ACUTE EFFECT OF EXTENSORS KNEE UNILATERAL ON LEG EXTENSION MACHINE WITH AND WITHOUT STIMULATION ON THE VIBRATING PLATFORM

ORIGINAL ARTICLE

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ABSTRACT

Introduction: A great number of studies have been conducted lately concerning the use of mechanical vibration as part of the training for improvement of physical conditioning. However, the majority of these studies have evaluated the effects of the exercises joined with the vibrating training in order to determine if there was post-training improvement, and did not evaluate the effects of both vibrating and non-vibrating platform exercises. Objective: To evaluate the acute effect of exercise on the knee extensors, with and without the stimulus of the vibrating platform. Methods: Thirty male active individuals, with age range between 18 and 45 years, randomly conducted three protocols: with the platform on (POG), the platform off (POFFG) and control group (CG). Each protocol began with a five minute warm-up on the ergonomic bicycle, with loads ranging from 75 to 100 watts and 70 rotations per minute, followed by six sets of 10 unilateral squats with one minute of pause between them, with or without mechanical vibrating, and finished with the Work Test, performed only on the dominant leg for determination of the physical valences: work, strength, power and speed. Results: Only the variable speed has presented statistically significant difference ($p < 0.05$) when the platform on was compared to the control. Conclusion: The training on the vibration platform had no influence on the work or muscle power variables, but it exerted negative influence on the movement velocity causing fatigue in the quadriceps muscles.

Keywords: vibrating platform, power (physiology), speed, work, muscular fatigue.

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INTRODUCTION

Clinic Studies have suggested that the vibrating mechanism improves muscular performance[1-3]. A single vibrating training (10 minutes at 26Hz) triggers significant result on muscles based on Bosco *et al.*[3]. Better performance on strength-speed, strength-power and vertical push was mentioned after a vibrating training[1].

Torvinen *et al.*[4] stated that a single vibrating power applied improves isometric force of knee extensors performance and vertical push in 3.2% and 2.5% respectively. Published studies reported the usage of vibrating platform as a means for training may cause potentiation or muscular fatigue[1-14] and the effect is transitory and lasts no longer than 30 minutes[14].

However, most studies analyzed the usage of platform and compared variables before and after vibrating training. There are no reports comparing the same the training, group and using the platform switched on or off. It is important to verify whether the acute effect on unilateral knee on the leg extension machine undergoes any vibrating training. This research has the objective of clarify whether vibrating training has any potentiating effect or causes muscle fatigue by analyzing the acute unilateral exercise performed on leg extension machine.

Methods

Our study used vibrating intensity of 30Hz and amplitude of 4 to 6 mm based on most studies which used intensity of 20Hz to 50Hz and amplitude of 2.5 to 6mm[3-11,13-23].

Sample

Sample composed of 30 male individuals aging 18 to 45 living in capital city of São Paulo, Brazil. Before enrolling in the research, participants were informed about all procedures that would be followed and signed a term of consent. This study was approved by the Research Ethics Committee at Federal University of São Paulo (Unifesp) under no. 0113/09 supported by Resolution 196/96 by National Health Council which establishes rules for research using human beings.

Procedures

On the first day of the research, participants took the test for Dynamic Maximum Strength – DMS (Globus Evaluation System: Software Tesys Suite Globus®, System Tesys 1000 Globus®, Encoder Globus® – Italy). The Enconder, that is a rotating encoder, has already been used in other studies to determine maximum strength, number of repetitions and speed of each movement[24-26]. Data provided by the Encoder quantify precisely the change of movements with or without charge.

On the second day, after 5-minute warm-up on an ergonomic bicycle (Life Fitness® 93ci – United States) charged from 75 to 100 watts and 70 rpm, participants followed the protocols CG, POG and POFFG on the vibrating platform. After an interval of one minute, individuals were submitted to a work test – Globus Evaluation System, Italy- on a unilateral extension chair (Life Fitness Hammer Strength® – USA) to check the physical valences below:

- Average Work – joules (J);
- Average Strength – newton (N);
- Average Power – watts (W);
- Average Speed – meters per second (m/s).

After each 48 hours at least, the individuals repeated the series at random until they completed all the three protocols.

In this study, work test was taken by performing repetition series until tiredness at 45% on 1RM found on the DMS. This figure was based in an average of numbers found in other studies[27-29]. Squat protocols based on Serravite *et al.*[30] were followed: Platform On Group (POG) – 6 series of 10 unilateral squats(90°) on a vibrating platform (30Hz; amplitude of 4 and 6 mm) and the dominant leg having to move every three seconds (Timer Globus® - Italy) reaching 30 seconds of vibration. Platform Off Group followed the same procedure above but the platform was switched off. Control Group solely underwent the work test with the dominant leg.

Pilot Study

To avoid error on the protocols applied and verify significant differences when comparing dominant and non-dominant leg, 16 male individuals aging 18 to 45 were evaluated. The protocols presented above were followed, repeated at random with the dominant and the non-dominant leg. One-way ANOVA of results obtained has not showed significant differences relating to dominance and for that reason our study only took the dominant leg into consideration.

Statistical Analysis

One-way ANOVA was applied to determine whether there was any differences among means of control groups, platform switched on and off for each variable studied: work, strength, power and speed. When differences were found, Tukey's test was applied do verify which means differ. Significance level was $p < 0.05$.

RESULTS

The variables analyzed were work, strength, power and speed. Each one was compared in three situations: control group (CG), platform off group (POFFG) and platform on group (POG). Speed was the only variable that showed statistically significant difference when CG and POG were compared. (table 1)

Table 1. Means and standard deviation related to work, strength, power and speed on the dominant leg for control groups, platform switched on and off.

	Control Group (CG)	Platform Off Group (POFFG)	Platform On Group (POG)
Work (J)	352,4 ± 123,4	343,3 ± 157,1	280,7 ± 121,2
Strength (N)	715,7 ± 191,8	699,6 ± 159,8	697,4 ± 192,0
Power (W)	341,6 ± 122,5	314,8 ± 133,4	277,1 ± 122,2
Speed (m/s)	0,514 ± 0,184	0,470 ± 0,193	0,379 ± 0,182*

*p < 0.5 between CG and POG.

DISCUSSION

Some studies analyzed the effect of vibrating training on muscular performance during training. Bosco *et al.*[1] while analyzing the effects of a 10-day consecutive training (5 daily series of 90s of vibration), found significant improvement on height and mechanical power during testing of constant pushing for 5 seconds. Runge *et al.*[22] verified that elderly after 12 weeks of vibrating training were 18% faster to stand up. Torvinen *et al.*[4] stated that there was a significant increase on pushing performance (8.5%) and a non--significant increase in the isometric force in the limbs extension (2.5%) after 4 months of vibrating training for young adults. Bogaerts *et al.*[10] observed increase of 9.8% in the isometric contraction, 10.9% in the explosive contraction and 3.4% in muscular mass of men in their late sixties who have trained for one year. Paradisis and Zacharogiannis[6] trained men and women under vibration for six weeks and observed that there were significant improvement in their performance in running and jumping. Jacobs and Burns[23] showed that the acute effect of vibration causes improvement of muscular training and flexibility right after stimuli. That effect increases the average of knee extension in 9.6%, torque peak in 7.7% and flexibility in 4.7cm. All these studies demonstrated that vibrating training triggers significant improvement in all variables studied.

However, reassuring other studies, results presented in this study have not shown any significant improvement in vibrating training. Evaluating female basketball players have shown no significant differences for high jumps, jumps against movement and 15-second jumps relating to control groups after 14 weeks of a series of exercises on the vibrating platform after the usual training. While training female and male basketball players on a vibrating platform for four weeks, Colson *et al.*[11] has not observed differences on performances of vertical jumps, 30-second jumps and 10-meter running but observed increase of isometric strength of knee extensors ($p > 0.001$) and high jump ($p > 0.05$).

Studies showing that vibrating training improves results on body conditioning did not compare effects of platforms switched either on or off over the same exercises. That made impossible to determine what influenced the results: was the training applied or the vibrating training itself? We compared the acute effect on individuals who used the platform switched on and off and the speed variable presented results that vibrating training figures worsen. Although, there have been no differences between POG and POFFG, there have been no differences between POFFG and CG either. That finding suggests that the association between vibrating training and the exercise (not solely exercising) caused a higher performance of knee extensor and thus causing muscular fatigue. Besides, there have been reports on the increase of myoelectric activity and higher concentration of lactate in capillaries which would explain the increasing activity in muscles and causing fatigue[12].

Delecluse *et al.*[5] trained women three times a week for 12 weeks with the purpose of comparing the effect of vibrating training and strength training on the knee extensor. The researchers divided the sample into four groups: vibration group (individuals performed static and dynamic exercises on the knee extensor on a vibrating platform), placebo group (individuals performed static and dynamic exercises on the knee extensor on a platform without vibration), muscular resistance group (training the knee extensor with dynamic exercises in machines) and control group (no training at all). Results showed that the strength of knee extensor has increased both in vibration group and resistance group. Whereas, placebo group and control group showed no significant increase.

Although they have studies a vibration group and a placebo group, they did not compare a group to the other. Comparisons were made within the same group before and after weeks of training. Thus, it was not possible to verify the real influence of vibration without comparing vibration and placebo groups. As we expected, there were no significant results

on variable strength because the charge used according to DMS and applied to the extending chair was the same for the three protocols followed by the samples.

CONCLUSION

According to the findings in our study, we have reached the conclusion that training on a vibrating platform does not influence on work or power of knee extensors. However, vibrating training has negative influence on movement speed causing muscular fatigue. As data found in scientific literature is contradictory, further studies should be recommended. Future researches should take potentiating effect and a probable inducing factor for muscular fatigue caused by vibrating stimuli into consideration.

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