

Evaluation of the Results of Scoliosis Surgeries in Iraq: A Five-Year Follow-up Study

Ahmed Hassan Alhashemi^{1*} , Wael Muhammed Kamber², Fareed K. Alsudany^{1*}, Yasser H. Motlaq³, Cagtay Ozturk⁴, Mehmet Aydogan⁵

¹Orthopedic Department, Ibn Sina Training Hospital, Baghdad, Iraq.

²Community Medicine Department, Ministry of Health, Baghdad, Iraq.

³Radiology Department, Ibn Sina Training Hospital, Baghdad, Iraq.

⁴Spinal Surgery Department, Liv Hospital, Istanbul, Turkey.

⁵Spinal Surgery Department, Memorial Sisli Hospital, Istanbul, Turkey.

*Correspondence to: Ahmed Hassen Al Hashemi (E-mail: Ahmedhamash@gmail.com) and Fareed Alsudany (E-mail: drfareed1977.fk@gmail.com)

(Submitted: 20 May 2025 – Revised version received: 05 June 2025 – Accepted: 06 July 2025 – Published online: 26 August 2025)

Abstract

Objective: This study set out to look at how safe and effective posterior spinal fusion (PSF) surgery is in scoliosis patients, and to explore both the complications and the outcomes after treatment.

Methods: We carried out a prospective study of 90 patients with scoliosis who underwent PSF surgery at Ibn Sina Training Hospital in Baghdad between 2019 and 2024. Each patient was followed both clinically and radiographically to check for complications during and after surgery. Radiographic evaluation focused on device failure, union or pseudoarthrosis, and the need for revision. Clinical outcomes were assessed using Cobb angle correction, pain reduction (Visual Analogue Scale, VAS), and patient satisfaction.

Results: The average age at surgery was 10 ± 5.1 years, and patients were followed for about 5 ± 3.2 years. Most surgeries went smoothly, though some complications were observed, including infection, broken screws or rods requiring revision, and cases of hemo- or pneumothorax, which required chest tube placement in 14 patients. Three of these complications resolved within the first postoperative week. Overall, pain levels were well controlled, with a mean postoperative VAS score of 2.1 ± 0.7 , and patients reported good satisfaction with the outcome.

Conclusion: This study suggests that PSF surgery for idiopathic scoliosis is both safe and effective, particularly when performed close to skeletal maturity. With at least five years of follow-up, our findings indicate that early surgical intervention can improve outcomes, reduce pain, and minimize the risk of complications. Delaying surgery well beyond skeletal maturity, however, appears to increase the likelihood of problems after treatment.

Keywords: Scoliosis/surgery, spinal fusion/methods, adolescent, spinal curvatures, musculoskeletal abnormalities

Introduction

The Scoliosis Research Society (SRS) defines adolescent idiopathic scoliosis (AIS) as a spinal deformity with a coronal Cobb angle greater than 10 degrees.¹ With a prevalence estimate of 2–3%, AIS is the most common cause of three-dimensional deformities of the spine.^{2,3}

Although it is mostly asymptomatic and non-life-threatening, the deformities stemming from AIS can have a major impact on a patient's quality-of-life, leading to concerns about physical appearance, pain, and limitation of function.^{1,2,4}

Paediatric scoliosis is broadly divided into early versus late onset scoliosis, with a diagnosis before the age of 10 years of age classified as early onset scoliosis.¹

Most early onset scoliosis will have an underlying diagnosis such as neuromuscular, congenital or syndromic.

Adolescent idiopathic scoliosis (AIS) occurs in individuals between the ages of 10 years and 18 years and has no underlying pathology. Patients who have a diagnosis of AIS and have a large curve may suffer from psychosocial distress including restricted social life with increased psychiatric consultations, higher rates of eating disorders and suicide.²

Thoracic curves of greater than 50° will progress into adult life and result in long-term disability, mainly back pain and poor quality of life.³

Treatment of scoliosis depends on patient age, curve type and severity and risk of curve progression.

Treatment options include conservative management, bracing or surgery. PSF remains as the gold standard for the treatment of thoracic and double major curves (most cases) (Figure 1). ASF is indicated for thoracolumbar and lumbar cases having a normal sagittal profile. A combination of ASF and PSF could also be used for the management of large curves (>75°) or stiff curves, young age, and to prevent crankshaft phenomenon.^{5,6}

Corrective surgery for Adolescent Idiopathic Scoliosis (AIS), involves many perioperative challenges including patient and family counseling, optimization of the patient, adequate pain control, effective management of side-effects due to opioids, and early mobilization amongst others. If these are not appropriately addressed, then they may result in a delayed return to function, prolonged hospital stay, and increased costs.

Methods

This was a descriptive prospective study, AIS patients who underwent PSF surgery at Ibn Sina training hospital in Baghdad during the period from 2017–2022 were included.

Exclusion criteria were (1) congenital, neuromuscular, or infantile scoliosis; (2) history of previous spinal surgery (3) presence of diseases which might affect the outcome such as rheumatoid arthritis and diabetes mellitus.



Fig. 1 a. x-ray of PSF.

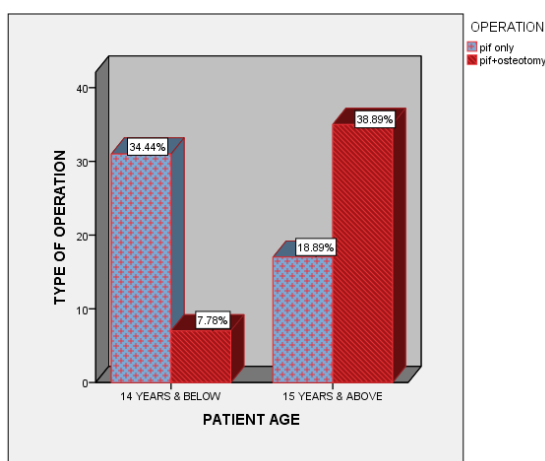


Fig. 2 Correlation between age and type of surgery.

Inclusion criteria:

All patient with AIS aging from 14 till 18.

All patients included in the study were concerned about the physical appearance and deformity of the back and that was the main indication for surgery

Total of 90 patients involved in the study 28 male and 62 female, 38 patients below 14 yrs and 52 patients above 15 yrs.

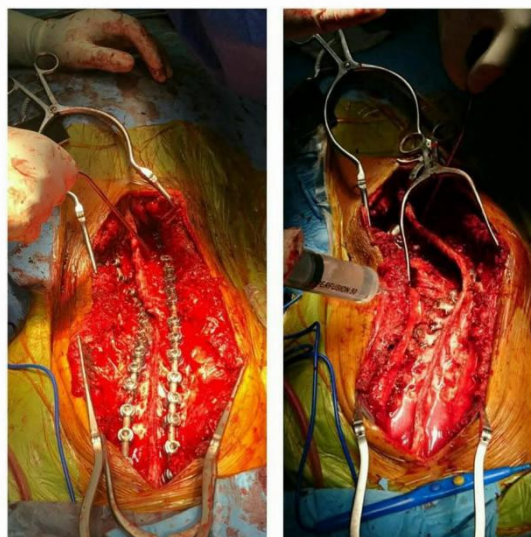
Psf surgery only done for 48 patients (53.3%) and 42 patients (46.7%) psf and osteotomy done to them (Figure 2).

Age at the time of study (years) 20.5 ± 6.8 , Age at the time of surgery (years) 14.4 ± 5.1 , Post-operative follow-up (years) 5.6 ± 3.2 .

All surgery were done under general anesthesia, and pre-operative prophylactic antibiotics were given. The patients were positioned prone. c-arm fluoroscopy used during surgery. Correction was done by de-rotating the apical vertebrae and fixation using pedicle screw and rod instrumentation.

Fusion was aided with the help of autogenous rib graft in cases needed rib resection. The whole procedure was done under motor-evoked potential surveillance.

Average time of surgery about 5 hours $\pm$ 2, all the patients given one pint of blood during surgery and send for 24 hrs ICU monitoring post operative. Suture removal was



b. Intra operative photo of PSF.

done on the 21st day, and some patients were discharged with thoraco-lumbosacral orthosis, which they wore till complete fusion, that was achieved in 3 months.

Plain standing spinal radiograph of C1–S1 in anteroposterior (AP) and lateral views, along with a lumbosacral MRI without contrast, was taken for radiographic assessments including the evaluation of device failure, union status of fusion site, and signs of infection.

Postoperative protocol was to restore the patient's homeostasis early by managing pain efficiently, permitting early mobilization, and aiming for early discharge so as to reduce the length of hospital stay, avoid complications. Patients were discharged when they were ambulating independently, tolerating oral diet and oral analgesics without any nausea or vomiting and able to pass flatus.⁷⁻⁹ After discharge, all patients were followed up periodically in outpatient clinics with the surgeon, specialty nurses, and physiotherapist and the progress documented.

Clinical outcome was evaluated using the visual analogue scale (VAS), which in a higher score was equivalent to an inferior outcome.

For this study the results outcomes were measured mainly on degree of correction of cobb angle because of its simplicity and due to technical difficulties related to patient location.

Most of patients were live in far area and referred to our center for achieving the surgery then followed up remotely on the nearest hospital. Thus the only available factor to assess outcome were post operative cobb angle correction and immediate patient condition post operative validated outcome scores (such as SRS-22, ODI, or SF-36) could not be used due to above causes.

Results

The collected data was introduced into Microsoft excel work sheet 2019 and loaded into SPSS–v26 software statistical program.

The descriptive statistics presented using tables (mean, $\pm$ SD, frequency percentages) and graphs. Chi square test used to find out significance of association between related categorical variable. *P* value less than 0.05 was considered as discrimination point for significance.

A total of 90 patients were evaluated in this study. The most common level of fusion was L3 followed by L4. The surgical and demographic characteristics of the patients have been summarized in Table 1.

The co-operation of patients and parents with the medical team is required to successfully implement enhance recovery after surgery.

Radiographic assessment of the patients Mean vertebral tilt below the site of fusion before and after surgery were $11.12^\circ \pm 7.92^\circ$ and $6.21^\circ \pm 5.73^\circ$, respectively. This difference was statistically significant ($P < 0.001$) (Table 2).

The complications reported in these study encompassed reoperation, adding on, coronal decompensation, postoperative infection, screw misplacement, pseudoarthrosis, and hardware failure. Out of 7 patients loss of follow up and uncooperative, 77 patients complete union and only 13 patients readmitted for revision because of infection or pseudoarthrosis or prominent hardware or broken rod (Figure 3).

Predictors of complications such as Female sex, long operative time and Thoracolumbar kyphosis, were highly associated with increase risk of complications and dural tear and post operative pain.

Some patients reported lower limbs neurological weakness immediately post operation (muscle power grade 3 to 4) resolved spontaneously with in 2 weeks.

Three patients passed during 1st week post surgery and send for forensic medicine.

Pre-operative Cobb angle between 45° and 50° was 55 patients, an angle 50° – 60° was 21 patients, an angle above 60° degree was 24 patients.

Post operatively 61 patients were having a Cobb angle of less than 15° and remaining patients had between 15° and 20° (Figure 4).

The mean post-operative VAS was 2.1 ± 0.7 . No significant correlation was observed between the values of VAS and follow-up period ($P = 0.321$, $r = -0.157$).

Only 14 patients (15.6%) needed chest tube intraoperatively specially those patients had ribs rections, the tubes removed after 5 to 7 days post surgery.

Posterior spinal fusion only done in 48 patients (53.3%), the remaining 48 patients (46.70%) needed posterior spinal fusion and osteotomy.

Discussion

In this study, we prospectively analyzed functional outcome of 90 patients with adolescent idiopathic scoliosis, who underwent posterior release, instrumentation, and fusion using autogenous rib graft. The surgeries were done by a different surgeon.

Table 1. Demographic characteristics of patients

		No.	%	Cumulative percent
Sex	M	28	31.1	31.1
	F	62	68.9	100.0
	Total	90	100.0	
Age	14 years & below	38	42.2	42.2
	15 years & above	52	57.8	100.0
	Total	90	100.0	
Operation type	P.I.F only	48	53.3	53.3
	P.I.F + Osteotomy	42	46.7	100.0
	Total	90	100.0	
Mean hospitalization post OP	4 days & below	39	43.3	43.3
	5 days & more	51	56.7	100.0
	Total	90	100.0	
Chet tube need	Not needed	76	84.4	84.4
	Needed	14	15.6	100.0
	Total	90	100.0	
Revision	No revision	77	85.6	85.6
	Revision required	13	14.4	100.0
	Total	90	100.0	

Table 2. Differences in pre and post surgery cobb angle

	N	Mean	Std. deviation
Cobb angle before surgery	90	72.06	5.553
Cobb angle after surgery	90	19.67	5.017
Angle differences	90	52.28	4.981

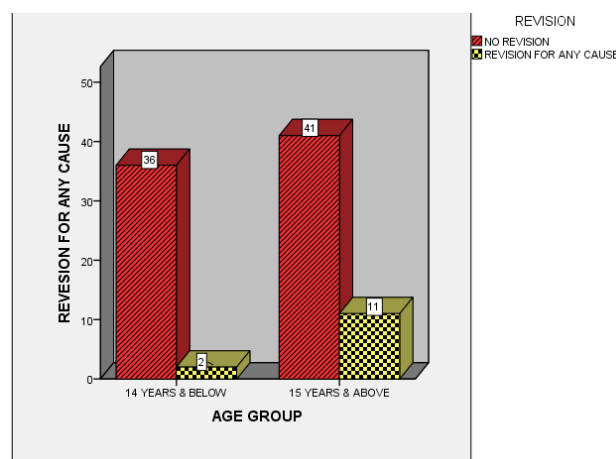


Fig. 3 Revision rate after surgery.

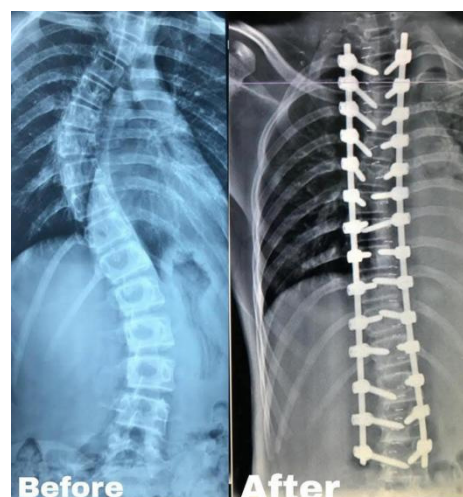


Fig. 4 x ray before and after surgery.

Currently there is an increasing awareness among orthopedic surgeons for evaluating functional over the radiological outcome.

The results of this study demonstrate that surgical intervention for Adolescent Idiopathic Scoliosis (AIS) yields favorable outcomes in terms of functional improvement, quality of life, and return to activity if was done around skeletal maturity period. These findings are consistent with previous studies that have reported significant improvements in quality of life, and return to activity.^{10,11}

Corrective surgery of AIS can result in several benefits for the affected patients including improvements in esthetics, quality of life, disability, back pain, psychological well-being, and breathing function.

We believe that our results are somewhat lower because they are the first cases of AIS to be treated in our center in Baghdad.

Scoliosis surgery by the modern pedicular screw technique were first done in our center (Ibn Sina training hospital) in 2016. There were a lot of successful sporadic case in other centers in Iraq.

Our paper is the first paper discussing the scoliosis results in Baghdad.

The patient were selected by a committee in the MOH then referred to our hospital were visitors team from many countries with the staff of our center were examining those patient and surgery was planned for the fit cases. In this program all kind of cases were treated surgically congenital and paralytic and AIS, but this study is mostly focused on the outcome of AIS. The selected cases were prepared for surgery by a team from orthopedic and medical and neurosurgery and rheumatology department. Full blood workout and CT scan and MRI were done with full spine x ray.

All surgeries were done under supervision of neurophysiology department to ensure patient safety during surgery.

Difficulties

The most difficult step was in long follow up of the patient due to remote location of most of the patient and the difficult transportation of most of patient.

Most of cases were followed up by local medical institute and sometimes the follow up with our staff were done by phone.

A study by Fletcher et al., found that 85% of patients returned to their preoperative level of activity following AIS surgery.¹²

Degenerative disc disease is also considered as one of the late complications of AIS both before and after the surgery, and its association with the severity of pain has been reported.¹³

Sponseller et al., found that nearly 40% of the patients in their data cohort had minor complications while 20% demonstrated a major complication.¹⁴ Their data set reported a death in their studied population.

Many previous studies did not find any correlation between Cobb's angle and the domains of the SRS questionnaire, and only a few have found significant correlation.¹⁵⁻¹⁷

In another study conducted by Ng Bobby, it was further demonstrated that the degree of curve rectification after surgery and the preoperative maximum Cobb angle serve as significant predictors of various outcomes. This reinforces the

notion that both the magnitude of the surgical correction and the initial severity of the spinal curvature are critical factors in shaping a patient's postoperative functional capacities, their perception of their own physical appearance, and their overall satisfaction with the treatment process.¹⁸

The correction in all planes as well as the low incidence of complications are repeated in multiple studies. They also reported little medium-term correction loss in the coronal plane and these results were repeated in short- and long-term studies¹⁹ that the results in our study are very good. The psychological changes in cosmetic perception of adolescents with AIS are well documented.^{20,21} Our data demonstrated there were a higher number of levels fused and higher blood loss associated with performing surgery on young adults with idiopathic scoliosis.

Ghandhari et al., found complete union in all cases, no device failure, and a mean post-operative ODI of 16.7. However, 16% developed new degenerative disc disease, and post-operative disability may increase over time.²²

The complication rate observed in this study is consistent with previous reports. A study by Coe et al., found that the overall complication rate following AIS surgery was 14.1%.²³ Similarly, a study by Smith et al., reported a complication rate of 16.3% following AIS surgery

The findings of this study have important implications for the management of AIS. The results suggest that AIS surgery is a effective treatment option for patients with significant curvature, and that it can yield significant improvements in functional ability and quality of life. However, the results also highlight the importance of careful patient selection and meticulous surgical technique to minimize the risk of complications.

Our study has several limitations. We have conducted this study in a medium number of patients in single center and need longer time of follow up.

Future studies should aim to address the limitations of this study. Large-scale, prospective studies with longer follow-up periods are needed to fully understand the outcomes of AIS surgery. Additionally, studies that compare the outcomes of AIS surgery to non-operative management are needed to determine the optimal treatment strategy for patients with AIS.

Conclusion

Earlier correction of the AIS curves (around skeletal maturity period) leads to better results less complication lowering the osteotomy need. Based upon the results obtained from this review of 90 patients of AIS with minimum five years of follow-up we suggest that the surgical method is efficient and safe. The outcomes in three-dimensional correction are satisfactory and comparable. No major complications were found, the functional results were very good, and there was minimal incidence of residual pain.

Abbreviations

AIS: Adolescent idiopathic scoliosis; AP: Anteroposterior; DDD: Degenerative disc disease; MRI: Magnetic resonance imaging; SRS: Scoliosis research society; PSF: Posterior spinal fusion; SD: Standard deviation; VAS: Visual analogue scale.

Acknowledgements

The research team would like to thank Ibn Sina training hospital for all the support and also all the participants and partners who played a role in the completion of this article.

Funding

All authors have declared that no financial support was received from any organization for the submitted work.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors' Contributions

Ahmed and Fareed supervised the project and edited the article critically and did the project, filled the form supervised and guided the investigation. Yasser was assisting and guiding throughout the study and prepared all the radiological films of the patients. Wael was actively involved in data collection and interpreted the data and did the statistical work. All authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

This study was conducted after getting the approval from the ethical committee at Ibn Sina training hospital. All patients who participated in the study were included after getting informed consent from their parents. ■

References

- Han J, Xu Q, Yang Y, Yao Z, Zhang C. Evaluation of quality of life and risk factors affecting quality of life in adolescent idiopathic scoliosis. In: *Intractable and rare diseases research* (Vol. 4, Issue 1, pp. 12–16). International Advancement Center for Medicine and Health Research (2015). <https://doi.org/10.5582/irdr.2014.01032>.
- Sanders JO, Carreon LY, Sucato DJ, Sturm PF, Diab M. Preoperative and perioperative factors effect on adolescent idiopathic scoliosis surgical outcomes. *Spine*. 2010;35(20):1867–71. <https://doi.org/10.1097/BRS.0b013e3181efa6f5>.
- Rodrigues LMR, Gotfryd AO, Machado AN, Defino M, Asano LYJ. Adolescent idiopathic scoliosis: surgical treatment and quality of life. *Acta Ortopedica Brasileira*. 2017;25(3):85–9. <https://doi.org/10.1590/1413-785220172503157788>.
- Pellegrino LN, Avanzi O. Prospective evaluation of quality of life in adolescent idiopathic scoliosis before and after surgery. *J Spinal Disord Tech*. 2014;27(8):409–14. <https://doi.org/10.1097/BSD.0b013e3182797a5e>.
- Kotwicki T, Chowanska J, Kinel E, Czuprowski D, Tomaszewski M, Janusz P. Optimal management of idiopathic scoliosis in adolescence. *Adolesc HealthMed Ther*. 2013;4:59.
- Viviani G, Raducan V, Bednar D, Grandwilewski W. Anterior and posterior spinal fusion: comparison of one-stage and two-stage procedures. *Can J Surg*. 1993;36:468–73.
- Gronitzky AL, Flynn JM, Muhly WT, Sankar WN. (2016). A rapid recovery pathway for adolescent idiopathic scoliosis that improves pain control and reduces time to inpatient recovery after posterior spinal fusion. *Spine Deform* 4:288–295.
- Chan CYW, Loo SF, Ong JY, Lisitha KA, Hasan MS, Lee CK. et al. (2017). Feasibility and outcome of an accelerated recovery protocol in Asian adolescent idiopathic scoliosis patients. *Spine Phila Pa* (1976) 42:E1415–E1422.
- Kim E, Lee B, Cucchiari G. (2017). Perioperative surgical home: evaluation of a new protocol focused on a multidisciplinary approach to manage children undergoing posterior spinal fusion operation. *Anesth Analg* 125(3):812–819. <https://doi.org/10.1213/ANE.0000000000002030>
- Weinstein et al. (2013). Adolescent idiopathic scoliosis: a review of the literature. *Journal of Pediatric Orthopedics*, 33(5), 531–536.
- Lonstein et al. (2013). Surgical treatment of adolescent idiopathic scoliosis: a review of the literature. *Journal of Pediatric Orthopedics*, 33(5), 537–544.
- Fletcher et al. (2014). Return to activity after surgical treatment of adolescent idiopathic scoliosis. *Journal of Pediatric Orthopedics*, 34(5), 531–536.
- Buttermann GR, Mullin WJ. Pain and disability correlated with disc degeneration via magnetic resonance imaging in scoliosis patients. *Euro Spine J*. 2008;17:240–9.
- Sponseller PD, Cohen MS, Nachemson AL, Hall JE, Wohl ME. Results of surgical treatment of adults with idiopathic scoliosis. *J Bone Joint Surg Am*. 1987;69:667–675. 10.2106/00004623-198769050-00005
- Hisam MA, Siti NS, Jou NP, Ghaneshinees S, Shaharuddin AR, Azmi B, Mohd K. Does the quality of life in operated patients with adolescent idiopathic scoliosis correspond with the radiographic parameters? *Malaysian Orthopaedic J*. 2015;9(2):37–40. <https://doi.org/10.5704/MOJ.1507.010>.
- Rushton PR, Grevitt MP. What is the effect of surgery on the quality of life of the adolescent with adolescent idiopathic scoliosis? A review and statistical analysis of the literature. *Spine*. 2013;38(9):786–94.
- Djurasovic M, Glassman SD, Sucato DJ, Lenke LG, Crawford CH. Improvement in Scoliosis Research Society-22R Pain Scores After Surgery for Adolescent Idiopathic Scoliosis. *Spine*. 2018;43(2):127–32. <https://doi.org/10.1097/brs.0000000000001978>.
- Herdea A, Stancu TA, Ulici A, Lungu CN, Dragomirescu M-C, Charkauoi A. Quality of life evaluation using SRS-30 score for operated children and adolescent idiopathic scoliosis. *Medicina*. 2022;58:674. <https://doi.org/10.3390/medicina58050674>.
- Di Silvestre M, Bakaloudis G, Lolli F, Vommaro F, Martikos K, Parisini P. Posterior fusion only for thoracic adolescent idiopathic scoliosis of more than 80 degrees: pedicle screws versus hybrid instrumentation. *Eur Spine J*. 2008;17(10):1336–49. doi:10.1007/s00586-008-0731-9.
- Zhang J, He D, Gao J, Yu X, Sun H, Chen Z, et al. Changes in life satisfaction and self-esteem in patients with adolescent idiopathic scoliosis with and without surgical intervention. *Spine (Phila Pa 1976)*. 2011;36(9):741–5. doi:10.1097/BRS.0b013e3181e0f034.
- Han J, Xu Q, Yang Y, Yao Z, Zhang C. Evaluation of quality of life and risk factors affecting quality of life in adolescent idiopathic scoliosis. *Intractable Rare Dis Res*. 2015;4(1):12–16. doi:10.5582/irdr.2014.01032.
- Ghandhari, H., Ameri, E., Nikouei, F. et al. Long-term outcome of posterior spinal fusion for the correction of adolescent idiopathic scoliosis. *Scoliosis* 13, 14 (2018). <https://doi.org/10.1186/s13013-018-0157-z>.
- Coe et al. (2018). Complications of surgical treatment of adolescent idiopathic scoliosis: a systematic review. *Spine*, 43(10), 739–746.

This work is licensed under a Creative Commons Attribution-NonCommercial 3.0 Unported License which allows users to read, copy, distribute and make derivative works for non-commercial purposes from the material, as long as the author of the original work is cited properly.