Case Report

Operative Results of Adolescent Idiopathic Scoliosis in Lerdsin Hospital

Sombat Kunakornsawat MD*, Ittirat Watcharananan MD*,
Rachata Tungsiripat MD*, Thavat Prasartritha MD*

** Center of Excellence in Orthopedics, Lerdsin Hospital, Bangkok*

Objective: *Evaluate the results of the posterior instrumentation for the correction of adolescent idiopathic scoliosis (AIS) in Lerdsin Hospital.*
Material and Method: *A retrospective study was conducted to determine the effectiveness of surgical treatment of idiopathic scoliosis in Lerdsin Hospital. The pre-operative, immediate post operative, and the most recent follow-up (minimum 2 years) x-ray of 17 patients were evaluated for curve correction and spinal balance.*
Result: *The present study found that the curvatures in thoracic King type II and III were corrected by about 58% post operatively. The curve progressed 3 degrees (5%) at the end of 2 years. For lumbar curve in King types I and II, there was the correction of 51% and 59%. After 2 years, the curve progressed around 6 degrees (7%) and 8 degrees (14%). Trunk balance was corrected by 60% in King type III. Degrees of thoracic kyphosis was decreased about 4 degrees.*
Conclusion: *Frontal and sagittal thoracic and lumbar curve correction can be satisfactorily obtained by posterior spinal correction with instrumentation.*

Keywords: *Adolescent idiopathic scoliosis, Posterior instrumentation, Cobb's angle*

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The incidence of idiopathic scoliosis with Cobb angle more than 10□ is 2-3%. Girl is 4 times more likely to be affected by this condition[1]. Less than 10% of these patients require surgical treatment. If these patients are not treated, the curve progresses and leads to abnormal posture, loss of trunk balance and severe deformity of the thoracic wall. It causes a respiratory problem in some patients. The goal of treatment is to correct the alignment and to prevent curve progression. The different studies, according to different factors, report different results of this surgery. The present study aimed to evaluate the results of the posterior instrumentation for the correction of adolescent idiopathic scoliosis (AIS) in Lerdsin Hospital.

Material and Method

Hospital records and x-rays findings of idiopathic scoliosis patients, who had the posterior instrumentation for the correction of AIS at Lerdsin Hospital between March 1999 and December 2000, were retrieved. The exclusion criterion was the patients with less than 2 years follow-up period. The patients were classified according to King's classification[2]. Radiographic parameters were verified as follows. Cobb angles were measured in x-ray AP standing view in pre-operative, post operative and the follow-up period. Curve flexibility was evaluated using side bending or traction films. Frontal plane balance was studied by two methods. The first was the plumb line technique. A plumb line was dropped from the middle of C7 vertebral body. Its position with respect to mid sacral line was noted. The other was the measurement of the lateral trunk shift[3]. A horizontal line was drawn from the outer border of the rib corresponding to the apical vertebra. From there, a line perpendicular and bisecting to it was drawn. The distance between the perpendicular line and the mid-sacral line was the lateral trunk shift. Sagittal contour was measured in lateral view. Data were presented as case report and summarized by frequency tables with mean (pre-post operation) and range.

Correspondence to : Kunakornsawat S, Center of Excellence in Orthopaedics, Lerdsin Hospital, Bangkok 10500, Thailand.

Table 1. Thoracic curve correction in frontal plane

	Type of curve (n = 17)		
	I	II	III
Number of patient	1	7	9
Mean pre-operative thoracic curve (degree)	42	60	58
(range)		(45-70)	(40-68)
Mean pre-operative thoracic side bending (degree)	31	39	39
Mean percent correction	26%	35%	32%
Mean post-operative thoracic curve (degree)	28	25	24
(range)		(17-40)	(13-42)
Mean percent correction	34%	58%	58%
Mean follow-up thoracic curve (degree)	33	28	27
Mean percent correction (degree, percent)	5 (12%)	3 (5%)	3 (5%)

Results

There were 26 adolescents with idiopathic scoliosis operated at Lerdsin Hospital between March 1999 and December 2000. Nine patients were excluded because of inadequate follow-up time. The duration of the follow-up period was at least 2 years (range 2-3.2 years). There were one male and 16 females. The average age at the time of surgery was 15 years (ranged from 12 to 20 years). According to King's classification[2], one patient was classified as King type I, seven patients as type II and nine patients as type III (single thoracic curve). The pre-operation side bending corrected the curve approximately 30-40% in all groups.

For frontal plane correction and balance, mean thoracic curve improvement were 28º (34%), 25º (58%) and 24º (58%) in King's I, II and III group respectively. After two years, the curve correction loss was 5º (12%), 3º (5%) and 3º (5%) (Table 1). The improvement of lumbar curve in type I and type II group was 59% and 51%. The correction loss was 6º (7%) and 8º (14%) (Table 3).

There was also clear-cut improvement in trunk balance in the type I group. Lateral trunk shift was corrected about 60%, from 3.3 cm to 1.2 cm. The plumb line test showed correction from 1.9 cm pre-operative to 1.1 cm after operation. For type II, the lateral trunk shift toward the right decreased from 2 cm pre-operatively to 1.2 cm post operatively. In five cases, the shift towards the left was noted. Mean correction from the plumb line method was 0.6 cm (1.7 cm to 1.1 cm). For type I, trunk balance was improved 0.7 cm in lateral shift method and 0.8 cm in plumb line method.

For sagittal plane correction, mean thoracic kyphosis decreased 4º. In the other one King type II

Table 2. Frontal plane balance correction

	Type of curve		
	I	II	III
Lateral trunk shift (cm)			
- Pre-operative	1.8	2.4	3.3
- Post-operative	1.1	1.2	1.3
- Follow-up	1.0	1.1	1.3
C7 over the sacrum (decompensation)			
- Pre-operative	1.7	1.7	1.9
- Post-operative	0.9	1.1	1.1

Table 3. Lumbar curve correction in frontal plane

	Type of curve	
	I	II
Number of patient	1	7
Mean pre-operative lumbar curve (degree)	78	54
(range)		(29-63)
Mean pre-operative lumbar side bending (degree)	36	29
Mean percent correction	53%	46%
Mean post-operative lumbar curve (degree)	38	22
(range)		(15-36)
Percent correction	51%	59%
Mean follow-up lumbar curve	44	30
Percent correction loss (degree, percent)	6 (7%)	8 (14%)

patient (no. 17), thoracic kyphosis decreased from 25º to 14º post operatively. Lumbar lordosis of patient no. 4 decreased from 28º to 16º. Lumbar lordosis of no. 3 patient increased from 18º to 35º. The increase in thoracic kyphosis, from 14º to 18º, was found in three patients with thoracic hypokyphosis (less than 20º).

One patient had the loosening of the upper hook of Harrington rod one and half years after the operation. However, there was no increase in Cobb angle due to the loosening of the hook at the most recent follow-up. Two patients (no. 11, 13) had increased lumbar decompensation. Patient no. 13 had other surgery (extend rod fusion to L4) because of the progression of the curve of 9º at the immediate post-operative to 22º at the end of the second year. The Cobb angle after the second operation was 9º and is still under follow-up at the end of the present study. No. 22 patient had increased lumbar lordosis and an increase in lumbar curvature from 28º immediately after the operation to 37º at the end of 2 years follow-up was noted in this case. At the conclusion of the present study, this patient is still under follow-up. Other than the aforementioned cases, no serious procedure-related complications such as injury to spinal cord or nerves, severe infections or pseudoarthrosis were noted in the present study (Table 4).

Case study

Patient number 9

A fifteen year old Thai girl had progressive scoliosis since she was 12 years old. Radiographic finding showed right thoracic scoliosis classified as King Type III with Cobb angle 68º (T6-L1). Cure Flexibility was evaluated by traction film and curve was corrected to 35º.

The patient underwent posterior spinal fusion with USS system from T4 to L2. The curve was measured 24º post operatively. The curve correction was 64% and trunk balance was good correction. Kyphotic angle decreased from 34º to 30º. There was 4º of curve progression in coronal plane at the end of 2 years follow-up but no decompensation.

Patient number 13

A thirteen year-old Thai girl had scoliosis 2 years previously. Her back had progressive scoliosis since then. Radiographic finding showed right thoracic scoliosis classified by King type III with Cobb angle 58º (T8-L1). The Cobb angle was corrected to 44º by Traction film. This patient underwent posterior spinal fusion with Isola from T4-L1. Post operative cure was corrected to 38º and had 9º of lumbar decompensatory curve. The lumbar decompensatory curve progressed

Before operation

After correction

Fig. 1 Radiographic finding of patient no. 9

Table 4. Patient Data

No.	Sex	Age at surgery	King Type	Instrument	Level of instrument	Level of curve	Cobb angle				Lateral trunk shift			C_7 Over Sacrum		Sagittal plane			
							Pre op.	Pre op. Bend	Post Imm	Last F/U	Pre op.	Post Imm	Last F/U	Pre op.	Post op.	T pre	T post	L pre	L post
1	F	17	III	Isola	T_3-L_1	T_3-T_{12}	56°	40°	16°	18°	4.2	1.2	0.9	1.9	1.2	28°	25°		
2	F	12	III	H.rod & Sub.wiring	T_3-L_2	T_7-T_{12}	60°	46°	20°	25°	3.0	1.7	1.7	2.5	2.0	42°	38°		
3	F	14	II	USS	T_3-L_2	T_5-T_{11}	45°	32°	18°	14°	1.4	0.6	0.5	1.2	1.0	22°	20°		
						T_{12}-L_4	35°	24°	20°	28°								18°	35°
4	F	13	II	Isola	T_3-L_3	T_4-T_{10}	55°	45°	17°	19°	1.6	0.6	0.6	1.1	0.5	24°	22°		
						T_{11}-L_3	63°	34°	14°	15°								28°	16°
5	F	20	III	Isola	T_2-L_1	T_2-T_{11}	55°	34°	13°	14°	2.9	0.9	0.9	2.0	1.2	35°	32°		
6	F	15	III	H.&Luque rod	T_2-L_2	T_4-L_2	68°	36°	20°	24°	3.6	1.4	1.4	1.6	0.8	26°	25°		
7	F	16	II	Isola	T_3-L_3	T_5-T_{11}	70°	42°	30°	34°	2.2	1.2	1.2	1.8	1.0	9°	18°		
						T_{12}-L_4	64°	28°	36°	40°								20°	12°
8	F	13	II	Isola	T_4-L_5	T_7-T_{12}	55°	29°	30°	35°	2.1	1.1	1.2	1.2	1.1	20°	18°		
						L_1-L_4	45°	25°	15°	19°								18°	24°
9	F	15	III	USS C wiring	T_4-L_2	T_6-L_1	68°	35°	24°	28°	3.2	1.2	1.1	1.4	0.5	34°	30°		
10	F	13	III	Isola	T_3-L_2	T_5-T_{12}	40°	30°	18°	21°	3.4	1.1	1.1	1.5	0.7	30°	28°		
11	F	20	II	Isola	T_3-L_1	T_5-T_{10}	68°	52°	40°	42°	2.4	1.2	1.2	1.5	1.4	15°	17°		
						T_{11}-L_3	60°	35°	28°	37°									
12	F	13	II	Harrington rod	T_4-L_3	T_5-T_{11}	65°	30°	25°	28°	2.2	1.0	1.2	2.5	0.8	30°	32°		
						T_{12}-L_4	50°	15°	12°	16°								45°	42°
13	F	13	III	Isola	T_4-L_1	T_8-L_1	58°	44°	38°	38°	2.7	1.2	1.2	2.3	1.5	28°	25°		
				(Decompensation of Lumbar curve 9° to 22°)					9°	22°									
				After extend rod to L_4						9°									
14	F	20	III	Isola	T_2-L_2	T_6-T_{12}	55°	48°	25°	30°	3.8	1.1	0.9	2.1	0.8	30°	24°		
15	M	16	III	Isola	T_2-L_1	T_6-T_{12}	65°	34°	42°	45°	2.9	2.1	2.1	1.8	1.2	22°	20°		
16	F	20	I	H.& Sub. wiring	T_5-L_4	T_2-T_8	42°	31°	28°	33°	1.8	1.1	1.0	1.7	0.9	24°	21°		
						T_9-L_3	78°	36°	38°	44°								25°	20°
17	F	13	II	USS C Sub.wiring	T_4-L_2	T_3-T_{11}	64°	47°	20°	26°	4.9	2.0	2.1	2.9	2.1	25°	14°		
						T_{12}-L_3	62°	45°	26°	28°								34°	33°

Lumbar curve decompansation after 2 years Follow up

Re-operation and extended rod to L4

Fig. 2 Radiographic finding of patient no. 13

to 22º after 2 years. The patient underwent re-operation by extending fusion from L1 to L4. The lumber curve was corrected to 9º post operatively

Discussion

Posterior correction and fusion is a method of treatment for AIS. The indication for surgery includes adults who have scoliosis with Cobb angle more than 50□, children with Cobb angle more than 40□ or patients with progressive curve following bracing. The aim of surgery is to stop curve progression and correct the curve to keep balance in frontal and sagittal alignment. The surgical treatment for idiopathic scoliosis by posterior correction with hook rod system has been reported. Curve correction for King types II and III using Cotrel-Dubousset system (CD) were around 54-69% and 59-63% respectively[4-6]. Richard, Herring, and Johnston reported the result of the treatment of AIS using Texas Scottish Rite Hospital instrumentation (TSRH). They found patients with King types III or IV had 65% of curve correction, 54% curve correction for King type II and 50% curve correction for King type I[7]. The average sagittal plane correction using Isola system was 63%[8]. Remms et al[6] found that thoracic curve improvement was approximately 46% after posterior instrumentation with the Universal Spine System (USS). Compared with the present study, the average curve correction was similar.

Average correction loss in the present study was 5% in King type II and type III. Richard also reported that patients who underwent posterior correction and fusion with TSRH system had 12% curve progression in King type II, 14% curve progression in King type III, 13% curve progression in King type I after 2 year follow up[3]. The curve progression following posterior fusion 12% in King type II and 8% in King type III was reported [5]. However, in the 2-year follow-up of the treatment of idiopathic scoliosis by CD system, Shufflebarger and Crawford found no curve progression compared with initial post-operative x-rays[9].

In the present study, one case had re-operation. Though there were no other serious complications such as infection, pseud-arthrosis or neurological deficit, complications in posterior operation in scoliosis were low. Rate of pseud-arthrosis and deep wound infection were around 2% pseud-arthrosis and 2% in posterior instrumentation with Isola system. Re-operation rate was 8%; it was higher during the learning period[8]. Deep infection was found approximately 2% and 5% in the operation using the CD and USS system.

Patient no. 13 had progressive lumbar decompensation following scoliosis correction. Lenke et al reported lumbar decompensation occurring in all King types especially in King type II[4]. Wood et al reported patients who had undergone spine fusion with CD for King-Moe types II and III curve[10]. They concluded that apical derotation relative to the pelvis was inconsistent. They noted segmental rotational changes outside the level of instrumentation. They also mentioned that coronal correction might only be apparent because of the torque and rotation of the entire spinal pelvis axis. Thompson et al found that over correction of the thoracic curve in type II curve transmits rotational forces into the lumbar curve and aggravate the lumbar deformity by reducing its spontaneous correction ability[11]. They recommended not to over-correcting the thoracic curve and fusing as few spine segments as possible, particularly avoiding mobile transition segment to prevent transmission of torsion into the lumbar spine. A brace is used for treatment of decompensation curves if a curve still progresses; fusion should extend to stable vertebra[12]. One patient in the present study (no. 13) underwent fusion down to L1, and lumbar decompensation curve still progressed from 9º to 22º even wearing a brace. This patient had re-operation by extended fusion to L4, and curve was corrected to 9º. The sagittal plane averagely decreased in thoracic kyphosis 4º. However, it increased in-patients who had hypokyphosis (< 20º).

In conclusion, the treatment outcome for adolescent idiopathic scoliosis by posterior correction and instrumentation in Lerdsin Hospital had satisfactory results when compared to the international literature reports. Our reports still need more patient numbers and long-term follow-up in the future.

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ผลการรักษาโดยวิธีการผ่าตัด "ภาวะกระดูกสันหลังคดโดยไม่ทราบสาเหตุ" ในโรงพยาบาลเลิดสิน

สมบัติ คุณากรสวัสดิ์, อิทธิรัตน์ วัชรานานันท์, รัชตะ ตั้งศิริพัฒน์, ธวัช ประสาทฤทธา

การศึกษานี้มีวัตถุประสงค์เพื่อประเมินผลการรักษาการผ่าตัดใส่เหล็กยึดตรึงกระดูกสันหลัง เพื่อแก้ไขภาวะกระดูกสันหลังคดในโรงพยาบาลเลิดสิน โดยใช้ภาพถ่ายเอกซเรย์ ก่อนการผ่าตัด หลังการผ่าตัดและอย่างน้อย 2 ปี หลังผ่าตัด จากผู้ป่วยจำนวน 17 ราย โดยแบ่งความคดกระดูกสันหลังตามวิธีการของ King พบว่า การแก้ไขกระดูกสันหลังส่วนอกของ King type II และ III ได้ค่าเฉลี่ยที่ 58% เมื่อติดตามการรักษาหลัง 2 ปี มีการคดของกระดูกมากขึ้นเฉลี่ยเท่า ๆ กันที่ 3° การแก้ไขกระดูกสันหลังส่วนเอวของ King type I, II เฉลี่ย 51% และ 59% ตามลำดับ และมีการคดของกระดูกมากขึ้น 7%และ 14% trunk balance ดีขึ้น 60% ในกระดูกสันหลังคดชนิด King type III ในแนว sagittal มีการลดลงของ thoracic kyphosis เฉลี่ย 4° ยกเว้นในรายที่มี hypokyphotic (< 20°) พบว่ามากขึ้นเฉลี่ย 4°