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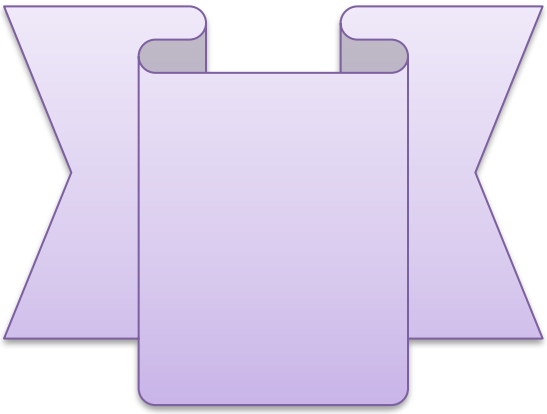

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Original Article

The Functional Outcome of Surgical Treatment of Adolescent Idiopathic Scoliosis

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ABSTRACT

Background: Adolescent idiopathic scoliosis [AIS] is a structural spinal deformity of unknown etiology that affects adolescents at or near their onset of puberty. It adversely affects patient's quality of life.

Aim of the Work: The current work aimed to assess the clinical, radiological and functional results of AIS surgical correction.

Patients and Methods: The study included 20 subjects with AIS who were treated by surgical intervention. Then, they were evaluated for clinical, radiological and functional outcome. Demographic data were collected on a preformed sheet. The preoperative assessment consisted of history taking and clinical examination. A standing posteroanterior, and lateral plain X-ray were performed for total spine [T1-S1]. The functional outcome was evaluated by the Scoliosis Research Society-30 [SRS-30].

Results: There was a female sex predominance [16 were females]. Patients below 15 years of age represented 70.0%. The mean ± SD Lenke classification was 3.20 ± 1.74, while number vertebrae was 10.35 ± 1.66. The primary Cobb angle ranged between 45 and 85˚, while the secondary Cobb angle ranged between 0 to 50˚ before surgery, and there was significant reduction of both primary and secondary Cobb angles after than before surgery. The shoulder imbalance was reported in all patients perioperatively, that was absent in all but one patient had slight elevation of the right shoulder after surgery. All had pelvic tilt before surgery that was absent postoperatively except for two patients who had slight tilt with significant improvement after surgery. Only 1 [5.0%] had postoperative complications [hypovolemic shock].

Conclusion: Surgical treatment of AIS had the highest probability to achieve better Cobb angle correction with good function and lower complication rate.

Keywords: Spinal Deformity; Adolescent idiopathic scoliosis; Satisfaction; Curve correction.

INTRODUCTION

Adolescent idiopathic scoliosis [AIS] is a structural, three-dimensional deformity of the spine. It affects 2-3% of general populations; 0.3 to 0.5% of them are progressive and need correction [1-2]. The surgery mainly aimed to restore a balanced trunk and achievement of solid fusion. It attains good radiological, clinical and functional outcomes. However, patient satisfaction and quality of life [QoL] may be poor. Many factors influence AIS postoperative outcomes, including age, sociocultural factors, ethnicity and gender. Recognition of these factors before surgery may help in prediction of the treatment outcome [3-4].

Patients older than 15 years of age at the time of surgery reported more satisfaction than younger patients. Individual factors like education may justify such findings. In addition, adolescents older than 15 years of age had more back pain due to asymmetric load distribution on the facet joints produced by scoliotic deformities. Surgical correction improves this pain and shares in higher patient satisfaction [5].

Male patients had higher postoperative satisfaction, due to higher "mental health" domain scores than females [2-6]. However, there is inconsistency in reported results. Additionally, the influence of the correction amount on functional outcomes of AIS is not well recognized. A weak correlation between curve of correction and functional outcomes was reported [4-9]. Also, another research showed a higher rate of complications after major corrections, comprising iatrogenic trunk imbalance [10]. But, the degree of correction after surgical intervention was a significant predictor of the functional scores, self-image/appearance and satisfaction [8- 12].

There is two main ways to classify idiopathic scoliosis. The first distinguishes infantile [from birth to 3 years of age] from juvenile [after 4 and before 10 years], and adolescent [> 10 years] types of scoliosis [13]. The second classification system differentiates between early from late-onset scoliosis, where early describes that before and late describes that after the age of 10 years [10].

The aim of this study was to assess the results of the surgical correction of adolescent idiopathic scoliosis clinically, radiologically and functionally.

PATIENTS AND METHODS

Between January 2018 & January 2022, twenty patients with AIS were included. All were selected from the orthopedic Department, Damietta Faculty of Medicine, Al-Azhar University, and Damietta, Egypt. The patient and his/her guardian signed an informed consent before surgery. This was performed after full explanation of the study procedure, and all aspects of benefits and complications related to the procedure. All patients are independent and active [as described by themselves] and were looking for treatment to uphold their quality of life. The average follow-up for all patients, was 6 months.

Patients were included when they had AIS with a Cobb angle > 20°, their age between 10 and 29 years at the time of surgery and signed an informed consent. On the extreme side, patients were excluded if they have other types of scoliosis [e.g., congenital, neurogenic, paralytic and post traumatic], had associated significant comorbidities, patients who did not completed the shortest follow up period [6 months], and patients refused to participate in the study.

Demographic data were collected on a preformed sheet. These data included patient's age, gender, calculated body mass index [BMI], medications and associated comorbid conditions [e.g., diabetes mellitus and hypertension].

The preoperative assessment consisted of history taking and clinical examination. The plain X-ray was completed on the standing posteroanterior, and lateral positions. It included the total spine [T1-S1]. Computed tomography [CT] and magnetic resonance imaging [MRI] was performed according to the need. Finally, the laboratory investigations were in the form of complete blood count [CBC], prothrombin time [PT], International normalization ratio [INR], liver and kidney function tests

All operations were performed under general anesthesia in prone position, after intravenous antibiotic administration, one hour before surgery. The surgery was performed by the posterior approach through posterior midline incision. Instrumentation with pedicle screws, reshoes and connecting pars if needed. Finally, suction drain was inserted for all patients and was applied for 48 hours after surgery.

Postoperatively, intravenous antibiotics were continued for the next four days and then shifted to oral medications. The postoperative assessment included clinical, radiological and functional assessment.

The radiographic assessment was achieved by X-ray examination at the postoperative 4th day, at the end of the 6th week, at the end of the 6th month after surgery and at the final follow-up. The curve magnitude was determined by the Cobb technique [14].

The percentages of flexibility were calculated by the equation [[the magnitude of the preoperative upright coronal Cobb angle - the magnitude of the bend Cobb angle] / the preoperative upright coronal Cobb angle]. The postoperative percent of correction was calculated from the coronal curves by the following equation [[the preoperative coronal Cobb angle - the magnitude of the coronal Cobb angle at final follow-up]/ by the preoperative Cobb angle]. The curve types were classified according to the Lenke classification [15]. The threshold level for doing only posterior spinal fusion [PSF] or combined anterior spinal fusion [ASF] and PSF was a curve magnitude of 70°. Bending views were used to determine the fusion levels.

The functional outcome was evaluated by SRS-30 questionnaire. It involves 30 questions, divided into 5 domains [pain, function, appearance, mental health and satisfaction]. Each question answer ranges from 1 [the worst scenario] to 5 [the best scenario] and the maximum total score is 150.

The following parameters were correlated with the SRS-30 results: [1] patient age at the time of surgery; [2] the use of braces before surgery; [3] the main thoracic Cobb angle; [4] the main thoracic curve correction; [5] patient gender and [6] complications.

Data management and Statistical Analysis

Data entry, processing and statistical analysis was carried out using SPSS version 20 [IBM® SPSS®, Chicago, USA Statistical Package for the Social Sciences]. Data were presented by their mean and standard deviation [SD] [quantitative data] or relative frequency and percentages [qualitative data], and suitable analysis was perfumed according to the type of data [independent samples student "*t*" test, paired samples "*t*" test, Chi square test, or its equivalents]. P-values less than 0.05 [5%] was considered statistically significant.

RESULTS

In the current work, data of 20 patients were analyzed. There was female sex predominance [16 were females]. The age ranged between 10 and 18 years, and those below 15 years of age represented 70.0%. The mean ± SD Lenke classification was 3.20 ± 1.74, while number vertebrae was 10.35 ± 1.66 [Table 1].

The primary Cobb angle ranged between 45 and 85°, while the secondary Cobb angle ranged between 0 to 50° before surgery. There was significant reduction of both primary and secondary Cobb angles after than before surgery [table 2].

The shoulder imbalance was reported in all patients perioperatively, that was absent in all but one patient had slight elevation of the right shoulder after surgery. In addition, all had pelvic tilt before surgery that was absent postoperatively except for two patients who had slight tilt with significant improvement after surgery [table 3].

The number fused segment [1] was in 20 [100.0%] of the studied cases. There were 20 [100%] had surgical techniques [Spondylo-desis].

There were 19 [95.0%] of the studied cases had no postoperative complications and only 1 [5.0%] had postoperative complications [hypo-volemic shock]. The mean Cincinnati correction index of the studied cases [Postoperative] was -9.04 ± 7.42 SD with range [-31.30 – -2.0].

The operative time ranged between 2.30 and 5.0 hours, while blood loss ranged between 300 and 1000.0 ml. the mean curve corrective percentage was 88.33 ± 12.99, while the mean loss of correction ranged between 0 and 35 degrees [table 4].

Table [1]: Distribution of the study cases according to patient demographics, Lenke classification and number vertebrae [n=20]

Variables		Statistics
Sex [n, %]	Male	4 [20.0%]
	Female	16 [80.0%]
Age [years]	Mean ± SD	13.15 ± 2.16
	Min. – Max.	10.0 – 18.0
Age group [n, %]	< 15	14 [70.0%]
	≥ 15	6 [30.0%]
Lenke Classification	Mean ± SD	3.20 ± 1.74
	Min. – Max.	1.0 – 5.0
	Median [IQR]	3.0 [1.0 – 5.0]
Number vertebrae	Mean ± SD	10.35 ± 1.66
	Min. – Max.	7.0 – 12.0
	Median [IQR]	10.0 [9.50 – 12.0]

Table [2]: Descriptive analysis of the study cases according to Primary and Secondary Cobb before and after treatment

		Preoperative	Postoperative	Test	p
Primary Cobb	Min. – Max.	45.0 – 85.0	0.0 – 30.0	3.931	**<0.001***
	Mean ± SD.	58.75 ± 13.50	6.75 ± 7.83		
	Median [IQR]	55.0 [46.0–70.0]	7.50 [0.0–10.0]		
Secondary Cobb	Min. – Max.	0.0 – 50.0	0.0 – 10.0	2.041	**0.041***
	Mean ± SD.	9.75 ± 17.73	6.0 ± 4.18		
	Median [IQR]	0.0 [0.0 – 15.0]	5.0 [5.0 – 10.0]		

Table [3]: Distribution of the study cases according to pre- and post-operative global balance and tilt

		Preoperative		Postoperative		Test	p
		No.	%	No.	%		
Global balance	Shoulder imbalance	20	100.0	0	0.0	4.37	**<0.001***
	Balanced shoulder	0	0.0	19	95.0		
	Slight elevated Rt. Shoulder	0	0.0	1	5.0		
Tilt	No tilt	0	0.0	18	90.0	4.30	**<0.001***
	Pelvic tilt	20	100.0	0	0.0		
	Slight tilt	0	0.0	2	10.0		

Table [4]: Descriptive analysis of the study cases according to Operative data

	Min. – Max.	Mean ± SD.	Median [IQR]
Operative time [hours]	2.30 – 5.0	3.19 ± 0.65	3.0 [3.0–3.30]
Blood loss [cm]	300.0 – 1000.0	585.0 ± 200.72	500.0 [500–600]
Curve correction [%]	53.80 – 100.0	88.33 ± 12.99	90.75 [78.85–100.0]
Loss of correction [°]	0.0 – 35.0	7.11 ± 8.71	5.0 [0.0–10.0]

DISCUSSION

Scoliosis is defined as a lateral spinal abnormality of the spinal curve provided that the Cobb angle of ≥10°. It may be primary or secondary. The primary [idiopathic] type mainly classified according to patient's age. However, the secondary type classified according to the etiology. Different causes were reported for secondary type [e.g., neuromuscular, congenital, developmental, or tumors] [16]. The primary type affects about 80.0% of all cases [17]. Girls were more affected than boys by AIS [18]. King introduced a classification system based on coronal radiographs and differentiating five types and recommended the specific levels of arthrodesis [19]. Subsequently, **Lenke *et al***. developed a new AIS classification system, based on the coronal and sagittal plans radiographs [20]. The AIS surgical treatment involves instrumentation to correct and stabilize vertebrates with meticulous spinal arthrodesis

by bone grafting. The main aims of AIS surgery are to re-correct the curve, get a balanced spine, and to improve cosmosis. This was achieved by different approaches [e.g., anterior, posterior or combined] [21]. AIS surgery witnessed introduction of new surgical techniques, use of pedicle screws, new techniques to reduce the curve, use of bone substitutes, blood conservation methods, and spinal cord monitoring. These advances have added to the complexity of the choice of surgical option [22]. There is little evidence to support the most reasonable treatment option. Ethical concerns are against randomized control trials in AIS. In addition, the small number of patients available for treatment in each center, adds to the challenges of these trials. Thus, the high-quality evidence is difficult to be established [23].

The aim of this study was to assess the result of surgical correction of adolescent idiopathic scoliosis clinically, radiologically and functionally.

In this study we demonstrated that there were 4 males and 16 females with mean age was 13.15 ± 2.16 years. This age was typical for adolescent scoliosis presentation. We can explain this unexpected percentage by the fact that most females sought medical advice and correction early in the course of the disease before the curve has reached such a degree. **Rahma *et al*.** [24] found that there were 16 male patients and 16 female patients [n = 32]. The mean age at presentation for patients was 13.63 years [range: 10–17]. In the **Ege *et al*.** [25], series [posterior only], 26 of 29 patients were females [n = 29]. The mean age was 14.6 years [12–28 years] at the time of surgery. **Hamzaoglu *et al*.** [26] study [posterior only] revealed that, there were four males and 11 females [n = 15]. The average age at the time of surgery was 17.8 years.

In this study both primary and secondary Cobbs were significantly reduced after than before surgery. **Rahma *et al*.** [24] found that the mean preoperative Cobb angle was 96.75 ± 20.59 and this was corrected to 80.69 ± 20.36 with a flexibility index of 16%. **Ahmed *et al*.** [27] found that the mean Cobb angle of thoracic curve was 59° for all patients submitted to thoracotomy with anterior or posterior arthrodesis, which showed a significant decrease after surgery to 39°, with a correction rate of about 31%. Data collected from other series using the combined approach revealed that in the **Bullmann *et al*.** [28] series [combined], the preoperative Cobb angle of the curve was 93.4 ± 12.2 [range: 80–122] and corrected to 72.1 ± 17.1 [range: 48–118] on bending films [flexibility is 23%]. In the **Li *et al*.** [29] study [combined], the immediate postoperative mean Cobb angle was 50.5°, with a correction rate of 48.6%.

Mariconda *et al*. [30] study showed that**,** there was a significant reduction in thoracic and lumbar angles with marked reduction in the rib hump, one year after surgery**. Mueller *et al*.** [31] found that the angle of the thoracic curve was 31.0º, with a final correction rate of 50.3%. The mean preoperative lumbar curve was 43.5º. Postoperatively, the lumbar curve angle was reduced to 16.3º, with a correction rate of 62.5%. **Maruyama *et al*.** [32] found that Cobb angle at the first postoperative visit was 48.5°±9.3°, the age at surgery was 16.0±2.6 years and Cobb angle just before surgery was 62.2° ± 8.5°.

All clinical parameters in the current series were significantly improved after intervention, and this improvement was more or less maintained during the follow-up period, 95.0% had balanced shoulder and only [5.0%] had slight elevated right shoulder. No postoperative tilt reported among 18 [90.0%] and 2 [10.0%] had slight tilt. **Abdelaziz *et al*.** [33] found that the surgical correction elicited a significant reduction in the Cobb's angle and pelvic tilt with significant increase in the lumbar lordosis reflecting the successful outcomes of the surgery.

In relation to clinical follow-up, **Rahma *et al*.** [24] found that rib hump was reduced from 16.81° preoperatively to 3.94° postoperatively without significant changes during follow-up [76.5% correction]. Shoulder imbalance was reduced from 4.44° preoperatively to −0.88° postoperatively without significant changes during follow-up [100% correction]. Waistline asymmetry was reduced from 0.75 pre-operatively to 0.20 postoperatively without significant changes during follow-up [73% correction]. Trunk shift was reduced from 2.31° preoperatively to 0.88° postoperatively without significant changes during follow-up [62% correction]. In the **Hamzaoglu *et al*.** [26] study [posterior only], shoulder imbalance was reduced in all patients from 10 ° to 1° without loss of correction during follow-up [90% correction].

Bullmann *et al.* [28] series [combined] revealed that, the rib hump was decreased from 23 to 11° [52% correction rate] without any correction loss at the final follow-up visit. The lumbar hump was corrected from 10 to 3° [70% correction rate] without relevant changes during follow-up.

In this study we illustrated that the mean Lenke classification was 3.20 ± 1.74 with range [1.0 – 5.0]. The mean Number vertebra was 10.35 ± 1.66. According to the prevalence of different Lenke types; the **Rahma *et al.*** [24] study included six main thoracic curves [type 1] [18.8%], six double thoracic curves [type 2] [18.8%], 10 double major [type 3] [31.3%], six triple major curves [type 4] [18.8%] and four thoracolumbar/thoracic curves [12.5%] [table 6]. The **Dobbs *et al.*** [34] study [combined] included five patients [25%] with type 2 curves [double thoracic], 10 patients [50%] with type 3 curves [double major] and five patients [25%] with type 4 curves [triple major]. The **Li *et al.*** [29] study [combined] included three patients [10%] with a type 1 curve [single thoracic curve], six patients [19%] with type 2 cures [double thoracic curves], 16 patients [52%] with type 3 curves [double major curves] and six patients [19%] with type 4 curves [triple major curves].

In study in our hands, we demonstrated that the number fused segment was 1 in 20 [100.0%] of the studied cases. There were 20 [100%] had surgical techniques [Spondylodesis]. **Rahma *et al.*** [24] found that the mean number of fused segments, the mean number of fused segments in our study was 14 ± 1.15 [range: 12–17]. In the **Bullmann *et al.*** [28] series [combined], the number of fused segments was 11.2 ± 1.2 [range: 9–13]. Meanwhile, in the **Li *et al.*** [29] series [combined], the mean number of fused segments was 13 [range: 10–14].

In this work, we demonstrated that the mean operative time was 3.19 ± 0.65 SD with range [2.30 – 5.0] and the mean blood loss was 585.0 ± 200.72 SD with range [300.0 – 1000.0], these two variables were shown to decrease in proportion to the experience of the surgeon. In terms of operative time and average blood loss, the average surgery time in the **Rahma *et al.*** [24] study was 318.75 ± 93.51 min, while the mean blood loss was 2390 ± 500 ml. In the **Bullmann *et al.*** [28] study [combined], the mean operating time was 412 ± 78 min [range: 250–540 min]. The mean intraoperative blood loss was 1533 ± 963 ml [range: 250–4500 ml]. In nearly all cases, the cell saver system was used with an average retransfusion of 372 ml [0–2100 ml]. Furthermore, patients received 2.2 units [0–4 units] of predonated blood on average.

Meanwhile, in the **Li *et al.*** [29] study [combined], the mean duration of surgery was 480 min [range: 360–630 min] and the mean intraoperative blood loss was 1648 ml [range: 1200–2000 ml]. The mean blood loss in our study was less than expected [585 ml], and this mean was lower than other matched literature of Bullmann [1533 ml] and Li [1648 ml]. This was statistically significant [$P < 0.001$]. This may be explained by the surgical technique of extensive posterior release, decortication for fusion and due to the mean number of fused segments in their series.

Our results showed that there were 19 [95.0%] of the studied cases had no postoperative complications and only 1 [5.0%] had postoperative complications [hypovolemic shock]. **Rahma *et al.*** [24] found that two patients developed permanent paraplegia [neurological complications 6.3%], two patients developed superficial infection [infection 6.3%], eight patients had cosmetic complications [six shoulder imbalance, two coronal imbalances with proximal junctional kyphosis, cosmetic complications 25.0%] and two patients required temporary respiratory support [respiratory complications 6.3%].

In the **Bullmann *et al.*** [28], one patient needed an additional chest tube insertion on the contralateral side due to extensive pleural effusion on the 3rd postoperative day. Another one had ileus, and treated conservatively. One patient had polyuria, which resolved by conservative therapy. A superficial wound revision in another one patient was required on the 3rd postoperative day due to a torn drain. No neurological complications or deep wound infections were recorded. However, at the 6th month after surgery, one patient had a fracture of a rod in the cephalad segment without breakage of the posterior rods, without any loss of correction or signs of pseudarthrosis. Four patients needed temporary ventilator support.

In the **Li *et al.*** [29] study [combined], one patient had pneumothorax, one had hemothorax, one had pleural effusion, one had pneumonia, one had superficial infection, and one developed transient gastrointestinal tract complications

[13% respiratory complications, 3% infection complications, 3% other complications].

In this study, we illustrated that the mean curve correction was 88.33 ± 12.99 with range [53.80 – 100.0]. The mean loss of correction was 7.11 ± 8.71 with range [0.0 – 35.0]. **Rahma *et al.*** [24] found that in terms of immediate and long-term postoperative correction, there was a significant correction [P < 0.001] of the mean preoperative Cobb angle from 96.75 ± 20.59 to a mean postoperative Cobb angle 29.75 ± 16.07, about 69% correction, which increased slightly to 31.25 ± 16.02 after follow-up, about 1% loss of correction [follow-up one year].

In the **Bullmann *et al.*** [28] series [combined], primary curve correction rate was 67%, with a mean postoperative Cobb angle of 31 ± 11.8°. The final correction was 65%, with a mean loss of correction of 1.9° or 2% [total follow-up 3 years]. **Li *et al.*** [29] found that the long-term postoperative mean Cobb angle was 53.7° for a correction loss of 3° or 3% [follow-up 3.5 years].

There are several weaknesses in this study included relatively small sample sizes and no comparative groups., and the corrections attained from the posteromedial translation will require future comparison to other reduction methods assessed with low dose stereo-radiography. Although the follow-up period was short, it is accepted that loss of correction after fusion in AIS occurs during the first year after surgery and that results of spine surgery can be evaluated after a minimum follow-up of 2 years.

In this study we concluded that surgical treatment of AIS had the highest probability to achieve better Cobb angle correction and lower complication rate. Moreover, our mean correction 88.33 ± 12.99 was one of the best correction rates among other matched studies, and loss of correction percentage [1%] was the least among other matched literature. Hypo-volemic shock was encountered in our study only and were mostly in one patient with a very large preoperative Cobb angle.

Conflict of Interest and Financial Disclosure: None.

REFERENCES

1. Costa L, Schlosser TPC, Jimale H, Homans JF, Kruyt MC, Castelein RM. The Effectiveness of Different Concepts of Bracing in Adolescent Idiopathic Scoliosis [AIS]: A Systematic Review and Meta-Analysis. J Clin Med. 2021 May 15; 10[10]:2145. doi: 10.3390/ jcm10102145.
2. Harris AB, Gottlich C, Puvanesarajah V, Marrache M, Raad M, Petrusky O, *et al*. Factors associated with extended length of stay in patients undergoing posterior spinal fusion for adolescent idiopathic scoliosis. Spine Deform. 2020 Apr;8[2]:187-193. doi: 10.1007/s43390-019-00008-0.
3. Sharma S, Bünger CE, Andersen T, Sun H, Wu C, Hansen ES. Do postoperative radiographically verified technical success, improved cosmesis, and trunk shift corroborate with patient-reported outcomes in Lenke 1C adolescent idiopathic scoliosis? Eur Spine J. 2015; 24[7]:1462-72. doi: 10.1007/s00586-014-3688-x.
4. Herdea A, Stancu TA, Ulici A, Lungu CN, Dragomirescu MC, Charkaoui A. Quality of Life Evaluation Using SRS-30 Score for Operated Children and Adolescent Idiopathic Scoliosis. Medicina [Kaunas]. 2022 May 18;58[5]:674. doi: 10.3390/ medicina58050674.
5. Rodrigues LMR, Gotfryd AO, Machado AN, Defino M, Asano LYJ. Adolescent idiopathic scoliosis: surgical treatment and quality of life. Acta Ortop Bras. 2017 May-Jun; 25[3]:85-89. doi: 10.1590/1413-785220172503157788.
6. Roberts DW, Savage JW, Schwartz DG, Carreon LY, Sucato DJ, Sanders JO, *et al*.; Spinal Deformity Study Group; Sarwark JF. Male-female differences in Scoliosis Research Society-30 scores in adolescent idiopathic scoliosis. Spine [Phila Pa 1976]. 2011 Jan 1; 36[1]:E53-9. doi: 10.1097/BRS.0b013e3181ef9efc.
7. Archer JE, Baird C, Gardner A, Rushton AB, Heneghan NR. Evaluating measures of quality of life in adult scoliosis: a systematic review and narrative synthesis. Spine Deform. 2022 Sep; 10[5]:991-1002. doi: 10. 1007/s43390-022-00498-5.
8. Mueller FJ, Gluch H. Adolescent idiopathic scoliosis [AIS] treated with arthrodesis and posterior titanium instrumentation: 8 to 12 years follow up without late infection. Scoliosis. 2009 Aug 12;4:16. doi: 10.1186/ 1748-7161-4-16.
9. Charalampidis A, Rundberg L, Möller H, Gerdhem P. Predictors of persistent postoperative pain after surgery for idiopathic scoliosis. J Child Orthop. 2021 Oct 1;15[5]: 458-463. doi: 10.1302/1863-2548.15.210090.
10. Glotzbecker MP, St Hilaire TA, Pawelek JB, Thompson GH, Vitale MG; Children's Spine Study Group; Growing Spine Study Group. Best Practice Guidelines for Surgical Site Infection Prevention with Surgical Treatment of Early Onset Scoliosis. J Pediatr Orthop. 2019 Sep;39[8]:e602-e607. doi: 10.1097/BPO. 0000000000001079.
11. Alzayed ZS, Majid OB, Alqahtani SA, Saba I, Al Rushud MA, Eissa AT. Young Patients' Satisfaction Following the Correction of Adolescent Idiopathic Scoliosis in Saudi Arabia: A Cross-Sectional Study. Cureus. 2022 Oct 8;14[10]:e30058. doi: 10.7759/cureus. 30058.
12. Newton PO, Ohashi M, Bastrom TP, Bartley CE, Yaszay B, Marks MC, *et al*. Prospective 10-year follow-up assessment of spinal fusions for thoracic AIS:

radiographic and clinical outcomes. Spine Deform. 2020 Feb;8[1]:57-66. doi: 10.1007/s43390-019-00015-1.

13. Konieczny MR, Senyurt H, Krauspe R. Epidemiology of adolescent idiopathic scoliosis. J Child Orthop. 2013 Feb;7[1]:3-9. doi: 10.1007/s11832-012-0457-4.

14. Cobb JR. Outline for the study of scoliosis. Instr Course Lect AAOS. 1948; 5:261-75.

15. Slattery C, Verma K. Classifications in Brief: The Lenke Classification for Adolescent Idiopathic Scoliosis. Clin Orthop Relat Res. 2018 Nov;476[11]: 2271-2276. doi: 10.1097/CORR.0000000000000405.

16. Oba H, Takahashi J, Kobayashi S, Ohba T, Ikegami S, Kuraishi S, *et al*. Upper instrumented vertebra to the right of the lowest instrumented vertebra as a predictor of an increase in the main thoracic curve after selective posterior fusion for the thoraco-lumbar/lumbar curve in Lenke type 5C adolescent idiopathic scoliosis: multicenter study on the relationship between fusion area and surgical outcome. J Neurosurg Spine. 2019 Aug 23:1-8. doi: 10.3171/2019.5.SPINE-181469.

17. Romberg K, Danielsson A, Olsén MF, Kjellby-Wendt G. Spinal mobility and muscle function in middle-aged patients treated for early onset idiopathic scoliosis: compared with untreated and treated adolescent onset patients. Spine Deform. 2022 Sep;10[5]:1085-1095. doi: 10.1007/s43390-022-00487-8.

18. Aulie VS, Halvorsen VB, Brox JI. Motor abilities in 182 children treated for idiopathic clubfoot: a comparison between the traditional and the Ponseti method and controls. J Child Orthop. 2018 Aug 1;12[4]:383-389. doi: 10.1302/1863-2548.12.170195.

19. Dimeglio A, Canavese F. The immature spine: growth and idiopathic scoliosis. Ann Transl Med. 2020 Jan;8[2]:22. doi: 10.21037/atm.2019.11.134.

20. Beauchamp EC, Lenke LG, Cerpa M, Newton PO, Kelly MP, Blanke KM; Harms Study Group Investigators. Selecting the "Touched Vertebra" as the Lowest Instrumented Vertebra in Patients with Lenke Type-1 and 2 Curves: Radiographic Results After a Minimum 5-Year Follow-up. J Bone Joint Surg Am. 2020 Nov 18; 102[22]:1966-1973. doi: 10.2106/ JBJS.19.01485.

21. Wang Q, Li M, Lou HME, Wong MS, He CQ. [Three-dimensional Ultrasound Assessment on Apical Vertebral Rotation in Patients with Adolescent Idiopathic Scoliosis:Reliability and Validity Analyses]. Sichuan Da Xue Xue Bao Yi Xue Ban. 2018 May;49[3]:436-441. Chinese [English Abstract]. PMID: 30014649.

22. Al-Mohrej OA, Aldakhil SS, Al-Rabiah MA, Al-Rabiah AM. Surgical treatment of adolescent idiopathic scoliosis: Complications. Ann Med Surg [Lond]. 2020 Feb 24;52:19-23. doi: 10.1016/j.amsu.2020.02.004.

23. Bao H, Shu S, Yan P, Liu S, Liu Z, Zhu Z, Qian B, Qiu Y. Fifteen Years and 2530 Patients: The Evolution of Instrumentation, Surgical Strategies, and Outcomes in Adolescent Idiopathic Scoliosis in a Single Institution. World Neurosurg. 2018 Dec; 120:e24-e32. doi: 10. 1016/j.wneu.2018.07.054.

24. Rahma HY, Habib HA, Negm HM, Sheha AF, Salim MA [2021]. Assessment of surgical outcome of adolescent idiopathic scoliosis. Menoufia Med J. 2021; 34[4]: 1439-1444. doi: 10.4103/mmj.mmj_32_21

25. Ege T, Bilgic S, Ersen O, Yurttas Y, Oguz E, Sehirlioglu A, Kazanci A. The importance and efficacy of posterior only instrumentation and fusion for severe idiopathic scoliosis. Turk Neurosurg. 2012;22[5]:641-4. doi: 10.5137/1019-5149.JTN.6038-12.1.

26. Hamzaoglu A, Ozturk C, Aydogan M, Tezer M, Aksu N, Bruno MB. Posterior only pedicle screw instrumentation with intraoperative halo-femoral traction in the surgical treatment of severe scoliosis [>100 degrees]. Spine [Phila Pa 1976]. 2008 Apr 20; 33[9]:979-83. doi: 10. 1097/BRS.0b013e31816c8b17.

27. Ahmed MM, Abdelhalim HA, Elamir RM. Pulmonary function before and after surgical correction of scoliosis. Egypt J Bronchol 2021; 15[1]:1-5. doi: 10.1186/s43168-021-00071-0.

28. Bullmann V, Halm HF, Schulte T, Lerner T, Weber TP, Liljenqvist UR. Combined anterior and posterior instrumentation in severe and rigid idiopathic scoliosis. Eur Spine J. 2006 Apr;15[4]:440-8. doi: 10.1007/ s00586-005-1016-1.

29. Li M, Ni J, Li Y, Fang X, Gu S, Zhang Z, Zhu X. Single-staged anterior and posterior spinal fusion: a safe and effective alternative for severe and rigid adolescent idiopathic scoliosis in China. J Paediatr Child Health. 2009 May;45[5]:246-53. doi: 10.1111/j.1440.1754.2009. 01491.x.

30. Mariconda M, Andolfi C, Cerbasi S, Servodidio V. Effect of surgical correction of adolescent idiopathic scoliosis on the quality of life: a prospective study with a minimum 5-year follow-up. Eur Spine J. 2016 Oct; 25[10]:3331-3340. doi: 10.1007/s00586-016-4510-8.

31. Mueller FJ, Gluch H, Wimmer C. Long-Term Outcome of Surgical Treatment in Adolescent Idiopathic Scoliosis. Chapter 14, In: Recent Advances in Scoliosis 2012, Dr Theodoros Grivas [Ed.], ISBN: 978-953-51-0595-4, pp 235-260.

32. Maruyama T, Kitagawa T, Takeshita K, Mochizuki K, Nakamura K. Conservative treatment for adolescent idiopathic scoliosis: can it reduce the incidence of surgical treatment? Pediatr Rehabil. 2003; 6[3-4]:215-9. doi: 10.1080/13638490310001642748.

33. Abdelaziz MA, Ali SH, AlQazaz MY, Elshatoury HA, Abou-Madawi A. Evaluation of Quality of Life [QoL] of Patients with Adolescent Idiopathic Scoliosis [AIS] after Surgical Correction. Egy Spine J 2020, 33[1], 2-13. doi: 10.21608/esj.2020.25269.1126.

34. Dobbs MB, Lenke LG, Kim YJ, Luhmann SJ, Bridwell KH. Anterior/posterior spinal instrumentation versus posterior instrumentation alone for the treatment of adolescent idiopathic scoliotic curves more than 90 degrees. Spine [Phila Pa 1976]. 2006 Sep 15;31[20]: 2386-91. doi: 10.1097/01.brs.0000238965.81013.c5.

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