The Effects of Vibration Therapy as a Recovery Tool After Intense Exercise

Final report submitted by:

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Introduction:

High intensity exercise can lead to muscle damage, resulting in muscle soreness, swelling and reduction in muscle strength. If the recovery is not sufficient or efficient it can increase the risk for injury and decrease the ability of the athlete to perform repetitive exercise and maintain overall performance.

There are a variety of recovery aids which are being used by athletes, such as: the use of compression garments, massage, cold water immersion, sauna etc. Additional recovery strategy currently growing in popularity is the application of vibration (Rhea et al. 2009; Broadbent et al. 2010). It has been suggested that the application of vibration could increase the blood flow to the muscle, increase muscle temperature, increases metabolite removal rate and accelerate muscle tissue remodeling. All these processes could reduce delayed onset muscle soreness (DOMS) and accelerate muscle recovery (Rhea et al. 2009; Broadbent et al. 2010; Lau et al. 2011).Although DOMS are one of the symptoms of muscle damage, they don't necessarily reflect or provide indication of the ability of the muscle to produce strength. That is, it is possible that an athlete will feel well (with no associated pain) but the ability to produce force is still low compare to baseline measurements.

The ability to produce force is an objective and important measure to quantify the recovery status of an athlete after intense exertion (Warren et al. 1999). The efficacy of vibration therapy for promoting recovery has been tested on a small number of studies with equivocal results. For example, Barnes et al. (2012) tested 8 healthy males who completed 300 eccentric contractions of the quadriceps of one leg on an isokinetic dynamometer. Immediately after exercise and 12 and 24 hours post-exercise, the subjects underwent either vibration therapy or a control treatment - no use of any recovery technique. The vibration therapy included 5 sets of 1min vibration at 26 Hz, with 6 mm peak-to-peak displacement. After two weeks after the initial trial, the subjects completed the second trial using the contralateral leg and other treatment. The study's results revealed that the use of vibration therapy reduced muscle peak force and average peak force 24 hours after the eccentric exercise compared to the control group. Another study tested the use of vibration therapy on muscle recovery and strength. This study found that the recovery of elbow flexor peak isometric torque was unaffected by vibration in untrained participants (Lau et al. 2010). This was further supported by Fuller et al. (2014), who found the use of vibration therapy didn't have an additional contribution to recovery after intense exercise compared to stretching or massage.

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The evidences regarding the benefits of vibration therapy as a recovery aid are limited. From the paucity of studies in this area it is suggested that there are no additional benefits for using vibration therapy. Yet, the use of different vibration techniques is currently quite popular among athletes and the several studies performed until today were done on non-athlete populations. Furthermore, these studies haven't tested functional variables such as the ability to produce power and performed a repeated performance. Performing a repeated exercise is similar to situations occasionally occur during ball games. Therefore, the proposed study will examine the use of vibration therapy as a recovery tool. The efficacy of this technique will be measure using functional and laboratory tests.

The purpose of the present study was to examine the effect of vibration therapy as a recovery tool on the ability to perform repeated exertion.

Methods:

The study and its procedures have received ethic approval by the Helsinki board at Hillel Yaffe Medical Center, Hadera, Israel. Inclusion criteria were: (a) participation in physical activity of at least three hours per week presently and in the previous year, (b) healthy individuals.

The participants arrived at the Ribstein Center for Sports Medicine and Research at the Wingate Institute on two different occasions, 7 days apart.

First visit - a gradual stress test was performed until exhaustion. Immediately at the end of the test a ten minute recovery period took place, in which either recovery methods was used (active or vibration technique). Immediately following the recovery period the participants performed two functional tests to examine their muscle power and endurance. The first test was countermovement jump (3 jumps performed with 15sec rest in between). The second test was 30sec jump test (continuous jumps). Two minutes resting period was taken between the tests. The tests were performed using the Optojump Next measuring system (Optojump, Microgate, Italy).

The recovery methods were:

1. Active: 3min slow walking (4 km/h), 2min standing, 5min slow walking (4 km/h).
2. Vibration therapy: 3min slow walking (4 km/h), 2min standing, 5min vibration therapy with TARANTULA: a special vibration machine designed for the lower extremities.

At the end of the exercise a peripheral blood sample was taken from the finger in order to measure blood lactate levels. Additional five samples were taken in 2min intervals until the end of the recovery period (total of 10min).

Technical information of the TARANTULA vibration machine- vibration frequency between 1-10 hertz, amplitude: 30mm.

Second visit - a gradual stress test was performed until exhaustion. Immediately at the end of the test a ten minute recovery period took place, in which the other recovery method was used (active or vibration technique). Afterwards the two functional tests were performed.

** The recovery methods were assigned randomly between the participants.

First visit protocol:

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1. Study's protocol explanation and consent form sign
2. Filling of a medical questionnaire
3. Medical interview and examination by a sport's physician
4. Anthropometric measures: height, weight, percentage body fat
5. Stress test - including ECG and blood pressure monitoring
6. Recovery - 10min - use of different recovery mode
7. Countermovement jumps test and 30sec jump test

Second visit protocol: (7 days apart)

1. Stress test
2. Recovery - 10min - using the other recovery mode not being used at the first visit
3. Countermovement jumps test and 30sec jump test

Measures taken during the study:

1. Lactate levels
2. Heart rate (monitored continuously during the exercise and during the recovery period)
3. Rate of perceived exertion - subjective evaluation of the difficulty level of the exercise (during the exercise, at the end and after the jumps' tests)
4. Jumps' height and peak power achieved during the test.

Non-parametric paired t-tests were used to analyze the differences between the two treatments (recovery methods).

Results:

13 participants completed the study.

Table 1: Physical characteristics of the subjects.

Characteristic	Mean	SD
Age (yrs)	27.2	5.0
Height (m)	178.7	6.4
Weight (kg)	72.9	6.7
Body Fat (%)	13.5	2.2
BMI (kg/m^2)	22.8	1.7
VO2max (L/min)	5.1	0.6
VO2max (ml/kg/min)	70.7	8.8

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HRmax (beat/min)	189.8	9.7
VE max (L/min)	162.8	23.1
Maximal running speed (km/h)	17.6	1.6
Anaerobic threshold (% of VO_2max)	82.0	4.1

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Table 2: Effect of two recovery methods on recovery parameters and repeated efforts ability (means±SD)

Parameter	Active recovery	Vibration therapy	P value
HR decline t_0-t_{10} (%)	43±5.2	51±3.9	0.004
Blood lactate decline t_0-t_{10} (%)	22.1±6.9	20.8±7	NS
CMJ height (cm)	37.2±4.54	38.64±4.99	0.046
CMJ Power (W/kg)	13.57±0.85	13.92±0.90	0.021

*NS- not significant, t_0- immediately following the stress test, t_{10}- after the recovery, HR- heart rate, CMJ- counter movement jump

Heart rate levels declined significantly faster when the vibration method was used. Mean maximal HR values were 188 b/min immediately after the maximal effort, and the mean values recorded at the end of recovery period were 93 b/min and 106 b/min for the vibration and standard (active) recoveries respectively.

There were no significant differences in blood lactate decline between the two recovery methods.

There were no significant differences in any of the 30sec jumps variables between the two recovery methods.

There were no differences in RPE values reported following the 30sec jumps tests between the two recovery methods, however, all subjects reported of a "better feeling" after they finished the recovery with the TARANTULA machine. All subjects, when asked, answered that they would prefer the vibration recovery on any occasion.

Discussion:

The evidences regarding the benefits of vibration therapy as a recovery aid are limited, specifically in athletes. Therefore, the aim of the present study was to examine the use of vibration therapy as a recovery tool. The efficacy of this technique was measured using functional and laboratory tests.

In this preliminary study, vibration therapy was found to be effective for reducing heart rate and blood lactate levels following an intense effort, even though the use of this method was on a passive subject. Heart rate levels following maximal effort declined faster using the TARANTULA, compared to the standard active recovery method.

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Blood lactate levels declined in a same manner for both recovery methods even though the TARANTULA machine was used on a passive subject. It should be noted that it is well known in the literature that using active recovery in comparison to a passive one can accelerate blood lactate removal. Therefore the finding that there was no difference in the lactate removal rate between active and the vibration method can suggest that the use of this method can lead to a positive outcome (faster recovery and better performance in a subsequent efforts), as was demonstrated in the functional tests' results that were performed in the current study. However we recommend furthering investigating whether the differences founded in repeated efforts abilities have any functional meaning.

Based on these results it may be concluded that using vibration therapy for lower extremities, with the TARANTULA machine, is an efficient mode of recovery from intense exertions. We assume that this method has a very good potential especially in sport settings where athletes need to recover quickly between efforts, and have limited time and space for this purpose.

We recommend future studies to examine whether a different vibrating rate and/or amplitude can achieve even better results and to further evaluate the use of the vibration method in comparison to other recovery modalities.

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