
INVITED LECTURE

SCOLIOSIS: THE BASIC ASSUMPTIONS AND RULES

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According to the general definition of scoliosis, it is an abnormal curvature of the spine. Rotation or more accurately twisting of the spine, may lead to a gradual curve, and it is almost always painless. Scoliosis is not a disease, it is a descriptive term. Curvatures of the spine in the frontal plane are present in order to maintain the upper body part in proper balance. However, when there are lateral curvatures of the spine, scoliosis exists as well. People with a family history of spinal deformity are at greater risk for scoliosis development. The early detection is essential. The risk factors for worsening of scoliosis curvatures, except for growth include: gender (scoliosis curvature in girls more often worsens during growth, as one compared to boys), age (when scoliosis appears in the younger child, the greater is the chance that the curvature will get worse), size of the curvature (with the higher degree of curvature, goes the greater probability that it will worsen over time), location (scoliosis curvature in the lower spine are with less opportunities of promotion than those in the upper spine). Unfortunately, scoliosis often becomes evident in the time when children become self-conscious about their bodies (10 to 15 years of age), so that parents and others have even less likelihood to see the problem. Scoliosis can lead to serious health problems, such as severe back pain, difficulty in breathing, physical deformities, and even injuries of lung and heart.

Keywords: *scoliosis, risk factors worsening, health problems***INTRODUCTION**

Scoliosis occurs in 2% of women and 0.5% of males in the general population. The first symptoms of scoliosis can be noticed at the age of 1-7 years, when they are the most commonly functional, static, and the curvature is reversible. There are several different "warnings" about the presence of scoliosis: shoulders are on different height level, one blade is more prominent; the head is not centered above the pelvis; one hip is positioned on higher level; costal arches are at different height levels; asymmetry of pelvic furrows can be noticed; changes in appearance or texture of the skin over the spine (holes, increased hairiness, color changes); the whole body bends to one side; fatigue. There are many causes of scoliosis, including congeni-

tal spine deformities, genetic conditions, neuromuscular changes, or leg length inequality. Other causes for scoliosis include cerebral paralysis, spina bifida, muscular dystrophy, spinal muscular atrophy and tumors.¹ Scoliosis may begin during the fetal development. The process of forming the so-called idiopathic scoliosis begins in the womb of the mother during delivery (study conducted on children 0.5 to 18 years of age, carried out at the Art Center, showed that over 95% of the children had an irregular arrangement of the pelvic bone). Lateral curvature of the spine in all these cases is not immediately apparent. The most common form of scoliosis, in 80% of cases, is idiopathic adolescent scoliosis (AIS), which develops in young adults around the onset of puberty (10-18 years).^{2,3} Most idiopathic scoliosis occurs in generally healthy people.⁴

OSTEOPOROTIC SCOLIOSIS

Some authors have published results of their research suggesting that metabolic bone diseases, osteoporosis in the first place, are important components of scoliosis occurrence and they even mention a special subcategory of osteoporotic scoliosis. Cardiorespiratory complications with a constant decline in spirometric values are described in these patients, in the late years of their life. One of the basic characteristics of scoliosis appearing as a result of osteoporosis, or vice versa, is a pain. The pain is the most common in the lumbar area, somewhat rare in the thoracic part of the spine. The pain located on the concave curvature, which indicates the following degenerative osteoarthritis including osteoporotic changes is described. Forecasting, the pain is dominant here, and can progress significantly. Low bone mass and osteopenia in the axial and peripheral part of the skeleton are common in adolescent idiopathic scoliosis (AIS). Recent studies have shown that patients with AIS have genes' polymorphism present which is linked to osteoporosis. No study has not yet linked polymorphism of vitamin D receptor (VDR) gene and bone mass in AIS.⁵

THE INFLUENCE OF M. PSOAS ON SCOLIOSIS

M. psoas is an active participant in the rotational movement of thoracolumbar spine. The first phase of the rotation is in unilateral shortening of the m. psoas, which leads to a one-sided lateral flexion to the side of shortened muscles. M. psoas shortening on the one hand, begins to bend the lumbar part of spine, and gets to a lateral curvature of the shortened muscle, with a rotation for which the concave side of the curvature is on the side of shortened m.psoas. According to the line of action of m. psoas, which is directed to forward and downwards, and lumbar spine has limited ability to rotate, a total of about 5 degrees, the rotational force is transmitted to the thoracic part, and then to the thorax with the ribs. The ribs and sternum are often faced in the opposite direction from the shortened m.psoas. The second phase is characterized by the rotation of the spine and thorax. Following the second phase, a person goes into a third phase. The pelvis goes in one direction, and the thorax in another one. Consciously or unconsciously (mostly unconsciously), the person will turn the body back into contra rotation, against the position that has been gained in the first two phases. This is the preferred position for a person (better posture in the mirror), by which the same direction of orientations of their sternum and chin is received. It is in the same direction as the knee orientation, which is certainly an advantage in walking. Even if a person looks perfectly balanced, yet there is a lot of balancing

in muscle tension, as if it is the accelerator and brake at the same time. The third stage involves the use of other muscles that will bring the thorax back in the opposite direction, and the diagnosis formulation as well as the treatment is demanding. In the third phase, we can see that one side of the ribs is closer to the hip than the other one. In the first phase, we see the same thing, but on the opposite side.

THE INFLUENCE OF THE PELVIC POSITION ON SCOLIOSIS

When the pelvis is in an asymmetrical position, it influences on the faster development of scoliosis process. Basic movement that changes the position of the pelvic bones in relation to each other, can occur in sacroiliac joints. Dislocation can occur in all directions. When the pelvic bones are moved upwards, they are also turning inwards, moving the upper part backwards and the lower part to the front. Sacral bones behave oppositely, rotating in the opposite direction. With the movement of the pelvis, within the connection with the upper and lower part of the skeletal system, it has also been reported about the progress according to the junction of sacral bone and the lumbar spine. The 5th lumbar vertebra is positioned in the direction of the sacral bone rotation and the spine positioned above the same turns in the opposite direction. This explains the stronger connection between the sacral bone and 5th vertebra than of those between the 4th and the 5th vertebra. This situation partly explains the occurrence of vertebrae's rotation in lateral curvatures of the spine (so called rotoscoliosis).⁶

DIAGNOSIS

In addition to taking a family history of disease, following diagnostic procedures are being done: clinical examination of the spine, shoulders, hips, legs and thorax for signs of scoliosis; X-ray image of the spine in the standing position to confirm the diagnosis and determining the size of the curvature of the spine; after that, the occasional X-ray images are recommended in the follow-up process of the spine curvature in order to continue or change the therapy program; in the most number of curvatures, CAT scan or MRI of the spine is recommended.⁷

COMPLICATIONS

Most people with scoliosis have a mild form of the disease, but sometimes scoliosis can cause complications. In severe scoliosis, with curvature greater than

70 degrees, the thoracic area can be reduced, which can interfere with breathing and heartbeats, and the risk of lung infections and pneumonia is increased.⁸ Adults who had scoliosis as children are more likely to have chronic back pain than are those in the general population.⁹ Also, people with untreated scoliosis may be more likely ones to have arthritis of the spine. Ribs located on the concave side of the curvature seem to be by their position significantly closer to the spine in relation to the ribs on the convex side whose significance of removal in the opposite direction of the spine is directly dependent on the degree of scoliosis curvature. The blade seems often as „winged” on the side of the lump, and *m. serratus anterior* is hypertonic. As a result of scoliosis, decreased breathing, has a long-term prognosis as a function of increasing the curvature (deteriorates). The asymmetry of quality of muscular tonus and trophic is often present in *m. scalenus*, *m. serratus posterior*, superior and inferior and *m. intercostalis*. This change is tangible and visually apparent. Asymmetry of muscles is due to greater and more frequent involvement of movement. *Psoas* muscle is almost always included in scoliosis, and particularly affects the curvature of the lumbar spine. *Psoas* muscle was always one-sidedly hypertonic in scoliosis, although it often does not correlate with positive Thomas test. In scoliosis, muscles of cervical segment of the spine are often in hypertonus, for trying to maintain the postural function. They are usually asymmetrically hypertonic, more expressive on the side where the head is tilted towards the shoulder. In any treatment of scoliosis, these important muscles are to be treated. Neurological component of scoliosis is manifested by a higher tendency to faster responses in the muscles than normal, on the concave side of curvature. Late reactions to stimuli are found in the muscles in people with idiopathic scoliosis (20-243 milliseconds compared to 5 milliseconds in healthy subjects). In idiopathic scoliosis a noticeable neurological asymmetry is often present. In people with this scoliosis type, the lack of strength in the resistance is present, especially in rotation. The changes in proprioception in some patients with idiopathic scoliosis are recorded, which perceive and accept the position of the body as balanced and with symmetrical posture no matter on the curvature size that leads to distortions.

TREATMENT

After it has been determined that a patient has scoliosis, the decision to treat scoliosis depends on the child's age, maturity, sex, family history, size of curvature and speed of growth.¹⁰ If a child has a curvature sizing 25-40 degrees and still rising, the use of proper

corset is also recommended. The usage of a corset will not cure scoliosis, but it influences on further progress of the curvature. Most corsets are worn at all times, during day and night. Children who wear a corset can participate in most everyday activities but have slight limitations. Once the skeleton is mature – in about 15-16 years of age for girls and 17-18 years for boys, or if the curvature is too large, sizing more than 40-45 degrees, corset will not help. Corsets are not significantly useful for the treatment of congenital scoliosis.¹¹ The experience through the therapeutic procedure of manual massage is that people with functional scoliosis may respond to massage by reduction of the symptoms, but the person with structural scoliosis will not respond to massage therapy. In cases of structural scoliosis (fixed, irreversible), the conventional methods are applied, such as corrective exercises, corsets, massage or electro stimulation. If the cause of scoliosis is not removed, these therapeutic procedures do not provide significant effects. The areas that are very important in creating the proper posture, reduction of the pain and further reduction the spinal curvature are the legs and walking, *m. psoas*, *m. rectus abdominis* and the way of breathing.^{12,13} Legs and walking. When standing and walking, it is important that the person has an equal weight on both feet and to be aware of any imbalance. Strengthening the legs creates a good basis from which the spine can become disburdened from the body weight. *M. psoas maior et minor*. These two muscles (a pair on each side of the body) are the main spinal flexors to the side. They are continued to the lateral muscles along the spine and to the small trochanter of the femur. Together with the *m. iliacus*, they form structural and functional unit (*m. iliopsoas*). Besides flexing the thighs, *m. iliopsoas* is an important postural muscle. When these muscles are strong enough leg aligns with the torso and frees the spine. *M. rectus abdominis*. Strong abdominal muscles are important in scoliosis. If these muscles are weak, they lead to fatigue of the back muscles which become tense. In extreme cases, it can cause an expressed lordosis of the lower back. Breathing. Awareness of breathing is important. Typically, less air enters the lung on the concave side of the spine.¹⁴

EXERCISES IN SCOLIOSIS CAN ONLY BE A PART OF THE SOLUTION

Exercises in scoliosis are designed to correct or improve the lateral and rotational curvature of the spine.¹⁵ But if exercises are being done for 30 minutes during a day, what happens with the rest of the day-time? Returning to the normal daily activities and not keeping the proper posture can undo what was achieved by exercise (regular form of muscle control). Experi-

ence has shown, that one with adequate derotational exercise can achieve very good results, especially in the initial rotation of thoracic and lumbosacral part so that appropriate exercises have not only therapeutic but also preventive significance. Due to a large number of scoliosis, significantly higher than what official statistics say, it would be ideal to include more or less all the children in the program of adequate exercise.¹⁶

So, scoliosis is not only caused by inadequate posture, diet, improper exercise or wearing backpacks, as it is often the opinion of parents of children who have scoliosis.

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