ORIGINAL ARTICLE

Case Report
A Comprehensive Rehabilitation Management of Post Operative Idiopathic Adolescent Scoliosis

Didik Febriyanto, Damayanti Tinduh

Department of Physical Medicine and Rehabilitation, Dr. Soetomo Hospital - Airlangga University, Surabaya, Indonesia

ABSTRACT

Objective: Reporting a comprehensive management of physical medicine and rehabilitation of post operative high S curve-idiopathic scoliosis in adolescent.

Methods: Patient was assessed for balance contraction of back muscles with biofeedback (BF), chest expansion and endurance capacity with conversed 6 minute walking test (6 MWT) results to metabolic equivalents (METs), pre and post spinal corrective surgery with Harrington's rod and pedicle screw.

Results: Pre and post surgical and rehabilitation integration programs showed improvements in Cobb's angle (thoracal/lumbar angle was 64°/32° became 20°/5°), chest expansion, spinal muscular balance and strength, and endurance capacity reflected by METS (5.5; 5.78; and 6.2 respectively).

Conclusion: There were improvements in Cobb's angle, chest expansion, spinal muscular balance and strength, and endurance capacity 6 months post therapy.

Keywords: *scoliosis, Cobb's angle, biofeedback, chest expansion, METs*

INTRODUCTION

Scoliosis is a pathologic lateral curvature of the spine, and the deformities occurred in three-dimension manner.[1,2] Scoliosis prevalence is 0.3-2% in the population, with ratio between female and male is 9:1. Adolescent scoliosis is more often found in women (95%). Curve progression is also more pronounced in women. While research conducted by Serianna and Syam[3] at 460 school children aged 7-17 years in Surabaya, obtained 31.5% incidence of scoliosis in which 98.6% were idiopathic, which is the same with other studies.[1,4,5]

Received in March 2013 and accepted for published in April 2013.

Correspondence address: Damayanti Tinduh, Department of Physical Medicine and Rehabilitation, School of Medicine Airlangga University, Jl. Prof. Moestopo 6-8, Surabaya. Email: daniellarosita@yahoo.com

This deformity raises three main complaints, which are cosmetic, pain and cardiopulmonary complications. In addition, since spinal deformity in scoliosis quite progressives, so needs early detection and treatment as soon as possible.[6,7]

Diagnosis and Treatment

Diagnosis is established from anamnesis, general inspection measurements such as weight, height, arm span, cardiopulmonal status, development of secondary sex characteristics, special inspections such as asymmetrical body, shoulder height, Tanner stage for breast development (Fig. 1), breast symmetrical, protrusion of the scapula, ribs, pelvic tilt, alignment of the spine, leg length discrepancy (LLD), curve flexibility, arm span and radiology examinations.[1] Table 1 shows the classification and treatment of Idiopathic Scoliosis.

Table 1. Classification and Treatment of Idiopathic Scoliosis[1]

Classification of Idiopathic Scoliosis	Cobb's Angle	Treatment
Mild	$< 20^0$	Observation and scoliosis specific exercises
Moderate	20^0 to 45^0	Orthoses (Milwaukee or low profile brace) and scoliosis exercise inside and outside the brace
Severe	$> 45^0$	Surgical management, if we wait for surgical proper time of bone maturity, the patient is given a brace/cast followed by exercise therapy

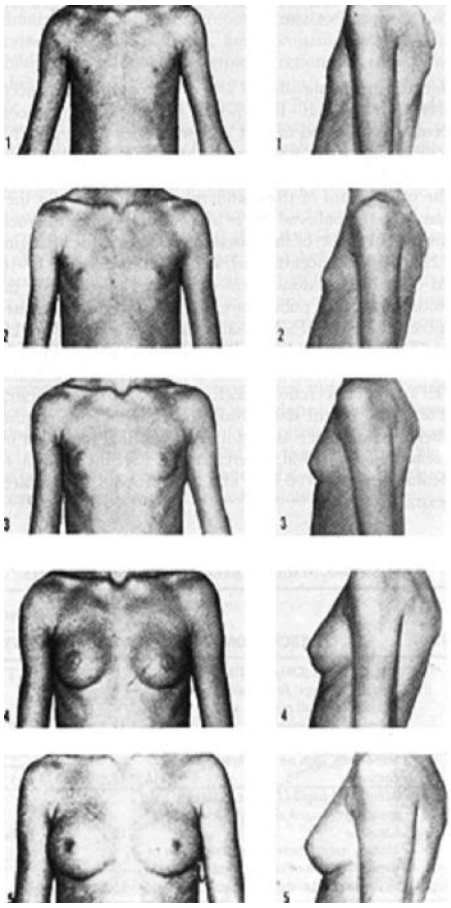

Figure 1. Tanner staging of breast development in girl[8]

Stage 1 : Prepubertal; Stage 2 : Breast bud stage with elevation of breast and papilla; enlargement of areola ; Stage 3 : Further enlargement of breast and areola; no separation of their contour; Stage 4 : Areola and papilla form a secondary mound above level of breast; Stage 5 : Mature stage with projection of papilla only, related to recession of areola

METHODS

A thirteen years old girl was referred from Orthopaedic inpatient clinic (surgery ward) with scoliosis. History of present illness, her right back looked more prominent than the left side. It was known at first time by herself and her mother about a year ago, while she was bathing. She had never complained any pain, weakness, nor dyspneu. She also had never complained any numbness nor tingling sensation. She did activities as usual and followed sport session in school but sometimes get tired.

She could do the independent ambulation with normal gait and she was right handed. Vital signs were within normal limit, body weight (BW): 39 kg, body height (BH): 153 cm, Arm span (AS): 155 cm, BH/AS ratio: 0.987. The chest expansion reduced on the measurement level of axilla and vertebra thoracal 4. Count test

was 27. Endurance capacity reflected by METS conversion from 6MWT was 5.5 METs. On palpation were found muscle spasms on upper and lower back area, no pain, no hamstring tightness.

Figure 2 showed specific examination on local status. Standing and sitting evaluation showed asymmetrical shoulder height (right shoulder 4 cm higher than left shoulder), left breast more prominent, right thoracal hump from VTh6-Vth12, with the apex on VTh9 (apex's height was 2.5 cm) and left lumbar hump from VL3-VL5, with the apex on VL4 (apex's height was 0.5 cm). There were good flexibilities of vertebra, reflected by the changes of the curve on right and left lateral bending. Curves were unbalanced, reflected by plumb line, which was on 0,5 cm to left side from gluteal fold. No leg length discrepancy.

Figure 2. Local Status

Anterior view on upright standing position, showed left breast more prominent, Tanner stage was 4 (Fig. A)Posterior view on :
(Fig. B) Upright standing position showed right shoulder higher than left shoulder
(Fig. C) Left lateral and (Fig. D) Right lateral bending standing position showed flexibility of the curve
(Fig. E) Forward bending standing position showed prominence of right thoracal and left lumbar humps
(Fig. F) Plumb line examination showed the unbalanced curves

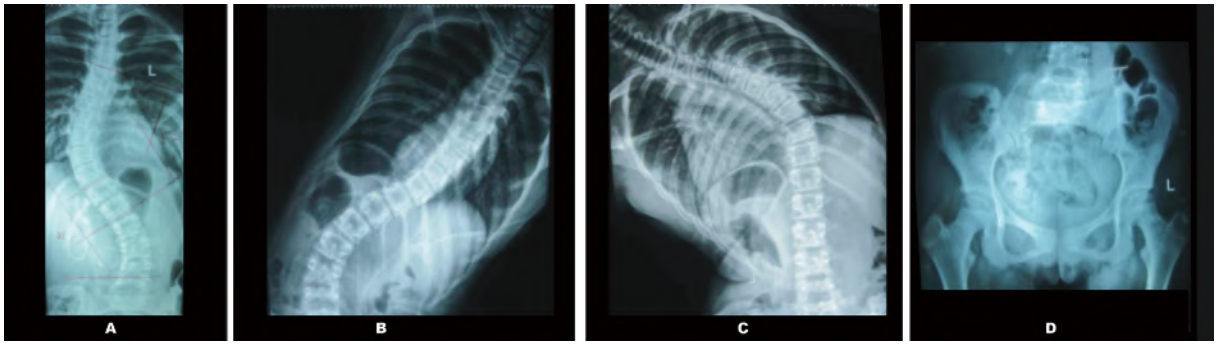

Figure 3. Pre surgery standard scoliosis plain radiographic examination

- There is a malalignment spine
- No congenital deformity in corpus vertebra
- Double curve:
  - o Thoracal curve with right convexity starting at VTh6 – VTh12, apex at VTh9, Cobb's angle 64° (Fig. A)
  - o Lumbar curve with left convexity starting at VL3-VL5, apex at VL4, Cobb's angle 32^0 (Fig. A)
  - o Right bending reduced the thoracal Cobb's angle to be 58^0 and increased lumbar Cobb'c angle to be 39° (Fig. B)
  - o Left bending increased the thoracal Cobb's angle to be 69^0 and reduced lumbar Cobb's angle to be 25^0 (Fig C)
- Degree of rotation (Moe's pedicle method) : +2 (Fig. A-C)
- Bone maturity (Risser) : 2 (Fig. D)

Figure 3 shows the standard scoliosis plain radiographic examination with an idiopathic scoliosis (adolescent type) double curves, and supports the diagnose of adolescent idiopathic scoliosis S Curve, right convexity, Thoracal curve VTh6 - VTh12 with apex curve at level VTh9, Cobb's angle 64^0 and left convexity Lumbal curve VL3-VL5 with apex curve at level VL4, Cobb's angle 32^0, flexible, Moe +2, Risser 2, unbalanced. The problems of this patient were spinal muscular imbalance, decreased chest expansion especially on abdominal parts and decreased endurance. Pre surgical rehabilitation programs consist of X-pattern scoliosis exercise, spinal muscular balance exercise with muscular biofeedback, deep breathing and chest expansion exercises and endurance exercise with static cycle.

Patient underwent scoliosis corrective surgical procedure with Harrington rod and pedicle screw application from VTh6 until VL2 on March 12th, 2012 (Fig. 4). After surgery, rehabilitation programs were continued with prescription of MSO brace (Fig. 5) to maintain the corrected curves, deep breathing and chest expansion exercises, isometric muscular contraction exercise against the pad within the brace, flexibility exercise out of the brace, muscular balance exercise with muscular biofeedback (Myomed 132), endurance exercise with static cycle. The brace should be worn every day until 3 month post surgery, to let the spinal fusion completed.

Figure 4. Post scoliosis corrective surgery standard scoliosis plain radiographic examination showed scoliosis SCurves

- Right convexity (Thoracal curve) was formed on VTh6 - VTh12 with apex at level VTh9, Cobb's angle 20°
- Left convexity (Lumbal curve) was formed on VL3-VL5 with apex at level VL4, Cobb's angle 5^0
- Harrington rod from VTh6 until VL2

Figure 5. Munster Spinal Orthosis (MSO) brace is a asymmetrical rigid plastic jacket

RESULTS

After underwent the surgical and rehabilitation programs, the patient showed the following improvements: body height became 155 cm, right and left shoulder and breast height were in the same level, decreased muscle spasm and improved spinal muscular balance, improved chest expansion, increased 6MWT coverage. Standard scoliosis plain radiologic examination showed double curves scoliosis with Cobb's angle 20^0 on VTh9 and 5^0 on VL4.

Table 2 showed the comparison of clinical and radiological examination pre, 8th day, 5th week and 3rd month post spinal corrective surgical procedure. There were significant improvement of spinal muscular contraction and coordination. From the simple analysis with one sample t-test, found that spinal muscular activities on concave were more affected. Chest expansion improved on the axilla and processus xyphoid level of measurement, significantly. Endurance capacity, reflected by METs, showed significant improvement too.

Figure 6 showed the dynamics of spinal muscle activities evaluation by muscle biofeedback (Myomed 132). There were increased minimal muscle contraction/rest (reflected increased muscle tone/muscle spasm) and reduced maximal muscle contraction on 8th days post surgical.

Table 2. Comparison of Clinical and Radiological Examination Pre and Post Spinal Corrective Surgery

	Pre Surgery		8 d Post Surgery		5 w Post Surgery		3 m Post Surgery		p	
Body weight (cm)	153		155		155		155			
Shoulder level	L 4 cm lower than R		L equal to R		L equal to R		L equal to R			
Breast symmetrization	L more prominenthan R		L equal to R		L equal to R		L equal to R			
Pelvic obliquity	L higher than R		L equal to R		L equal to R		L equal to R			
Spinal muscular activity	L	R	L	R	L	R	L	R	L	R
a. Thoracal area										
Minimum contraction/rest (mv)	18	35	15	35	8	5	17	23	.01*	.04*
Maximum contraction (mv)	219	270	78	62	111	178	98	77	.03*	.06
Average contraction (mv)	83	110	27	28	39	45	39	33	.03*	.07
Power contraction	4994	6615	2125	2146	2339	2687	3077	2587	.02*	.045*
b. Lumbar area										
Minimum contraction/ rest(mv)	53	16	16	17	5	17	22	17	.1	.001*
Maximum contraction (mv)	85	43	70	65	32	40	93	68	.02*	.01*
Average contraction (mv)	70	30	29	30	20	29	44	32	.03*	.001*
Power contraction	4205	1772	2081	2358	1190	1723	3462	2305	.03*	.001*
Chest expansion	I	E	I	E	I	E			I-E difference	
a. Axillar level (cm)	76	74	76	74	79.5	76			.038*	
b. Thoracal vertebra 4 level (cm)	79	77	79	77	78	74			.057	
c. Processus Xyphoid level (cm)	70	67	70	67	69	73			.010*	
Metabolic Equivalents (METs)	5.5				5.78		6.2		0.001*	
Radiologic Examination										
a. R Thoracal Cobb's angle (VTh9) (°)	64		20							
b. L Lumbar Cobb's angle (VL4) (°)	32		5							

Note :
L=left, R=right, I=inspiration, E=expiration
*Statistically significant if p < .05 (One sample t-test)

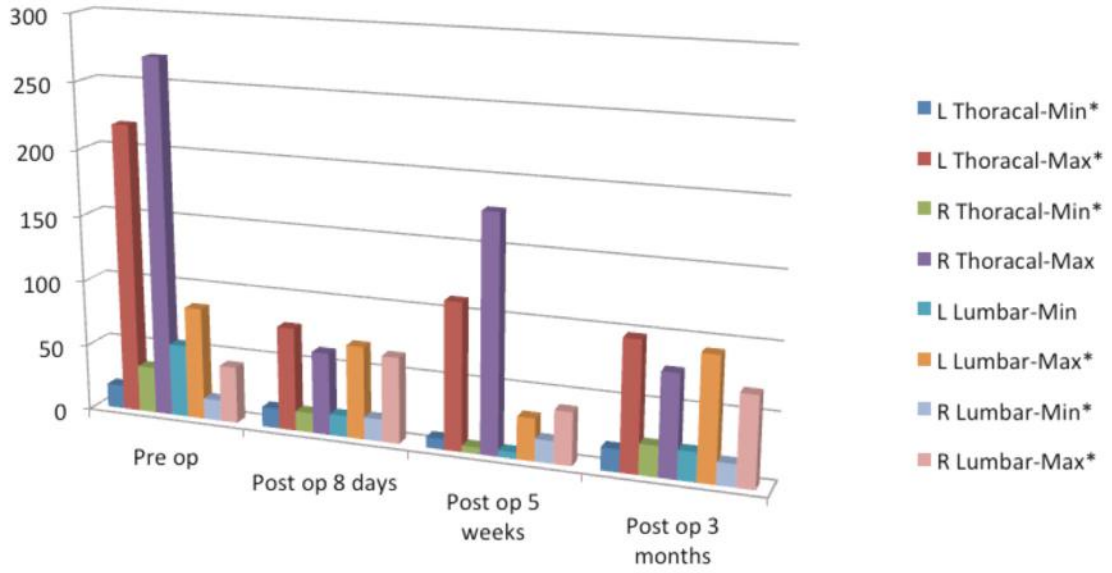

Figure 6

Comparison of biofeedback measurements on spinal muscular activities (R=right, L=left, Max=maximum muscular activity, Min=minimum muscular activity, *statistically significant-see table 2)

DISCUSSION

There are significant visible clinical progresses concomitant with improved Cobb's angle, include spinal muscular endurance and strength, chest expansion and endurance capacity post rehabilitation (Table 2).

Cobb's angle

Spinal corrective surgery for scoliosis has been done with insertion of Harrington rod and pedicle screw on VTh6 to VL2. It gives sufficient corrective effect and internal stabilizer for the spine. Plain radiograph showed improve Cobb's angle post surgery, and achieved satisfying corrected Cobb's angle (20^{o} on Thoracal Cobb's angle and 5^{o} on Lumbar Cobb's angle).

Twenty degree is a favorable angle to gain the lesser angle of spine lateral deviation in nonsurgical patient. In this patient, this particular angle facilitates the patient to do the more effective and efficient exercise to improve spinal muscular balance, to maintain corrected spine deviation. Rehabilitation program should be directed to improve muscular activity. Flexibility exercise for bending and rotation should be avoided within 3 month post surgical procedure, to prevent the failure of the rod and screw.

Spinal muscular activities balance

Spinal muscular activities balance can be assessed from diagnostic muscle biofeedback (Myomed 132). The recorder electrode were placed bilaterally on parathoracal and paralumbar area at the level of maximum hump, to measure the minimum/rest, maximum and average contraction of the muscle beneath this area simultaneously for each level. The minimum contraction shows the ability of the muscle to release the tension, reflects its muscle tone. The maximum contraction shows the ability of the muscle to contract maximally. The difference between minimum and maximum contraction shows the power stored within the muscle to do the voluntary contraction. Comparison between the left and the right side shows the left and right muscle coordination, and scoliosis patient usually shows bad coordination of her/his left and right spinal muscle coordination, which lead to spine deviation. The muscles on the convex side usually shows the more tension condition than concave side in minimum contraction, because this muscle always in lengthen position as a consequences of failure of muscular correction

to spine deviation. This condition can lead to early fatigue of this muscles and back pain.

The serial measurement of minimum thoracal and lumbar muscles activities in this patient showed the more tension on the spinal muscle the convex area presurgical and reduce significantly on the 5th week post surgical evaluation. The serial of maximum and average thoracal and lumbar muscle activities showed balance improvement and remodeling of left-right coordination, which were confirmed by power contraction result. Evaluation on the eight days post surgical showed persistent high minimum and decrease maximum contraction caused by muscle spasm post surgical came from pain and immobilization. At 5th weeks post surgical evaluation, can be seen expected condition, where there is decreased muscle spasms and muscle strength improved as the consequences of improve left-right spinal muscle coordination.

The result of muscle biofeedback is affected by the ability of the patient to understanding the command, see the graph and adjust her/his voluntary muscle contraction with the visual feedback, and fatigue. This patient showed her fatigue in the last evaluation (3 months post surgical evaluation) because she has underwent orthopaedic evaluation before done biofeedback evaluation, and the conclusion of the last evaluation should considered about this specific condition.

Chest expansion and endurance capacity

Chest expansion evaluation 8th day post surgery was not improved, could be affected by the surgical suture which was still wet and pain, lead to ineffective deep breathing and chest expansion exercise. Chest expansion improved on 5th week evaluation, because the healing process has been completed and more free movements of the shoulder and thoracal area, so the deep breathing and chest expansion exercise more effective. Chest expansion reflects the flexibility of intercostal muscles.

Endurance capacity is reflected by METs as a conversion of 6MWT. It showed improvement with the increased endurance exercise prescription and affected by the improvement of better oxygenation coming from good chest expansion.

CONCLUSIONS

The expected outcome of the scoliosis patient after spinal corrective surgery is the improvement of Cobb's angle, which lead to improvement of muscle balance, normal chest expansion and optimize the endurance capacity. This patient, which underwent the comprehensive rehabilitation management pre and post surgical procedure, showed the significant clinical and radiological improvements, and should maintain her corrected spine with maintain spinal muscular coordination.

REFERENCES

1. Cailliet R. Scoliosis Diagnosis and Management. Philadelphia, FA Davis Company.1980.
2. Kisner C, Colby LA. Therapeutic Exercise Foundation and Techniques 2nd ed, Philadelphia: FA Company.1990.
3. Thamrin S. Terapi Latihan Skoliosis Idiopatik. Dalam Bunga Rampai Rehabilitasi Medik, Pertemuan Ilmiah Tahunan I PERDOSRI, Jakarta. 2002.p.138-50.
4. Paul SM. Scoliosis and Other Spinal Deformities. In: DeLisa JA, Gans BM, Walsh NE, Bockenek WL, Frontera WR, Geiringer SR et al. Physical Medicine & Rehabilitation: Principle and Practice. 4th ed. Philadelphia: Lippincott William & Wilkins; 2004.p.679-98.
5. Prabhakar R. Scoliosis Idiopathic, E-Medicine Specialties.2009. Available from: http://emedicine.medscape.com/article/413157-overview.
6. Weiss HR, Negrini S, Hawes MC, Rigo M, Kotwicki T, Grivas TB et al. hysical exercises in the treatment of idiopathic scoliosis at risk of brace treatment – SOSORT consensus paper 2005. Scoliosis. 2006;1:6.
7. Scoliosis. Wikipedia Encyclopedia. Available from http://en.wikipedia.org/wiki/Scoliosis [cited on June 2012].
8. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. Arch Dis Child. 1969; Jun;44(235):291–303.