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Review Article

Physiotherapy Section

Vibration Therapy in Management of Delayed Onset Muscle Soreness (DOMS)

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ABSTRACT

Both athletic and nonathletic population when subjected to any unaccustomed or unfamiliar exercise will experience pain 24-72 hours postexercise. This exercise especially eccentric in nature caused primarily by muscle damage is known as delayed-onset muscle soreness (DOMS). This damage is characterized by muscular pain, decreased muscle force production, reduce range of motion and discomfort experienced. DOMS is due to microscopic muscle fiber tears. The presence of DOMS increases risk of injury.

A reduced range of motion may lead to the incapability to efficiently absorb the shock that affect physical activity. Alterations to mechanical motion may increase strain placed on soft tissue structures. Reduced force output may signal compensatory recruitment of muscles, thus leading to unaccustomed stress on musculature. Differences in strength ratios may also cause excessive strain on unaccustomed musculature. A range of interventions aimed at decreasing symptoms of DOMS have been proposed. Although voluminous research has been done in this regard, there is little consensus among the practitioners regarding the most effective way of treating DOMS.

Mechanical oscillatory motion provided by vibration therapy. Vibration could represent an effective exercise intervention for enhancing neuromuscular performance in athletes. Vibration has shown effectiveness in flexibility and explosive power. Vibration can apply either local area or whole body vibration. Vibration therapy improves muscular strength, power development, kinesthetic awareness, decreased muscle sore, increased range of motion, and increased blood flow under the skin. VT was effective for reduction of DOMS and regaining full ROM. Application of whole body vibration therapy in postexercise demonstrates less pressure pain threshold, muscle soreness along with less reduction maximal isometric and isokinetic voluntary strength and lower creatine kinase levels in the blood.

Keywords: DOMS, Management, Vibration therapy

INTRODUCTION

Theodore Hough was the first one to give a detailed description of DOMS [1]. DOMS can result from unaccustomed eccentric training [2]. DOMS usually occurs after an increase in the intensity or volume of training or when the schedule of exercises is altered or a new one is implemented [3,4]. Several hypotheses have been propounded for the mechanism of DOMS. These are Lactic Acid theory, Muscle spasm theory, Connective tissue damage theory, Muscle Damage theory, Inflammation theory and Enzyme efflux theory [5,6]. The classical symptoms of DOMS strength losses, pain, swelling, tenderness or stiffness, loss of full range of motion, flexibility, force production and mobility [3,5,6]. DOMS can be tackled in two ways: Prophylactic and therapeutic. The prophylactic action of vibration therapy has been extensively discussed by Veqar and Imtiaz [7]. Till date there has been no gold standard treatment for DOMS. However, there has been several methods for decreasing DOMS by increased flexibility and power measures [3,4]. More specifically application of vibration has shown effectiveness in flexibility and explosive power [8].

Vibration therapy has been shown to bring about an improvement in range of motion and increased blood flow under the skin, muscular strength, power and development. It has also been postulated that it improves the kinaesthetic awareness [8]. A mechanical oscillatory motion is provided through vibration. Vibration may be defined as an oscillatory change of force, acceleration and displacement with respect to time. The exercises pertaining to it may be forced oscillations where energy is being transferred from a source to a resonator [9]. Vibration could represent an effective exercise intervention for enhancing neuromuscular performance in athletes.

Acute Responses of Vibration Therapy

Acute responses occur due to various physiological effect of vibration therapy [7]. Vibration therapy causes muscle contraction by stimulating muscle spindles and alpha-motoneurons [10]. WBV increases Electromyographic activity. Oxygen consumption is directly proportional to vibration, muscle temperature [11] and skin blood flow [4]. Sometimes erythema is visible in the postvibration session in the lower extremities especially in new users [12]. WBV also have endocrine effects. In elderly males and females, an acute increase in the circulating levels of insulin- like growth factor I and cortisol was observed [13].

- **Muscle and Tendon Responses:** Vibration exercises comprises of a cyclic transition between eccentric and concentric muscle contractions and also that the gastrocnemius muscle tendon complex is elongated by 1% of its total length during 6 Hz vibration cycles [14].
- **Neurophysiological Responses:** Passive muscle vibration causes a reflex contraction, also known as the tonic vibration reflex [15]. After termination of single muscle vibration, the H-reflex continues to be reduced for some minutes [15,16]. Inconsistent results have been reported for the stretch reflex, with some authors reporting enhancement [15,17] and others depression [16]. Muscle spindles seem to be less responsive after vibration termination [18]. Exposure to vibration exercise is acutely followed by reflex enhancement, the exact details and mechanisms of this enhancement are yet undetermined.
- **Emg Responses:** Hagbarth et al., concluded that motor activity increases during submaximal, but not during maximal contractions with the application of vibration. Several factors are responsible for instance inhibition by Golgi organ afferents owing to the large force application [19].

Investigator	Size	Sample characteristics	Types of study	Intervention	Outcome measure	Key results
1. Lau et al., (2011)	15	young men	Randomized crossover	Effect of 30-min VT at 30 mins after and 1, 2, 3, and 4 days post-exercise	Recovery rate of DOMS, and range of motion, muscle strength and serum creatine kinase activity	VT was effective for reduction of DOMS and recovery of ROM after strenuous eccentric exercise except swelling, recovery of muscle strength, and serum creatine kinase activity.
2. Rhea et al., (2009)	16	Untrained adult men	Experimental	iTonic platform (frequency, 35 Hz; amplitude, 2 mm).	Perceived pain was recorded at 12, 24, 48, and 72 hours post exercise.	Reducing the pain of muscle soreness and tightness after strenuous training.
3. Broadbent et al., (2010) 55.	29	Male recreational runners	RCT	VT on the upper and lower legs	Visual analogue scale plasma inflammatory markers	VT decrease muscle soreness an d IL6.
4. Yu-sin Kim et al., (2011)	21	Student	Experimental	whole body vibration(WBV) ultrasound therapy & control group	Algometer and visual analogue scale	WBV group was the most effective group of decreased DOMS among three groups.
5. Nelson, S.P., et al., (2011)	1	An adult man	Case report	WBV low frequency (5Hz) in the VP	VAS , Level of difficulties tenderness, muscle stiffness and the limitations of movements	Reduce pain, muscle soreness and muscle stiffness.
6. Cormie et al., (2006).	9	Moderately resistance-trained men	Experimental	30-second bout of whole- body vibration	Peak force (PF) during the IS and jump height (JH) and peak power (PP) during the CMJ. Average integrated electromyograp hy (IEMG)	Increasing vertical jump height however No significant differences were observed in CMJ PP; PF during IS or IEMG.
7. Mohammadi & ahebazamani et al., (2012) [42]	30	College males	RCT	Before exercise 50Hz vibration for 1 min.	Range of motion at elbow jount, Circomference of nondominant elbow and Muscle soreness were recorded before, after, 24 , 48, 72, 96 (hr) after eccentric contractions.	VT before eccentric exercise may prevent and control DOMS.

[Table/Fig-1]: Studies conducted on role of vibration therapy on management of DOMS

• **Cutaneous Receptors Responses:** The sensation of pressure and touch is masked during vibration [20], and also postvibration [21]. Some cutaneous mechanoreceptor afferents get aroused for many minutes postvibration [21] and this may be the physiological reason for the tingling sensation often experienced postvibration. On the basis of gate control hypothesis [22] we can infer that vibration strongly impacts affrents discharge from fast adapting mechanoreceptors and muscle spindles and hence become an effective pain reliever.

• **Pain Perception Responses:** Vibration can be used as transcutaneous electrical nerve stimulation (TENS) [23] to reduce the perception of pain [7]. Passive vibration has reduced pain in 70% of patients with acute and chronic musculoskeletal pain [24] and passive 80 Hz vibration has been shown to reduce pain caused by muscle pressure [25]. More recent evidence suggests that pain perception in DOMS depends partly on fast myelinated afferent fibres, which are distinct from those that convey most other types of pain [26].

Vibration therapy and DOMS Management

Vibration is an effective modality in the field of rehabilitation. Vibration therapy improves muscular strength, power development and kinesthetic awareness [27], increased flexibility, motor unit synchronisation. Various researches which shows effectiveness of vibration therapy in management of DOMS explain in [Table/Fig-1]. study experimentally revealed that DOMS and its modulation by vibration in elbow flexors muscles decreased muscle soreness [27], increased range of motion, increased blood flow under the skin [2,4]. Lundeberg et al., concluded that vibration relieved pain by activating the large diameter fibres while suppressing the transmission activity in small diameter fibres [24,28].

Vibration therapy prevents sarcoma disruption which occurs due to the strain of eccentric exercises and thus helps in preventing DOMS [29]. Vibration therapy leads to increase of skin temperature and blood flow [30]. Application of 50 Hz vibration can considerably reduce Interlukin-6 and Lymphocyte which laterally converts into macro phages and cause further disruption of the WBC and RBC [31]. They found no significant but substantial increase in neutrophils 24 hours postexercise. Increase neutrophils recruitment is suggestive of increased capacity of fight infection and reduced inflammation.

Whole Body Periodic Acceleration (WBPA) as a recovery means after high-intensity eccentric resistance exercise improved strength recovery and had a positive impact on DOMS symptoms [32]. Application of direct vibration (f = 80 Hz) to extensor carpi radialis muscle were enhanced motor-evoked potentials of TMS [33]. Acute indirect vibration may increase the motor cortex to enhance muscular performance. Vibration could be a feasible option in the early stages of rehabilitation where low levels of muscle force are required due to limited joint mobility [34].

The application of whole body vibration in DOMS vibration group compare to ultrasound group shows less grading in VAS value, resultant vibration therapy is more effective than ultrasound [35].

VT was effective for reduction of DOMS and recovery of ROM after strenuous eccentric exercise except swelling, recovery of muscle strength, and serum creatine kinase activity [36]. At low frequency (5Hz) WBV was reducing the level of muscle soreness and tightness or spasm after strenuous training [37]. iTonic platform (frequency, 35 Hz; amplitude, 2 mm) Reduce pain, muscle soreness and muscle stiffness [38].

Aminian-Far A et al., concluded that application of whole-body vibration training session, after a bout of eccentric exercise was associated with reduced symptoms of delayed-onset muscle soreness like maximal isometric and isokinetic voluntary strength loss, plasma creatine kinase level, pressure point threshold, and muscle soreness were less than in the control group. And also no effect on thigh circumference was seen [39]. These all effect may be because synchronization among active motor units, or a shift to slow-twitch fiber activation (or a combination of these) [39].

Amir H Bakhtiyari et al., Concluded that in non VT group shows decreased IMVC force reduced PPT, significantly increased symptoms of DOMS and CK levels in compared to the VT group so vibration therapy prior to eccentric exercise is effective in prevention and management of DOMS [40].

Based on the work done over time it can be hypothesized that vibration therapy may lead to an increased proprioceptive/neuro-muscular function, increased muscle power/strength, prevention of muscle atrophy, increased joint stability due to prevention of muscle atrophy/increased muscle strength and muscle stability, increased flexibility of muscles and joints, decreased muscle soreness/stiffness, preventing loss of bone mass/increasing bone mass, increased blood flow and oxygen uptake, potential hormonal responses leading to pain reduction, mood improvement, potentially improving lymphatic drainage [41]. Vibration therapy may be effective intervention as a treatment and control DOMS, enhances performance and help to prevent injuries.

CONCLUSION

Presence of DOMS may cause pain and discomfort which can impede physical training, performance and daily activities. Although DOMS is experienced by large number of population, its effective treatment is not well-established. Vibration therapy may work at the level of prevention as well as management. Based on the researches it can be implied that it increases proprioceptive neuro-muscular function, increased muscle strength and potential hormonal responses which leads to pain reduction, mood improvement, potentially improving lymphatic drainage. However, very few researches have been conducted in this regard and hence it is hoped that this paper will set the stage for further researches to follow.

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