

EFFECT OF LUMBO-PELVIS STABILITY ON GLOBAL MOTOR PATTERNS IN ADOLESCENT WITH DIGNOSED IDIOPATHIC SCOLIOSIS BASED ON THE FMS TEST

¹Anna Brzęk, ^{2,3}Irmina Blicharska, ²Jacek Durmała, ³Michał Rżany

¹ Institute of Kinesiology, Chair of Physiotherapy, Medical University of Silesia, Poland

² Department of Medical Rehabilitation, Medical University of Silesia, Poland

³ The Student Scientific Set near the Kinezjology Institute, Chair of Physiotherapy, Medical University of Silesia, Poland

Abstract

Introduction During the somatic muscles development, proper muscle balance in the spine and pelvis determine correct development of physical activity. Lumbo-pelvic complex is a system affecting the biomechanics of the whole body. During daily activities and increased physical activity practiced by children in their free time may occur a repetitive pathological movement patterns thus increasing the risk of injury, as well as the uncontrolled development and fixation of pathological compensation. Spontaneous compensation impact directly on the development of abnormalities in body posture and dangerous idiopathic scoliosis.

The aim of this study was to measure the level of the lumbo-pelvic stabilization in adolescents with idiopathic scoliosis and to determine effects of this on the basic movement patterns and parameters on scoliosis.

Material and methods The study group consist of adolescent of both sexes, aged 14-18 years whose divided into two subgroup. Group A-basic group consist of 30 adolescent with diagnosed idiopathic scoliosis with primary curve 25.16 ± 9.3 Cobb. They was hospitalized for a 21-days in the Department of Rehabilitation and subjected therapy according procedures of DoboMed. Group B- control consist of 35 subjects - high school students with the correct posture.

Research Tools The body posture evaluated by scoring Kasperczyk's Scale and the measurement of spine in the sagittal plane using the Plurimeter V-Rippsteina. Stability of the Lumbo-pelvic complex was based on Stabilizer Pressure Bio-Feedback, and to assess patterns of motor test was used FMS-Functional Movement Screen. ATR- ankle of trunk rotation were checked with Bunell's Scoliometer. In control group the measurement was used to exclude scoliosis. In the group of patients with scoliosis curvature angle values were determined using the Cobb on the basis of

current X-ray, taken as part of routine medical visit, which was dictated by medical reasons, in consultation with doctor.

Results During activation the deep muscles which stabilize lumbar spine, in both group (56% of group A and 42.8% in group B) observed additional movement of other muscles. The often occurring compensation is move initiated by bending the spine. There was a statistically significant correlation between the size of lumbar lordosis and level of LM complex stabilization in group A ($R = 0.39$, $p < 0.042$). Also confirmed the theory that the greater value of Cobb in the thoracic spine has girls with reduced or even abolished thoracic kyphosis ($R = -0.75$, $p < 0.00001$). In the group of patients with scoliosis reported a statistically significant correlation between the number of points obtained in the evaluation of Kasperczyk's point method and the sum of points obtained in the test (FMS $R = 0,57$, $p < 0.001$).

Conclusions

1. The lower level of lumbar stabilization in both groups may be the result of improperly oriented activity without appropriate activating of transverse abdominal muscle, and other deep stabilizers.
2. In the group of patients with scoliosis incorrect compensation during motor tasks are associated with abnormalities of posture.
3. Changes in the spine affect on the movement's patterns throughout the whole body.

Key words: idiopathic scoliosis, lumbo-pelvic stability, motor patterns

Introduction

The lumbo-pelvic system consists of numerous structural and functional connections in all human body. Deep spine stabilizers, particularly the transverse abdominal muscle, the multifidus muscle and the muscles of the pelvis floor, are responsible for its proper functioning and the correct level of stability^[1,2]. Panjabi's theory regarding the stability of kinematic links of the musculoskeletal system distinguishes following subsystems : the active (the myofascial system), the passive (osteoarticular) and the nervous system. Their correct functioning and cooperation ensures the suitable level of stability. The whole may be labelled as the stabilization system. Abnormalities in the operation of one of the components of the above-mentioned triad of subsystems lead to overloading of the other two, and as a result they beget multiple compensations and overloads in the

musculoskeletal system. During the somatic development the maintenance of the correct muscle balance within backbone and pelvis impacts on the proper physical development^[3,4]. The daily chores as well as intensified physical activity of children and youth at their leisure time may predispose towards the incidents of recurring pathological movement patterns, increasing in consequence the risk of injuries, but also being conducive to uncontrolled development and consolidation of pathological compensation mechanisms. The scholars who deal with the subject of lumbo-pelvic stabilization system functioning and disorders rely on the search for the role of the deep muscles in low back pain. There is a lack of available studies that would cover the given subject in case of children and youth, especially as far as idiopathic scoliosis is concerned. Scoliosis, which is three dimensional curve of the spine influences the biomechanics of the whole body, including the positioning of the pelvis. It constitutes as well the attachment deep muscles place and other ones, which are responsible for keeping the proper body posture^[1]. The aim of the research was to establish the level of lumbo-pelvic system stabilization in the subjects with idiopathic scoliosis that had been diagnosed in their cases and to measure its influence on the rudimentary movement patterns and the parameters distinctive of the curvature.

Materials and methods

Study groups 65 teenagers of both sexes participated in the study. Group A (the main one) comprised 30 people in the age group between 14-18 years old ($x = 15,7 \pm 1,46$), who were the Rehabilitation Department patients, with diagnosed idiopathic scoliosis. The subjects were exposed to the process of intensive physiotherapy in stationary conditions over 21 days with the application of the DoboMed method. The average value of the Cobba angle was $25,2^\circ \pm 9,3$. Table no.1 presents a thorough description of the group. Group B (the control group) consisted of 35 subjects – the junior high school students in the Silesian region in a similar age bracket ($x = 15,03 \pm 0,78$). None of them has been diagnosed to suffer from scoliosis.

Research tools

The same diagnostic tools were employed to carry out the measurements in both groups, by the same researcher. Kasperczyk visual-point method has been utilized to evaluate the body posture. It is founded on the visual assessment of individual elements of body posture in coronal and sagittal plane. The arrangements of the following elements i.e. the head, shoulders, scapulas, abdomen, knees, chest shape, the magnitude of thoracic kyphosis, lumbar lordosis, and also feet and the presence of scoliosis are given points according to a specific scale where 0 signifies the correct state, 1 point is given for a slight deviation, 2-3 for a considerable one, 3-5 in case of structural changes. The scale takes into account all the possible abnormalities within a given element and provides the possibility to appraise its extent, if they are large, advanced or whether only minor

deviations occur. After aggregating the points the subject's posture may be determined as very good, good, bad, or very bad. Kasperczyk's study allowed to draw up a painstaking depiction of the group in terms of the most frequent deviations involving the chest, the thoracic kyphosis shape, the arrangement of knees or feet. Moreover, it allowed to pinpoint the prevalent body posture type^[5,6]. The degree of the backbone's curvatures in the sagittal plane of the thoracic kyphosis and the lumbar lordosis was measured with V-Rippstein's plurimeter.

The measurement of the angle of the trunk rotation (ATR) was conducted while sitting, when the Adams' test (bending the trunk) was being performed. The measurement was recorded on every level of curvature in the group of people suffering from scoliosis. In case of the Junior High School students the research was meant to exclude scoliosis. Values up to 3° ATR were acknowledged to be a norm^[7]. The lumbo-pelvic system stability level was established on the basis of the examination with Stabilizer Pressure- Bio-feedback by Chattanooga company. The device allows to differentiate whether during a given movement the deep muscles stabilizers are flexed, or if compensation ensues in reality through the global muscles activity^[8]. The study was pursued when the subject was either lying on their back or being prostrate. The most frequent compensations present while performing the global movement patterns were defined on the basis of FMS- Functional Movement Screen test. The test consists of seven movement-centered tasks, which performance quality is rated according to strictly defined scale^[9]. In the group of people with scoliosis the curvature angle values were established by Cobb's method on the basis of a valid X-ray which was made as a routine doctor's visit, being dictated by medical stakes in agreement with the attending physician. The pronouncement of scoliosis on the basis of objective examination was the condition for a subject to be included in the main group.

Tabl. 1. Characteristic of the study group

CHARACTERISTIC	STUDY GROUP
Number of subject	30
Mean age	15,7
Location of the curve	

C-Th	10%
Th	37,5%
Th-L	25%
L	27,5%
The average value of the curve	Cobb angle
C-Th	28,5°
Th	23,94°
Th-L	19°
L	22,54°

Statistical analysis

The collected data have been placed in one database and they have been prepared with Excel programs belonging to Ms Office 2007 package and Statistica v. 10. The lumbo-pelvic system stability level, the quality of performed movement patterns and the extent of backbone's curvatures in sagittal planes were estimated in this study as the foremost issues. Then, it was analyzed how the given measurement parameters differed from the respective groups under the study. The assessments of the measurable parameters relations were done with the R- Pearson coefficient, in case of non-measurable components Chi-square (χ^2) test was employed, but for the evaluation of the comparative intergroup parameters the „t” Test was used for dependent and independent samples. Values working out at $p < 0,05$ have been accepted as statistically important for all the calculations.

Results

Statistical analysis displayed some individual diversity of results. It emerges from the individual analysis of the number of points in Kasperczyk's study that, in the main group the summaric point value varied in the bracket between 10 to 22 points ($x=15,91$ $s=2,98$), whereas in the control group only from 1 to 16 ($x=7,24$ $s=3,38$). The greatest deviations were detected in foot arch (68, 89% group A and 65,5% group B), however the least in case of chest arch. The below diagram illustrates the point values obtained for individual elements in both groups (Figure no.1)

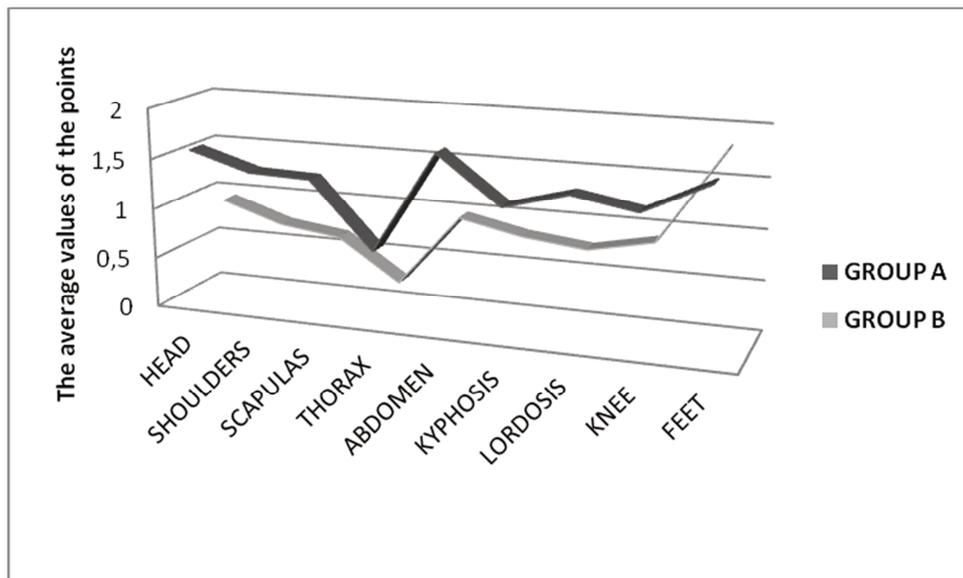


Fig.1 The average values of the results derived during research with Kasperczyk's method in both groups

All the differences between the groups in arrangement and shape of the assessed elements are statistically important ($p < 0,05$). The least difference was noted in case of foot arch. The final points difference obtained between the tested groups was also statistically significant and amounted to $T=14,15$, $p < 0,0000$.

The statistical analysis of backbone's curvatures in the sagittal plane exhibited that in both groups the thoracic kiphosys is reduced 52,2% or flattened 32,6%. It is connected with patomechanisms of scoliosis occurrence in the group suffering from scoliosis. The people in the control group reached an average kyphosis value of 24° , which is a norm for a given parameter according to Dobosiewicz^[10,11]. The distinctions between the groups are statistically significant ($T=2,08$, $p < 0,05$). The lordosis values were correct in both groups, they were within the limits of the accepted norm (24° do 36°).

In the group of people with scoliosis, in line with current reports, a correlation has been discerned between ATR and the original curvature value of Cobb's angle ($R = -0,75$, $p < 0,0000$) pointing to the existence of greater rotation in case of subjects with higher curvature values.

The below diagram demonstrates a percentage distribution of the results derived in both groups from the lumbo-pelvic system stability measurement.

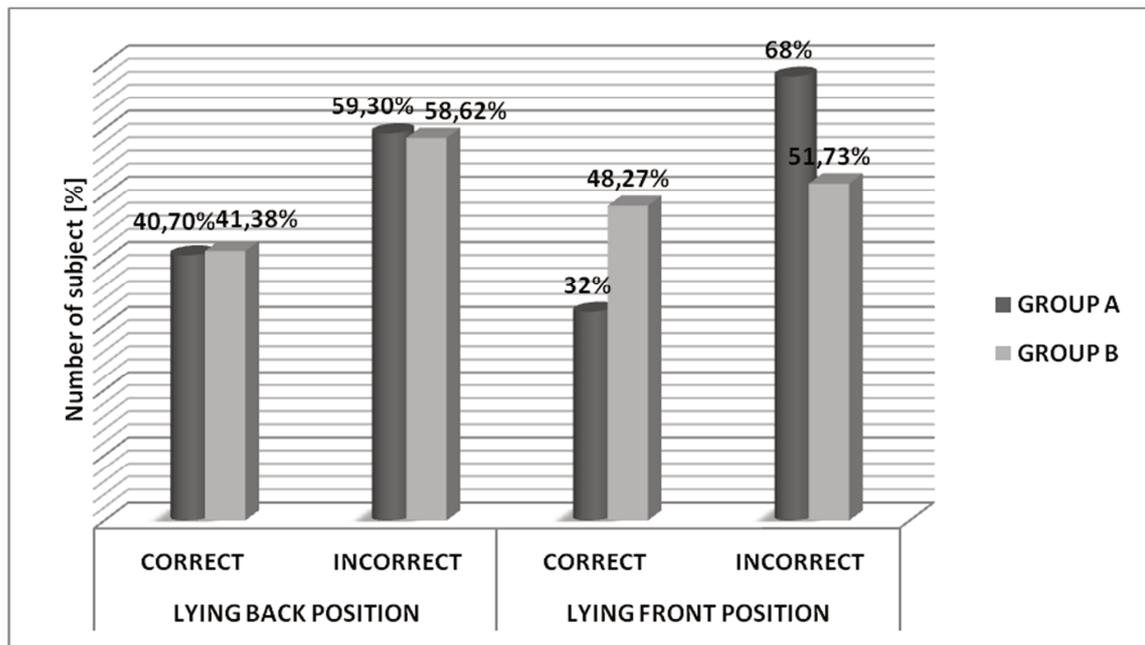


Fig. 2. Percentage distribution of the results derived in both groups from the lumbo-pelvic system stability measurement

There is a preponderance of people in both sample groups, who cannot correctly flex the deep muscles. Slightly better results were gained by the subjects with the proper body posture (group B). Better results were yielded in case of lumbo-pelvic system stability assessment in lying on one's back. 43,1% of the sample groups received correct results in lying on back, but only 36,59% of the subjects obtained correct results in lying with the face downwards. It is related to easier control and flexing of transverse muscle in that position. When put into practice, this result may be used for the choice of the appropriate starting position in the initial stage of deep muscles activation exercises. There was detected as well the correlation between the extent of lumbar lordosis and the values obtained in the lumbo-pelvic system stability research of the main group ($R=0,39$, $p<0,042$).

The Scrutiny of functional tests showed the presence of numerous compensations during FMS test. Both groups dealt worst with the so-called „Deep Squat” test which entails making a deep knee bend. So many as 94,4 % of all the tested performed it wrongly. The greatest difficulties in the main group were observed within the nervous-muscle coordination 65,5%. The trunk stability during the movement of the limbs turned out to be undeniably the weakest part of the kinematic chain, which was noticed in all the subjects of group A. In the group of Junior High School youth the results looked similarly. The trunk stability also transpired to be the weakest link in the group of people suffering from scoliosis, which was detected in 82,8 % of the subjects. There were found statistically important differences between the sample groups in points that were numerically

obtained in FMS test ($t=3,98$; $p >0,0005$). The presence of synkinesis while performing of the exercises was perceived in 54,68% of the subjects. The majority of the first and the second group was qualified to the injury risk group or the group of heightened injury risk. In group A the number of points neither depended on the extent of the original curvature ($R = 0,3$; $p >0,21$) nor its location. However, it hinged on the lumbo-pelvic system stabilization level ($R = -0,43$, $p <0,022$ in prostrate lying and $R = -0,5$; $p <0,006$ in back lying). The relations between the results assessed in FMS test and the extent of the curvatures in the sagittal plane ($X^2=3,65$, $p >0,16$ przy $df= 2$). were not evaluated. A negative correlation was found between the points gained through the posture examination by Kasperczyk's method, and the FMS test points in the group of people with scoliosis ($R=-0,57$, $p <0,001$). More common compensations took place in the subjects with worse body posture.

Discussion

The human body posture is characterized among other things by the extent of the backbone's curvature in the sagittal plane and the proper length of individual muscles. Many authors who handle the subject of scolioses indicates to decrease of the thoracic kyphosis during their course, but some of them claim that the decline of given curvature is a progression factor. In the study in hand this fact was also confirmed, because 84,8 % of the subjects were determined to have their thoracic kyphosis lessened or absent. It is perturbing, however, that many children and youth struggle with disturbed thoracic kyphosis in the form of flat back 65 % and round back 24,17%.

Another distressing fact is that the people with defects as well as the ones who possess a proper posture have a low lumbo-pelvic system stability level. Low results were also derived in another study on a group of physiotherapy students. There seems to be an urgent need to find the cause of the current state of affairs not to encumber the present generation with high percentage of people in the future suffering from the pains of lumbo-pelvic section of the backbone. The causes of it may be engendered by the lack of awareness of those being examined and seldom rate of doing exercises/activities connected with selective flexion of local muscles. Shaping and enhancing of the segmentary stabilization is one of the key elements of the therapy with people wrestling with physical control conditions and the deficits of joint protection mechanisms, but sometimes in older years the overlapping of injuries, pain and the diminishing of gravity's load are three chief factors which disrupt the working of joint protective mechanisms. They may affect the physical control, lead to acquisition of altered motor behaviours, and as a result to vary markedly the clinical picture of patients. It seems lucid that individual approach to a sick person is required as well as the selection of suitable diagnostic tests and the therapy plan adjusted to every single patient's needs. It ought to be mentioned that children who are helped to recuperate at the Rehabilitation Ward in

stationary conditions where this process is intensified, are subjected to activities several times each day.

The FMS test which helps to identify the weak link of functional state seems to be a precious diagnostic tool. It aids in detection of improper physical patterns or the lack of ability to perform them^[12]. Observing them early on the consolidation of them will be avoided and the concomitant consequences. In case of posture defects it may also serve as a recovery indicator, pointing to which of the elements to pay main attention to and later it may act as a progress benchmark.

The results that have been culled also prove that the existence of a defect within the posture causes limitations, which impede the performance of correct activity, as a result of which there are created multiple improper compensations while performing movement patterns. A correctly performed movement should happen while maintaining a proper body posture. However, the limitations which exist in the musculoskeletal system connected with the defect prevent it.

Conclusions

a. A low level of the lumbo-pelvic stability complex was reported among the children and youth, which may be associated with sedentary lifestyle, or the lack of properly oriented physical education.

b. The synkinesis of global muscles during a physical examination can be a sign of the level of control of the lumbo-pelvic stability complex.

c. The limitations within the musculoskeletal system associated with the occurrence of poor posture result in numerous abnormal compensations during the execution of individual movement patterns, which may lead to numerous overloads and dysfunctions in the future.

d. The alterations in the spinal cord influence individual movement patterns within the whole body.

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