Traction of the Spine Versus Stretching Exercises in Management of Adolescent Idiopathic Scoliosis

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ABSTRACT

Background and purpose: *Based on the need for nonsurgical approaches to treat idiopathic scoliosis, this study was conducted to compare between two training programs, traction and stretching exercises.* ***Subjects and methods:*** *The study included fourty patients of moderate scoliosis (Cobb's angle ranged from 20 to 40 degrees), with age ranged from 15 to 25 years divided into two groups. The first group with mean age 19.31±2.54 years followed a physical therapy program of exercises in the form of strengthening exercises for convex side, strengthening exercises of abdominal muscles, stretching of back muscles, and traction of the spine by suspension on wallbar using body weight force with postural instructions of active daily living (ADL), three sessions per week for three months. The second group with mean age 19.18±2.69 years, submitted to a physical therapy program of exercises in the form of strengthening exercises for convex side, strengthening exercises of abdominal muscles, stretching of back muscles, and stretching muscles of concave side with postural instructions of ADL, three sessions per week for three months. Outcome measures were anteroposterior view of loading X-ray, is to detect any change in Cobb's angle of lower spine and upper spine. Tape measurement is to detect range of motion (ROM) of trunk flexion, and visual analogue scale (VAS) is to measure the pain.* ***Results:*** *There was a significant difference in the first group (t. of pain=0.02, t. of ROM of trunk flexion=0.005, t. of Cobb's angle of lower spine =0.01), and t. of Cobb's angle of upper spine=0.02. In the second group, there was a significant difference in pain and ROM with no significant difference in Cobb's angle of lower spine and Cobb's angle of upper spine where t. of pain=0.03, t. of ROM=0.02, t. of Cobb's angle of lower spine =0.07, and t. of Cobb's angle of upper spine=0.075.* ***Discussion and Conclusion:*** *This study showed that patients rehabilitated with traction is better than stretching exercises in correction of scoliotic curves of the spine in management of scoliotic patients.*
Key wards: *Abnormal curvature, lateral curvature, spinal curvature, postural scoliosis, structural scoliosis, idiopathic scoliosis, adolescent idiopathic scoliosis, thoracic scoliosis, spinal deformity, low back pain, surgical and conservative management.*

INTRODUCTION

Idiopathic scoliosis is estimated to affect about 2-3% of adolescent females age 10-16 years. Scoliosis is a spinal deformity characterized as a lateral curvature of the spine greater than 10°, measured by the Cobb method on standing upright spine radiographs. While most cases of scoliosis are classified as idiopathic, a minority of scoliosis cases are traced to structural anomalies, such as wedged vertebrae or abnormal soft tissue development. In addition to lateral curvature, scoliosis is also recognized in the sagittal plane. Although a distinct cause is unknown, it is postulated to arise from an injury to the vertebral growth plate during the adolescent period, causing cessation of further development[4,17].

Scoliosis is an abnormal lateral (side-to-side) curvature of the spine with rotation (twisting) of the vertebrae within the curve. The cause of scoliosis is unknown in 80

percent of cases – meaning that the person is otherwise healthy. This is called idiopathic scoliosis. (In the other 20 percent it is caused by other disorders, e.g. muscular dystrophy, cerebral palsy, polio, degeneration of the spine in older adults)[1,13]. Idiopathic scoliosis often runs in families. Though it can occur in a child of any age, most cases of Idiopathic Scoliosis begin between the ages of 10 and 15 years during a growth spurt. In this age group it called Adolescent Idiopathic Scoliosis (AIS) or just Adolescent Scoliosis[19,23]. This condition can occur in both boys and girls but girls are several times more likely than boys to develop severe curvatures. Though the cause of Idiopathic Scoliosis remains unknown, it is interesting to note that the majority (90%) of curves of the upper spine are on the right side, while the majority (70%) of curves of the lower spine are on the left side[24,25]. Curves that affect both the upper and lower spine are called double major curves – S shaped curves. Single curves are C shaped. In some cases a curve in the lower spine may be compensatory – the body's way of balancing the curve in the upper spine – rather than structural[6,30]. A structural curve of the upper spine with a compensatory curve of the lower spine is not considered a double curve[7,29].

Most clinical outcome surveys have revealed that, by early adulthood, the majority of scoliosis patients suffer from pain. Only one large, controlled survey has been carried out, to date. In that study, 1178 young adults, interviewed 10 years after diagnosis of adolescence, reported a significantly higher incidence of pain than 1217 control subjects.[1] Of the scoliosis patients reporting pain, 23% (147/650) described it as 'horrible, excruciating, distressing' compared with 1% (6/416) of the control subjects who reported pain. Similar results were reported at >44 year follow up[27]. Of a subset of 69 patients treated in adolescence (from an original population of 444), twice as many scoliosis patients (77% vs 35%) suffered from pain compared with a population of adults of comparable age (>55 years). Incidence of chronic pain was almost three fold higher in the scoliosis patients (61%) compared with the controls without scoliosis (22%). This is despite the fact that the 'control' population was selected from hospital clinics, nursing homes, and senior citizens' centers where incidence of disability is exceptionally high[3,26]. How scoliosis causes pain is not clear, but the magnitude of pain in adult scoliosis patients recently has been found to be inversely proportional to curvature flexibility. Related factors linked with pain include regional balance, instability and pathological mechanical loads on spinal elements[22,30].

The superior and inferior end vertebrae of the scoliotic curve are identified by carefully observing the rotation of vertebral bodies and the width of the intervertebral space. The intervertebral space is almost normal, and the vertebrae are in neutral position without substantial rotation in the superior and inferior end vertebra. Lines are drawn tangential to superior endplate of the superior end vertebra and the inferior endplate of the inferior vertebra. The Cobb-Webb angle is the angle formed at the intersection of these lines or the angle formed at the intersection of the lines perpendicular to these lines. A Cobb angle of at least 10° is essential for diagnosing scoliosis. The Cobb technique uses the position of spinous process for assessing the degree of vertebral rotation. The vertebra is divided into 6 equal segments by drawing 5 vertical lines. The spinous process is normally situated in the midpart of the vertebra overlying the third line. With increasing rotation, the spinous process is rotated toward the convex side of the curve[2].

MRI is also used to investigate occult intraspinal tumors, which can occur with scoliosis but without any neurologic symptoms or signs; to exclude other underlying abnormalities, such as tumors, infections, and disk prolapse; to evaluate atypical scoliosis or an atypical curve in a child with normal neurologic findings; to evaluate the patient before surgery because assessment of the spinal cord in patients with postoperative neurologic symptoms can be difficult because surgical devices that produce artifacts; to evaluate rotational deformity and distinguish intervertebral from intravertebral rotation (Standard derotational surgery is suboptimal in those with predominant intravertebral rotation.); and to ascertain the severity of the curve[7,15].

The primary aim of scoliosis management is to stop curvature progression. Improvement of pulmonary function (vital capacity) and treatment of pain are also of major importance[5]. The first of three modes of conservative scoliosis management is based on physical therapy. Indications for conservative management of scoliosis (guidelines), It has to be emphasized that, physical therapy for scoliosis is not just general exercises but rather one of the cited methods designed to address the particular nuances of spinal deformity, and application of such methods requires therapists and clinicians specifically trained and certified in those scoliosis specific conservative intervention methods[9,10]. The second mode of conservative management is scoliosis intensive rehabilitation, which appears to be effective with respect to many signs and symptoms of scoliosis and with respect to impeding curvature progression[14]. The third mode of conservative management is brace treatment, which has been found to be effective in preventing curvature progression and thus in altering the natural history of IS[16,21,22,26]. It appears that brace treatment may reduce the prevalence of surgery, restore the sagittal profile and influence vertebral rotation. There are also indications that the end result of brace treatment can be predicted[22,23,31].

The primary goal of scoliosis surgery is to achieve a solid bony fusion. The surgical technique used to achieve such an arthrodesis is vastly more important than the instrumentation system that the surgeon needs to use[15,32].

Modern instrumentation systems have been shown to allow for adequate curve correction but with little or no ability to diminish associated rib humps[11]. Despite claims of certain instrumentation systems to derotate the spine, little actual derotation has been documented. Derotation of the instrumented curve also has been shown to possibly occur at the expense of creation of new rotation in uninstrumented portions of the spine[21].

The aim of the current study is to compare between traction of the spine and stretching exercises in management of idiopathic scoliosis.

MATERIALS AND METHODS

Subjects

All subjects were Idiopathic Scoliotic patients. The study included 40 females volunteer patients moderate scoliosis (Cobb's angle ranged from 20 to 40 degrees) with age ranged from 15 to 25 years and divided into 2 groups. The first group with mean age 19.31±2.54 years followed a physical therapy program of exercises in the form of traction of the spine on wallbar by using body weight force, stretching of back muscles, strengthe-ning of convex side, and strengthening exercises of abdominal muscles, three sessions per week for three months. The second group

with mean age 19.18±2.69 years, submitted to a physical therapy program of stretching of concave side of scoliosis and back muscles, strengthening of convex side, and strengthening exercises of abdominal muscles, three sessions per week for three months. All the patients were listed at out clinic of orthopaedic departments at Cairo University hospitals. All of them were suffering from pain, limitation of ROM trunk and limitation of ADL.

Instrumentations

1- Loading X-ray (siemens Poly phase 50 appartus, siemens).
2- Visual analogue scale is to measure the pain severity.
3- Tape measurement is to detect range of motion of trunk flexion (fingertip-floor test).

Procedures

The patients signed an informed consent form, and were informed about the whole procedures before testing and training:

Treatment procedures:

The first group submitted to physical therapy program in the form of strengthening exercises for the muscles of the convex side (instruct the patient to be in side lying position of concave side and try to raise the upper trunk up as much as possible (10 repetitions with 3 sets, 6 seconds rest between each repetition, and 1 minute rest between the sets. the resistance is progressed according to repetitions), strengthening abdominal exercises (from crock lying position and ask the patient try to touch the knees by his hands,10 repetitions with 3 sets, 6 seconds rest between each repetition, and 1 minute rest between the sets, the resistance is progressed according to repetitions), traction of the spine (instruct the patient to stand on front of wallbar and catch the highest point of the wallbar and suspend herself with feet are off the floor (5 repetitions, 30 seconds in position of traction, 30 seconds in position of relaxation), and stretching of back muscles (from crock lying position and the therapist taking both lower limbs toward the chest (5 repetitions,30 seconds in position of stretching, 30 seconds in position of relaxation), and postural instructions for ADL. The program continued for 3 months, 3 sessions per week performed and supervised by the same physical therapist.

The second group submitted to physical therapy program in the form of strengthening exercises for the muscles of the convex side (instruct the patient to be in side lying position of concave side and try to raise the upper trunk up as much as possible (10 repetitions with 3 sets, 6 seconds rest between each repetition, and 1 minute rest between the sets, the resistance is progressed according to repetitions), strengthening abdominal exercises (from crock lying position and ask the patient try to touch the knees by his hands,10 repetitions with 3 sets, 6 seconds rest between each repetition, and 1 minute rest between the sets. the resistance is progressed according to repetitions), stretching of concave tight muscles (instruct the patient to be in side lying position of convex side and upper trunk outside the bed then stretch the patient by the therapist (5 repetitions, 30 seconds in position of stretching, 30 seconds in position of relaxation), and stretching of back muscles (from crock lying position, and the therapist taking both lower limbs toward the chest (5 repetitions, 30 seconds in position of stretching, 30 seconds in position of relaxation), and postural instructions for ADL. The program continued for 3 months, 3 sessions per week performed and supervised by the same physical therapist.

Assessment procedures:

All the patients were assessed before treatment and reassessed after 3 months and followed up after 6 months by:

1- Anteroposterior view of loading x-ray, is to detect any change in scoliotic curve by measuring Cobb's angle (meeting of two lines, a horizontal line from the superior surface of the first vertebrae of the curve and a horizontal line from the superior surface of last vertebrae of the curve) for upper and lower trunk.
2- Visual analogue scale is to measure the pain which is represented from (0) grade to (10) grade. Zero grade means no pain, (10) grade means unbearable pain, from 1 to 10 means graduation intensities of pain. The subject was asked to indicate the level of pain by placing a dash at the appropriate level on the 10 cm horizontal line.
3- Tape measurement is to detect range of motion of trunk flexion (fingertip-floor test) for both groups as following: The patient was instructed to bend as far forward as he could with his knees straight, and to try to touch his toes, then the distance from his fingertips to the floor was measured, pre and post the program of exercises and pre and post of surgical approach, to detect if there is a change or not.

Data Analysis

The collected data were Statistically treated and the following values were found minimum, maximum, mean, SD., one sample paired t-test to compare between pre and post in the group and two sample unpaired t-test to compare between 2 groups, at a confidence level of (P = 0.05).

RESULTS

The results of the first group:

There was a significant improvement of pain after physical therapy treatment from (6.76±1.08) to (2.13±0.62), ROM of trunk flexion increased from (18.59±4.02) to (3.36±1.69), Cobb's angle of lower spine decreased from (28.13±2.91) to (19.53±1.85), and Cobb's angle of upper spine decreased from (22.63±2.19) to (13.86±1.42) tab. (1) fig. (1).

Table (1): Pre and post values of pain, ROM of trunk flexion, Cobb's angle lower spine, and Cobb's angle of upper spine, in first group.

	Pain		**ROM**		**Cobb's angle of lower spine (LS)**		**Cobb's angle of upper spine (us)**	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Min	4	1	15	1	24	16	20	11
Max	8	3	25	6	34	22	26	16
Mean	6.76	2.13	18.59	3.36	28.13	19.53	22.63	13.86
SD	1.08	0.62	4.02	1.69	2.91	1.85	2.19	1.42
t. value	0.02*		0.005*		0.01*		0.02*	

(*) significant, P ≤ 0.05 (**) no significant, P ≥ 0.05 gr.(group).

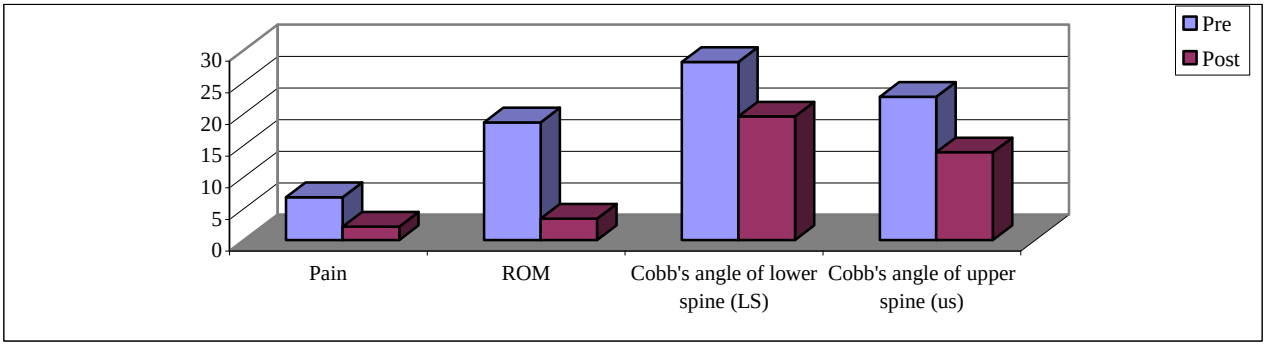

Fig. (1): The mean values of pain, ROM of trunk flexion, Cobb's angle lower spine, and Cobb's angle of upper spine, in first group.

The results of the second group:

There was a significant improvement of pain after physical therapy treatment from (6.77±1.09) to (2.27±0.86), ROM of trunk flexion increased from (18.66±4.23) to (4.22±2.55), but no significant improvement in Cobb's angle of lower spine where changed from (27.23±2.92) to (24.9±2.84), and Cobb's angle of upper spine changed from (22.71±2.24) to (20.95±2.16), tab. (2) fig. (2).

Table (2): Pre and post values of pain, ROM of trunk flexion, Cobb's angle of lower spine, and Cobb's angle of upper spine, in second group.

	Pain		**ROM**		**Cobb's angle of lower spine (LS)**		**Cobb's angle of upper spine (us)**	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Min	5	1	14	1	23	21	21	18
Max	8	4	26	8	32	29	25	23
Mean	6.77	2.27	18.66	4.22	27.23	24.9	22.71	20.95
SD	1.09	0.86	4.23	2.55	2.92	2.84	2.24	2.16
t. value	0.03*		0.02*		0.07**		0.075**	

(*) significant, P ≤ 0.05 (**) no significant, P ≥ 0.05 gr.(group).

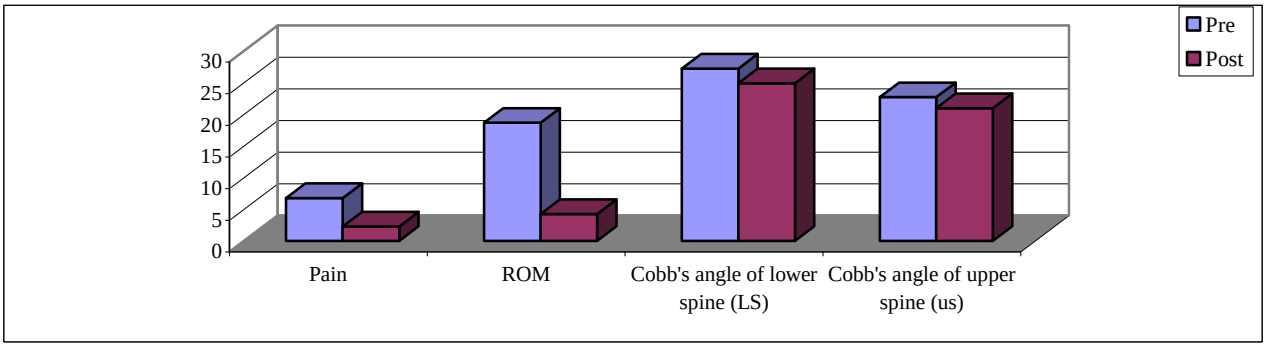

Fig. (2): The mean values of pain, ROM of trunk flexion, Cobb's angle of lower spine, and Cobb's angle of upper spine, in second group.

Comparison between both group

1- There is no significant difference between pre measures of the first group and pre measures of the second group of pain, ROM of trunk flexion, and Cobb's angle of lower spine, and Cobb's angle of upper

spine, where t. value of pain 0.56, t. value of ROM of trunk flexion 0.37, and t. value of Cobb's angle of lower spine 0.47, and t. value of Cobb's angle of upper spine 0.68, tab. (3) fig. (3).

Table (3): The mean values of pre test of pain, ROM of trunk flexion, Cobb's angle of lower spine, and Cobb's angle of upper spine, in both groups.

	Pain		**ROM**		**Cobb's angle of lower spine (Ls)**		**Cobb's angle of upper spine (us)**	
	1st gr.	2nd gr.	1st gr.	2nd gr.	1st gr.	2nd gr.	1st gr.	2nd gr.
Min	4	5	15	14	24	23	20	21
Max	8	8	25	26	34	32	26	25
Mean	6.76	6.77	18.59	18.66	28.13	27.23	22.63	22.71
SD	1.084	1.09	4.02	4.23	2.91	2.92	2.19	2.24
t. value	0.56**		0.37**		0.47**		0.68**	

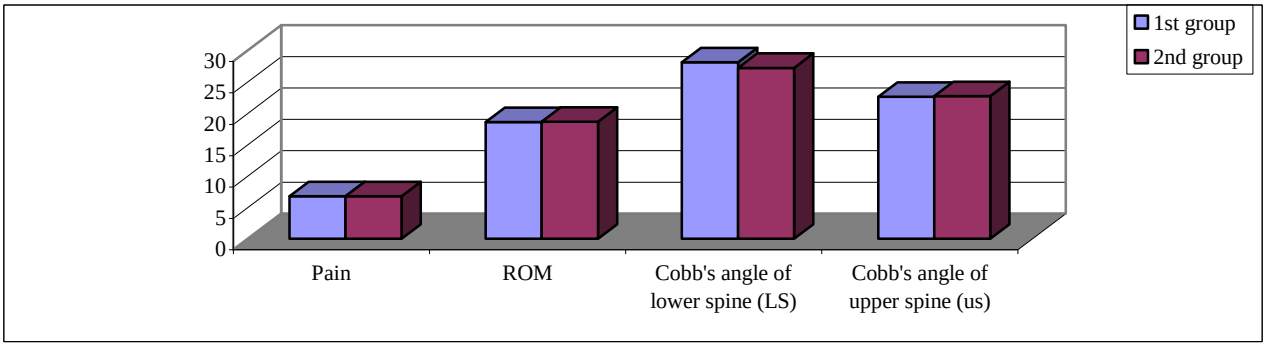

Fig. (3): The mean values of pre test of pain, ROM of trunk flexion, Cobb's angle of lower spine, and Cobb's angle of upper spine, in both groups.

2- There is a significant difference between post measures of the first group and post measures of the second group of ROM of trunk flexion, Cobb's angle of lower spine, and Cobb's angle of upper spine, where t. value of ROM of trunk flexion 0.02, t. value of Cobb's angle of lower spine 0.03, and t. value of Cobb's angle of upper spine 0.045. With no significant difference in pain where t. value of pain 0.06, tab. (4) fig. (4).

Table (4): The mean values of post test of pain, ROM of trunk flexion, Cobb´s angle of lower spine, and Cobb´s angle of upper spine, in both groups.

	Pain		**ROM**		**Cobb´s angle of lower spine (Ls)**		**Cobb´s angle of upper spine (us)**	
	1st gr.	2nd gr.	1st gr.	2nd gr.	1st gr.	2nd gr.	1st gr.	2nd gr.
Min	1	1	1	1	16	21	11	18
Max	3	4	6	8	22	29	16	23
Mean	2.1363	2.2727	3.3636	4.2272	19.534	24.909	13.863	20.9545
SD	0.6248	0.8624	1.6934	2.5571	1.857	2.8429	1.4236	2.1632
t. value	0.06**		0.02*		0.03*		0.045*	

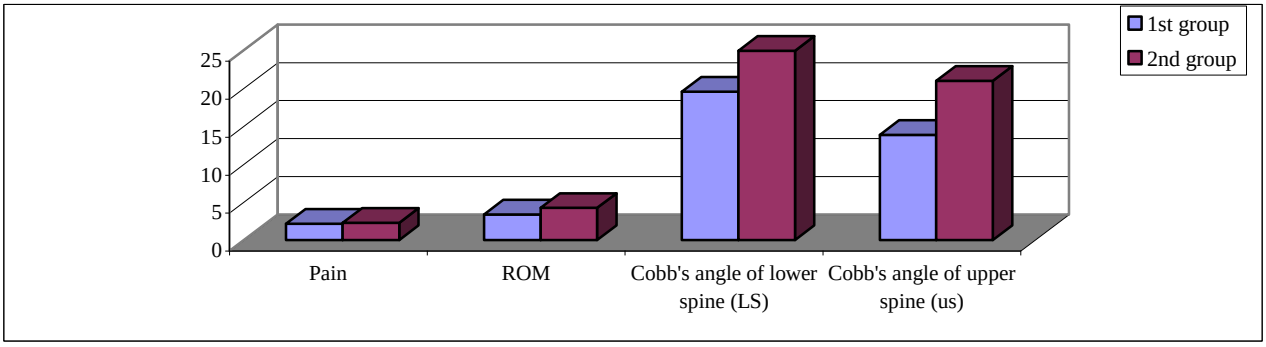

Fig. (4): The mean values of post test of pain, ROM of trunk flexion, Cobb´s angle of lower spine, and Cobb´s angle of upper spine, in both group.

DISCUSSION

The goal of nonoperative treatment of patients with scoliosis in our study is to correct and maintain the spine in a balanced position in the coronal and sagittal planes over a level pelvis. This goal is achieved through traction or stretching to correct the spinal deformity[28].

The results of this study showed that there was a significant results of the first group in pain, ROM of trunk flexion, Cobb´s angle of lower spine, and Cobb´s angle of upper spine because of using of exercise program which include:

Stretching exercises of back muscles which is decreasing spasm of the muscles and improving the circulation which decreases the concentration of metabolites, and decreasing the hypertonicity and hyperactivity of the lumbar erector spinae. And also is increasing ROM due to increasing elasticity of the back muscles[8,12].

Traction of the spine on wallbar was used to stretching of tight muscles by using of body weight which is giving equal stretching force on both sides of the spine and affect on the whole length of the spine (longitudinal stretching of upper and lower spine).

Strengthening of the abdominal muscles which is considered the anterior wall of the spine and must be strong enough to protect the spine from anterior aspect. A recent focus in the physiotherapy management of patients with back pain has been the specific training of muscles surrounding the spine (deep abdominal muscles and lumbar multifidus), considered to provide dynamic stability and fine control to the lumbar spine[20].

The use of exercise alone for the treatment of idiopathic scoliosis has been suggested for many years. Although exercise has traditionally been used to stretch tight trunk musculature and strengthen muscles of the trunk, it has been shown that exercise alone will not halt the progression of or correct an existing moderate or severe scoliosis. Exercise alone may be beneficial as a treatment for patients with very mild idiopathic scoliosis. Exercise used in conjunction with other methods of correction such as traction which has been shown to be beneficial[18,23].

The program of traction and strengthening of the abdominal muscles was creating a controlling and balancing between agonist and antagonist muscles of whole the spine.

In the second group, significant results in pain, ROM of trunk flexion, with no significant results in Cobb´s angle of lower

spine, and Cobb´s angle of upper spine due to using of exercise program which include:

Stretching exercise of back muscles which is decreasing spasm of the muscles and improving the circulation which decrease the concentration of metabolites, and decreasing the hypertonicity and hyperactivity of the lumbar erector spinae. And is increasing of ROM due to increasing elasticity of the back muscles[8,12].

Stretching exercise of tight concave muscles was applied to decrease the spasm and hyperactivity of concave side musculature, and strengthening of the weak convex side muscles which creating a muscle balance and normal passway of line of gravity. Strengthening of the abdominal muscles which is considered the anterior wall of the spine and must be strong enough to protect the spine from anterior aspect[12,18].

In comparison of results of both groups, there is a significant improvement in the first group more than in the second group in ROM of trunk flexion, Cobb´s angle of lower spine, and Cobb´s angle of upper spine. This is explained by the assumption that the power of traction (using of body weight) is more than the power of stretching exercises, and also is equal in both sides of the spine.

The results of this study showed the traction of the spine is effective than stretching exercises in management of idiopathic scoliosis.

From all of the above, we found that the traction program, strengthening of convex side and abdominal muscles, and following instructions of correct way of ADL are the appropriate regimen for idiopathic scoliosis.

Conclusion

This study showed that traction of the spine is very effective to be included in the program of management of idiopathic scoliotic patients and its sharing in the correction of Cobb´s angle (lateral curvature of the spine) which is the pathomechanic in the scoliosis.

REFERENCE

1- Ascani, E., Bartolozzi, P., Logroscino, C.A., Marchetti, P.G., Ponte, A., Savini, R., Travaglini, F., Binazzi, R. and Di Silvestre, M.: Natural history of untreated IS after skeletal maturity, Spine; 11: 784-789, 1986.

2- Cobb, J.R.: The problem of the primary curve, Am J Orthop Dec; 42-A: 1413-1425, 1960.

3- Deviren, V., Berven, S., Kleinstueck, F., Antinnes, J., Smith, J.A. and Hu, S.S.: Predictors of flexibility and pain patterns in thoracolumbar and lumbar IS, Spine; 27: 2346-2349, 2002.

4- Freidel, K., Petermann, F., Reichel, D., Steiner, A., Warschburger, P. and Weiss, H.R.: Quality of life in women with idiopathic scoliosis, Spine; 27: E87-E91, 2002.

5- Grivas, T.B., Vasiliadis, E., Chatziargiropoulos, T., Polyzois, V.D. and Gatos, K.: The effect of a modified Boston brace with anti-rotatory blades on the progression of curves in idiopathic scoliosis: aetiologic implications, Pediatric Rehabilitation; 6: 237-242, 2003.

6- Goldberg, M.S., Mayo, N.E., Poitras, B., Scott, S. and Hanley, J.: The Ste-Justine Adolescent Idiopathic Scoliosis Cohort Study. Part II: Perception of health, self and body image, and participation in physical activities, Spine; 14: 1562-1572, 1994.

7- James, J.I.P.: Idiopathic scoliosis: The prognosis, diagnosis, and operative indications related to curve patterns and the age of onset. J Bone Joint Surg Br.; 36: 36-49, 1954.

8- Kouledakis, Y., Fristhknecht, R. and Murthy, M.: Knee flexion to extension peak torque ratios and low back injuries in highly active individuals, Int J Sports Med, 18(4): 290-295, 1997.

9- Landauer, F., Wimmer, C. and Behensky, H.: Estimating the final outcome of brace

treatment for idiopathic thoracic scoliosis at 6-month follow-up. Pediatric Rehabilitation; 6: 201-207, 2003.
10- Landauer, F. and Wimmer, C.: Therapieziel der Korsettbehandlung bei idiopathischer Adoleszentenskoliose. MOT; 123: 33-37, 2003.
11- Lenke, L.G., Bridwell, K.H. and Baldus, C.: Cotrel-Dubousset instrumentation for adolescent idiopathic scoliosis, J Bone Joint Surg Am Aug; 74(7): 1056-1067, 1992.
12- Li, Y., Mcclure, P.W. and Pratt, N.: The effect of hamstring muscles stretching on standing posture and on lumbar and hip motions during forward bending, Phys Ther, 76(8): 836-845, 1996.
13- McMaster, M.: Infantile idiopathic scoliosis: Can it be prevented?, J Bone Joint Surg Br.; 65: 612-617, 1983.
14- Mehta, M.H.: Active auto-correction for early AIS. Journal of Bone and Joint Surgery; 68: 682, 1986.
15- Mielke, C.H., Lonstein, J.E. and Denis, F.: Surgical treatment of adolescent idiopathic scoliosis. A comparative analysis, J Bone Joint Surg Am; 71(8): 1170-1177, 1989.
16- Nachemson, A.L. and Peterson, L.E.: Members of Brace Study Group of the Scoliosis Research Society. Effectiveness of treatment with a brace in girls who have adolescent idiopathic scoliosis, J Bone Joint Surg.; 77: 815-822, 1995.
17- Nault, M.L., Allard, P., Hinse, S., Le Blanc, R., Caron, O., Labelle, H. and Sadeghi, H.: Relations between standing stability and body posture parameters in adolescent idiopathic scoliosis. Spine, 27: 1911-1917, 2002.
18- Negrini, S., Antoninni, G.I., Carabalona, R. and Minozzi, S.: Physical exercises as a treatment for adolescent idiopathic scoliosis. A systematic review. Pediatric Rehabilitation; 6: 227-235, 2003.
19- Pehrsson, K., Larsson, S., Oden, A. and Nachemson, A.: Long-term follow-up of patients with untreated scoliosis: A study of mortality, causes of death, and symptoms. Spine; 17: 1091-1096, 1992.
20- Peter, B.O., Grad, D.M.P., Lance, T. and Garry, T.: Evaluation of specific stabilizing exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis, Spine, 22: 2959-2967, 1997.
21- Rajasekaran, S., Dorgan, J.C., Taylor, J.F. and Dangerfield, P.H.: Eighteen-level analysis of vertebral rotation following Harrington- Luque instrumentation in idiopathic scoliosis, J Bone Joint Surg Am; 76(1): 104-109, 1994.
22- Rigo M.: Intraobserver reliability of a new classification correlating with brace treatment, Pediatric Rehabilitation; 7: 63, 2004.
23- Rigo, M., Reiter, C. and Weiss, H.R.: Effect of conservative management on the prevalence of surgery in patients with adolescent idiopathic scoliosis. Pediatric Rehabilitation; 6: 209-214, 2003.
24- Riseborough, E.J. and Wynne-Davies, R.: A genetic survey of idiopathic scoliosis in Boston, Massachusetts, J Bone Joint Surg Am.; 55: 974-982, 1973.
25- Robinson, C.M. and McMaster, M.J.: Juvenile idiopathic scoliosis: Curve patterns and prognosis in one hundred and nine patients, J Bone Joint Surg Am.; 78A: 1140–1148, 1996.
26- Schwab, F.J., Smith, V.A., Biserni, M., Gamez, L., Farcy, J.P. and Pagala, M.: Adult scoliosis: quantitative radiographic and clinical analysis, Spine; 27: 387-392, 2002.
27- Sevastik, J.A. and Stokes, I.A.F.: Idiopathic scoliosis: Terminology. Spine: State of the Art Reviews; 14: 299-303, 2000.
28- Soucacos, P.N., Zacharis, K., Soultanis, K., Gelalis, J., Xenakis, T. and Beris, A.E.: Risk factors for idiopathic scoliosis: review of a 6-year prospective study. Orthopedics; 23: 833-838, 2000.
29- Stokes, I.A.F.: Three dimensional terminology of spinal deformity: A report presented to the Scoliosis research Society by the Scoliosis Research Society Working Group on 3-D Terminology of Spinal Deformities, Spine, 19: 236-248, 1994.
30- Weinstein, S.L., Zavala, D.C. and Ponseti, I.V.: Idiopathic scoliosis: long term follow-up and

prognosis in untreated patients, J Bone Jt Surg.; 63-A: 702-712, 1981.
31- Weiss, H.R., Weiss, G. and Petermann, F.: Incidence of curvature progression in idiopathic scoliosis patients treated with scoliosis in-patient rehabilitation (SIR): an age- and sex-matched cotrolled study, Pediatric Rehabilitation; 6: 23-30, 2003.
32- Winter, R.B.: The idiopathic double thoracic curve pattern. Its recognition and surgical management, Spine; 14(12): 1287-1292, 1989.

الملخص العربي

المقارنة بين شد العمود الفقري وتمارين الإطالة في معالجة انحناء العمود الفقري الجانبي العفوي للمراهقين

يعتبر الانحناء الجانبي الذي يحدث بمنطقة العمود الفقري بداية من الفقرات الصدرية حتى الفقرات القطنية من أهم أسباب آلام أسفل الظهر وأيضا إعاقة الأنشطة اليومية. ولذلك تمت دراسة تأثير برنامج العلاج الطبيعي المتمثل في شد العمود الفقري بوسيلة التعليق على السلم الحائطي باستخدام وزن الجسم ، شد عضلات الظهر مع تقوية العضلات الضعيفة و تقوية عضلات البطن بالمقارنة مع برنامج العلاج الطبيعي المتمثل في تمارين شد العضلات القصيرة مع تقوية العضلات الضعيفة و تقوية عضلات البطن لحالات الانحناء الجانبي . وفى هذه الدراسة تم استخدام شد العمود الفقري باستخدام وزن الجسم مع تقوية العضلات الضعيفة ، مع تقوية عضلات البطن . وقد أجرى البرنامج لمجموعة واحدة 3 جلسات أسبوعيا لمدة 3 شهور لمجموعة واحدة مكونة من 20 مريضاً ، نفس البرنامج بنفس الأخصائي لكل مريض ويتضمن البرنامج أيضا التعليمات الصحيحة للأنشطة اليومية. ومجموعة أخرى تم استخدام تمرينات شد عضلات الظهر مع تقوية العضلات الضعيفة، مع تقوية عضلات البطن. وقد أجرى البرنامج لمجموعة واحدة 3 جلسات أسبوعيا لمدة 3 شهور لمجموعة واحدة مكونة من 20 مريضاً، نفس البرنامج بنفس الأخصائي لكل مريض ويتضمن البرنامج أيضا التعليمات الصحيحة للأنشطة اليومية . وقد ظهر من الدراسة أن برنامج العلاج الطبيعي الأول أكثر تأثيرا لعلاج مرضى الانحناء الجانبي خصوصا بالمنطقة الصدرية ويمكن استخدامه كعلاج وقائي . وفى هذه الدراسة أثبتت النتائج أهمية شد العمود الفقري باستخدام وزن الجسم مع تقوية العضلات الضعيفة ومدى تأثير ذلك على النتائج .