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# Deviations of the centre of feet pressure in girls with scoliosis and scoliotic posture

# Wychylenia środka nacisku stóp u dziewcząt ze skoliozą i postawą skoliotyczną

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## SUMMARY

**Introduction.** The aim of the research was to analyze selected deviations of the centre of feet pressure (COP) in girls with scoliosis and scoliotic posture. **Material and methods.** 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°. The deviations of the centre of feet pressure were examined by static-dynamic Tecnobody's ST 310 Plus Stability System platform. **Results.** Forward-Backward Standard Deviation Y was from 6,57 with opened eyes (OE) to 7,32 with closed eyes (CE). The difference in Romberg's Test was 0,75. Medium-Lateral Standard Deviation X was from 3,89 with opened eyes (OE) to 5,54 with closed eyes (CE). The difference in Romberg's Test was 1,65. Average Forward-Backward Speed Y was from 11,96 with opened eyes (OE) to 17,29 with closed eyes (CE). The difference in Romberg's Test was 5,33. Average Medium-Lateral Speed X was from 9,96 with opened eyes (OE) to 13,89 with closed eyes (CE). The difference in Romberg's Test was 3,93. **Conclusion.** In a study with closed eyes (CE) it has been observed a significant increase of the centre of feet pressure deviations for: 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). Correlation analysis of the centre of feet pressure deviations with age demonstrated an important connections only in case of Medium-Lateral Standard Deviation X (r= -0,38, p=0,043).

**Key words**: Forward-Backward Standard Deviation Y, Medium-Lateral Standard Deviation X, scoliotic postures, idiopathic scoliosis

**STRESZCZENIE**

**Wstęp**. W etiologii skolioz coraz częściej zwraca się uwagę na dyskretne, trudne do zdiagnozowania zmiany neurologiczne. Celem badań była analiza wybranych wychyleń środka nacisku stóp (COP) u dziewcząt ze skoliozą i postawą skoliotyczną. **Materiał i metody**. Badaniami objęto 28 dziewcząt w wieku 7-18 lat. W badaniach kręgosłupa wykorzystano radiogramy cyfrowe Exhibeon. Na podstawie wielkości kąta skrzywienia kręgosłupa wyodrębniono postawę skoliotyczną: 1-9° i skoliozy: ≥10°. Wychylenia środka nacisku stóp badano statyczno-dynamiczną platformą ST 310 Plus Stability System firmy Tecnobody. **Wyniki**. Forward-Backward Standard Deviation Y wynosiła od 6,57 z oczami otwartymi (OE) do 7,32 z oczami zamkniętymi (CE). Medium-Lateral Standard Deviation X wynosiła od 3,89 z oczami otwartymi (OE) do 5,54 z oczami zamkniętymi (CE). Average Forward-Backward Speed Y wynosiła od 11,96 z oczami otwartymi (OE) do 17,29 z oczami zamkniętymi (CE). Average Medium-Lateral Speed X wynosiła od 9,96 z oczami otwartymi (OE) do 13,89 z oczami zamkniętymi (CE). **Wniosek**. W badaniu z oczami zamkniętymi (CE) zaobserwowano istotny wzrost wychyleń środka nacisku stóp dla: Medium-Lateral Standard Deviation X (p=0,022162), Average Forward-Backward Speed Y (p=0,000071) i Average Medium-Lateral Speed X (p=0,000916). Analiza korelacji wychyleń środka nacisku stóp z wiekiem wykazała istotne związki w jedynie w przypadku Medium-Lateral Standard Deviation X (r= -0,38, p=0,043). Zależność ta była odwrotnie proporcjonalna.

**Słowa kluczowe**: średnie odchylenie Y, średnie odchylenie X, postawa skoliotyczna, skolioza idiopatyczna

## INTRODUCTION

Human maintains his balance by skeletal muscles under the control of the nervous system. The nervous system based on received informations recruits motor units, selects the excitation thresholds of several muscles, sets rules for their coordination and affects on the nature of movement by excitatory and inhibitory processes. This causes a change in the viscoelastic properties of the muscles, and thereby the viscoelastic properties of the whole body performing specific oscillating movements during free-standing position. During the free-standing, human behaves like an inverted one-segmental pendulum, which is stabilized by antigravity muscles with viscoelastic properties. Imposed model of stability is a second order oscillating system, also known as a viscoelastic model [1].

The posturographic concept is defined as a whole group of research methods for assessment the quality of postural control. Such studies can be performed in many ways by using the various techniques. In the static posturography the assessment of the balance is usually performed on the basis of small involuntary movements analysis in the centre of gravity of the body, during the free-standing position. These movements, called the postural

sway, could be recorded for example by a video computer system or by a special platform, which records forces and moments of feet pressure to the ground [2].

In the etiology of scoliosis increasingly attention is paid to a discreet, difficult to diagnose neurological disorders. Within the meaning of etiopathogenesis, scoliosis is only a symptom, an external expression of unrecognized pathology. More and more supporters has got the conception of multifactorial, genetically determined minimal changes in the central nervous system, causing dysfunctions in postural system [3-16]. Those dysfunctions are visible in the deviations of the centre of feet pressure (COP) in posturography tested.

**MATERIAL AND METHODS**

The study included 28 girls aged 7-18 years old with scoliotic posture and idiopathic scoliosis. All respondents 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. 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. Then the selected parameters of primary and secondary spinal curves have been analyzed:

- the length of the curvature is the distance between the inflection points of the spine,
- the length of the curvature/the total length of the spine (TLS), is the ratio of the distance between the inflection points and the distance of C7 and sacrum bone in a straight line,
- the depth of the curvature, is a maximum transverse distance of the spine line from the straight line connecting the ends of the curves,
- the depth of the curvature/the total length of the spine (TLS) is the ratio of the maximum transverse distance of the spine line from the straight line connecting the ends of the curves and the distance of C7 and sacrum bone in a straight line,
- the angle of the curvature is the angle between tangents of the curve at both ends of the bending of the spine taking into account the direction of the curvature,
- the absolute value of the curvature (AVC), is the angle between tangents of the curve at both ends of the bending of the spine without taking into account the direction of the curvature.

Based on the size of the angle of spinal curvature there were identified scoliotic posture: 1-9° and scoliosis: ≥10°. For the study of postural reactions, the computerized posturography has been used. Those reactions were examined by static-dynamic Tecnobody's

ST 310 Plus Stability System platform. The research on the platform based on continuous observation of the centre of feet pressure (COP). By recording the horizontal deflection 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. Vector addition of force moments allowed to designate the resultant ground reaction force at the moment, which is graphically presented as a dot on statokinesigram. 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 eys*), second with closed eyes (CE – *close eys*). 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 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. To facilitate the correct positioning of the tested person, the platform was equipped with a pattern to keep the feet apart. 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 following postural reactions so-called the centre of feet pressure deviations (COP):

- 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,
- 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
- anteroposterior speed (*Average Forward-Backward Speed Y*), 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 X*), ), 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.

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 level of significance was $p<0,05$. The aim of the research was to analyze selected deviations of the centre of feet pressure (COP) in girls with scoliosis and scoliotic posture.

**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 posture, and 7 (25%) with idiopathic scoliosis. The frequency and type of defect didn't depended on age (Tab. 1). Forward-Backward Standard Deviation Y was from 6,57 with opened eyes (OE) to 7,32 with closed eyes (CE). The difference in Romberg's Test was 0,75. Medium-Lateral Standard Deviation X was from 3,89 with opened eyes (OE) to 5,54 with closed eyes (CE). The difference in Romberg's Test was 1,65. Average Forward-Backward Speed Y was from 11,96 with opened eyes (OE) to 17,29 with closed eyes (CE). The difference in Romberg's Test was 5,33. Average Medium-Lateral Speed X was from 9,96 with opened eyes (OE) to 13,89 with closed eyes (CE). The difference in Romberg's Test was 3,93 (Tab. 2). 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 1,23. 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 (Tab. 3). Medium-Lateral Standard Deviation X in the age group of 7-11 was from 5,250 with opened eyes (OE) to 5,625 with closed eyes (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 (Tab. 3). 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 (Tab. 3). 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 (Tab. 3). There was a significant effect of study options in Romberg's Test (OE/CE) for: 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 study with closed eyes, a significant increase of these reactions has been observed. There were no significant effects only in Forward-Backward Standard Deviation Y (Tab. 4). The deviations of the centre of feet pressure (COP) that have been observed generally slightly increased with age, but the increasement was not statistically significant (Tab. 4). Correlation analysis of postural reactions (OE-CE) with age showed a significant connection only in case of Medium-Lateral Standard Deviation X (r= -0,38); (p=0,043). This dependence is inversely proportional. In older children, this parameter was lower (Tab. 5).

**DISCUSSION**

Idiopathic scoliosis of the spine arise and develop only during the growth period, and are a typical multi-faceted syndromes of distortions. Distortions can be caused by various etiological factors. Changes occur in the spine and directly related elements of the skeleton, muscles and ligaments. Secondary, disturbances arise in the internal organs, especially of the

chest, which limits the efficiency and exercise capacity of the patient. The entire group of scoliosis is the result of the primordial imbalance of vertically-poised spine. The imbalance is initially present in the sagittal and frontal planes, and over time it leads to create a multi-faceted changes. Distortions stated in scoliosis are the result of a biological reaction system, aiming to restore the disturbed mechanical balance of the spine. Analysis of compensation phenomenon in scoliosis confirms the opinion about the corrective nature of this process. The treatment of scoliosis is the desire to stop or reverse the biological corrective process and that's why it fails so often. The functional properties of the spine doesn't change only when the passive and active stabilizing mechanism is capable of symmetric tension. Scoliosis compensation is associated with stabilization of the body and postural reactions. Higher amplitudes of postural reactions testifies about a worse stabilization of the body. In the stabilization of the body an important role plays postural tension, its size and distribution. Dysfunctions of the postural tension are the cause of compensation in locomotor system. They are a substitutional solutions, enabling stabilization. Scoliosis are a diseases associated with disorders of the central stabilization of the body caused by postural hypotension [24]. Disorders in deviations of the centre of feet pressure occurring in scoliosis affects on pathoetiology of scoliosis and the reversal movements of individual body segments increases the amplitudes of these deviations. Probably the disorders of central stabilization and postural hypotonia (seen in deflections of COP) associated with the dysfunction of the CNS are primary and they precede scoliotic changes. Only in-depth knowledge of the pathogenesis and development of the scoliosis can indicate the appropriate ways of treating them. Scoliotic changes aren't defined by orthopedists themselves and it will be needed a broad cooperation of neuropathologists. In the curvatures of the spine increasing attention is being paid to a discrete neurological changes. In the present state of knowledge, the theory of muscle tension imbalances as a pathomechanical cause of idiopathic scoliosis has got the important substantiation and clarifies a number of seemingly conflicting observations and concepts. A further stage of work on the etiology of scoliosis should focus around the issues associated with a regulation of postural tension. The central nervous system hides many of unknowns, knowledge of which may explain the etiology of scoliosis or indicate the next stage of research. Both people with postural disorders, as well as for which the impediments in free-standing have been used generally exhibits a greater deviations of the centre of feet pressure. In general, the higher deviations occurs in children.

## CONCLUSIONS

1. In a study with closed eyes (CE) it has been observed a significant increase of postural reactions for Medium-Lateral Standard Deviation X, Average Forward-Backward Speed Y and Average Medium-Lateral Speed X.
2. Correlation analysis of postural reactions with age showed a significant connection only in case of Medium-Lateral Standard Deviation X. This dependence was inversely proportional. In older children this parameter was lower.

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Table 1. Faulty postures in the frontal plane and age

| Independent variables | Age | | | |
|---|---|---|---|---|
| | 7-11 | 12-14 | 15-18 | Total |
| Scoliosis posture | 6 | 10 | 5 | 21 |
| % of column | 75,00% | 76,92% | 71,43% | |
| % of row | 28,57% | 47,62% | 23,81% | |
| % of total | 21,43% | 35,71% | 17,86% | 75,00% |
| Scoliosis | 2 | 3 | 2 | 7 |
| % of column | 25,00% | 23,08% | 28,57% | |
| % of row | 28,57% | 42,86% | 28,57% | |
| % of total | 7,14% | 10,71% | 7,14% | 25,00% |
| Total | 8 | 13 | 7 | 28 |
| % of total | 28,57% | 46,43% | 25,00% | 100,00% |
| $\chi^2 = 0,072$; df = 2; p = 0,96 | | | | |

Table 2. Deviations of the centre of feet pressure with opened and closed eyes (OE/CE)

| Postural reactions OE/CE | n | x | s | Median | Minimum | Maximum | Interval | Slant | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|
| FBSD (OE) | 28 | 6,57 | 2,54 | 6 | 3 | 12 | 9 | 0,288 | -0,745 |
| MLSD (OE) | 28 | 3,89 | 1,87 | 4 | 2 | 10 | 8 | 1,953 | 4,756 |
| AFBS (OE) | 28 | 11,96 | 5,57 | 10 | 5 | 31 | 26 | 1,798 | 4,100 |
| AMLS (OE) | 28 | 9,96 | 3,90 | 9 | 4 | 22 | 18 | 1,230 | 2,291 |
| FBSD (CE) | 28 | 7,32 | 3,56 | 6 | 3 | 16 | 13 | 1,244 | 0,960 |
| MLSD (CE) | 28 | 5,54 | 2,62 | 5 | 2 | 16 | 14 | 2,432 | 8,964 |
| AFBS (CE) | 28 | 17,29 | 6,83 | 16,5 | 8 | 36 | 28 | 0,944 | 0,983 |
| AMLS (CE) | 28 | 13,89 | 4,11 | 13 | 8 | 22 | 14 | 0,609 | -0,616 |

Table 3. Deviations of the centre of feet pressure with opened and closed eyes (OE/CE) and age

| Independent variables | (OE-CE) | Dependent variable | Dependent variable | Dependent variable | Dependent variable | n |
|---|---|---|---|---|---|---|
| | | Average | Standard deviation. | -95,00% | 95,00% | |
| 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 |
| 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 |
| 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 |
| 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 |

Table 4. Analysis of variance for deviations of the centre of feet pressure[1]

| Forward-Backward Standard Deviation Y | | | | | |
|---|---|---|---|---|---|
| Independent variables | SS | DF | MS | F | p |
| Free term | 2551,463 | 1 | 2551,463 | 187,1297 | 0 |
| Age groups | 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 groups | 4,293 | 2 | 2,146 | 0,3667 | 0,696696 |
| Error | 146,332 | 25 | 5,853 | | |
| Medium-Lateral Standard Deviation X | | | | | |
| Independent variables | SS | DF | MS | F | p |
| Free term | 1125,051 | 1 | 1125,051 | 224,0488 | 0 |
| Age groups | 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 groups | 10,804 | 2 | 5,402 | 1,1406 | 0,335718 |
| Error | 118,41 | 25 | 4,736 | | |
| Average Forward-Backward Speed Y | | | | | |
| Independent variables | SS | DF | MS | F | p |
| Free term | 11242,27 | 1 | 11242,27 | 176,7624 | 0 |
| Age groups | 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 groups | 17,26 | 2 | 8,63 | 0,5914 | 0,561102 |
| Error | 364,79 | 25 | 14,59 | | |
| Average Medium-Lateral Speed X | | | | | |
| Independent variables | SS | DF | MS | F | p |
| Free term | 7544,246 | 1 | 7544,246 | 380,5748 | 0 |
| Age groups | 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 groups | 14,753 | 2 | 7,376 | 0,5796 | 0,567481 |
| Error | 318,176 | 25 | 12,727 | | |

[1] In analysis of ariance the symbols mean: SS – sum of square, DF –degree of freedom, MS –mean of squares, F – ratio of MS effectu to MS error, p – level of significance.

Table 5. Correlation analysis for deviations of the centre of feet pressure with opened and closed eyes (OE/CE) and age

| Postural reactions | Age (OE) | Age (CE) |
|---|---|---|
| FBSD Y | R=-0,16 | R=-0,32 |
| | p=0,41 | p=0,09 |
| MLSD X | **R=-0,38** | R=-0,25 |
| | **p=0,043** | p=0,19 |
| AFBS | R=-0,27 | R=-0,32 |
| | p=0,15 | p=0,08 |
| AMLS | R=-0,11 | R=-0,12 |
| | p=0,56 | p=0,53 |