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Postural deviations in Romberg's Test in girls with scoliosis and scoliotic posture

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Abstract

The aim of the research was to analyze postural deviations in Romberg's Test in girls with idiopathic scoliosis and scoliotic posture. 28 girls aged 7-18 years old were involved in the study. Spine research was made by Exhibeon digital radiography. Based on the size of the angle of spinal curvature there were identified scoliotic posture: 1-9° and scoliosis: ≥ 10°. Postural reactions were examined by static-dynamic Tecnobody's ST 310 Plus Stability System platform. There were 21 (75%) children with scoliotic posture, and 7 (25%) with idiopathic scoliosis. Postural reaction of FBSD was from 6.57 with opened eyes (OE) to 7.32 with closed eyes (CE). Postural reaction of MLSD was from 3.89 with opened eyes (OE) to 5.54 with closed eyes (CE). Postural reaction of AFBS was from 11.96 with opened eyes (OE) to 17.29 with closed eyes (CE). Postural reaction of AMLS was from 9.96 with opened eyes (OE) to 13.89 with closed eyes (CE). Analysis of variance with dual classification revealed a significant effect in Romberg's Test options (OE/CE) to: Average COP X (p = 0.002264), Average COP Y (p = 0.000009), Perimeter (p = 0.000008), Ellipse Area (p = 0.029882), Medium-Lateral Standard Deviation X (p = 0.022162), Average Forward-Backward Speed Y (p = 0.000071) and Average Medium-Lateral Speed X (p = 0.000916). In the examination with eyes closed it has been observed a significant increase of this variances. There was no significant effects only in Forward-Backward Standard Deviation Y. Most of postural deviations did not fit the norm.

KEYWORDS: postural deviations, scoliosis and scoliotic posture, Romberg's Test, Plus Stability System platform, Exhibeon digital radiography.

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Introduction

Body posture defects and scoliosis are disorders related with the disturbed static, adjustment reactions, as well as with efficiency of balance reactions, which overlap on consciously performed programme of voluntary movements. Systems which are responsible for maintaining the body posture in balance in children with scoliosis are disturbed [3, 28]. Within the meaning of etiopathogenesis, scoliosis is only a symptom, an external expression of unrecognized pathology, which may occur in any segment of the spine and in children of all ages [2, 14]. Although the scoliosis is clearly a postural distortion, at the same time it is a result of compensation abilities of the body, allowing to keep the head setting and shoulder girdle above the pelvis [20, 25]. The final shape of the trunk is the result of deforming processes and compensative reaction, so that the body, at the expense of massive disorder of its own form, maintains the orientation of the body [17, 18, 24]. At the present state of knowledge, it is reasonable to talk more about the etiological factors, not about the theory (genetical, metabolic etc.) of scoliosis formation. Currently the concept which has got the

most supporters is a multifactorial, including genetical (CHD7 gene) conditioned pathology of central nervous system, which causes changes in postural system [7, 22]. The aim of the research was to analyze postural deviations in Romberg's Test in girls with scoliotic posture and idiopathic scoliosis on Tecnobody's ST 310 Plus Stability System platform.

Material and Methods

The study included 28 girls aged 7-18 years old with scoliotic posture and idiopathic scoliosis. All examined persons were selected intentionally. Children attended to the Interschool Centre of Corrective Exercises in Starachowice. The research was conducted in June 2011. Spine research was made by Exhibeon digital radiography. Pixel Technology's Exhibeon digital radiology is a valuable diagnostic tool, which replace a traditional X-ray film. Exhibeon runs on Linux and Microsoft Windows operating systems. Exhibeon digital radiology allows, among others, to outline the central sacral vertical line, visible on X-ray of the spine on the computer screen, measure of the angle of axial circle rotation and to determine the Cobb angle. Radiographs have been taken of a free-standing position, anterior-posterior projection and lateral. X-ray included lumbar, thoracic and cervical spine, chest, and pelvis with hip joints. The Cobb angle has been marked on X-ray of the spine, which is visible on the computer screen. These deviations were examined by static-dynamic Tecnobody's ST 310 Plus Stability System platform. The research based on continuous observation of the centre of feet pressure (COP). By recording the horizontal deflections of the body (postural sway) as a function of time, the detailed information concerning the postural system has been obtained. The COP displacements reflected the movements of center of body mass (COM) in the frontal and sagittal plane. The frequency of signal was 20 Hz. Change of the maximum pressure on the soles of the feet during the deviations of the body was perceived by mechanical-electronic transducer consisting of three sensors installed inside the platform. Recorded signal was processed from the analog information into digital, and then elaborated by computer program. The appropriate software created the possibility to calculate the resultant ground reaction force, which is the sum of the moments of the forces acting on the platform in three points of measurement. There was performed a standard stability rating test in a free-standing position (Romberg's Test). The test consisted of two successive samples lasting 30 seconds each: first with opened eyes (OE – open eyes), second with closed eyes (CE – close eyes). Measurements were taken in the morning. The tested person was carefully instructed about the test sequence. The silence has been assured during examination, because auditory stimuli acting on man in terms of attention can significantly impair the postural reflexes. The examined person has been ensured about the total harmlessness of the performed test. During the study, the investigator was behind the tested person all the time, not passing any messages. During the measurements with opened eyes (OE), the examined person has been asked to focus his sight on a point of reference, located on the computer screen. The center of vision speckle was located at a distance of 1 meter from examined person. Before starting the test with closed eyes (CE), researcher made sure that the tested person is able to maintain an upright posture without visual control. The examined person stood on a platform barefoot, because shoes could interfere his posture. The feet were set with careful precision: heels 2 cm from each other, feet apart at the angle of 30°, so that the center of gravity of a polygon base was in the sagittal axis of the platform at a distance of 3 cm from its center. The examined person took a habitual position with arms lowered along the torso and head straight. Test started at the time when investigated person took a posture, and on the screen the way of centre of feet pressure deviation was displayed. It has been analyzed the selected parameters, which records the centre of feet pressure deviations (COP): Average load point X (Average COP X (provides lateral coordinates X (mm)); Average load point Y (Average COP Y (provides anterior-posterior coordinates Y (mm)); Perimeter. It is the total length of the path traveled by the COP in both planes during the oscillation (mm); Ellipse area. It is the total area which circled the COP in both planes during the oscillation (); The mean deviation X (Medium-Lateral Standard Deviation X), is the mean oscillation along the X axis (mm) and medium lateral deviation (mm), which is the average distance between the extreme deviations of the centre of feet pressure in the lateral plane; The mean deviation Y (Forward-Backward Standard Deviation Y). Is the mean oscillation along the Y axis (mm), medium anteroposterior deviation (mm) − the average distance between the extreme deviations of the centre of feet pressure in the sagittal plane; Anteroposterior speed (Average Forward-Backward Speed), is the mean oscillation speed along the Y axis (mm/s). It is the length quotient of deviations of the centre of feet pressure during the test, which indirectly informs about the dynamics of regulation process of postural stability in a standing position; Lateral speed (Average Medium-Lateral Speed), is the mean oscillation speed along the X axis (mm/s). It is the length quotient of deviations of the centre of feet pressure during the test, which indirectly informs about

the dynamics of regulation process of postural stability in a standing position. For statistical calculations, depending on the compatibility of variable distributions with normal distribution, and the value of skewness and kurtosis, parametric or non-parametric tests have been used. Variables were verified in terms of normal distribution by Shapiro-Wilk test. Variability of quantitative traits in terms of categorial features (age group, study options) were verified by analysis of variance with single and double classification for the repeated measurements. The application of this test did not require group equality, normal distribution or homogeneous variance. The level of significance was $p < 0.05$.

Results

Based on the size of the angle of spinal curvature there were identified: scoliotic posture (1-9°) and scoliosis (≥ 10°). There were 21 (75%) children with scoliotic

Table 1. Postural deviations and age

Independent variables	Postural deviations (OE-CE)	Dependent variable				
		Average	Standard error	−95.00%	95.00%	n
Age group		Average COP X				
7-11 years old (1)	Average COP X (OE)	0.750	0.317	0.096	1.404	8
7-11 years old (2)	Average COP X (CE)	5.125	1.507	2.022	8.228	8
12-14 years old (3)	Average COP X (OE)	1.077	0.249	0.564	1.590	13
12-14 years old (4)	Average COP X (CE)	3.846	1.182	1.412	6.280	13
15-18 years old (5)	Average COP X (OE)	0.571	0.339	−0.127	1.270	7
15-18 years old (6)	Average COP X (CE)	4.286	1.611	0.968	7.603	7
Age group		Average COP Y				
7-11 years old (1)	Average COP Y (OE)	2.625	2.268	−2.045	7.295	8
7-11 years old (2)	Average COP Y (CE)	8.625	2.363	3.759	13.491	8
12-14 years old (3)	Average COP Y (OE)	5.923	1.779	2.259	9.587	13
12-14 years old (4)	Average COP Y (CE)	9,385	1.853	5.568	13.202	13
15-18 years old (5)	Average COP Y (OE)	2.571	2.424	−2.422	7.564	7
15-18 years old (6)	Average COP Y (CE)	10.286	2.526	5.084	15.488	7
Age group		Perimeter				
7-11 years old (1)	Perimeter (OE)	659.000	66.053	522.960	795.040	8
7-11 years old (2)	Perimeter (CE)	830.000	83.007	659.045	1000.955	8
12-14 years old (3)	Perimeter (OE)	483.539	51.817	376.820	590.257	13
12-14 years old (4)	Perimeter (CE)	756.615	65.116	622.507	890.724	13
15-18 years old (5)	Perimeter (OE)	506.714	70.614	361.282	652.147	7
15-18 years old (6)	Perimeter (CE)	682.429	88.738	499.670	865.187	7
Age group		Ellipse Area				
7-11 years old (1)	Ellipse Area (OE)	681.875	101.240	473.367	890.383	8
7-11 years old (2)	Ellipse Area (CE)	892.875	281.122	313.894	1471.856	8
12-14 years old (3)	Ellipse Area (OE)	362.846	79.419	199.279	526.413	13
12-14 years old (4)	Ellipse Area (CE)	965.615	220.530	511.426	1419.805	13
15-18 years old (5)	Ellipse Area (OE)	336.714	108.230	113.810	559.619	7
15-18 years old (6)	Ellipse Area (CE)	587.571	300.532	−31.385	1206.528	7

posture, and 7 (25%) with idiopathic scoliosis. The frequency and type of defect didn't depended on age. Average COP X in the whole group was from 0.86 with opened eyes (OE) to 4.32 with eyes closed (CE). The difference in Romberg's Test was 3.46. Average COP X in the age group of 7-11 was from 0.750 with opened eyes (OE) to 5.125 with eyes closed (CE). The difference in Romberg's Test was 4.38. In the age group of 12-14 was from 1.077 with opened eyes (OE) to 3.846 with eyes closed (CE). The difference in Romberg's Test was 2.77. In the age group of 15-18 was from 0.571 with opened eyes (OE) to 4.286 with eyes closed (CE). The difference in Romberg's Test was 3.72 (Table 1). Average COP Y in whole group was from 4.14 with opened eyes (OE) to 9.39 with eyes closed (CE). The difference in Romberg's Test was 5.25. Average COP Y in the age group of 7-11 was from 2.625 with opened eyes (OE) to 8.625 with eyes closed (CE). The difference in Romberg's Test was 6.00. In the age group of 12-14 was from 5.923 with opened eyes (OE) to 9.385 with eyes closed (CE). The difference in Romberg's Test was 3.46. In the age group of 15--18 was from 2.571 with opened eyes (OE) to 10.286 with eyes closed (CE). The difference in Romberg's Test was 7.72 (Table 1). Perimeter was from 539.464 with opened eyes (OE) to 759.035 with eyes closed (CE). The difference in Romberg's Test was 219.57. Perimeter in the age group of 7-11 was from 659.00 with opened eyes (OE) to 830.00 with eyes closed (CE). The difference in Romberg's Test was 171. In the age group of 12-14 was from 483.53 with opened eyes (OE) to 756.61 with eyes closed (CE). The difference in Romberg's Test was 273.08. In the age group of 15-18 was from 506.71 with opened eyes (OE) to 682.42 with eyes closed (CE). The difference in Romberg's Test was 175.71 (Table 1). Ellipse area was from 447.464 with opened eyes (OE) to 850.321 with closed eyes (CE). The difference in Romberg's Test was 402.857. Ellipse Area in the age group 7-11 was from 681.87 with opened eyes (OE) to 892.87 with closed eyes (CE). The difference in Romberg's Test was 211. In the age group of 12-14 was from 362.84 with opened eyes (OE) to 965.61 with closed eyes (CE). The difference in Romberg's Test was 602.77. In the age group of 15-18 was from 336.71 with opened eyes (OE) to 587.57 with closed eyes (CE). The difference in Romberg's Test was 250.86 (Table 1). Analysis of variance with dual classification revealed a significant effect of study options in Romberg's Test (OE/CE) to: Average COP X ($p = 0.002264$), Average COP Y ($p = 0.000009$), Perimeter ($p = 0.000008$) and Ellipse Area ($p = 0.029882$). In the study with eyes closed it has been observed a significant increase of

Table 2. Analysis of variance for repeated measures

Independent variables	SS	DF	MS	F	p
Average COP X					
Free term	355.4234	1	355.4234	39.78722	0.000001
Age group	2.726	2	1.363	0.15258	0.859287
Error	223.3276	25	8.9331	–	–
OE-CE	170.9892	1	170.9892	17.04399	0.000356
OE-CE – Age group	6.6765	2	3.3383	0.33275	0.720074
Error	250.8056	25	10.0322	–	–
Average COP Y					
Free term	2252.927	1	2252.927	31.35051	0.000008
Age group	42.919	2	21.459	0.29862	0.744452
Error	1796.563	25	71.863	–	–
OE-CE	427.822	1	427.822	30.70523	0.000009
OE-CE − Age group	44.295	2	22.148	1.58956	0.223953
Error	348.33	25	13.933	–	–

Independent variables	SS	DF	MS	F	p
Perimeter					
Free term	22264980	1	22264980	308.8161	0
Age group	209145	2	104573	1.4504	0.253531
Error	1802446	25	72098	–	–
OE-CE	557081	1	557081	31.0743	0.000008
OE-CE – Age group	34777	2	17389	0.9699	0.392918
Error	448185	25	17927	–	–
Ellipse Area					
Free term	21245034	1	21245034	52.54667	0
Age group	801211	2	400606	0.99084	0.385378
Error	10107697	25	404308	–	–
OE-CE	1643698	1	1643698	5.30357	0.029882
OE-CE − Age group	487872	2	243936	0.78709	0.466126
Error	7748081	25	309923	–	–

Table 3. Postural deviations and age

Independent variables	Postural deviations (OE-CE)	Dependent variable				
		Average	Standard error	−95.00%	95.00%	n
Age group		Medium-Lateral Standard Deviation X				
7-11 years old (1)	MLSD (OE)	5.250	0.598	4.019	6.481	8
7-11 years old (2)	MLSD (CE)	5.625	0.929	3.712	7.538	8
12-14 years old (3)	MLSD (OE)	3.615	0.469	2.650	4.581	13
12-14 years old (4)	MLSD (CE)	6.077	0.729	4.576	7.577	13
15-18 years old (5)	MLSD (OE)	2.857	0.639	1.541	4.173	7
15-18 years old (6)	MLSD (CE)	4.429	0.993	2.384	6.473	7
Age group		Forward-Backward Standard Deviation Y				
7-11 years old (1)	FBSD (OE)	7.625	0.899	5.774	9.476	8
7-11 years old (2)	FBSD (CE)	8.375	1.276	5.747	11.003	8
12-14 years old (3)	FBSD (OE)	6.000	0.705	4.548	7.452	13
12-14 years old (4)	FBSD (CE)	7.231	1.001	5.169	9.292	13
15-18 years old (5)	FBSD (OE)	6.429	0.961	4.450	8.408	7
15-18 years old (6)	FBSD (CE)	6.286	1.364	3.476	9.095	7
Age group		Average Forward-Backward Speed				
7-11 years old (1)	AFBS (OE)	14.500	1.955	10.473	18.527	8
7-11 years old (2)	AFBS (CE)	19.250	2.440	14.226	24.274	8
12-14 years old (3)	AFBS(OE)	10.846	1.534	7.687	14.005	13
12-14 years old (4)	AFBS (CE)	17.308	1.914	13.366	21.249	13
15-18 years old (5)	AFBS (OE)	11.143	2.090	6.838	15.448	7
15-18 years old (6)	AFBS (CE)	15.000	2.608	9.629	20.371	7
Age group		Average Medium-Lateral Speed				
7-11 years old (1)	AMLS (OE)	12.000	1.347	9.227	14.773	8
7-11 years old (2)	AMLS (CE)	14.500	1.502	11.407	17.593	8
12-14 years old (3)	AMLS (OE)	8.923	1.056	6.748	11.099	13
12-14 years old (4)	AMLS (CE)	13.846	1.178	11.420	16.273	13
15-18 years old (5)	AMLS (OE)	9.571	1.440	6.607	12.536	7
15-18 years old (6)	AMLS (CE)	13.286	1.606	9.979	16.592	7

these deviations (Table 2). Medium-Lateral Standard Deviation X was from 3.892 with opened eyes (OE) to 5.535 with eyes closed (CE). The difference in Romberg's Test was 1.64. Medium-Lateral Standard Deviation X in the age group of 7-11 was from 5.250 with open eyes (OE) to 5.625 with eyes closed (CE). The difference in Romberg's Test was 0.375. In the age group of 12-14 was from 3.615 with opened eyes (OE) to 6.077 with closed eyes (CE). The difference in Romberg's Test was 2.462. In the age group of 15-18 was from 2.857 with opened eyes (OE) to 4.429 with closed eyes (CE). The difference in Romberg's Test was 1.570 (Table 3). Forward-Backward Standard Deviation Y was from 6.571 with opened eyes (OE) to 7.321 with

Table 4. Analysis of variance for repeated measures

Independent variables	SS	DF	MS	F	p
Forward-Backward Standard Deviation					
Free term	2551.463	1	2551.463	187.1297	0
Age group	25.471	2	12.736	0.9341	0.406243
Error	340.868	25	13.635	–	–
OE-CE	4.899	1	4.899	0.8369	0.369023
OE-CE − Age group	4.293	2	2.146	0.3667	0.696696
Error	146.332	25	5.853	–	–
Medium-Lateral Standard Deviation					
Free term	1125.051	1	1125.051	224.0488	0
Age group	24.892	2	12.446	2.4786	0.10423
Error	125.536	25	5.021	–	–
OE-CE	28.178	1	28.178	5.9492	0.022162
OE-CE − Age group	10.804	2	5.402	1.1406	0.335718
Error	118.41	25	4.736	–	–
Average Forward-Backward Speed					
Free term	11242.27	1	11242.27	176.7624	0
Age group	122.6	2	61.3	0.9638	0.395157
Error	1590.02	25	63.6	–	–
OE-CE	329.29	1	329.29	22.5668	0.000071
OE-CE − Age group	17.26	2	8.63	0.5914	0.561102
Error	364.79	25	14.59	–	–
Average Medium-Lateral Speed					
Free term	7544.246	1	7544.246	380.5748	0
Age group	39.132	2	19.566	0.987	0.386746
Error	495.582	25	19.823	–	–
OE-CE	179.884	1	179.884	14.134	0.000916
OE-CE − Age group	14.753	2	7.376	0.5796	0.567481
Error	318.176	25	12.727	–	–

closed eyes (CE). The difference in Romberg's Test was 0.75. Forward-Backward Standard Deviation Y in the age group of 7-11 was from 7.625 with opened eyes (OE) to 8.375 with closed eyes (CE). The difference in Romberg's Test was 0.75. In the age group of 12-14 was from 6.000 with opened eyes (OE) to 7.231 with closed eyes (CE). The difference in Romberg's Test was 123. In the age group of 15-18 was from 6.429 with opened eyes (OE) to 6.286 with closed eyes (CE). The difference in Romberg's Test was 0.143 (Table 3). Average Medium-Lateral Speed X was from 9.964 with opened eyes (OE) to 13.892 with closed eyes (CE). The difference in Romberg's Test was 3.928. Average Medium-Lateral Speed X in the age group of 7-11 was from 12.000 with opened eyes (OE) to 14.500 with closed eyes (CE). The difference in Romberg's Test was 2.250. In the age group of 12-14 was from 8.923 with opened eyes (OE) to 13.846 with closed eyes (CE). The difference in Romberg's Test was 4.923. In the age group of 15-18 was from 9.571 with opened eyes (OE) to 13.286 with closed eyes (CE). The difference in Romberg's Test was 3.720 (Table 3). Average Forward-Backward Speed Y was from 11.964 with open eyes (OE) to 17.285 with closed eyes (CE). The difference in Romberg's Test was 5.32. Average Forward-Backward Speed Y in the age group of 7-11 was from 14.500 with opened eyes (OE) to 19.250 with closed eyes (CE). The difference in Romberg's Test was 4.750. In the age group of 12-14 was from 10.846 with opened eyes (OE) to 17.308 with closed eyes (CE). The difference in Romberg's Test was 6.460. In the age group of 15-18 was from 11.143 with opened eyes (OE) to 15.000 with closed eyes (CE). The difference in Romberg's Test was 3.860 (Table 3). Analysis of variance with dual classification revealed a significant effect in Romberg's Test options (OE/CE) to: Medium-Lateral Standard Deviation X ($p = 0.022162$), Average Forward-Backward Speed Y ($p = 0.000071$) and Average Medium-Lateral Speed X ($p = 0.000916$). In the examination with eyes closed it has been observed a significant increase of this variances. There was no significant effects only in Forward-Backward Standard Deviation Y (Table 4). The deviations of the centre of feet pressure (COP) that have been observed generally slightly decreased with age, but this decrement was not statistically significant. Most of postural deviations did not fit the norm (Table 4).

Discussion

Postural system uses an external reference system created on the basis of gravity field and visual stimuli [6, 7]. The second reference system is the internal system, based on individual patterns of sensory activity, corresponding to so-called good posture [4, 21]. In the CNS it consists of polymodal representations, so-called body schema [11, 12]. Despite the absence of an external reference system, we can restore the general scheme of upright posture [9, 15, 19]. The central representation of the body is partly genetically determined and partly

acquired in the process of ontogenetic development [26]. This representation allows for the vertical orientation of the body and mutual correct position of each of its parts [13]. In body posture defects and scoliosis, the system controlling balance reactions, postural reflexes and voluntary movements is disturbed. As early as 1969, Yamada et al. reported dysfunction in proprioceptive postural reflexes in 57 scoliosis cases among the 70 individuals examined, and only one case in the 20-sucject control group. They confirmed a significant correlation between balance disorders and the angle of curvature, progression rate and the degree of skeletal maturity. According to these researchers, delayed development of balance may be an etiologic factor in idiopathic scoliosis [29]. The results of this study were confirmed by Sahlstrand, et al. [27] and Lidström, et al. [16]. These researchers observed considerably worse postural control in children with scoliosis compared to those who were healthy. They also noticed that with the smallest angle of the curvature, postural sways were clearly higher than in scoliosis with a considerable deformity. These researchers suggested that body balance disorders may be the causative factor in juvenile-type idiopathic scoliosis. In addition, they found an increase in the lateralization of patients with scoliosis. This increase was even higher with the distortion of perception caused by 'switching off' the sense of vision. Greater curvatures are accompanied by a considerably greater lack of balance. Herman, et al. [10], while using a simple force platform and rotary chair, observed that patients with scoliosis showed changes investibulo-ocular reflexes. Gauchard, et al. [8] observed dynamic and static balance in idiopathic scoliosis, and according to him, scoliosis disturbs balance. In the static test, the site, number of arches and the size of curvature of the spine are important, while in the dynamic test, in multi-arch scoliosis with a large angle of curvature, the researcher observed deterioration of the capacity for maintaining balance. Allard, et al. [1] evaluated static balance in a group of 13-year-old girls with idiopathic scoliosis, seeking relationships between the abilities to maintain balance and the body mass of the examined girls. He observed that those with a higher body mass had lower abilities to maintain static balance, compared to girls who had lower body mass. In turn, Eshraghi, et al. [5] investigated the parameters of static and dynamic balance in 14-year-old girls with kyphosis, and compared the results with children lacking defects. He found considerable differences between groups; the mean parameters of dynamic balance were worse in girls with hyperkyphosis. In Poland, this problem was undertaken by, among others, Ostrowska, et al. [23]. The objective of their studies was an attempt to use the method of mathematical modelling to evaluate the motor characteristics of children with idiopathic scoliosis during the process of maintaining balance in a standing position, with the presence of external interferences. The study was conducted among a group of 42 children aged 13-18, with idiopathic scoliosis, and a control group comprised of 40 healthy children. Body balance was examined by the stabilographic method using a platform recording the COP signal. The examined person standing on the stabilograph was unexpectedly, lightly pushed. The result was the mean value from 10 measurements. Analysis of the results showed significant differences in the way of reacting to the balance disturbance. Persons with scoliosis were characterized by greater postural sways, compared to those who were healthy. In these individuals, the speed of losing balance after its disturbance was lower and depended on the value of the angle of spine curvature. The higher the angle of curvature, the slower the process of balance loss, the lower speed and acceleration, and the longer time required for stabilization of posture. In children with idiopathic scoliosis, the upright position is more susceptible to balance disturbances and is characterized by worse stability. In scoliosis, the reaction on the part of the nervous system to balance disturbance is clearly delayed, and characterized by lower impulsiveness [1]. An increase of postural sway in the study with eyes closed is not surprising. However, all postural deviations in Romberg's Test (OE/CE) in children with scoliotic changes doesn't fit the norm. Disorders of postural sway that occur in scoliosis affects pathoetiology of scoliosis, and reverse movements of individual body segments increases the amplitude of postural reactions.

Conclusions

In a study with closed eyes (CE) it has been observed a significant increase of postural deviations in Average COP X, Average COP Y, Perimeter, Ellipse Area, Medium-Lateral Standard Deviation X, Average Forward-Backward Speed Y and Average Medium-Lateral Speed. No significant differences in Romberg's Test were observed only in Forward-Backward Standard Deviation Y. Sight information has got a strong, stabilizing influence during standing, and even a temporary eye closure causes an increase of amount and amplitude deviations. Scoliosis are the diseases associated with disorders of the central stabilization of the body caused by postural hypotension.

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