbar Fusion in Adolescent Idiopathic Scoliosis: A Comprehensive Review of the Literature. *Arch Bone Joint Surg* 2023;11:313-320. doi: 10.22038/abjs.2022.61439.3014.
11. **Hosseini P, Xu R, Kotheeranurak V, et al.** Preservation of spine motion in the surgical treatment of adolescent idiopathic scoliosis using an innovative apical fusion technique: A 2-year follow-up pilot study. *Int J Spine Surg* 2018;12:441-452. doi: 10.14444/5053.
12. **Hosseinpou-Feizi H, Soleimanpour J, Sales JG, Arzroumchilar A.** Lenke and King classification systems for adolescent idiopathic scoliosis: interobserver agreement and postoperative results. *Int J Gen Med* 2011;4:821-825. doi: 10.2147/ijgm.s25403.
13. **Norheim EP, Roisli Y, Dybvik E, Steen H.** Cervical spine compensation in adolescent idiopathic scoliosis. *Spine Deform* 2015;3:327-331. doi: 10.1016/j.jspd.2014.11.008.
14. **Phan P, Parent, EC, Lou E, et al.** A rule-based algorithm can output valid surgical strategies in the treatment of AIS. *Eur Spine J* 2015;24:1370-1381. doi: 10.1007/s00586-014-3736-6.
15. **Puno RM, An HS, Winter RB, Essman JA.** Treatment recommendations for idiopathic scoliosis. *Spine* 2003;28:2102-2114. doi: 10.1097/01.brs.0000088480.08179.35.
16. **Schlager B, Law YM, Alobaid D, et al.** Range of surgical strategies for individual adolescent idiopathic scoliosis cases: Evaluation of a multi-centre survey. *Spine Deformity* 2023;12:35-46. doi: 10.1007/s43390-023-00756-0.
17. **Slattery C, Verma K.** Classifications in brief: The Lenke Classification for adolescent idiopathic scoliosis. *Clin Orthop Relat Res* 2018;476:2271-2276. doi: 10.1097/corr.0000000000000405.
18. **Tingsheng L, Zhang L, Chen W, et al.** Validation of artificial intelligence in the classification of adolescent idiopathic scoliosis and the compairment to clinical manual handling. *Orthop Surg* 2024;16:2040-2051. doi: 10.1111/os.14144.
19. **Chan CYW, Chiu CK, Ng YH, et al.** An analysis of preoperative shoulder and neck balance and surgical outcome in 111 adolescent idiopathic scoliosis patients with two subtypes of Lenke 1 curves. *J Neurosurg Spine* 2021;34:37-44. doi: 10.3171/2020.5.spine20397.
20. **Wilke H, Shirazi-Adl A, Arjmand N, et al.** Range of International Surgical Strategies for adolescent idiopathic scoliosis: Evaluation of a multi-center survey. *JOR Spine* 2024;7:e1324. doi: 10.1002/jsp2.1324.
21. **Zárate-Kalfópulos B, Martinez-Rios HR, López-Meléndez F, et al.** Idiopathic scoliosis's surgical treatment. Results in Mexico's National Rehabilitation Institute. 24-month follow-up. *Cir Cir* 2018;86:392-398.
22. **Zhang B, Zhang J, Wang S, et al.** Automatic Lenke Classification of adolescent idiopathic scoliosis with deep learning. *JOR Spine* 2024;7:e1327. doi: 10.1002/jsp2.1327.