

Why all the shaking?

Vibration therapy and its clinical effects

Cindy Trowbridge PhD, LAT, ATC, CSCS

Associate Professor – The University of Texas at Arlington



Disclosure

- I have received past research funding from Accelerated Care Products, Game Ready[®], Hyperice[™], and Viatherm[™]
- I have no financial interest or investment in Accelerated Care Products, Game Ready[®], Hyperice[™], and Viatherm[™] or other modality products.

Objectives

1. Review the different techniques to deliver vibration therapy including whole body vibration and local muscle vibration.
2. Review the parameters including frequency and magnitude associated with vibration modalities.
3. Describe the reported physiological changes that are associated with vibration therapy in the context of orthopedic treatment and rehabilitation.
4. Explain the role vibration therapy likely has in the perception and modulation of pain.
5. Interpret clinical findings from peer reviewed research to help clinicians develop evidence-based protocols for different vibration modalities.



Vibration Therapy

- Vibration therapy uses vibration as a physical tool during treatment.
- Massage and therapeutic applications
- Physical exercise – even if a person has physical limitations or mobility issues



Vibration Therapy

Short and fast propagation of elastic waves producing deformations around an equilibrium position.

- Systemic vibration therapy (SVT) or Whole-body vibration (WBV) therapy occurs when mechanical vibration is generated in a vibrating platform, and it is transmitted to the body of the individual.

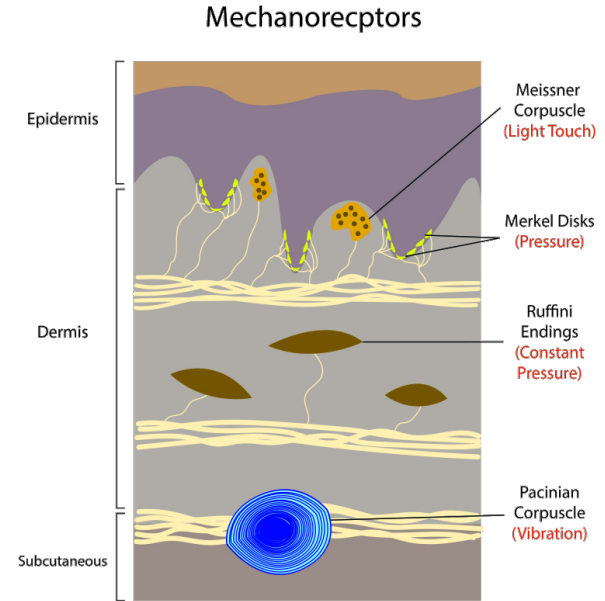


- Local vibration therapy (LVT) is applied locally by small and portable vibrators, and it is applied directly in a region of the body over the tendon or muscle belly.

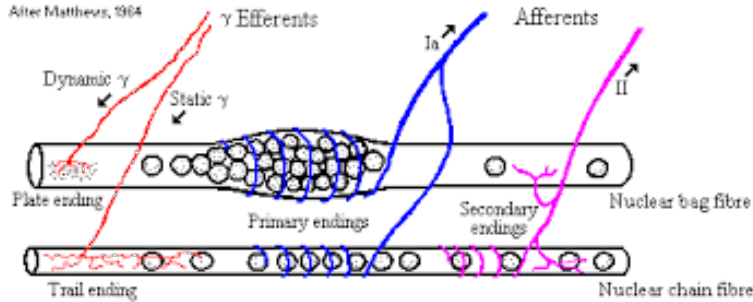


Mechanical Vibration

- Mechanical vibrations (oscillatory waves) are naturally present in various cells, tissues, and organs
 - The body perceives vibration as typical sensation and relies on this stimulus for growth and repair
 - Provides sensory signals to the somatosensory cortical areas of the brain
- **Mechanoreceptors are somatosensory receptors (large α - β nerve fibers)**
 - Types: Meissner's corpuscles, Pacinian corpuscles, Merkel's disks, and Ruffini's corpuscles
 - Role: Relay extracellular stimulus (vibration) to intracellular signal transduction through mechanically gated ion channels (biological effect).



Role of Muscle Spindle

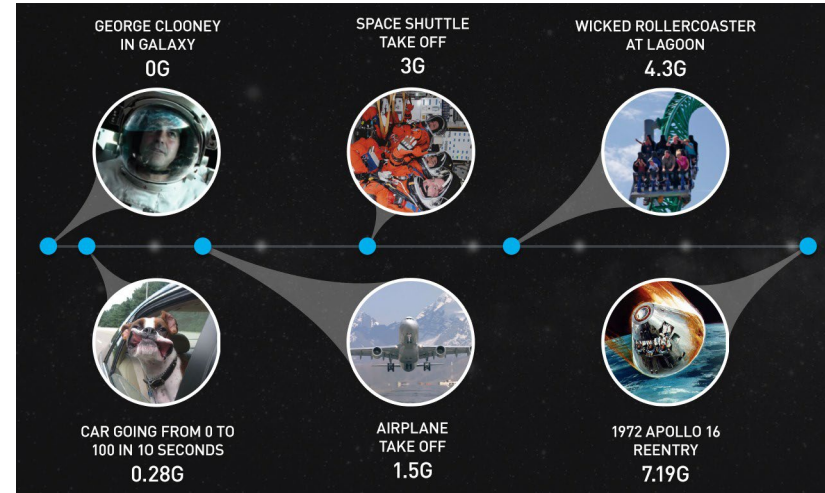


WBV offers a practical method for training relaxed musculature which has applications to health and rehabilitation (e.g., injury, immobilization, bed-rest, micro-gravity) (Zaidell et al., 2013)

- **Tonic Vibratory Reflex (TVR)**
- Local and systemic vibration targets both the *primary and secondary sensory endings* – mimicking both dynamic and static stretching
 - Myotatic stretch reflex – both agonist and antagonist
- Involuntary production of strength via motor unit synchronization
 - EMG activity remains 25% higher the alteration of force perception induced by localized tendon vibration (Martin & Park, 1997).
 - Greater muscle activation during higher frequency vibration (Zaidell et al., 2013). Recruitment of previously inactive muscle fibers

Properties of Vibration

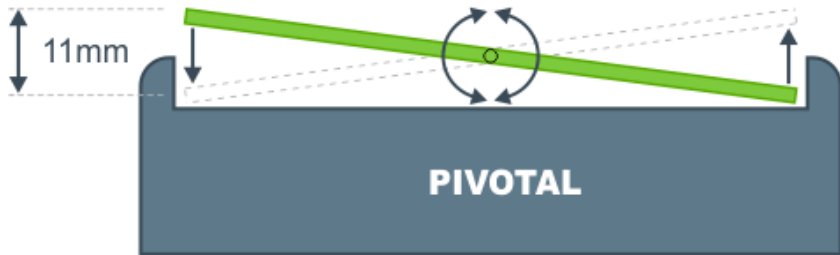
- **Frequency**
 - Number of times an object oscillates, or vibrates, per unit of time
 - Cycles per second (Hertz/Hz) or Cycles per minute (CPM).
- **Amplitude**
 - Intensity or displacement (motion up and down) of the plate movement represents the energy being delivered to your body.
- **G-forces** (Gravity)
 - The stimulus of gravity is essential for life as without enough stimulus from gravity the body will slowly break down and weaken its natural defenses and muscle mass and bone density will deteriorate.



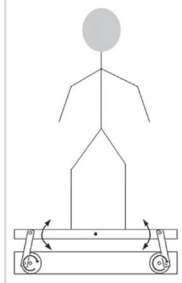
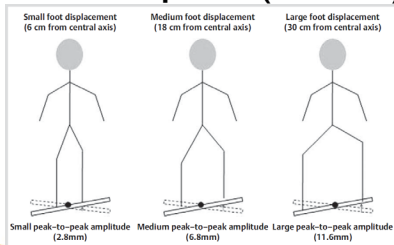
0.1G to 2.5G



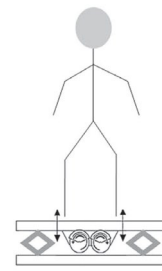
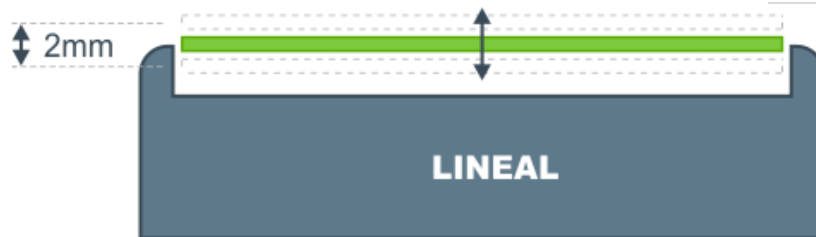
Physics of Systemic Vibration



Amplitude is adjusted by moving your hands or feet closer (**less**) or further apart (**more**)



5 Hz to 50 Hz
(30-50 Hz)



On a lineal plate there is typically a “high or low” button to adjust amplitude



THE ARC WAVE VIRTUAL TRAINING



Beginner Class with Rachel

10 minute class

5 body weight exercises with 5 sets



Beginner Basics with Rachel

25 minute class

No weight with little movement



Beginner Breathing & Breilatation with Rachel

8 minute reflexes and re-emerging class



Beginner Hip Mobility with Jonathan

8 minute class

No weight with little movement

BEGINNER BASICS



Beginner Basics with Rachel

25 minute class

No Weight with stationary poses



Beginner Class for Active Adults with Emily

18 minute session

Great for First Time Users or Adults 55 & Older

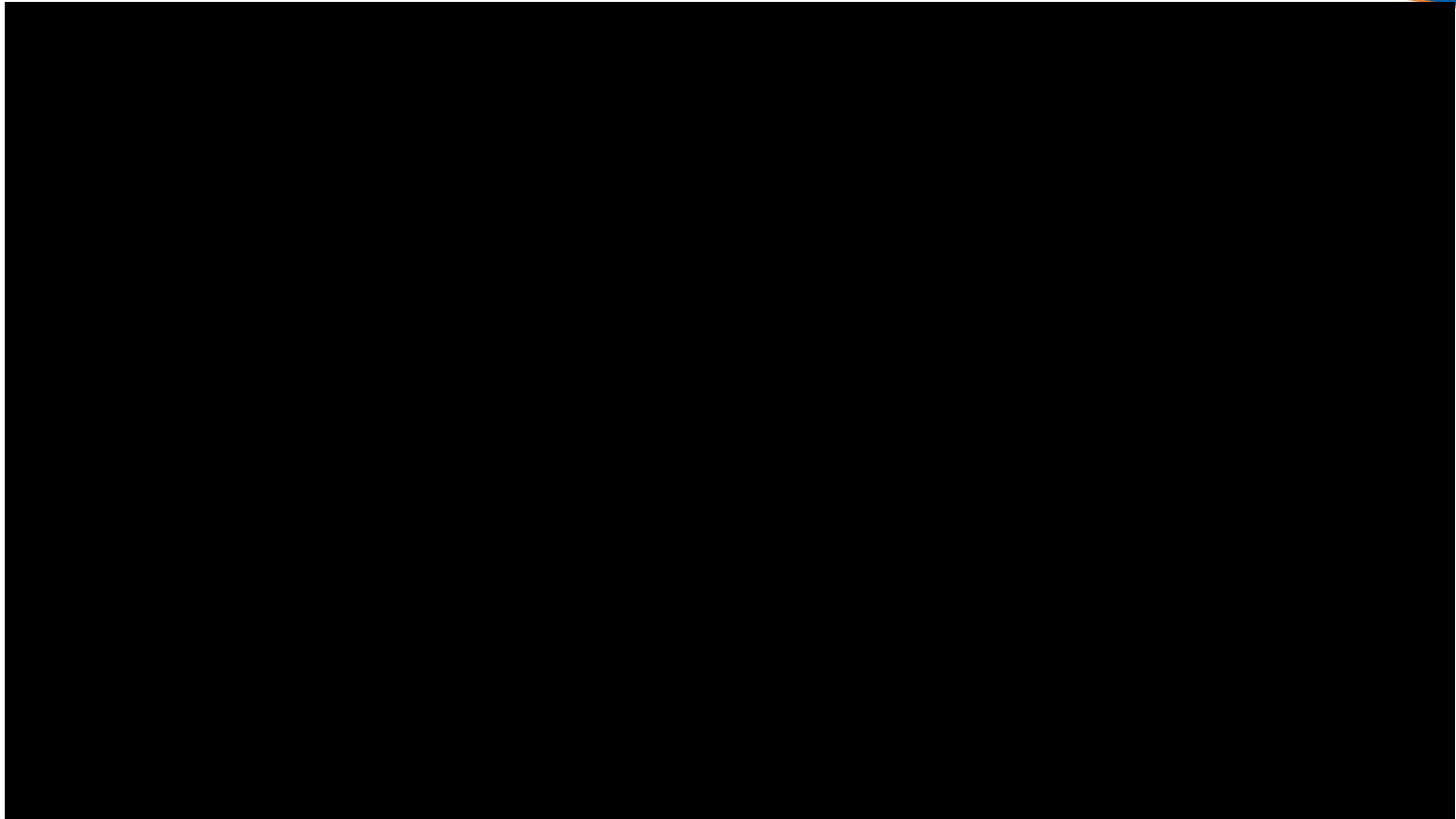




Physics of Local Vibrations

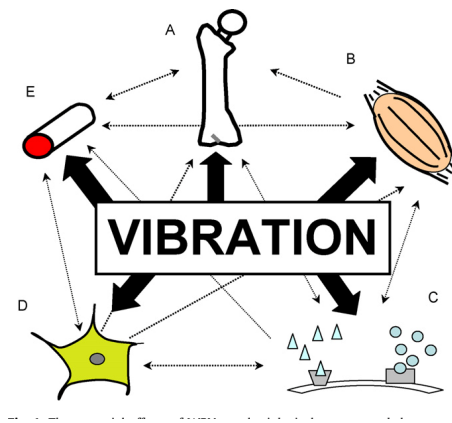
- Percussive therapy with massage gun has frequencies of 17-500 Hz
 - The Theragun uses 2400 pulses per minute on high setting and 1750 on lower setting
 - The Hypervolt uses 170 Hz
- Vibrating foam rollers or balls typically use 48, 60, or 72 Hz
- Venom (Hyperice) vibrates around 88 Hz





Articles

About 121,000 results (0.10 sec)



“only a few studies described specific vibrational training protocols, and this lack of information generates uncertainties regarding the most effective vibration intensities, frequencies, and application protocols” Cerciello et al., 2016

Heterogeneity of Studies

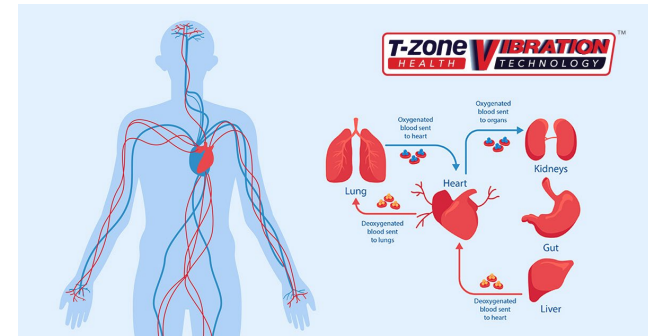
- Available literature is quite heterogeneous in terms of how local vibration therapy is applied (direct vs indirect), the type of control / sham procedure applied, and the frequency, amplitude, and duration settings used during vibration protocols (Germann et al., 2018).
 - Frequency: 5 to 300 Hz, and the
 - Amplitude: 0.12 to 12 mm
 - Time frames: 6 seconds up to 30 minutes



Purported Physiological Changes

Vascular

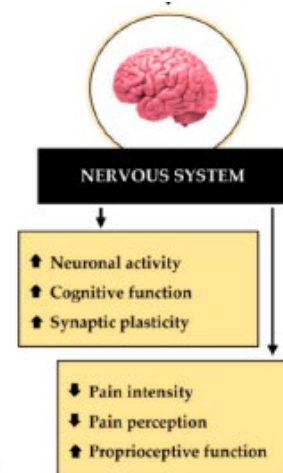
- improves elasticity of blood vessels
- improves blood flow to the peripheral circulation
- enhances blood supply to the skin
- stimulates lymphatic circulation



Purported Physiological Changes

Systemic

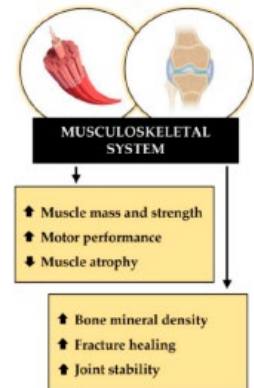
- relieves pain - modulate proprioceptive function
- enhances corticospinal excitability and intracortical processes
 - protecting and/or preventing the development of age-related cognitive disorders
- supports metabolism
- improves mental health
- relaxes whole organism



Purported Physiological Changes

Musculoskeletal

- increase the elasticity of the tendons and fascia (increase in temperature)
- increase muscle strength, muscle mass, and flexibility
 - accelerated rehabilitation
- reduces fatigue
- improving neuromuscular function through postural control strategies, muscle tuning mechanisms and tonic vibration
 - motor unit activation and firing frequency
- increase bone mineral density



Pain relief

Perception and Modulation

Address the pain

“If you don’t use it, you will lose it”

- An estimated 20.4% (50.0 million) of U.S. adults had chronic pain and 8.0% of U.S. adults (19.6 million) had high-impact chronic pain
- The effect pain has on motor performance can both be subtle and more salient (Stanisic et al., 2022).
 - Subtle: redistribution of activity within/between muscles, increased variability
 - Salient: avoidance of the motor behavior causing or increasing the pain.

50 million

adults have **chronic pain**
daily or almost daily.



Relieving Pain

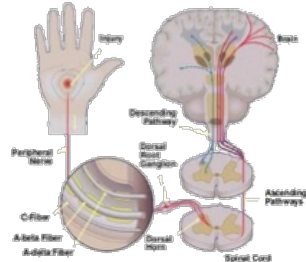
MUST ALTER

Pain Perception

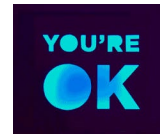
Pain Modulation



Physiology of Pain Perception



(Adapted with permission from WARD Scientific American® Medicine.)



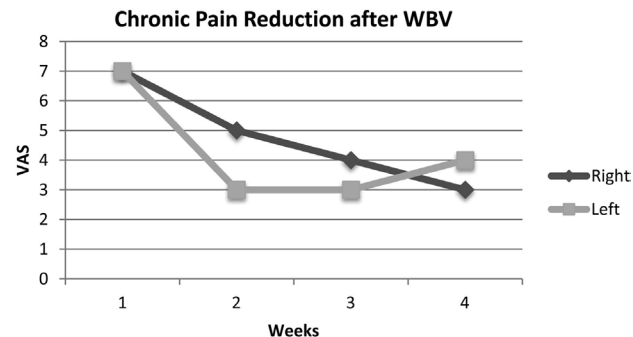
Pain Relief from Vibration

Gate Control and Noxious Inhibitory Control (pain for pain relief)

- Pain relief associated with vibration can be attributed both to gate control theory and diffuse noxious inhibitory control (Coghill et al., 1994).
 - **Gate Control – Pre-synaptic**
 - large diameter sensory fibers (A- β) connected to mechanoreceptors reduce input from small diameter (C-fibers). (Kessler & Hong, 2013).
 - **Central Biasing and Endogenous Opiate – Post-synaptic**
 - Proximity of areas responsible for processing pain and vibrotactile sensations in the somatosensory cortices of the brain (Kessler & Hong, 2013).

Pain Relief from Vibration

- Pain relief in diabetic neuropathy patients
 - Over the 4-week study - three times per week
 - Four, 3-min bouts of WBV (25 Hz; amplitude=5 mm), three times per week.
 - Participants stood on the vibration platform with their knees bent at 20° to the vertical with 30 s of rest between bouts.
- Vibration therapy offers a non-pharmaceutical and non-invasive treatments, which is accessible to large populations



Clinical Findings

Dissertation

Stephen Newhart PhD, CSCS

- Sedentary women >40 years old
 - 3X/week WBV with body weight exercise training – 4 weeks
- **Results:**
- Y –balance
 - Right leg - 25 % overall improvement from pre to post
 - Left leg - 31% overall improvements from pre to post
- Leg extension strength
 - 36 % overall improvement from pre to post
- Plank
 - Average improvement of 45% from pre to post
- SF-36 – Physical and Mental scale improvements



Methods Procedures



Kneeling Medicine
Ball Throw (Power)



Hip Internal / External
Rotation (Flexibility)



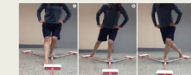
5 Repetition
Maximum Knee
Extension (Strength)



Timed Plank (Core
Muscle Endurance)

SF-36

Physical Functioning	Role Limitations Due to Physical Problems	Bodily Pain	General Health	Vitality	Social Functioning	Role Limitations Due to Emotional Problems	Mental Health	Summary Scores



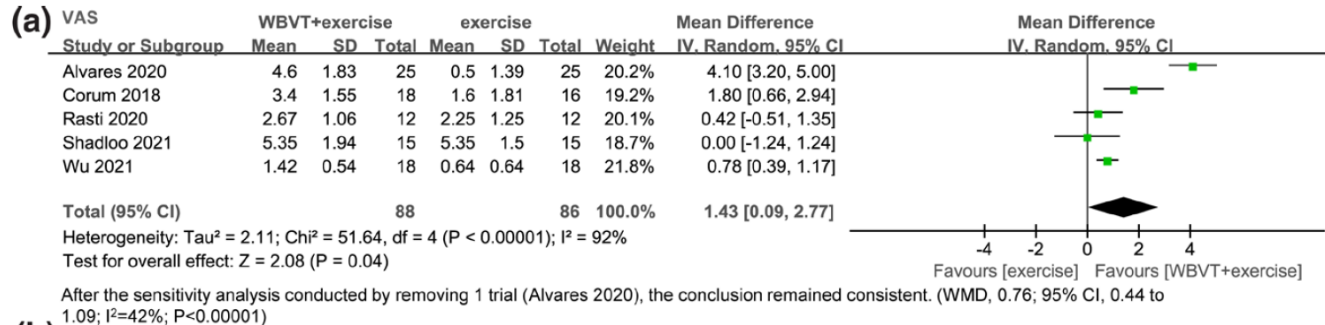
Y-Balance
(Dynamic Balance)



- Blood Pressure
- Popliteal Blood Flow
- Flow Mediated Dilation

Patellofemoral Pain

- WBV training in combination with exercise showed better pain reduction
- Frequency: 15Hz to 60Hz
- Amplitudes: < 1mm to 10mm
- Duration: 3 times a week for 4-8weeks



Delayed Onset Muscle Soreness

- Improved function
- Improved flexibility
- Reduced perception of soreness
- Increased oxygenation
- Reduced IL6 levels

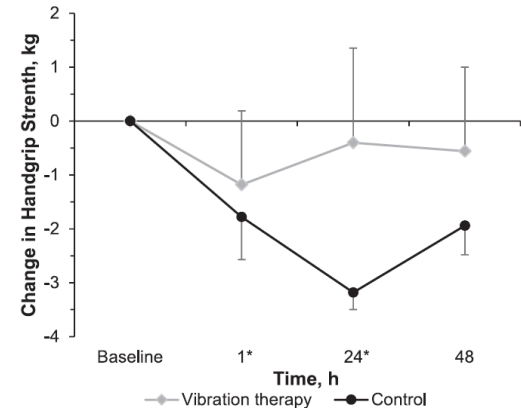
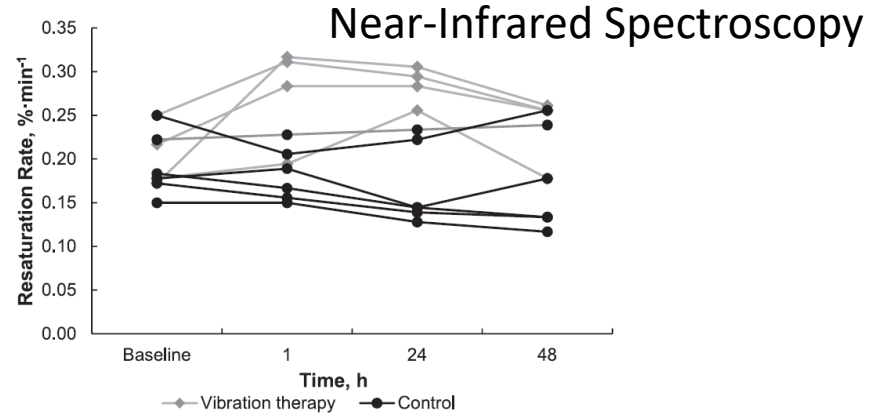
Cerciello et al., 2016

Table 2. Clinical applications of WBV: musclesoreness.

Author	n. of patients	Type of vibration	Duration	Control group	Outcome
Rhea 2009 ³⁸	8	35 + 50 Hz	1min X2	n.8 control group	Reduced musclesoreness and tightness
Broadbent 2010 ⁴¹	15	40 Hz	1 min X 3	n.14 Control group	Reduced musclesoreness and IL6 levels
Lau 2011 ⁴⁰	15	65 Hz	30 min	n.15 control group	Decreased soreness
Aminian-Far 2011 ³⁹	15	35 Hz	60 sec	n.17 control group	Reduced DOMS via muscle function improvement
Mohammadi 2012 ⁴²	15	50 Hz	1 min	n.15 control group	Prevention of musclesoreness
Wheeler 2013 ⁴⁵	10	30 Hz	10 min	n. 10 control group	No differences in DOMS, flexibility, or explosive power
Koh 2013 ⁴³	20	20 Hz	10 min	n.20 ultrasound group n.20 control group	Decreased soreness
Manimmanakorn 2015 ⁴⁴	8	30-40 Hz	10 min	n.8 active recovery	increased muscle oxygenation and blood flow

Delayed Onset Muscle Soreness

- Local vibration therapy
- Percival et al (2022) Created DOMS using an eccentric training program for the wrist flexors
- Vibration therapy – vibrating foam roller Pulseroll
 - Frequency 45 Hz for 10 minutes
 - First session was 1 hour post exercise induced muscle damage (EIMD)
 - 2x daily separated by 8 hours for 48 hours post-EIMD



ACL Rehabilitation

Systematic Review (n=13 studies)

- Local muscle vibration (foam rollers or handheld) protocols at a frequencies higher than 100 Hz
 - Hamstring peak torque [weighted mean difference (WMD) 12.67, 95% CI 4.51–20.83]
 - Quadriceps peak torque (WMD 0.11, 95% CI –0.06 to 0.29).
 - Open-eye mediolateral postural control (WMD 0.26, 95% CI –1.26 to 1.77)
 - Improvement of hamstring-to-quadriceps ratio for functional activities
- VT causes muscles and tendons to act like springs, storing energy slightly and releasing mechanical forces abruptly – increasing the training effect of a variety of exercises

Maghbouli et al., 2021

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ArcWave Training Videos

Science Based Body

- Beginner
 - <https://www.youtube.com/watch?v=u6bmifWjKdQ&t=1180s>
 - <https://www.youtube.com/watch?v=K6lfhTkTmhA&t=4s>
- Intermediate
 - <https://www.youtube.com/watch?v=N8OkPtJC888&t=2s>
 - <https://www.youtube.com/watch?v=tUjg73S7Xk0>
- Advanced
 - <https://www.youtube.com/watch?v=4tO9FSyw3wk>
 - <https://www.youtube.com/watch?v=0c39qzooAPk>



Dr. Fit

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Cindy Trowbridge
ctrowbridge@uta.edu