EFFECTS OF MECHANICAL VIBRATION APPLIED AT SAME DIRECTION OF MUSCLE SHORTENING ON SUPERIOR LIMBS FATIGUE

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Abstract. *Mechanical vibration has been used in sports training to increase strength performance and as preventive treatment for such diseases as osteoporosis and Parkinson's disease. The use of vibration is based on fact that exposure of skeletal muscular system to mechanical vibrations may create a muscle contraction reflex called tonical vibration reflex (TVR). The aim of the present study was to verify the effects of mechanical vibrations applied in the same direction of muscle shortening on superior limbs fatigue. Sixteen volunteers, males, age 26,1 ± 4,9 perfomed on a random way two MVCs of elbow flexors muscles. Each contration was perfomed for six seconds, with rest of 30 minutes. During one of contractions four seconds of mechanical vibration (frequency of 20 Hz and amplitude of 6 mm) was added at the same direction of muscle shortening. A significant difference ($p < 0.01$) was observed between values of two MVCs. There was a significant decrease on muscle strength produced at the end of MVC without vibration. However, there was no difference on values of maximal strength on both contrations. Conclusion: mechanical vibration applied in the same direction of muscle shortening on superior limbs was able to decrease muscular fadigue produced during maximal voluntary contraction.*

Keywords*: Mechanical vibration, isometric training and muscle strength*

1- INTRODUCTION

Several studies have demonstrated significant increases in muscle strength in individuals exposed to mechanical vibration due to its effects on medullar reflexes , the so-called "tonic reflex to vibration", resulting from the rapid sequential stretching of muscles (Rittweger, Beller, and Felsenberg, 2000; Rubin et al., 1998; Wilhelm et al., 1998; Bosco et al., 1999 a and b). Such studies were carried out with two kinds of vibration: whole body vibration (WBV) and localized vibration, which is applied perpendicularly to the muscle or tendon. Considering that the objective of the use of mechanical vibration is to promote successive muscle stretching, Silva, Couto, and Szmuchrowki (2008) developed a device that allows the application of vibration in the direction of muscle contraction. They observed a 10% increase in maximal strength in individuals submitted to conventional strength training and a 26% increase in individuals submitted to strength training associated with mechanical vibration in the direction of the muscle contraction during the same period. The objective of this study is to investigate the effect of the application of mechanical vibration in the direction of the muscle contraction on upper limb fatigue during voluntary maximal contraction of the elbow flexors.

2. METHODS

2.1 Subjects

Male volunteers (16) with mean age of 26.1 ± 4.9 years, body mass of 80.3 ± 11.8 kg, and 178.1 ± 7.8 cm tall participated in this study.

2.2 Testing procedures and instruments

All volunteers gave their free informed consent and answered the questionnaire PAR-Q. Aiming at getting the volunteers familiarized with the equipment and the task, they made two voluntary maximal elbow contractions with the

dominant member, either associated or not with mechanical vibration. An interval of 5 minutes was kept between muscle contractions.

The volunteers performed a 6 seconds maximal voluntary contraction (MVC) after reaching the maximal strength plateau. The procedure was repeated after a 30 minutes interval. During one of the muscle contractions, 20 Hz vibration with amplitude of 6 mm was applied for 4 seconds after the maximal strength plateau was reached. The volunteers should continue performing MVC for another 2 seconds after vibration was removed, completing 6 seconds of muscle action. To avoid the effect of the sequence on the results, the 16 volunteers were randomly assigned to two groups (A and B). Group A performed MVC without mechanical vibration first, followed by MVC with applied mechanical vibration after a 30 minutes interval. Group B started the procedure performing MVC associated with the application of mechanical vibration and MVC without the application of mechanical vibration after a 30 minutes interval.

The maximal muscle strength plateau values were compared with the values obtained 6 seconds after the maximal strength was reached.

2.4 Statistical analysis

To compare pre- and post- test results, the data were analyzed with paired T-student test at significance level of 0.01.

3. RESULTS

Table 1 gives the maximal strength values obtained at the start of MVC and 6 seconds after contraction.

Table 1: Maximal and final strength values during MVC.

Voluntary	MVC without vibration		MVC with vibration	
	Fmax (N)	Ffinal (N)	Fmax (N)	Ffinal (N)
1	181,0	130,0	180,0	156,0
2	252,0	232,0	257,0	254,0
3	226,0	222,0	225,0	236,0
4	246,0	238,0	226,0	254,0
5	230,0	200,0	140,0	190,0
6	266,0	258,0	266,0	267,0
7	289,0	279,0	289,0	283,0
8	276,0	230,0	270,0	250,0
9	274,0	247,0	246,0	230,0
10	264,0	268,0	265,0	283,0
11	236,0	203,0	212,0	229,0
12	357,0	305,0	301,0	320,0
13	309,0	300,0	302,0	308,0
14	259,0	260,0	255,0	253,0
15	244,0	220,0	247,0	248,0
16	263,0	241,0	231,0	236,0
Average	260,8	239,5*	244,5	249,8
SD	38,8	42,3	42,7	40,4

4. DISCUSSION

Several studies have demonstrated significant increase in muscle strength in individuals submitted to mechanical vibration (Rittweger, Beller, and Felsenberg, 2000; Rubin et al., 1998; Wilhelm et al., 1998; Bosco et al., 1999 a and b). Silva et al. (2008) observed that training associated with vibration in the muscle contraction direction resulted in higher strength than without it. Rittweger et al. (2000), De Ruiter et al. (2003), and Herda et al. (2008) observed a decrease in lower limb strength alter training associated with vibration performed until exhaustion, after 2 min of vibration, and after 20 min of vibration, respectively. Mcbride, Porcari, and Scheunke (2004) compared the effects of the application of vibration on muscle fatigue after 10 series of 10 maximal strength repetitions in dynamic training. The application of mechanical vibration did not have an effect on the reduction of fatigue resulting from the proposed training. Otherwise, in the present study, there was no significantly decrease of strength at subjects exposed to vibration training. At subjects exposed to conventional training there was a decrease of strength. These results suggest that application of vibration in the direction of muscle contraction for 4 seconds reduced the effects of fatigue produced during MVC of the elbow flexor muscles.

5. CONCLUSION

Mechanical vibration applied in the direction of muscle contraction can reduce the fatigue generated during maximal voluntary contraction of the elbow flexor muscles.

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