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ORIGINAL RESEARCH PAPER

CRANIAL ELECTRICAL STIMULATION IN FITNESS WITH WEIGHTLIFTING TOOLS

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Abstract

Sport trainings are based on two essential components: the preparatory process and the athlete's level of training as the result of the training process. The most important task of the coach is to find the most efficient way how to prepare an athlete so that he would achieve the highest capacity and would be able to implement it. Application of cranial electrical stimulation in sport is not fully explored. The aim of the study was to determine the influence of cranial electrical stimulation on the strength parameter indicators of fitness athletes who use weightlifting tools. In the study participated 10 men (representatives of fitness sport, of Latvian Academy of Sport Education, who use weightlifting tools in the training process). The age of these athletes was 21±3 years. The average weight of the athletes was 76±3.2kg and the average height was 156±15.5cm. An exercise set "lifting a weight bar to the chest" was developed. A 10 minute session of cranial electrical stimulation was applied. During the test a weightlifting bar of the company "Eleiko" was used and FiTRO Dyne Premium cable was attached on one end of the bar which was connected to a computer system and registered the data obtained during the control exercise performance. During the experiment the results obtained during two tries of control exercise performance were compared, which are the difference between the average strength parameters and the difference between the maximum strength parameters before the application of cranial electrical stimulation (hereinafter – CES), performing the first three repetitions, comparing them to the last three repetitions performed after the application of the stimulation. After cranial electrical stimulation the maximum strength parameters improved by 533.23±11.09N ($\alpha<0.05$).

Fitness sport representatives and coaches, in order to improve the level of training of their student, must pay attention to the application of CES in the training process with weightlifting tools.

Key words: *weightlifting tools, cranial electrical stimulation, strength.*

Introduction

The specific characteristics of muscles can be evaluated in the process of interaction with external and internal objects. In sport, strength measuring equipment, sport gears, counteraction of an opponent, resistance forces of the external environment and other objects are counted as the external objects. Body parameters, muscle strength of antagonists, biomechanical peculiarities of the movement apparatus functions are counted as the internal objects. The mechanical parameters (strength, speed, strength expression time) registered during the performance of physical exercises only relatively characterize muscle properties, because they are exposed to motivation, testing conditions and duration, the contingent's ability to implement their motor potential, individual technique, body mass geometry, anatomical peculiarities of the movement apparatus. Therefore, only the expression of the muscle physical properties can be judged by the testing results.

Sport exercises according to the mechanical and physiological parameters significantly differ from a person's daily work activity. Therefore, evaluation of muscle physical properties for people who are engaged in sports is topical and provides an opportunity to receive new information about the adaption of a person's movement apparatus to physical load. The correlation "strength-height" reflects the strength development level (relevant in combined sports) and muscle topography (very topical for trauma prevention). The correlation "strength-speed" characterizes muscle power (the ability to perform fast and strong movements). Quantitative evaluations provide an opportunity to determine muscle physical property development dynamics and if there is a need to organize a necessary training process adjustment. One of the training process management options is to be based on the dynamic similarity principle. What it means: knowing the peculiarities of the competition exercise performance muscles, it is possible to determine the pace, speed, weight amount in special exercises with the dynamic similarity aim for the competition exercise. It is very important that the tools and methods, which are used in physical property preparation, would create not only a functioning environment of the movement apparatus similar to the competition conditions, but also record modelling in the future.

Continuous increase of sport results takes place by increasing the amount of training loads and intensity, by improving the training material provision, as well as by applying a complex scientific approach in the training process. Along with psychological, biological and methodological factors it all makes one look for new reserves for the increase of sport training efficiency. Thoroughly developed divisions into periods, method and tool dynamics, harmonized training regimen create levels of diversity category with the highest degree. These are socio-psychological, efficiently-energetic and kinematic-dynamic variations for the interaction of the athlete's body with the external environment during the performance of an exercise. An athlete's development and improvement, functioning of the body is a targeted training process in different environmental conditions in order to achieve a goal. Biological systems are considered to be a prerequisite for the operation of the system, but the amount of information – the cause of development rate change. Information between the body and the external environment is considered to be a process with different coherence in time and space. The management efficiency of such process depends on how much the internal, targeted body diversity surpasses the external diversity, how much the leading system's diversity exceeds the subordinated diversity system. Training influences retain the qualification criteria and lead the main movement programme to a successful solution of a movement task in different conditions of the external environment.

The training range and nature creates an information reserve for a successful action in the future, providing further opportunities for targeted development. If the influence accents do not coincide with a useful development direction and movement elements, structure, states, then the information-to-be-acquired obtains a role of a destructive factor, which will destroy the natural development algorithm, which is in harmony with the development of all the rest of the body systems.

Sport training is based on two essential components: the preparatory process and the athlete's level of training as the result of the training process. The most important task of the coach is to find the most efficient way how to prepare an athlete so that he would achieve the highest capacity and would be able to implement it. Application of cranial electrical stimulation in sport is not fully explored. There is no detailed analysis of cranial electrical stimulation's influence on the functional state of athletes, on the movement dynamic parameters. The cranial electrical stimulation therapy is considered safe and the therapy is based on an electric micro current. Athletes use cranial electrical stimulation to increase concentration abilities before competition. (Mateo, 2011; Song, 2007) The physiological

operation mechanism of cranial electrical stimulation is being studied. (Braverman, 1990; Brotman, 1989; Gilula, 2005) Cranial electrical stimulation is suitable for athletes to solve the problem with stress. (Song, 2007; Hefferman, 1996) One electrical stimulation session is enough for improving a person's functional state and preserving the capacity. (Ковалев, 2004) A situation is marked in studies that the greatest effect of cranial electrical stimulation was when the subjects had high level of fatigue. (Kirsch, 2004; Overcash, 1989) By applying cranial electrical stimulation, it is possible to perform vegetative state adjustments, characterized by changes of heart rate variability indicators. More effectively cranial electrical stimulation affects athletes who have a high level of training. (Троянов, 2005) A cranial electrical stimulation session increases the subjects' functional state, reduces the blood pressure by 11%, reduces anxiety level by 15% and the short-term memory test results improve by 25%. (Ковалев, 2004) Milostnoj in his study developed the methodology of the optimal cranial electrical stimulation frequency application for wrestlers. During the maximum load the stimulation was applied with the current strength from 0 to 3.5mA for four minutes, then the pulse incidence, duration and current strength was changed. The session duration was 24 minutes. After the session, positive dynamics of beta-endorphin indicators was observed in the wrestlers' blood. Cranial electrical stimulation positively influences the renewal of hemodynamic and psycho physiological processes for wrestlers after the maximum loads. (Милостной, 2007)

The aim of the study was to determine the influence of cranial electrical stimulation on the strength parameter indicators of fitness athletes who use weightlifting tools.

Material and Methods

In the study participated 10 men (n=10), (representatives of fitness sport, of Latvian Academy of Sport Education, who use weightlifting tools in the training process). The age of these athletes was 21±3years. Body weight was measured with electronic scales SENCOR SBS60115. The average weight of the athletes was 76±3.2kg. Height was determined with the help of an anthropometer and the average height was 156±15.5cm.

An exercise set "lifting a weight bar to the chest" was developed, (Fig.1.)

Figure1. The Phases of Control Exercise

Which consisted of 12 repetitions and between the repetitions a 15 second rest was taken. (Fig.2.)

1-3	3 repetitions with a 15s rest between the repetitions
	15min rest
4-6	3 repetitions with a 15s rest between the repetitions
	15min CES session
7-9	3 repetitions with a 15s rest between the repetitions
	5min rest
10-12	3 repetitions with a 15s rest between the repetitions

Figure 2. Exercise Set with a Weightlifting Bar

These twelve repetitions were divided into four tries. Between the first and the second try the athlete rested for 15min, after performing the second try a 10min cranial electrical stimulation session was applied, while after the performance of the third try the athlete rested for 5min and performed the last – closing try (Fig.3.).

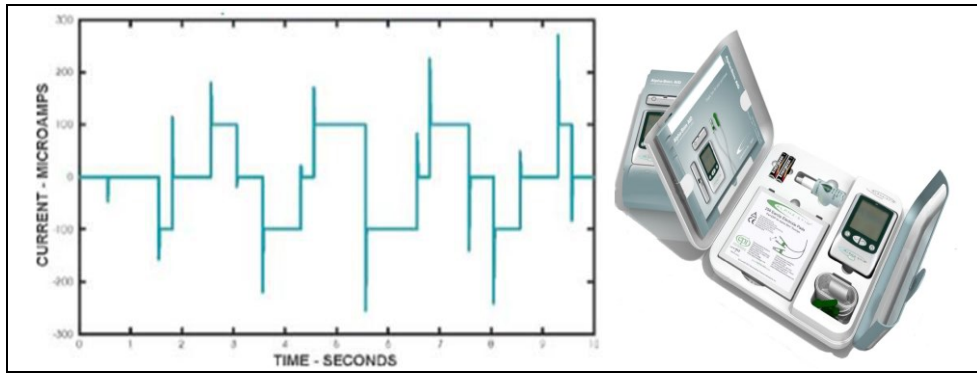

Figure 3. Alpha Stim SCS (USA) and Elecrtical waves (Kirch, 2002, 2004)

Before starting the control exercise, the athlete was instructed on what awaits him during the stimulation. One was told about the duration of the session (10min), about the anticipated changes in the body during the influence. When the athlete was introduced with everything, the stimulation session was initiated. The athlete was seated. The electrodes were moistened with a salt water fluid, put on the earlobes and the stimulation session was initiated. Initially, the current level was on level „0", then it was gradually increased until the moment when one starts to feel the first unpleasant feelings. At this point the current was slightly reduced again until the unpleasant feelings passed, and the therapy was continued with such current. If the unpleasant feelings returned again, then the current was reduced again, but it was never allowed to be less than the mark „1", as then the Alpha-Stim SCS is not turned on and stimulation is not performed. After the Alpha-Stim SCS stimulation the control exercise test was repeated – lifting a weightlifting bar to the chest at the utmost strength and speed.

Each performed repetition during the exercise performance was recorded by the computer software Fitronic Premium, which portrayed the data obtained – numbers, in the form of tables – curves, showing each and every smallest change in a numerical form in each performed try and repetition. FiTRO Dyne Premium (Slovakia) is a computer technology based system created for representing the athletes' movement dynamic parameters in a graphical and numerical form (Fig.4). During the test a weightlifting bar of the company "Eleiko" was used and FiTRO Dyne Premium cable was attached on one end of the bar which was connected to a computer system and registers the data obtained during the performance of the control exercise.

The results obtained during the experiment were processed in the computer programme Excel Statistics 3.1., with the help of which the theoretical value of the Student's t-test was calculated and the increase was determined (is statistically believable or is not statistically believable) (Dravnieks, 2004).

Results

During the experiment some pedagogical functions were conducted: – control function (strength level during the performance of the control exercise was determined), – methodological function (the methodological sequence of the developed exercise set was determined), – comparative function (differences between the subjects in comparison with the presented results were determined).

During the experiment the results obtained during two tries of control exercise performance were compared, which is the difference of the average strength parameters and the difference of the maximum strength parameters before the application of cranial electrical stimulation (hereinafter – CES), performing the first three repetitions, comparing them to the last three repetitions performed after the application of the stimulation. (Fig. 4.)

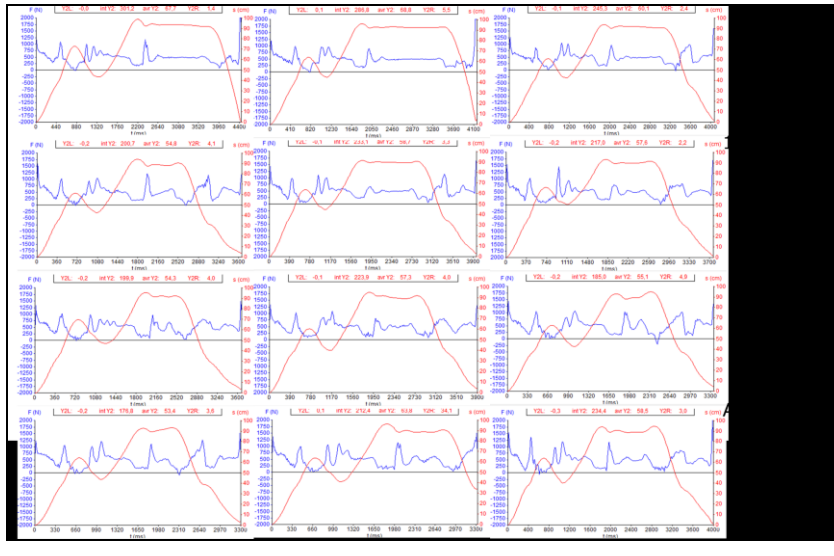

Figure 4. Graphs of Control Exercise Movement Performance

The average strength parameters during the performance of the first three repetitions before applying the CES session were in an average range of 597±25.3N.

After applying the CES session the average strength indicators during the performance of the last three repetitions (10 – 12) were 622.23±1.7N. (Fig. 5.)

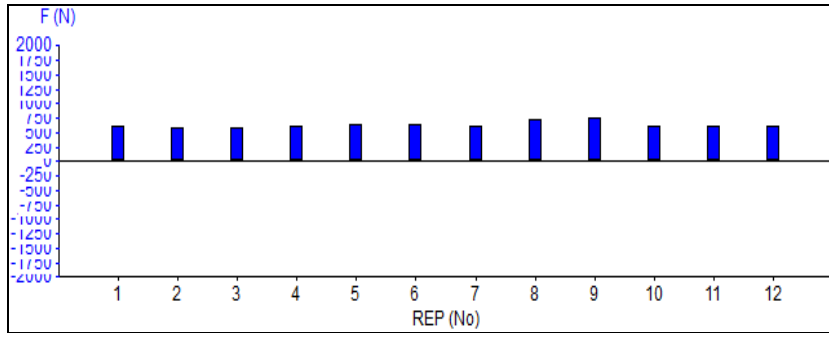

Figure 5. The Average Strength Indicators during the Performance of the Control Exercise Before and After CES (n=120)

After applying the CES session, the resulting difference improved by 24.6±2.1N. The average strength parameter difference obtained during the performance, according to the data obtained by the computer programme Excel Statistics 3.1., the theoretical value of the Student's t-test and the increase are statistically believable $\alpha<0.05$.

By contrast, the maximum strength parameters when performing the first three repetitions before applying the CES session were in an average range of 1204.3±113.5N. After applying the CES session, the maximum strength indicators during the performance of the last three repetitions (10 – 12) were 1383.13±319N (Fig.6). After applying the CES session, the resulting difference improved by 178.83±11.2N. The maximum strength parameter difference obtained during the performance, according to the data obtained by the computer programme Excel Statistics 3.1., the theoretical value of the Student's t-test and the increase are statistically believable $\alpha<0.05$.

The maximum strength parameters recorded during the experiment when performing all twelve repetitions of the control exercise, which were divided into four tries, before the application of the cranial electrical stimulation session were in an average range of 1163.93±17.7N. After applying the CES session the maximum strength indicators during the control exercise performance improved by 533.23±11.09N and amounted to 1697.16±28.8N. (Fig. 6.)

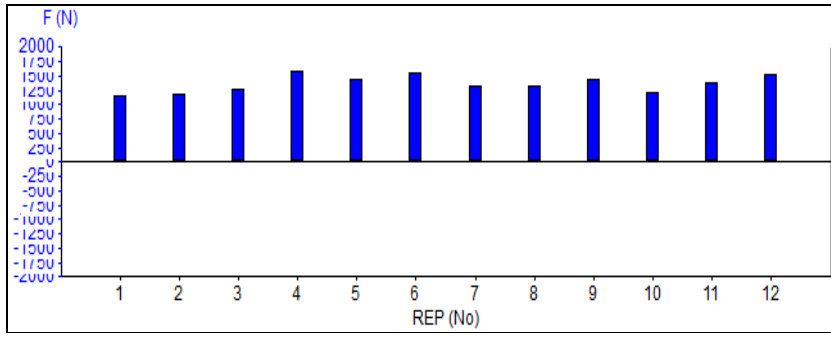

Figure. 6. The Maximum Strength Indicators during the Performance of the Control Exercise Before and After CES (n=120)

The maximum strength parameter difference obtained during the performance, according to the data obtained by the computer programme Excel Statistics 3.1., the theoretical value of the Student's t-test and the increase are statistically believable $\alpha<0.05$.

Also, the average indicator strength parameters during the control exercise performance improved after the cranial electrical stimulation session from 493.02±19.06N to 890.69±21.3N, which is by 397.67 higher than without applying the CES session. According to the data obtained by the computer programme Excel Statistics 3.1., the theoretical value of the Student's t-test and the increase are statistically believable $\alpha<0.05$.

Discussion

The results obtained confirm that cranial electrical stimulation has an immediate effect. Immediately after CES the first phase is the „delay phase", 5min after CES the second phase the „activation phase" begins. During the delay phase the strength indicators are reduced. CES application is effective for athletes who feel depressed, anxious, too worried or tired before competition. The results obtained in the study could be helpful for optimizing the athletes' pre-competition state. When preparing fitness representatives for competitions, using the effect of cranial electrical stimulation and strength indicator control, it is possible to predict the training performance efficiency. In order to optimize the fitness training performance efficiency with weightlifting tools, cranial electrical stimulation is an effective tool.

Often one subject with higher average strength indicators is also the owner of higher maximum strength. This can be explained by the overall physical preparation, which is obtained before the experiment, the muscle fibre type, the feeling of comfort in the respective day, as well as by the fact

that the strength and power development specifics and the control exercise performance technique was taken into consideration.

The positive results and harmlessness of using Alpha-Stim have been proven. (Bravermans, 1990) So far a precise physiological mechanism of cranial electrical stimulation has not yet been fully understood, it is still being intensively studied. Scientists follow the hypothesis that cranial electrical stimulation indirectly affects brain tissue, in the hypothalamus portion (the highest centre of vegetative function regulation, nervous and endocrine system coordination) so accustoming brain to produce neurohormones and neurotransmitters, until the right balance of these substances is restored in the brain. Cranial electrical stimulation activates the endogenous opioid peptide system of the brain, mainly β-endorphin. (Kirsch, 2004; Brotman, 1989) Experts note that cranial electrical stimulation is a non-pharmacological treatment type for depression, anxiety and insomnia. (Hefferman, 1996) Cranial electrical stimulation normalizes the psychophysical state, the result of which is the anti-stress and anti-depression effect (Gigula, 2005), increases capacity, reduces fatigue, improves sleep quality (Kirsch, 2002), improves tissue healing processes and is an effective anaesthetic (Foster, 2001; Gibson, 1987). Cranial electrical stimulation normalizes the activity of the autonomic nervous system, vascular tone, and arterial pressure and stimulates the immune system (Трояновъ, 2005), influences the parasympathetic nervous system, resulting in reduced vascular tone, increased amount of oxygen in blood and normalized activity of the cardiovascular system as a whole. Cranial electrical stimulation influences the respiratory cycles, they become less frequent and the breathing depth deepens. (Баевский, 2005)

Conclusions

The results compiled and obtained during the test confirm that the application of a cranial electrical stimulation session has an immediate effect on athletes' physical capacity, which during the test reflected in the increase of the athlete's average and maximum strength indicators. After cranial electrical stimulation the maximum strength parameters improved by 533.23±11.09N ($\alpha<0.05$), while the average strength parameters improved from 493.02±19.06N to 890.69±21.3N ($\alpha<0.05$), which is by 397.67N higher than without applying the CES session. According to the data obtained during the experiment it can be concluded that cranial electrical stimulation can be applied not only in medicine, but also in sport as a tool that positively influences the athlete's functional state, which is based on the movement dynamic parameters. According to the compiled and registered data it can be judged that only one cranial electrical stimulation session is

sufficient for the improvement of a person's functional state and capacity preservation.

After the performance of the control exercise by all subjects and the analysis of the data obtained, it can be concluded that the Apha Stim session had a more positive effect on athletes who have a higher level of training.

Fitness sport representatives and coaches, in order to improve the level of training of their student, must pay attention to the application of CES in the training process with weightlifting tools. During the CES therapy very weak electrical impulses are used, which indirectly stimulate and normalize brain activity and affect brain tissue in the hypothalamus portion, as well as positively affect the athlete's strength expression parameters.

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