THE IMPACT OF VISUAL DYSFUNCTION ON CORE STABILITY IN VISUALLY IMPAIRED AND BLIND INDIVIDUALS, INCLUDING FREQUECY OF FALLS – A PILOT STUDY

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Abstract

Introduction The term *core stability* refers to the capacity of deep trunk muscles, and their important role during stability pelvic and lumbar region in statics and dynamics.

Aim The aim of the thesis was to examine the capacity of deep trunk muscles in visually impaired and blind individuals. What is more, its purpose was to collect information concerning falls on face incidents frequency within a control group- one without dysfunction.

Materials and methods The study included visually and blind case subjects. The study participants were inhabitants of selected cities of Silesia region who are the members of the Polish Association of the Blind. The study consisted of two independent parts. The first part contained a survey questionnaire, while in the other part a test measuring the capacity of the deep trunk muscles was utilized. The test measured a stable posture in static and dynamic conditions. Test was preceded by interview in which we asked about frequency of falls. Programs used to calculate the results: Statistica and Excel.

ResultsIndividuals with visual dysfunction present differences for capacity of core stability in the face when compared to the control group. We can also observe inversely proportional dependence between obtained results and frequency of falls in the study group.

ConclusionsIn individuals with Visual dysfunction worse capacity of the deep trunk muscles is related to declined locomotor function and an increased risk of falls. Therefore, it is essentialto implement motor rehabilitation *program which will* strengthen deep trunk muscles.

Keywords: core stability, falls, visual dysfunction

Introduction

Term core stability refers to condition which is characterized by balanced and simultaneous order on stability and mobility. Stability should be considered as dynamic process, which gives possibility tokeep stability of the body at suitable functional situation and which allows for controlled trunk movements as well as distal body parts. All that while the spine is prevented from overloading.

The concept of core stability refers to the low quadrant of the body which incorporates hip-joints and low part of the trunk, including muscles which supply thoraco -lumbar spine (thoracic part of the musculus longissimus thoracis iliocostalis), lumbar spine

(musculus multifidus, lumbar part of the musculus iliocostalis and musculus longissimus thoracis, musculi intertransversarii, musculi interspinales, musculi rotators), muscles located in the back part of thoraco-lumbar spine, musculus quadratus lumborum, and abdominal muscles (musculus transversus abdominis, musculus rectus abdomnis, musculus obliquus internus abdominis and musculus obliquus externus abdominis). The role of the diaphragm is also worth mentioning at this point. Also thoraco-lumbar fascia participates in core stability of lower part of trunk because it is place to which several important muscles are attached. The above-mentioned muscles can be classified as stability or mobility muscles to perform their function – coordination dynamics movements of the trunk [2,3].

Bergmark’s Local stabilizing system it is group of muscles which is directly attached to spine, the best example is musculus multifidus lumbar spine. Deep system plays an important role stabilization process- those specific muscles help to stabilize particular elements of kinematic chain (vertebrae.). However, the system on its own has no further capacity to control global lumbar spine’s orientation. Smaller muscles such as musculi intertransversarii and musculi interspinales are mainly seen as important source of proprioception. Representative of the local system within abdominal wall is musculus transverses [3, 11].

Global muscle system involves large surface group of trunk muscles which are not directly attached to the spine and include lots of segments. These muscles generate torques during implementing trunk movements and control the position of the spine, balance and external balanced the load trunk and transfer the load from the chest to the pelvis [2,3,11].

Vision is human's one of the key sensorimotoric systems. The quality of life depends on visual perception, Vision is not only responsible visual feelingsbut is also one of the basic elements of postural control [Famuła i In.]. The light from environment stimulates the roads and cones which stimulate optic nerve. The optic nerve transfer the signal to visual centers located in occipital lobe, where impulse or unworked information are processed into useful information about environment. To keep the balance, the person on whom the external forces influence, is able to adjust to the situation by using visual feedback which gives useful information about the environment and the relation of the body towards its elements. The person who is influenced by external forces is able to adjust to given situation- by using visual feedback in order to regulate body's stability [3,4].

The blind are usually disabled from birth or lost vision in the early childhood and don't remember visual impression. A certain blindlost vision in later age. Congenital blindness can be result of the no formation of the optic nerve or as a consequence of the disease during pregnancy. Loss or significant weakness of sight in later life may be due to various diseases or injuries. For example, because of diseases such as glaucoma, cataract and retinopathy and certain systemic disease (e.g. diabetes), which can lead to loss of vision as a result of the general weakness of the human body. To loss of visual acuity and blindness, direct injury to the globe is relatively rare even when the orbital bones are involved. The incidence of facial fracture–associated visual loss and blindness range from 0.32 to 10.8 percent [10].

Aim

The aim of the thesis was to examine the capacity of deep trunk muscles in visually impaired and blind individuals. What is more, its purpose was to collect information concerning falls on face incidents frequency within a control group- one without dysfunction.

Materials

The study included visually impaired and blind case subjects. The study participants were inhabitants of selected cities of Silesia region: Katowice, Mikołów, Ruda Śląska and Chorzów who are the members of the Polish Association of the Blind and control group – without visual dysfunction – associated with these institutions. Those people formedprincipal group of examination. The control group consisted of people without visual dysfunction. In Total, 59 people took part in the study. Group representing the blind 9 people in the age 38-79 (x=61,5 ±12,81), therein 5 women and 4 men; group of visually impairment: 30 people in the age 39-84 (x=66,76 ±10,28), therein 22 women and 8 men; control group: 20 people in the age 55-77 (x=70 ±5,86), therein 13 women and 7 men. The age is an important factor which influences the functioning of vision [5,8].

Among visually impaired are people with measured and substantial degree of the disability. Those people who did not agree to participate in the study or who use and benefit from orthopedic aids such as: prosthesis, elbow or axillary crutches, walkers, canes,wheelchairs or any other aids without which the standing position could not be held.

Methods

The study consisted of two independent parts.The first part contained a survey questionnaire while in the other part a test measuring the capacity of the deep trunk muscles was utilized. The test measured a stable posture in static and dynamic conditions.

This test is a reliable procedure. It allows for rating the susceptibility of trauma, stability, integration and efficiency of the nervous system.

The study participants were asked to holda standing position on the both legs, on the right legs, on the left legs. This positions were performedperformed in static and dynamic conditions. Dynamic conditions were achieved on Thera Band trainer of balance. Visually impaired individuals were tested bespectacled and without glasses. The test wascarried out in a safe environment for the study participants. During the test one of the researchers measuredtime, while second researcher secured the study participant. The test was preceded with a short interview, which was to demonstrate the factors causing disrupting of core stability. The interview included question concerning the number of falls during the period of one year.
The time was measured from verbalcommand “start” within30 seconds or until the change of the position ofthe test. Changes ofposition were: touchingthe ground or shimming the static leg bytheraisedlimbs, displacement of the foot of static limb, jumbling on the static leg or touchingthe researcher.

These studies have been authorized by the Bioethics Committee of Medical University of Silesia: resolutionnumber KNW/0022/KB1/6/12 on 24.01.2012.

Programs Statistica 10 and Excel were used to calculate the results.

Results

All examined participants achieved the result of 30 sec. during the evaluation of central stabilization in standing position with both feet on the ground, on still surface. However, while maintaining standing position on one leg, the results were worse in all groups. The members of the control group achieved better result in comparison to principalgroup. In this group, its blind participants were achieving better results while standing on the left leg, worse results were while standing on the right leg.

Tab. 1. Time of maintaining the positionon a stable surface.

	Standing position on the both legs	Standing position on the right legs	Standing position on the left legs
Blind individuals	x=30s. ± 0	x=5,1s. ± 4,17	x=7,5s. ± 7,45
Visually impaired individuals bespectacled	x=30s. ± 0	x=8,63s. ± 10,38	x=7,0s. ± 8,95
Visually impaired individualswithout glasses	x=30s. ± 0	x=8,03s. ± 9,76	x=6,93s. ± 8,05
Control group	x=30s . ± 0	x=13,6s . ± 8,08	x=17,55s . ± 9,05

Similar analysis were brought on dynamicground, here the results were *similar*. The examined control group participants presented better results. The blind gained the worst results while standing on left leg. While standing on the right leg they achieved better results than visually impaired individuals who performed this activity bespectacled. (tab.2)

Tab. 2 Time of maintaining the position on a dynamic surface.

	Standing position on the both legs	Standing position on the right legs	Standing position on the left legs
Blind individuals	x=30s. ± 0	x=5,0s. ± 6,79	x=2,7s. ± 2,79
Visually impaired individuals bespectacled	x=30s. ± 0	x=4,06s. ± 4,27	x=5,6s. ± 6,83
Visually impaired individualswithout glasses	x=30s. ± 0	x=6,36s. ± 7,6	x=5,36s. ± 6,25
Control group	x=30s . ± 0	x=11,2s . ± 5,44	x=11,8s . ± 6,28

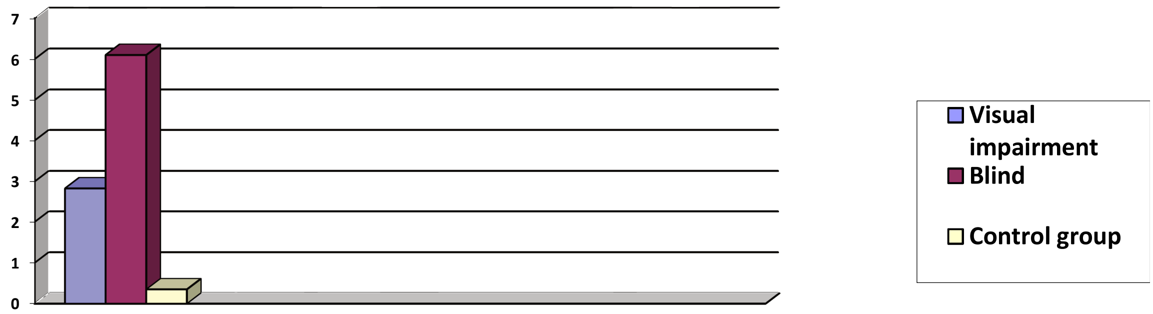
In principal group that was examined both the blind as well as visually impaired individuals presented worse skills of core stability in comparison to members of control group. The results showed that significantly shorter time of maintaining standing position with both feet on the still ground was achieved by visually impaired individualswithout glasses when comparing to control group members, as well as when in standing position on the left legs (t: 4,34 p<0,000072) and on right legs (t: 2,11 p<0,04). When bespectacled, the only significant difference to the control group, was the time of maintaining the standing position on the left leg (t:4,06 p<0,001). The blind individuals significantly shortly held standing position on the right leg (t:3,1 p<0,04).

When conducting analogical analysis on dynamic ground many differences could br noticed. Individuals from the control group achieved better results to those visually impaired individuals bespectacled(t:5,17 p<0,000004), with glasses of (t:2,45 p<0,017) and to the result of blind individuals (t:2,36 p<0,02).

Similar differences could be noticed when analyzing the maintaining the standing position on the left leg. Here the results showed that visually impaired individuals bespectacled and without glasses achieved shorter results than individuals from the control group(appropriately*:* t:3,24 p<0,002 i t:3,56 p<0,0084). Blind individuals had also worse results in this activity (t:3,99 p<0,0004).

What is interesting is the fact, that when comparing the results of maintaining standing position on the right leg, on dynamic surface the group of blind individuals and visually impaired bespectacled individuals achieved better results when they had the glasses taken of (t:2,24 p<0,02).

When taking the results for theamount offallsduring the year into the account, it shows that the mostly blind individuals fell down (x=6,1 ±10,43). Visually impaired individuals fell less often (x=2,83 ±5,06). In the control group such situations were incidental (x=0,35 ±0,67).



Between a group ofvisually impairedand the control group (t:2,17 p<0,03) and theblindgroupand the control group (t:2,56 p<0,01) there are statistically significant results.

Discussion

This research is only a pilot study due to the small number of the study participants. We suggest it should be repeated on a larger group of respondents. However, the research has already shown that this test allows for evaluation of decreased efficiency of the central stabilization in individuals with visual dysfunction which results in the greater number of falls. Disorder ofthe centralstabilizationis mainlyrelated to thelumbarregion,omitting the globalconsequences ofthe disorder.

Coordination ofglobal and localmuscles is likethe interplayof musical instrumentsin the orchestra. All instrumentslike all thecore musclesare responsible forthe final result, whereineachtaskishighly specialized, but they are allrequired for the properfunctioning of the orchestra [11].

As mentioned above vision is one of the sensory mechanisms which detects perturbations of balance (along vestibular and proprioception)[1,5,7]. It has been shown that vision plays an important role in balance, mobility and falls [4,7,8,13]. This is demonstrated in swaymeter experiment – swaying increases 50% or more with eyes closed compared to both eyes open while standing on firm surface and while standing on foam. There are moderate correlations between measured visual function (acuity and contrast sensitivity) and swaying. Swaying is strongly associated with risk of falls. The postural control system is mostly challenged during activity. It depends on environment, pathological conditions or age – elderly people are more dependent on vision than young ones. Romberg's quotient (sway eyes open/sway eyes closed), which describes the effect of visual stabilization on posture is 0,48 in patients over 85, compared with 0,78 at age 50-60.Visual mechanisms for correcting swaying are relatively slow when compared with muscle and tendon stretch receptors. Moreover, reaction times are generally increased in elderly people. This partly explains why elderly people are less able to correct loss of balance [4,5,9,13]. It is important to say that there is higher ratio of falls within blind, older people in comparison to deaf ones or those without dual sensory impairment [8]. The impairment of core stability may lead to higher risk of falls which may lead to limitation of mobility and activeness, feeling of helplessness, depression or institutionalization. [1,6,11,12]. It seems crucial to create rehabilitation program which shall strengthen localmuscles of lumbarregion for individuals with visual dysfunction.

Conclusions

1. Individuals with visual dysfunction are characterised with lower efficiency of core stabilization.
2. The risk of falls rises at those individuals with visual dysfunction.
3. Blind and visually impaired individuals should take part in therapeutic programs which aim would be to strengthen local stabilizers.

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