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Case Report

Effectiveness of a protocol involving acute whole-body vibration exercises in an adult and health individual with delayed-onset muscle soreness observed after running: a case report

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Whole-body vibration (WBV) exercises in vibratory platforms (VP) have emerged in sports and in the rehabilitation procedures of clinical disorders. Delayed onset muscle soreness (DOMS) is described as an uncomfortable and debilitating disease. The purpose of this study is to present a case report involving the use of a protocol with acute WBV exercises to treat DOMS found in an adult and healthy man after running. To examine the influence of WBV on the extent of DOMS in a healthy man, he has answered questions about his clinical condition before and after a group of acute exercises of WBV in a VP. These questions were asked just before, just after and 24 hours after the exercises in WBV considering the previous conditions of the man. The sequence of positions of the subject under the VP, the frequency used (5Hz), the time to work and to rest may play a critical role in the decreasing of the unwanted side effects of the DOMS. Moreover, the WBV promotes an effect that could help reduce the severity of the pain, of the muscle soreness and of it stiffness due to the exercises, as the running, in untrained individuals. The inclusion of a protocol involving an acute treatment with different positions in the VP is expected to reduce pain, muscle soreness and stiffness and to help in the recovery of the daily activities in untrained subjects. This protocol, using a low frequency (5Hz), could be useful also to trained subjects with undesirable conditions after exercises.

Keywords: whole-body vibration exercises; Soreness; Muscle; Treatment; Low frequency; Platform.

INTRODUCTION

Whole-body vibration (WBV) exercises in vibratory platform (VP) have emerged in sports training and in the rehabilitation procedures of various clinical disorders (Cardinale and Wakeling, 2005). Zepetnek et al (2009) have cited five factors that are related to the response of the human skeletal system to the WBV exercises, as vibration direction (vertical or oscillatory altering), vibration frequency (measured in hertz), vibration magnitude measured as amplitude (displacement of the vibration in millimeters) and acceleration (in gravitational units), duration of the work in the VP, and body position/posture on the platform. Several protocols have been reported and the frequency has been used is in the range of 3-6 Hz and

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the amplitude in the range of 2-7mm (Madou and Cronin, 2008).

Delayed onset muscle soreness (DOMS) is described as an uncomfortable and debilitating disease. It might include muscle pain, muscle soreness or muscle stiffness that could be felt 24-48 hours after continuous exercises (Schutzer and Graves, 2004). DOMS is particularly observed:

(i) at the beginning of a new exercise program,
(ii) after a change in sports activities,
(iii) after a strong increase in the duration of exercises, or
(iv) after a potent increase of the intensity of exercises.

DOMS is normally resolved up to 5 to 7 days (Mchugh et al., 1999). There is no enough scientific evidence of neural inhibition of damaged muscle (Mchugh et al., 1999) or changes in motor unit activation (Sayers et al., 2001) in the DOMS. In consequence, probably the symptoms associated with this disorder could be more likely related to the inflammatory process (Schutzer and Graves, 2004; Sayers et al., 2001; Connolly et al., 2003).

As DOMS may cause some reduction professional (sport and work) activities, and consequently, studies have been designed to find ways to prevent, to control and to treat DOMS. There is no one simple way to treat delayed onset muscle soreness. Physiotherapy procedures as, manual procedures, cryotherapy, stretching, ultrasound, and electrical current modalities have been used. However, they have not been shown to be consistently effective to treat DOMS (Cheung et al., 2003). Furthermore, Herbert and Gabriel (Herbert and Gabriel, 2002) have reported that muscle stretching, both before and after exercise, does not reduce DOMS in young, healthy adults (Herbert and Gabriel, 2002).

Visual analog scales (VAS) have been shown to be effective for measuring perceived pain in clinical and therapeutic environments and in another clinical situation (Sayers et al 2001).

There are principally three methods of VP:

(i) The vibration is applied directly to the muscle belly or the tendon of muscle by a vibration unit (punctual system) (Moran et al., 2007)

(ii) The vibration enters the human body via hands when griping a vibration dumbbell (Cochrane and Hawke 2007), bar (Poston et al., 2007) and/or pulley system (Issurin et al., 1994) (segmental vibration);

(iii) The vibration enters via feet when standing on vibration platform.

The use of vibration platforms represents the most common form of vibration exercise. There are two types of vibration platforms:

1) Platforms that vibrate in a predominantly vertical direction (vertical platform) and

2) Platforms that vibrate through rotation over a horizontal axis (oscillating platform) (Abercromby et al., 2007).

Several controlled studies have suggested the positive effects of WBV exercises in strength or power development (Delecluse et al., 2003; Russo et al., 2003), flexibility (Fagnani et al., 2006; Van Den, 2006), and bone mass (Rubin et al., 2003). In addition, Bakhtiary et al (2007) found that the vibration training, punctual system, before eccentric exercise may prevent and control the DOMS. Increased blood flow to facilitate recovery and regeneration, increased flexibility, and possible pain inhibition may be mechanisms for such a decrease in pain. Rhea an co-workers (Rhea et al., 2009) have reported that utilization of a vertical platform as a recovery/regeneration tool may be effective for reducing the pain of muscle soreness and tightness after strenuous training.

However, to our knowledge, no previous studies have measured the effectiveness of oscillating platform with low frequency (5Hz) for reducing the pain of muscle soreness. Therefore, the purpose of this work is to present a case report involving the use a simple protocol with oscillating platform at 5Hz, to treat delayed-onset soreness found in an adult and health individual after running.

CASE REPORT

Methodology

To examine the influence of WBV on the extent of DOMS in a healthy man, he has answered several questions about his clinical condition before and after a group of acute exercises of WBV in a vibratory platform (Novaplate fitness evolution, DAF *Produtos Hospitalares Ltda, São Paulo*).

The questions were about the difficulty to walk, or to run, or to climb a ladder, or the interest to start a physical activity. Other questions were related to the tenderness, to the muscle stiffness, to the limitations of the movements and to the general satisfaction.

A VAS (0, no to 10, maximum) was used to measure the difficulty to walk, or to run, or to to climb a ladder, or the interest to start a physical activity.

The same scale was used in another set of questions that were related to the tenderness, muscle stiffness and the limitations of the movements (0, maximum to 10, no).

The satisfaction was evaluated with the VAS (0, no to 10, maximum).

These questions were asked just before, just after and 24 hours after the exercises in WBV considering the previous conditions of the man.

Subject

An adult man (age, 49 year old, weight 76kg, height 1.64m) volunteered and provided informed consent to participate in this study. Moreover, he has also agreed with the publication of the images shown in figures. He is healthy and has trained some exercises running (10 km) in the streets for some years ago. He has stopped these exercises for 2 years and has recently returned to run again (10 km) at least 2 days per week, during (60

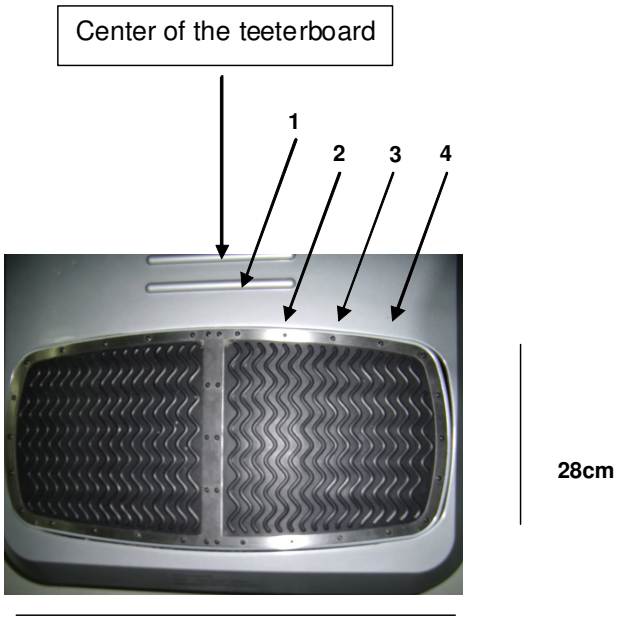

Figure 1. The possible position of the feet of the subject on the teeterboard of the platform

Figure 2. The subject was with both feet under the teeterboard

mins). Two weeks later, he has felt that he was not well. He has described an uncomfortable muscle pain, muscle soreness and muscle stiffness. He decided to do an acute treatment in the VP.

Characteristics of the vibratory platform

The vibratory platform used in our office is based in the oscillating system. It is a side-alternating vibration device working as a teeterboard (28cm x 58cm) with amplitude of 0 (zero) in the center of the platform up to the maximum in the edge. The position of the feet of the subject on the platform will define the amplitude that is used in the exercise and it is controlled during the exercise. On the position 4, the larger position, the greater amplitude will be obtained (7.07mm). Figure 1 shows the possible

Figure 3. The subject was stand up in front of of the platform with a right foot under the platform and the left foot under the floor (a) and the left foot under the platform (b).

foot positions on the platform used in our routine when the subject in orthostatic position seeing the panel of the platform.

Frequencies are variable from 5 up to 30Hz and the VP can be adjusted to work in specific and controlled frequency during the exercise.

Steps of the whole-Body Vibration treatment Session

The platform is based in an oscillating system with reciprocating vertical displacements on the left and right side of a fulcrum. The session in the platform involved some steps.

(i) The subject sat in a chair with the feet under the platform (figure 2). The frequency used was 5Hz during 1 min and both feet were in position 3 (amplitude 5mm) in both sides of the teeterboard.

(ii) He was stand up in front of the platform with a right foot under the platform and the left foot under the floor (figure 3a). The frequency used was 5 Hz during 1 min and the both feet were in position 3 in both sides of the teeterboard. This step was repeated with the alterations of the positions of the feet (figure 3b).

(iii) The subject has with both feet under the platform in the position 3 of the teeterboard and the frequency used was 5 Hz during 1 min (figure 4). In this step the man was instructed to be in a comfortable squat position. (iv)The step iii was repeated five times with a rest of 1 min after each 1 min of work in the platform. In a general condition, the subject was wearing training shoes and was under the platform and this equipment was in front of a mirror, as it is shown in the Figure 5. This condition permits that the subject might observe and control the posture of his whole body. Moreover, in the several steps of the protocol a physiotherapist was near of the subject.

RESULTS

Table 1 shows the measure in a VAS related to the limitation of movements, the level of pain, the difficulty to walk, to run and to climb a ladder and the interest in to start a physical activity just after and before to complete the protocol in the platform and after 24 hours. It is possible to verify a decrease of the level of

Figure 4. The subject was stand up in front of of the platform with both feet under the platform.

Figure 5. The subject was stand up in front of the platform that was in front of a mirror.

these uncomfortable conditions in almost all of the parameter evaluated just after to end the exercise in the VP that is maintained up to the follow up of 24 hours.

Table 2 shows the measure in a VAS related to the feeling of tenderness and muscle stiffness just after and before to complete the protocol in the platform and after 24 hours. It is possible to verify a decrease of the level of these uncomfortable conditions in almost all of the criteria evaluated.

Table 3 shows the measure in a VAS related to the feeling of the satisfaction of the subject due to the exercises in the VP. It is possible to verify an important increase of the satisfaction that is maintained, at least up to 24 hours.

Table 1. The effect of acute treatment in vibratory platform in a subject with DOMS

Clinical conditions	Before	After	24h after
Pain	3	1	1
Difficult to walk	2	1	1
Difficult to run	4	2	1
Difficulty to climb a ladder	4	1	1
Interest to star a physical activity	10	10	10
Limitation of the movements	3	1	1
Total	**26**	**16**	**15**

Table 2. The measurement of uncomfortable conditions in a subject with DOMS submitted to acute treatment in a vibratory platform

Clinical conditions	Before	After	24h after
Tenderness	4	1	1
Muscle stiffness	3	1	1
Total	**7**	**2**	**2**

Table 3. The measurement of satisfaction due to effect of acute treatment in vibratory platform in a subject with DOMS

	Before	After	24h after
Satisfaction	6	9	9

DISCUSSION

Several authors have suggested that physical exercises are very important in the prevention of several diseases and to maintain the human health (Booth et al., 2002; Newton and Galvão, 2008). However, in some situations, undesirable conditions have been reported. DOMS has been described as an undesirable side-effect of exercises and pain, tenderness, swelling, and muscle stiffness may be felt in a relative small period of time after. These side-effects can produce unwanted conditions to daily activities (Schutzer and Graves, 2004).

The suggestions of rehabilitation procedures to treat DOMS are welcome and the use of WBV exercises seems to be a worthwhile alternative (Rhea et al 2009). Our data (Table 1 and 2) also reveal an important reduction in the uncomfortable symptoms due to the DOMS when the patient performed exercises of WBV in a vibratory platform in an acute treatment. Moreover, the level of satisfaction is increased due to the treatment with WBV exercises. Naturally, further clinical studies are necessary to try to identify the possible physiologic mechanisms involved in the decrease of the

uncomfortable conditions related to the DOMS after the acute treatment involving WBV exercises.

The success of the WBV exercises depend on the various factors, as the frequency and amplitude, and Marín et al (2009) have presented data suggesting that wearing shoes does alter the neuromuscular response to WBV stimuli, and exercise professionals should consider such differences when using WBV to target neuromuscular activation of such muscle groups. The sequence of positions (Figures 2, 3, 4) of the subject under the platform, the frequency used (5Hz), the time to work and to rest may also play a critical role in the decreasing of the unwanted side effects of the DOMS. The positive effect of this frequency in the treatment of the DOMS, using the proposed and controlled protocol with a low frequency is worthwhile, due to several authors reported protocols using frequencies about 35Hz (Rhea et al 2009). However other authors have used lower frequencies as 2 Hz with biological effects as 26 Hz (Jackson et al., 2008). Moreover, the whole-body vibration promotes an effect, like a massage, that could help reduce the severity of the pain, of the muscle soreness and of the muscle stiffness due to the exercises, as the running, in untrained individuals. Cafarelli et al (1990) and Edge et al (2009) have reported that low-frequency vibrations (5-15Hz) may act as a mechanical massage to accelerate the recovery process by increasing blood flow to and from the damaged muscle, remove waste products and stimulate the muscle receptors to ease muscular tension. Edge et al (2009) have also described that acute WBV as a recovery modality following high-intensity interval training in well-trained, middle-aged runners using a frequency of 12Hz.

Conclusion

In conclusion, the inclusion of a simple protocol involving an acute treatment with different positions and a low frequency (5Hz) in the VP is expected to reduce pain, muscle soreness and muscle stiffness and to help in the recovery of the daily activities in untrained subjects. Probably, this protocol could be useful also to trained subjects with undesirable conditions after exercises.

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