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The importance of visual control in the process of maintaining the balance of the body

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Abstract

Maintaining body balance is a complex process influenced by many components, ie the organ of balance, proprioceptors and the organ of sight. Keeping your balance allows you to safely perform your daily life activities. In the case of impairment of one of the components of the equilibrium system, the postural control process is disturbed. In this situation, other sensory systems are involved to partially compensate for the deficiencies. In the case of turning off the visual inspection, the body balance is strongly disturbed as evidenced by the results of scientific research.

Key words: body balance; visual control

Body posture and balance

Humans are the only beings that only move on 2 limbs. Therefore, a human is characterized by an upright attitude. Keeping your balance while standing is not easy. This makes it difficult to have a small support surface, relatively high body height and to locate the center of gravity of the body approximately 2/3 of its height. These factors cause constant but slight disturbances. In spite of this, the efficient work of the balance system ensures stability of the posture. The work of the balance system consists in the continuous recovery of the lost balance through the appropriate reaction consisting in stimulation of selected muscle groups [1,2].

Kasa J. register equals the group of coordinating abilities, enabling the body or object to be kept in a relatively stable position [3]. Kuczyński et al. consider that the human balance relies on the ability to maintain the projection of the center of mass of the body inside the support area determined approximately by the foot contour [4].

Construction and operation of the balance system

The balance system consists of several organs and senses, which must work closely together in order for the balance to work effectively.

• vestibular organ (labyrinth), it has special receptors located in the inner ear (labyrinth), in its middle part, the so-called vestibule, they also occur in the posterior part, i.e. in the ampulla of semicircular canals;

• the organ of the sense of deep feeling, it is equipped with specialized receptors (proprioceptors) located in the muscles, tendons, fascias, joint capsules, vessels and internal organs. The purpose of these receptors is to register stimuli, ie: pressure, stretching and tension;

• the organ of vision [6].

Two cooperating systems: control and controlled (regulated) take part in the process of maintaining the equilibrium. Maintaining the balance of the body in a standing position takes

place through the process of regulation in the feedback loop within the synchronized two systems. The regulatory basis is the organ of movement - an adjustable system, where the muscles are an active part of the motor system, while the osteoarticular system allows transferring the forces released by the muscles. The motor organ is controlled by the nervous system. Extremely important in the process of maintaining balance is the vestibular organ. The tasks of the vestibular organ include: control of the reflex reactions of the organism, providing information about the position of the head in relation to the neck and other parts of the body, maintaining muscle tone of the whole body, triggering tension reflexes, triggering vestibulo-atrial reflexes, ensuring stabilization of gaze during head movements, triggering vegetative reactions with the respiratory system, circulatory system, controlling the balance of the body within the integrated receptor organs (the organ of sight, deep feeling) in close cooperation with the CNS [6]. Controlling the correct posture requires giving the body a proper figure. However, the control of posture stability is mainly related to dynamic issues. The nervous system deals with the control of posture based on the integration of information flowing from the vestibular organ receptors, retinal receptors, muscle proprioreceptors, tendons, joints, skin exteroids (touch, pressure). The vestibular organ is responsible for proper positioning of the head with respect to the direction of gravity. In addition, with the help of the visual system, it participates in spatial orientation. With muscular proprioceptors, which are distributed in the joints, tendons and skin, information about the mutual position and movements of particular parts of the body to the brain is conveyed. These receptors also relay signals to the muscles. Then, the impulses reach the effector organs - muscles of the trunk, limbs and eyeballs - causing their reflex reactions coordinating the posture of the body and causing the body's return to equilibrium. Integration of stimuli with proprioceptors, vestibular receptors and retinal receptors occurs at the level of the brainstem, especially in the midbrain [7].

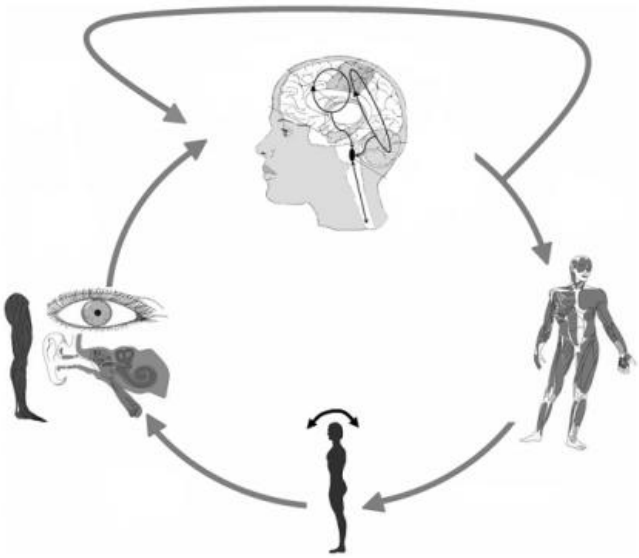

Figure 1. Postural control scheme [8].

Visual control and body balance

Sight is one of the most important senses in a person's life. Its lack results in a huge limitation in the everyday life of the person affected by this problem [9].

Visual inspection is an important component in maintaining body balance. Sight allows you to orient yourself in the position of the body in space, and focusing your eyes on one point helps you maintain your balance [10]. The role of sight in postural control is relatively dependent on the degree of difficulty maintained body balance and increases over the years. Lack of visual stimuli contributes to compensation and greater involvement in the body balance maintenance of other sensory systems [11]. Even the stimulation of the eye muscles by vibration increases the body's movements in a specific direction, depending on the irritated muscles. In critical conditions, the importance of sight increases relatively. When no visual information is available, compensation is made by switching on the upper limb mechanoreceptors by finding a point of contact by touching a specific support with the finger [12,13]. People with permanent eye damage have a better developed proprioceptive system. Somatosensory information helps them maintain balance during various tasks. In addition, people with visual impairment strategy of ankle replacement substitute the strategy of the hip joint to maintain balance and increase their safety. Thanks to this strategy, more muscles are involved, and thus the stability of the body is better [14].

Research

There are many studies comparing the balance of the body with visual control and after it is turned off.

Kaźmierczak Urszula et al. in their study, they attempted to compare the balance of people with visual disabilities with sighted people. 10 blind and 13 visually impaired people participated in the study. There were 4 men and 6 women among the blind. The age range was 43-70 years with an average age of 61.3. There were 5 men and 8 women in the visually impaired. The respondents were in the age group 41-69, of which the average age was 59.2. The inclusion criterion was vision problems. The exclusion criteria were problems with balance and dizziness. The control group consisted of 25 people without visual problems, with an average age of 63.9 years. The body balance of the subjects was assessed using a posturographic platform study. Analysis of the results showed that blind people scored worse than those with normal eyesight. The total path of the center of gravity was much longer among the blind. Blind persons also had significantly higher antero-posterior and lateral deflections than in the visible group. The group of visually impaired persons got a more similar result to the control group. The sighted persons obtained slightly better results in comparison to the visually impaired, but these were not statistically significant differences [14].

Whereas Kowalik T. et al. they examined the balance of 81 women and 30 men. The subjects were sighted people. Two attempts were made to study the balance, one with visual control, and the other after turning off the visual inspection (the subjects were wearing glasses that completely prevented vision). The evaluation of postural control was carried out by means of the general equilibrium test Eurofit. The test person has the task of standing on the beam on one leg in specific position for one minute. The investigator counts the subject's errors, eg touching the ground. The number of trials needed to maintain the balance on the beam is the result of the test. The results of the test in the group of women showed very large differences between the standard examination and the examination without visual inspection. The average result without glasses was 7.76 while with glasses 25.9. The results among men were similar. The average result without glasses was 9.60 while the glasses with 28.7. These results clearly indicate deterioration of the balance after the visual control is turned off [1].

Also Paraskevi Giagazoglou et al. in their study they dealt with the comparison of the balance between blind and sighted people. The study involved 10 blind women (age 33.5 ± 7.9 years;

height 163 ± 5 cm; mass 64.5 ± 12.2 kg) and 10 sighted women (age 33.5 ± 8.3 years; height 164 ± 6 cm; mass 61.9 ± 14.5 kg). The balance of subjects was measured using a platform, subjects had to perform 3 different tests of increasing difficulty: Normal Quiet Stance (1 min), Tandem Stance (20 sec), and One-Leg Stance (10 sec). The control group also performed these tasks without sight control. Analysis of the results showed that blind people showed a worse balance compared to sighted people. In addition, the comparison of the test results with the visual inspection and without visual inspection performed in the control group showed that the balance of sighted people after the visual control was turned off significantly deteriorated [15].

Summary

There are many scientific studies devoted to the impact of visual control on the balance. The research presented above is closely focused on this subject. The analysis of the results clearly indicate a strong dependence of the control of the balance from the eyesight. Turning off visual inspection affects deterioration of postural stability.

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