Original Article

Use of kinesiotherapy means for the rehabilitation of the S-shaped scoliosis

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Published online: November 30, 2019

(Accepted for publication: November 15, 2019)

DOI:10.7752/jpes.2019.s6349

Abstract

Purpose: Information on the therapeutic value of S-shaped scoliosis rehabilitation.

Material. The study focused on one subject of 21 years old, diagnosed with dorso-lumbar scoliosis, lumbar spine rotated in the axis and asymmetrical pelvis; the patient has been complaining of pains in the lumbar area for more than a year. The tests and procedures used: measurement with the plumb line, Adam's forward bend test; circling of spinal apophyses; thoracic and hemithoracic perimeters; drawing of scapular and pelvic anatomical reference points; drawing of the Rhombus of Michaelis; measuring of leg length; examination of spine mobility (articular examination, muscular examination) and radiography .

Results. Highlighting the changes in the thoracic perimeters indicators and the differences of the right lower limb length as a result of the asymmetrical global deformation entailed by the changes of spine curves. Determination of the scoliosis severity by comparing the vertical line of left thoracic distance and right lumbar distance with the normal values. Increase of spine mobility at cervical and dorso-lumbar level, improvement of muscle deficiency and elimination of pain in lumbar area.

Conclusions. By early application of the specific and non-specific kinetic means and observance of the principles of effort progressivity and treatment individualization, very good results are obtained, which confirm the proposed hypothesis.

Key words: spine deficiencies, scoliosis, evaluation, rehabilitation program .

Introduction

The spine is the most important segment of the locomotor system. The movements of the spine are performed in the joints of both vertebral bodies and articular processes (Avramescu, 2007; Timnea & Baican, 2017). The spinal disorders, although known since ancient times – some of them, such as the idiopathic scoliosis – remain problems not solved even today. This would not be a problem in itself, but it still becomes one because the incidence of spinal disorders among children and adolescents, especially the girls, is increasing continuously (Calina & Rusu, 2018; Moldovan, 2016). Scoliosis is an incompletely reducible lateral deviation, with progressive evolution and consequences on its morphology and functionality. Scoliosis manifests itself in three planes (Illés, Lavaste, & Dubouset, 2019): frontal, sagittal and horizontal (on a larger or smaller surface) with the rotation of the vertebral bodies, so that the spinous apophyses are rotated towards the scoliosis concavity and the vertebral bodies towards the convexity, without losing the osteoarticular continuity (Burnei & Toma, 2016; Jianu, 2019; Sbenghe, 1987).

The causes of scoliosis have long been unknown, but over time it has been established that these deformities occur as a result of the decrease of bones resistance to the action of pressure asymmetric factors, by laxity of the segments and weakening of the back muscles (Moțet, 2011, p.88). The etiology of the disease is unknown in 90% of the cases (idiopathic scoliosis) while the causes of the scoliosis can be identified in 10% of the cases (Ciortan, 2019; Jianu & Zamfir, 1995). An exhaustive classification of scoliosis was made by the Scoliosis Research Society, which developed a specific terminology to allow classification, measurement, evaluation, study of curves and causes of scoliosis (Ciortan, 2019) by: etiopathology, topography, degree of curves, degree of spinal mobility (King). Kinesiotherapy combats the muscles-ligaments imbalance and helps in the development of the muscular groups necessary to maintain the correction obtained by postural gymnastics. The objectives of the kinesiotherapist include: stopping the evolution of scoliosis, strengthening of spine muscles, increase of spine mobility, adjustment of physiological attitude and posture, diminution of body secondary asymmetries (Negrini et al., 2011; Kotwicki, 2013; Rabolu, 2017; Weiss, 2010).

The purpose of the paper is the information on the therapeutic value of S-shaped scoliosis rehabilitation.

The hypothesis of the paper is that particularly good results can be obtained if the specific and non-specific kinetic means are applied early and if the principles of effort progressivity and treatment individualization are observed.

Material & methods

Participants and Procedure

The study monitored a subject aged 21 years, diagnosed with dorso-lumbar scoliosis, lumbar spine rotated in the axis and asymmetrical pelvis; the subject has been complaining of pains in the lumbar area for more than a year. The scoliosis started in the pubertal period and its causes are not known. Due to the sports practiced over time and to the well-developed muscles, the scoliosis has not progressed and has not caused severe changes in the trunk. The patient has not undergone any surgery and has not followed any kinesiotherapeutic program until the start of the study.

The study was conducted in three stages: the first stage focused on the analysis of the specialized literature; the second stage included the initial evaluation, the anamnesis and the implementation of the kinesiotherapeutic program depending on the objectives set; the third stage - the final evaluation in which the patient's evolution and the necessary recommendations were established.

The research was carried out throughout 7 months (from October 2015 to May 2016) within the Swedish Organization for Individual Humanitarian Aid and at patient's home.

The apparatus, equipment and materials used in the kinesiotherapy room or at home: mattress, weights, cane, fitness ball, cable machine, goniometer. Also, a camera was used to capture the physical exercises made during the rehabilitation and also for the initial and final testing of the subject.

Tests and procedures used: measurements with the plumb line; Adam's forward bend test; circling of spinal apophyses; thoracic and hemithoracic perimeters; drawing of scapular and pelvic anatomical reference points; drawing of the rhombus of Michaelis; measuring of leg length; examination of spine mobility (articular examination, muscular examination); radiography.

Objectives of the S-shaped scoliosis rehabilitation:

- elimination of the spine pains;
- toning in shortening of the left thoracic paravertebral muscles;
- toning in elongation of the right thoracic paravertebral muscles;
- toning in shortening of the right lumbar paravertebral muscles;
- toning in elongation of left lumbar paravertebral muscles;
- return of the pelvis and scapular belt to the normal position;
- increase and rehabilitation of joints mobility;
- creation of the correct attitude reflex by adopting corrective positions.

Kinesiotherapeutic program applied (example):

- 15 sessions / month in the physical rehabilitation center and 5 sessions / month at patient's place (total 20 sessions / month).

- 8 hours/month swimming or per month (1h /session).

a) Stretching exercises for elimination of the lumbar pains:

- From dorsal decubitus, bent knees, flexion of the thigh on the pelvis, the knees are grabbed with both hands and drawn to the chest (30"x3 - break 10");

- From seated position, abduction of the lower limbs, the right arm is raised and the trunk is bent sideways on the left foot. Return to the initial position and the exercise is repeated with left arm up and trunk bending on the right foot (8x4-on each side);

b) Exercises for toning in shortening of the left thoracic paravertebral muscles in elongation of the right thoracic paravertebral muscles:

- From ventral decubitus, right arm extended forward, left arm laterally, with a weight of 1 kg; extension of the left arm (3x12);

- From ventral decubitus, right arm extended forward, left arm near the body, then the left arm is raised laterally with a weight of 1 kg (3x12);

c) Exercises for toning in shortening of the right lumbar paravertebral muscles and elongation of left lumbar paravertebral muscles:

- Side stand in front of an imaginary basket, with the right foot on the bench, execution of a hook shot with the right hand (3x12);

- From seated position, the left knee is grabbed with both hands and the thigh is flexed on the pelvis by bringing the knee close to the chest as much as possible (3x12);

d) Exercises for returning the pelvis and the scapular belt to the normal position:

- From seated position, the buttock is lifted on the side of the lumbar convexity (3x12);

- From seated position, with a cushion under the right buttock, the arms near the body, the arm is then flexed at 180 degrees (3x12).

Note: The exercises used for scoliosis treatment can be simplified up to corrective postures, movements of the trunk and of the lower – upper limbs, followed by crawling exercises, active and passive returns to the initial position, balance exercises, suspensions and breathing exercises. Exercises with kinesiotherapy portable devices, exercises made on fixed apparatus, exercises with sport games elements, combined with massage and

rest in corrective or hypercorrective positions can be also used during the progressive correction (Sbenghe, 1987).

Results

The results of the anthropometric measurements indicators are listed in table no 1, regarding the thoracic perimeter at rest, inspiration, expiration and thoracic amplitude and the length of the lower limb.

Table no 1. Results of the anthropometric indicators

Indicators		Initial testing	Final testing
Thoracic perimeter, cm	At rest	89	88
	Inspiration	92	93
	Expiration	85	84
	Thoracic amplitude	7	9
Lower limb, cm	right	96	98
	left	98	98

Table no 2 shows the results of the measurements with the plumb line regarding the determination of the degree of scoliosis and the imbalance created by the right or left side (thoracic and lumbar).

Table no 2. Results of the measurements with the plumb line

Indicators	Initial testing	Final testing	Normal
Thoracic - left. cm	1.5	1.2	0.5
Lumbar - right. cm	2.0	1.8	

Table no 3 shows the results of the test with the Rhombus of Michaelis, namely the drawing of the scapular and pelvic anatomical reference points necessary to determine the asymmetry at shoulders level and pelvis level.

Table no 3. Results of the test with the Rhombus of Michaelis

Indicators	Initial testing	Final testing	Normal value
Lateral superior right, cm	6.0	6.3	6.5
Lateral superior left, cm	7.0	6.5	6.5
Lateral inferior right, cm	7.5	7.5	7.5
Lateral inferior left, cm	8.5	8.0	7.5
Transversal, cm	10.0	10.0	10.0
Vertical, cm	8.5	9.0	11.0

Table no 4 presents the results for the degree of mobility of the cervical spine, concerning the flexion and extension of the head and neck in sagittal plane, head and neck tilt to the left and to the right in frontal plane and rotation of head and neck in transverse plane to the left - right; as for the dorso-lumbar level, related to the normal values (Balint, 2007).

Table no 4. Results of the degree of mobility of the cervical spine

Indicators		Initial testing	Final testing	Normal value
Flexion, degrees		42	44	30-45
Extension, degree		30	35	35-45
Tilt, degrees	left	21	28	40-45
	right	22	28	
Rotation, degrees	left-right	40	45	45-70

Table no 5 shows the results of the degree of mobility of the dorso-lumbar spine, regarding the flexion and extension of the trunk in sagittal plane, tilting of the trunk to the left and to the right in frontal plane and rotation of the trunk in transverse plane to the left - right; as for the dorso-lumbar level, related to the normal values (Balint, 2007).

Table no 5. Results of the degree of mobility of the dorso-lumbar spine

Indicators		Initial testing	Final testing	Normal value
Flexion, degrees		77	80	80-90
Extension, degr		30	30	20-30
Tilt, degrees	left	22	22	20-35
	right	16	22	
Rotation, degr	left	40	48	30-35
	right	48	48	

Discussion

The review of the specialized literature on the deficiencies of the spine, especially the scoliosis, highlight different studies that help us to better know the problems of the research. These concerns refer to the diagnosis and the conservation treatment of the adolescent idiopathic scoliosis (Balsano & Negri, 2019), the perception of the gravitational vertical in the adolescents with idiopathic scoliosis (Berre et al., 2019), paraclinical investigations in scoliosis included in the lesson of orthopedics (Bogdan, 2019), application of the manual therapy techniques in the patients with severe idiopathic scoliosis –post-surgery stage (Dobreci, 2008).

Some scientific approaches focused on the analysis of the morbidity of thoracoplasty, and more specifically its effect on pulmonary function, after surgery with hybrid constructs using sublaminar bands in adolescent idiopathic scoliosis (Duray et al., 2019); to determine whether functional walking performance measured with Timed Up-and-Go and center of pressure progression pattern is different across adolescents with various curve severity of idiopathic scoliosis (Gao et al., 2019); comparison of the benefits of walking sticks versus a walker on the trunk and lower extremity muscular control in patients with adult degenerative scoliosis (Haddas et al., 2019).

Other studies refer to a fast 3-D ultrasound projection imaging method for scoliosis assessment (Jiang et al., 2019); optimal management of idiopathic scoliosis in adolescence (Kotwicki et al., 2013); recovery kinetics following spinal deformity correction: a comparison of isolated cervical, thoracolumbar, and combined deformity morphometries (Passis et al., 2019); scoliosis in patients with Friedreich ataxia: results of a consecutive prospective series (Simon et al., 2019), The “Risser+” grade: a new grading system to classify skeletal maturity in idiopathic scoliosis (Troy et al., 2019); effectiveness of physical exercises in the treatment of scoliosis (Vutan et al., 2018).

The research started with the anamnesis and the following measurements: circling of spinal apophyses; Adam’s forward bend test; drawing of scapular and pelvic anatomical reference points; drawing of the Rhombus of Michaelis.

The comparative analysis between the tests of the thoracic perimeters indicators highlights the diminution of the perimeter at rest and in expiration, the increase of the values in inspiration, increase of the thoracic amplitude and differences of the light leg length resulted from the asymmetric global deformation caused by the changes of the spine curves (table no 1).

The results of the measurements with the plumb line show a diminution of the vertical line of left side thoracic distance by 0.3 cm and by 0.2 cm right lumbar (the normal value is 0.5 cm), determining the scoliosis degree of the thoracic and lumbar imbalance created on right and left side (table no 2).

The results analysis of the Rhombus of Michaelis testing point out the value of the lines between the tops of the shoulder blades and between the two iliac ridges, namely the increase by 0.3 cm right superior laterally, decrease by 0.5 cm left superior laterally, by 0.5 cm –left inferior laterally and an increase by 0.5 cm vertically. The comparison with the normal values shows that there are still asymmetries at the level of the shoulders and at pelvis level, which means that there is still a need to continue the recommended and applied kinesiotherapeutic treatment (table no 3).

The results analysis of the cervical spine mobility shows an increase by 0.2 cm of the mobility degree at head and neck flexion movement in final testing, with the value of 44 degrees (the normal value is 30-45 degrees); at extension movement – increase by 0.5 degrees at final testing, with the value of 35 degrees (the normal value is 35-45 degrees); at head and neck tilt to the left – increase by 0.7 cm in final testing, with the value of 28 degrees and by 0.6 cm to the right, with the value of 28 degrees (the normal value is 40-45 degrees); at head and neck rotation movement to the left-right - increase by 0.5 cm, with the value of 45 degrees (the normal value is 45-70 degrees) (table no 4).

Regarding the results analysis of the dorso-lumbar spine mobility, it is also found out an increase of the mobility level at the flexion movement of the trunk by 0.3 cm in final testing, with the value of 80 degrees (the normal value is 80-90 degrees); the extension movement reveals unchanged values of 30 degrees (the normal value is 20-30 degrees), at trunk tilt to the left – unchanged values of 22 degrees while the trunk tilt to the right has an increase by 8 degrees in final testing, with a value of 22 degrees (the normal value is 20-35 degrees); the trunk rotation movement to the left has an increase by 8 degrees in final testing, with the value of 48 degrees while the rotation to the right – unchanged values of 48 degrees in final testing (the normal value is 30-35 degrees), highlighting a very good mobility level above the normal values (table no 5).

As for the muscle examination, it results that the patient showed no muscle deficiency in any of the two tests. At the end of the treatment, the patient no longer experienced pain in the lumbar area. Therefore we consider that the rehabilitation program was correctly applied from the kinesiology point of view and it led to improvements in the recovery process.

The results of the study highlight the therapeutic importance of the rehabilitation programs in S-shaped scoliosis. This therapeutic program was based on the selection, creation and development of the best method for the patient, enabling him to have a professional and social life as normal as possible. It is necessary to inform the population, especially the parents that in the case of an untreated scoliosis the spine may deform even more, becoming rigid and difficult to correct and requiring a complicated treatment. Because the patient started the

rehabilitation in adulthood, we recommend the continuation of the rehabilitation treatment by kinesiotherapy and by other means as well, like: physiotherapy, massage, treatment by electrotherapy, mud therapy (which works through the three well-known factors: thermal, physical and chemical) etc.

Conclusions

The adults with scoliosis must adopt the necessary methods to maintain and promote optimal health, such as regular physical exercises and the specific back care throughout life.

The study showed the changes in the thoracic perimeters indicators and the differences of the right lower limb length as a result of the asymmetrical global deformation caused by the modifications of the spine curves.

The scoliosis severity was established by comparing the vertical line of left thoracic distance and right lumbar distance with the normal values.

The increase of spine mobility at cervical and dorso-lumbar level leads to the improvement of muscle deficiency and to the elimination of pain in lumbar area.

By early application of the specific and non-specific kinetic means and by respecting the principles of effort progressivity and treatment individualization, very good results are obtained, which confirm the proposed hypothesis.

Conflicts of interest - The authors have no conflicts of interest to declare.

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