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INFLUENCE OF LOCAL VIBROSTIMULATION ON FOCUS PERSISTENCE

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Abstract. *Nowadays computers, data input and processing is vital part of many companies, and this job is carried out mostly by humans. Employees have to focus all the day for not to allow errors. In many companies there can be a several breaks for rest. Local vibrostimulation is a vibration method, which can offer stimulating, tonic effect on central nervous system, therefore increasing human physical abilities. Aim of research: Comparison of 30-45 year old, physically active and inactive women under the influence of local vibrostimulation. Participants carried out digital focus test for one week long, during a second week they executed this test again after a local vibrostimulation session. After processing average results we observed significant increasement (0.956 before vibrostimulation and 1.381sec after vibrostimulation) in focus persistence test, which makes us believe that local vibrostimulation of upper back muscles can lead to focus increasement of office workers.*
Keywords: *focus persistence, local vibrostimulation.*

Introduction

Working with computers increases the responsibility of each individual for their work. Constant information overloading and mental strain creates chronic psychological overload, which can be observed as emotional exhaustion, cynicism, lack of professional self-indulgence. Psychological strain not only causes central nervous system response in the form of fatigue, but also increases muscle tension, thus increasing muscle fatigue, feeling discomfort and pain (Roja, Roja, Kaļķis, Kaļķis, & Laganovska-Dīriņa, 2007). These factors may reduce the reaction and persistence of the focus that can negatively affect the employee's professional duties.

Both physical and mental fatigue significantly prolong the response time on certain stimuli. The amount of focus is quantitatively is characterized with the speed at which the subject chooses one from many stimuli, but qualitatively with the accuracy with which these stimuli were selected. The efficiency indicator is a

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complex that is made up both of quantitative and qualitative indicators (Крылов & Маничев, 2000).

Local vibrostimulation can be applied for the development of physical abilities of human (Issurin, 2005). Local vibrostimulation means that a particular place is stimulated, the subject is usually at a resting position at that time. Local vibration stimulation can be divided, depending into the site of application: on the muscle itself, on the tendon of the muscles, on the ligament, on the attachment location of tendon/ligament to the bone. Local vibrostimulation equipment is characterized by easily variable vibrostimulation parameters and piston motion planes, nozzles. There are a number of machines that implement vibration in one or two planes (Issurin, 2005).

Research shows that muscular automatic, passive contraction involves a higher number of muscle fibers than the conscious, potentialy strongest muscle contraction, however, if the stimulation intensity is too high, muscle fatigue may occur, the muscle can be overstrained (Delecluse, Roelants, Diels, Koninck, & Verschueren, 2005; Cormie, Deane, Triplett, & McBride, 2006), this fact has been proven by measuring the electromyographic activity of muscles (Delecluse, Roelants, & Verschueren, 2003).

These studies also suggest that, based on measured twice as high electric activity in the muscles during vibration, processes in the central nervous system (CNS) are stimulated, resulting in a greater CNS training effect than all the training methods known to date. In this research we wanted to assess this CNS stimulating effect of local vibrostimulation on reaction and focus persistence. Aim of research: Comparison of 30-45 year old, physically active and inactive women under the influence of local vibrostimulation.

Literature review

Vibration is characterized by a number of parameters, which, when varied, also changes the vibration effect, thereby acting differently on the structure of the various substances of human body, simply swinging, resonating, or even breaking them. Tissue resonance can be achieved if the frequency of oscillation of the tissue itself coincides with the frequency of the oscillation applied to them externally.

Carmelo Bosco and Marko Cardinale point out that vibration is a mechanical stimulus characterized by oscillatory movements, and biomechanical parameters that determine the intensity of vibrostimulation are amplitude (mm), frequency (Hz), and vibrostimulation strength (light, medium, strong) (Cardinale & Bosco, 2003), as well as the direction of vibration - forward, backward, sideways. Some authors, analyzing their studies, consider that vibration amplitude is the most important factor in achieving maximum vibration effect (Marín & Rhea, 2010; Rittweger, 2010). Vibration devices are characterized by acceleration measured

in meters per second in squares or gravitations - g (1g = 9.8m/s2). Some other scientists in their studies consider exactly acceleration as an important factor in ensuring vibration effect (Issurin & Tenenbaum, 1999). Vibrostimulation with acceleration, acting on a muscle group or a separate muscle, causes it to change its length. These changes in muscle length are transmitted to the central nervous system (CNS), which processes the signal and sends it back to the vibrated muscle or muscle group (Abercromby et al., 2007).

There are two separate vibration trends used in rehabilitation and sports training. In one case, the vibration is carried out directly on a particular muscle group, muscle tendon, ligament. In the second case it is the whole body vibration.

The methodology of applying the vibration training can be various and depends not only on the vibration parameters, but also on the application plan when the vibration is used – before training as a warm up, during a training or separately as individual procedure when only local vibrostimulation or whole body vibrations is applied. Vibrostimulation can be used as a warm up instrument, in which case vibration is used just before the basic training with increased vibration parameters. If vibration is used as an instrument for the direct development of physical abilities, then vibration can be used during the basic training (development of strength, power and flexibility) (Issurin, 2005).

Methodology

In our study we used local vibrostimulation, directly acting on the muscles of upper back, with an accent on the middle part of the erector spinae group, as the central part of the sympathetic nervous system is the lateral side of the spinal cord and the partially lumbar gray matter. The local vibrostimulation was performed on erector spinae muscle group from the seventh vertebra of the neck down to the third lumbar vertebrae, including an muscles supraspinatus, rhomboideus minor et major, partially latissimus dorsi.

The experiment uses a dosed frequency of 70Hz and an amplitude of 2mm. One of the basic conditions for frequency selection is the vibrating surface as well as the amount of muscle mass, so the frequency can vary greatly. Frequency can also be selected based on the muscle sensations of the participants in the experiment, which in this case will indicate the effect of vibration on the nervous system. In this case, the frequency was chosen according to the subjective sensations of the participants, so that the vibration would not cause unpleasant sensations, but in the same time vibration must not be too weak, then stimulating effect cannot be achieved. The local vibration stimulation frequency of 70Hz is considered to be the medium strength frequency that was accepted by the experiment participants. The condition of experiment was that each subject has a different muscle mass and therefore muscle tones is slightly different, that

requires frequency and amplitude variation to induce resonant oscillations. Therefore, in order not to complicate the course of the experiment, and for each participant not to change the frequency and amplitude of vibration, the participating women were selected by a similar body configuration. Amplitude 2mm was the maximum that could be installed on the equipment used in the experiment. We used this range to achieve a tonic effect on large muscles. The study used local vibrostimulation equipment RE21.

During the local vibrostimulation, there is only one independent variable - the downforce of the vibrostimulator. To partially eliminate the variability of this parameter, the vibrostimulation was performed by one person during the whole experiment, who was instructed to try not to change the downforce of the vibrator during the experiments.

The experiment was carried out in year of 2016, in Bauska city, Latvia. As a research base we used 10 female office workers, 30 – 45 years old.

Research results

In order to determine the focus persistence of physically active women during the working day, the participants of the experiment performed a digital attention, reaction speed test with a graphical interface used as a control exercise. The first phase of the experiment lasted one week from Monday to Friday. In this week, the participants of the experiment performed only a digital test of focus persistence. For each participant, the test result was calculated as the arithmetic mean of the three test runs performed. The test results showed focus level during the working day. Summarizing the average results of all respondents per day, the daily indicators for the persistence test were obtained, after which the mean of the persistence test for all five working days, showing the persistence of focus throughout the week (see Table 1).

Table 1 ***Average results of focus persistence in each day, seconds***

Day of week	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Total average**
Average results	1,018	0,918	0,924	1,083	0,836	0,956

n=10

For a good result in a test is considered 2 seconds, very good is considered 3 seconds and excellent - over 4 seconds. The arithmetic mean of the first week of experiment indicates that focus persistence rate is low, as the arithmetic mean does not exceed one second.

As the second stage of the experiment is an application of local vibrostimulation before the digital focus persistence test. The period in this stage of experiment was the same as in first stage – working days from Monday to Friday. At this stage of the study we added the local vibration with toning effect (to receive increasement of muscle tone and hoping to stimulate sympathetic nervous system), setting the maximum amplitude of the vibrostimulator (2mm) using the U-shaped nozzle and individually adjusting the frequency close to the pain threshold (70Hz in our case). Equal vibration stimulation amplitude and frequency 70Hz were applied to all participants. Local vibration stimulation for the upper back was performed before the focus persistence test. We applied a local vibrostimulation procedure for 4-5 minutes, immediately followed by a digital focus test. The result of the focus test was obtained by calculating the mean arithmetic from 3 test results. Participants completed focus test three times in a row, recording each test result (Table 2).

Summarizing the total test results of all participants, the arithmetic mean values for the overall persistence for the week were obtained.

Table 2 ***Average results of focus persistence in each day after application of local vibrostimulation, seconds***

Day of week	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Total average**
Average results	1,496	1,220	1,088	1,345	1,756	1,381

n=10

Comparing average arithmetic test results without local vibration stimulation with test results using local vibrostimulation results in the following – before vibrostimulation average result was 0,956sec, after local vibrostimulation – 1,381sec, so we observed an increasement in focus persistence time in digital test. For statistical analysis we used variation (15%), significance level with alpha one-tail test, the increasement in persistence may be considered as significant ($\alpha<0.05$).

Conclusions

The results of the study shows that local vibration stimulation could increase the productivity and save the time that would be spent in correcting inaccuracies. Local vibration stimulation can be used as an active break instead of a simple break, thus providing stimulation of the sympathetic nervous system throughout the working day, not just on the first part of a day. As the results of the first week's

focus test show, end-of-week focus persistence drops sharply, increasing the incidence of various errors in the work. It may take extra time for employees to correct errors and additional costs for the employer if mistakes are made and they needs to be corrected. There are previous researches, where local vibrostimulation was applied to achieve tonic effect on muscles, thus increasing anaerobic power for rowers (Ciekurs, Krauksts, Krauksta, Smila, & Kaupuzs, 2017), so we used same effect on nervous centers of sympathetic nervous system centers in spinal cord for tonic effect, increasing focus persistence. Average arithmetic test results without application of vibrostimulation and with application vibrostimulation indicate that local vibrostimulation can influence the sympathetic part of the vegetative nervous system, resulting in increased focus during the working week.

References

Abercromby, A., Amonette, W., Layne, C., McFarlin, B., Hinman, M., & Paloski, W. (2007). Vibration exposure and biodynamic responses during whole-body vibration training. *Medicine&Science in Sports & Exercise, 39*(10), 1794-1800.

Cardinale, M., & Bosco, C. (2003). The use of vibration as an exercise intervention. *Exercise and sport sciences reviews, 31*(1), 3-7.

Ciekurs, K., Krauksts, V., Krauksta, D., Smila, B., & Kaupuzs, A. (2017). The effect of local vibrostimulation on electromyography parameters in rowers. *Society. Integration. Education. Proceedings of the International Scientific Conference, Volume III*, 325-333.

Cormie, P., Deane, R., Triplett, N., & McBride, J. (2006). Acute effects of whole-body vibration on muscle activity, strength, and power. *The Journal of Strength & Conditioning Research, 20*(2), 257-61.

Delecluse, C., Roelants, M., Diels, R., Koninckx, E., & Verschueren, S. (2005). Effects of whole body vibration training on muscle strength and sprint performance in sprint-trained athletes. *International Journal of Sports Medicine, 26*(8), 662-8.

Delecluse, C., Roelants, M., & Verschueren, S. (2003). Strength increase after whole-body vibration compared with resistance training. *Medicine & Science in Sports & Exercise, 35*(6), 1033-41.

Issurin, V. (2005). Vibrations and their applications in sport. *Journal of Sports Medicine and Physical Fitness,* 45, 324-36.

Issurin, V., & Tenenbaum, G. (1999). Acute and residual effects of vibratory stimulation on explosive strength in elite and amateur athletes. *Journal of Sports Sciences, 17*(3), 177-82.

Marín, P.J., & Rhea, M.R. (2010). Effects of vibration training on muscle power: a meta-analysis. *The Journal of Strength & Conditioning Research, 24*(3), 871-8.

Rittweger, J. (2010). Vibration as an exercise modality: how it may work, and what its potential might be. *European Journal of Applied Physiology, 108*(5), 877-904.

Roja, Z., Roja, I., Kaļķis, V., Kaļķis, H., & Laganovska-Dīriņa, I. (2007). *Komunikācija ar datoru - komforts vai diskomforts? Tev palīdzēs ergonomika: noderīgi padomi strādājošiem pie datora.* (b.i.) Rīga.

Крылов, А.А., & Маничев, С.А. (2000). *Практикум по общей, экспериментальной и прикладной психологии*. Санкт-Петербург: Питер.