ORIGINAL RESEARCH PAPER

VIBROSTIMULATION IN BOBSLEIGH

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Abstract

Foreign literature contents studies about the general effects of vibrostimulation on the human work capacity, so we had an interest in local vibrostimulations application possibilities in the Olympic kind of sport - bobsleigh. Aim of study was to determine how local vibrostimulation can be used in bobsleigh and whether it is appropriate. As main methods we used method of test exercise, vibrostimulation, pedagogical experiment and method of questionnaire. Study took place in Ventspils Olympic Sports Center, Latvian bobsleigh team training camp during the sample period from 12th to 17th July. The study subjects was 26±2 years old, average weight 99±3kg, their experience aim a high performance sports training process an average of 6 years (including bobsleigh), n = 10. During all the camp the athletes took the test exercises - bobsleigh push from standing position and bobsleigh push from run. In addition we interviewed athletes' group, which took procedures of vibrostimulation to determine the muscle senses during and after vibration, as well as areas where the vibration should not be applied. Processing the experimental results we found that in bobsleigh push from standing position the mean results of experimental group remained worse. In bobsleigh push from run results of both groups deteriorated by 0.02sec ($p > 0.05$). Comparing the groups the difference was not reliable at the beginning of the experiment, at the end of the experiment ($t_t > t_e$). Processing results of questionnaire found that the athletes feel very unpleasant during and after vibrostimulation of calves muscle tendons (four respondents), quadriceps and calves muscle vibrostimulation (three respondents). Athletes mentioned the fact that just after vibrostimulation seen quite a feeling of lightness in leg musculature.

Key words: *Vibratory stimulation, muscle senses, training process in bobsleigh, testing.*

Introduction

Vibration is a method that has been known for a time, was also used in the Soviet space program, and with the Soviet Union collapsed, it became known in the world more widely. In Latvia studies of vibration in sport was engaged by Vladimir Nazarov (Назаров 1987), who called the vibration as biomechanical stimulation, and professor Viesturs Krauksts. There are widely distributed a variety of whole body vibration equipment which can be performed with a variety of exercises for various sports. Sports scientists have done research on the effects of vibration on the human work capacity changes, the study results showed a positive dynamics of human work capacity (Bosco, Cardinale and Tsarpela 1999), however, remains a problem - how to adapt vibrostimulation for individual sports, stick to a methodology? Furthermore, the whole body vibration has an important downside - it is not possible to separate vibration for the one muscle, muscle tendons, because, when the whole body or regional body part vibration initiates, oscillations partly are absorbed by articular cartilage, intervertebral discs and more. Equipment of whole body vibration is heavy, bulky, they are not very portable. We in Latvian Academy of Sport Education have equipment of local vibrostimulation, that is portable and can therefore be better included in the training process of various kinds of sports. Olympic sports coaching process is characterized to be carefully planned, they has testing and punctual athlete selection cycle, the major competitions - the Olympics, so it can be quite accurately mean to detect impact of vibrostimulation on sport-specific test results.

Materials and methods

The study was carried out in Ventspils Olympic Centre. In study participated ten athletes, in average of 26±2 years old, personal body weight was 99±3kg, athletic experience (including bobsleighs) in an average of 6 years. Athletes were divided into two groups, one of them was the experimental while the other control group. Test exercise was special training device pushing from standing position and run, this test exercise is common in bobsleigh training process of the preparation period characterizing athletes physical capacities.

Simulator has been pushed from standing position in 30 meter distance, push from run distance is about 1,5+20 m, 1.5m athlete used to be sped up before the start pushing simulator. After processing of the initial results of the groups we determined, that groups were homogeneous (coefficient of variation did not exceed 10% limit) and equivalent ($t_t > t_e$), therefore, suitable for the experiment. Experimental group parallel to the overall training process used local vibrostimulation, which was carried out on following muscle groups of the both lower extremities - the thigh quadriceps muscle, hamstrings, calves and Achilles tendon. Muscle groups were chosen because they are the most pressured in bobsleigh drills, so we were hoping to reach a higher vibration effects. Local vibration was carried out two times a day - in the morning and evening. In the morning, the vibration amplitude was 2mm and the vibration frequency reached 100Hz, but at the evening vibration amplitude was reduced to 1.5mm, the frequency remained 100Hz, but was increased vibration time. Some researchers recommend the vibration frequency, which is close to 100Hz (tab.1). Discussed in references (Roll, Weddell and Ribot 1989) there are indications that primary muscle spindle aferentus CNS stimulates at the frequency of 100Hz. It was assumed that if the frequency of primary afferents of the muscle spindles is synchronized with the frequency of mechanical vibration, it will be possible to achieve greater effect of vibrostimulation (Jackson, Turner 2003). With such a vibration methodology we hoped to achieve warm-up effect in morning and restorative effect at evening sessions. Planning of local vibration procedures can be seen in the table 1.

Table 1.

Local vibration plan for 6-day training period

	Duration in morning session, min	Duration in evening session, min
Day/Amplitude	*2mm*	*1.5mm*
1	0,3	1
2	1	1,30
3	1	2
4	1	2x1
5	1	2x1,30
6	1	2x1,30

Duration of evening vibration procedure was gradually increased, assuming that muscle adapts vibrostimulation load like any physical load, and during vibration muscle contracts unknowingly (Issurin 2005). Vibration procedures were carried out by local vibration equipment RE21 (Fig.1), that has vibration frequency range till 100Hz, and amplitude variations from 0 to 2mm. Vibration was applied to a whole muscle, sliding the vibrotode over the muscle in direction to the torso, pushing metabolism products via lyph vessels and venous blood vessels.

Figure 1. Local vibration equipment RE21

Athletes trained twice a day throughout the experiment. Training camp workout structure was as follows: before the first workout was performed aerobic load (jogging), stretching exercises followed. In the main part of workout athletes took various sprint drills and other exercises for leg muscle development using body weight. This was followed by various types of running on different surface. The second workout at the same workout day began with 30 minutes warm-up, which was followed by a some of sports game after coach's discretion, immediately after that a exercises of static strength development were carried out. The main part of the training has been organized to develop strength abilities by a set of exercises with free weights, loads are on average six rounds in six repetitions, load value was corresponded to 75% of 1RM (Repetition Maximum). In strength developing workout were used a combination of different methods - repetitions and series method, the maximum effort method and extensive interval circle drill method. Training plans were developed and the process led by head coach of Latvian Bobsleigh team Sandis Prūsis, he was assisted by the Jānis Ozols.

Athletes questionnaire was carried out as follows: during vibration the athletes were asked to express in written form their own muscle senses, total body senses, and the overall workout feelings for the period from the beginning of the experiment and since previous vibration. At the end of the experiment athletes were interviewed on the same issues, as well as the athletes' belief in connection with the use of vibrostimulation in future bobsleigh training process, answers and insights recorded in a free written form. Records were analyzed and searched for keywords of interest for future research to provide.

Experimental data were processed by mathematical statistical methods, which included the arithmetic mean, coefficient of variation, standard error, Student's criterion for independent and related groups.

Results

After the experiment we compared data of both groups in bobsleigh push from standing position. Average result of control group in bobsleigh push become worse by 0.07sec ($p<0.05$), but result of experimental group become worse by 0.04 ($p<0.05$). Difference between groups was not significant neither in the beginning, not at the end of experiment ($t_t>t_e$) (Fig.2).

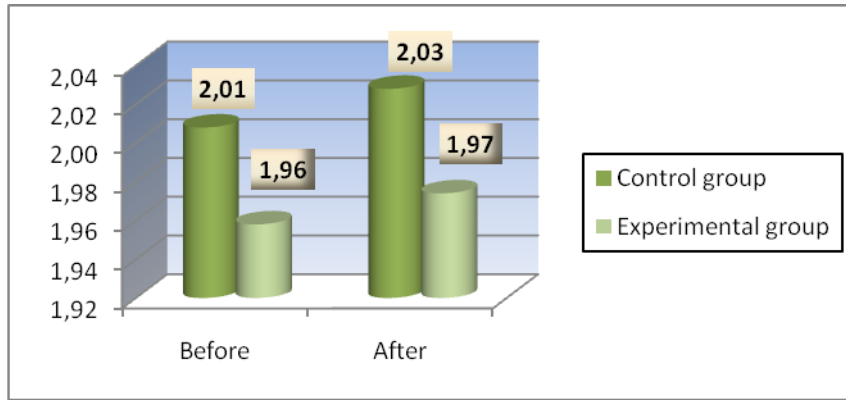

Figure 2. Bobsleigh simulator push from standing position, average results, n=10

Control group mean result in bobsleigh simulator push from run increased for 0.02sec ($p<0.05$), while the result increasement of experimental group remained just 0.01sec ($p<0.05$).

Comparing the group with each other, the difference was not reliable at the beginning of the experiment, and at the end of the experiment ($t_t > t_e$) (Fig.3).

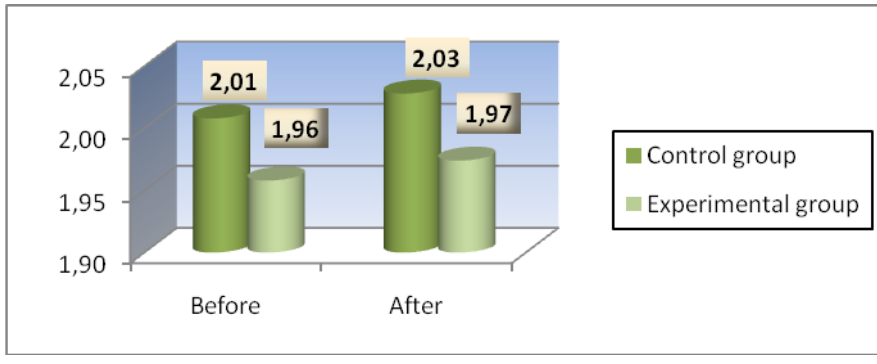

Figure 3. Bobsleigh simulator push from run, average results, n=10

In athletes questionnaire, collecting data in the graph, were three possible credits of athletes answer: "Yes", "No," and without a specific allegation (Fig.4).

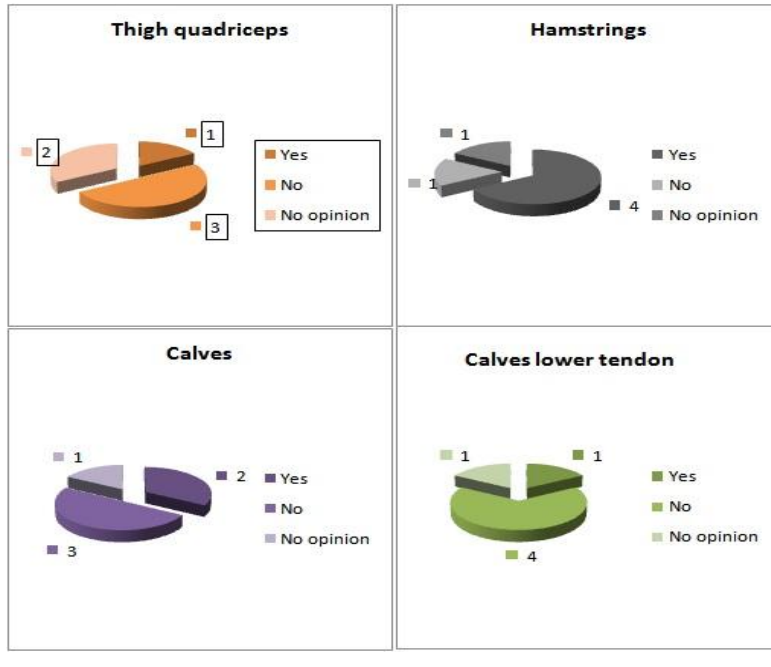

Figure 4. Results of athletes questionnaire about vibrostimulation of lower extremities, n=6

If the athlete specific detection of vibrostimulation caused the positive muscle feelings during or immediately after vibrostimulation throughout the period, the athlete's response was marked with a "Yes", and if the athletes muscle had opposite feelings, then "No", if the athlete did not have any specific muscular sensation, then his answer to a particular detection was not credited.

We can see that athletes are not very well refer to the vibrostimulation of quadriceps muscle, lower leg muscles and transition of lower leg muscles to tendon and Achilles tendon, except in certain cases, but there are four positive feedback on the hamstring vibrostimulation.

Most athletes (4 of 6) was observed in the positive sense of the Achilles tendon during vibrostimulation (Fig.5).

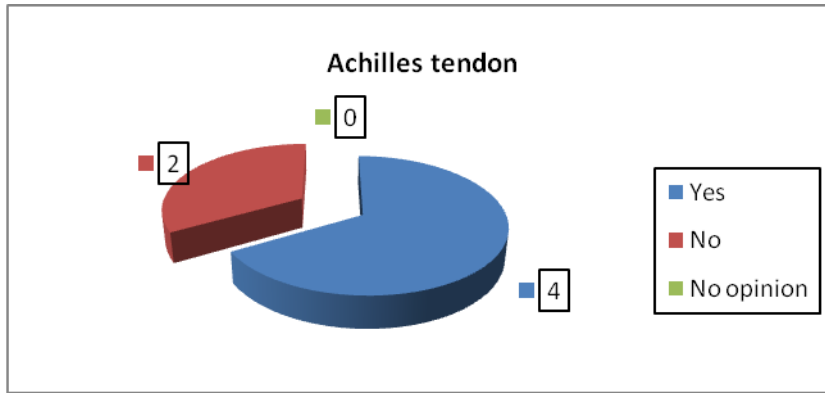

Figure 5. Results of athletes questionnaire about vibrostimulation of Achilles tendon, n=6

All athletes involved in the procedures felt a sense of ease immediately after the procedure, one athlete admitted muscle flexibility improved, and one athlete stated that vibrostimulation is too relaxing and reduces muscle tone.

Discussion and conclusions

Vibrostimulation in world of sport has been realized by the low frequency stationary vibroplates. We used high-frequency local vibrostimulation, which until now has been successfully used in clinic (Bishop 1974, Mattews 1966). Summarizing the study results, we can conclude that vibrostimulation has effect, the experimental group result in bobsleigh push from standing position increased by 0.04sec, while the control group by 0.07sec after applying local vibrostimulation.

It should be noted that during the training camp the test results mostly are getting worse (results are increasing), that is because the realization of a physical feature or a form of expression training requires more effort and athletes does not have time to recover, it is related to the cumulative fatigue, which increases during training camp, and load of high frequency vibrostimulation also summarizes to overall load (Bishop 1974, Mattews 1966). There are studies showing that procedures of vibrostimulation three times a week for five weeks did not give reliable improvement of results (Delecluse, Roelants, Diels, Koninckx, Verschueren, 2005). In bobsleigh simulator push from run result of experimental group increased by 0.01sec, but result of control group increased by 0.02sec, we can conclude, that chosen methodology of local vibrostimulation affects maximal strength (first two steps in simulator push) more than explosive strength expression (first two steps with body weight).

During questionnaire one of the athletes noted increased muscular flexibility (stretching exercises was performed more successfully), and the effect is confirmed by studies (Nazarov, Zilinsky 1984; Issurin, Liebermann, Tenenbaum 1994). We can say that vibrostimulation can be applied on Achilles tendon and hamstrings only, as the biomechanical analysis of bobsleigh simulator push say that hamstring muscle is most important in this movement (Клочков, 1992). We reached goal of our research - vibrostimulation can be an effective method for improving the performance of bobsleigh, even 0.07sec improvement is enough in Olympic kind of sport, where in one tenth of a second can finish up to the six crew.

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Submitted: July 8, 2010
Accepted: May 2, 2011