

Vibration for Pain Management

Effects of local vibration and pulsed electromagnetic field on bone fracture: A comparative study.

The results of the present study suggest that application of direct local LMHFV (low-magnitude, high-frequency vibration) on fracture has promoted bone formation, showing great potential in improving fracture outcome.

Hollins Perception. 2017 Aug;46(8):987-999 **High frequency low amplitude best at pain relief**

J Sport Rehabil. 2017 Aug 8:1-23 **Vibrating roller superior for knee pain relief to regular roller or sham**

Zafar H, Alghadir A, Anwer S, Al-Eisa E. Arch Phys Med Rehabil. 2015 Aug;96(8):1525-32.

Therapeutic effects of whole-body vibration training in knee osteoarthritis: a systematic review and meta-analysis. Studies demonstrated mixed results in favor of additive effects of WBV for reducing pain and improving function in knee OA. There was considerable variation in the parameters of the WBV included in this systematic review. **Conclusion: WBV training reduces pain and improves function in individuals with knee OA.**

Kakigi R, Shibasaki H. **Mechanisms of pain relief by vibration and movement.** J Neurol Neurosurg Psychiatry. 1992;55:282–286. doi: 10.1136/jnnp.55.4.282.

Roy EA, Hollins M, Maixner W. **Reduction of TMD pain by high-frequency vibration: a spatial and temporal analysis.** Pain. 2003;101:267–74.

Weerakkoby NS, Percival P, Hickey MW, Morgan DL, Gregory JE, Canny BJ, Porske U. **Effects of local pressure and vibration on muscle pain from eccentric exercise and hypertonic saline.** Pain. 2003;105:425–435.

Yarnitsky D, Kunin M, Brik R, Specher E. **Vibration reduces thermal pain adjacent dermatomes.** Pain. 1997;69:75–7.

Vibration for Repair

Benedetti MG Boccia G et al. Int J Rehabil Res. 2017 Jul 18 **High frequency vibration, but not electrostim, improved physical function and reverses hypotrophy of quadriceps.**

Effect ... on hand function in patients with distal radius fractures. Imaie R, Osumi M et al. Clin Rehabil. 2017 May;31(5):696-701

“[Tendon vibration] was an effective post-surgery management strategy not only for pain alleviation, but also hand function in patients with distal radius fractures...improvements persisting for up to two months.”

The acute effects of local vibration therapy on ankle sprain and hamstring strain injuries. Peer KS, Barkley JE, Knapp DM Phys Sports Med. 2009;37(4):31-38

“Relative to the post-control condition, local vibration for 10 minutes significantly ($P < 0.03$ for all) increased ankle dorsiflexion and eversion and hamstring flexibility, and significantly ($P \leq 0.05$) decreased perceived ankle and hamstring stiffness.”

Localized Application of Vibration Improves Passive Knee Extension in Women with Apparent Reduced Hamstring Extensibility: a Randomized Trial. J of physiotherapy. Bakhtiary AH, Fatemi E, Khalili MA, Ghorbani R. 2011;57:165–171.

The anabolic activity of bone tissue, suppressed by disuse, is normalized by brief exposure to extremely low-magnitude mechanical stimuli. Rubin C, Xu G, Judex S. *FASEB J.* 2001;15(12):2225-2229.

Lau W.Y., Nosaka K. (2011) **Effect of vibration treatment on symptoms associated with eccentric exercise-induced muscle damage.** *American Journal of Physiology Medicine & Rehabilitation* 90(Pt 8), 648-657

Vibration therapy: clinical applications in bone. Thompson WR, et al. *Curr Opin Endocr Diabetes Obes.*2014;21:447–453.

“Additional physiological mechanisms [of] vibration include improved blood flow to injury and enhanced hormonal responses, including testosterone and growth hormone, evidence for a more systemic effect [on] tissue healing.”

Low-intensity vibration improves angiogenesis and wound healing in diabetic mice. Weinheimer-Haus EM, Judex S, Ennis WJ, Koh TJ *PLoS One.* 2014; 9(3):e91355.

Vibration for Athletic Training and Post-Surgical Rehabilitation Local Vibration improves the efficacy of rehabilitation and reducing the risk of osteoarthritis.

Blackburn JT *Arch Phys Med Rehabil.* 2014 Nov;95(11):2021-8

Pamukoff DN *Arch Phys Med Rehabil.* 2016 Jul;97(7):1121-9 **Local muscle vibration acutely improved quadriceps function and could be useful modalities for restoring quadriceps strength in individuals with knee pathologies**

A Randomized, Double-Blinded, Placebo-Controlled Clinical Trial Evaluating the

Effectiveness of Daily Vibration After Arthroscopic Rotator Cuff Repair. Lam PH, Hansen K, et al. Am J Sports Med 2015 43: 2774.

5 minutes of vibration was applied daily after arthroscopic rotator cuff repair for 6 months. Vibration did provide acute pain relief at 6 weeks after surgery (visual analog scale [VAS] score, 2.24 \pm 0.29 cm) compared with placebo (VAS score, 3.67 \pm 0.48 cm) (P<.003).

Improvement of stance control and muscle performance induced by focal muscle vibration in young-elderly women: a randomized controlled trial. Filippi GM, Brunetti O, Botti FM. Arch Phys Med Rehabil. 2009 Dec(12):2019-25 .

60 sedentary women had three 10-minute vibration sessions a day for 3 consecutive days applied to contracted or relaxed quadriceps, or received placebo (non-vibrated group). At 24 hours, the area of sway decreased by 20%, vertical jump increased by 55%, and leg power increased by 35%. These effects were maintained for at least 90 days.

Focal vibration of quadriceps muscle enhances leg power and decreases knee joint laxity in female volleyball players. Brunetti O, Botti FM et al. J Sports Med Phys Fitness. 2012 Dec;52(6):596-605.

18 volleyball athletes, (age=22.7 \pm 3 years) were assigned to vibration on contracted or relaxed quads or sham vibration (NV). Combined contraction and vibration can significantly and persistently improve muscle performance and knee laxity in volleyball women players.

Luo J, McNamara BP, Moran K. **A portable vibrator for muscle performance enhancement by means of direct muscle tendon stimulation.** Med Eng Phys. 2005;27(6):513-522.

Gilsanz V, Wren TA, Sanchez M, Dorey F, Judex S, Rubin C. **Low-level, high-frequency**

mechanical signals enhance musculoskeletal development of young women with low BMD. J

Bone Miner Res. 2006;21(9):1464-1474.

Gusi N, Raimundo A, Leal A. **Low-frequency vibratory exercise reduces the risk of bone fracture more than walking: a randomized controlled trial.** BMC Musculoskelet Disord. 2006;7:92.

Brunetti O, Filippi GM, Lorenzini M, et al. **Improvement of posture stability by vibratory stimulation following anterior cruciate ligament reconstruction.** Knee Surg Sports Traumatol Arthrosc. 2006; 43(11):1180-1187.

Delayed Onset Muscle Soreness To Compare the Effect of Vibration Therapy and Massage in Prevention of Delayed Onset Muscle Soreness (DOMS). Imtiyaz S, Vegar Z, Shareef MY. J Clin Diagn Res. 2014 Jan;8(1):133-6.

45 nonathletic women were randomized to 15 minutes of massage, 5 minutes of focal vibration, or no intervention prior to exercise. Vibration therapy and massage are equally effective in prevention of DOMS. Vibration therapy reduced pain and decreased 48h LDH level.

Vibration Therapy in Management of Delayed Onset Muscle Soreness (DOMS). Vegar Z. Imtiyaz S. J Clin Diagn Res. 2014 Jun;8(6)LE01-4.

“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.... and lower creatine kinase levels in the blood.”

Effects of vibratory stimulations on maximal voluntary isometric contraction from delayed onset muscle soreness. Koh HW, Cho SH et al. J Phys Ther Sci. 2013 Sep;25(9):1093-5.

DOMS was induced in the musculus extensor carpi radialis longus of 60 adults. Ultrasound or vibratory stimulation for 10 minutes or control was used. Vibration had a positive effect on recovery of muscle function from DOMS compared to the control group, while ultrasound did not.

Vibration Therapy Reduces Plasma IL6 and Muscle Soreness After Downhill

Running. Broadbent S, Rousseau J, J. Throp

RM, Choate SL, Jackson FS, Rowlands DS. Br J Sports Med. 2010;44:888–894.

Focal Cryotherapy for Pain: Compressive cryotherapy versus cryotherapy alone in patients undergoing knee surgery: a meta-analysis.

Springerplus. 2016 Jul 13;5(1):1074. Song M et al.

“Compressive cryotherapy tended to have less pain than cryotherapy alone at POD2 and POD3, while compressive cryotherapy had a strong tendency towards less swelling over cryotherapy alone at POD1 and POD2.”

Cryotherapy for Recovery - Quadriceps Muscle Function After Rehabilitation With

Cryotherapy in Patients With Anterior Cruciate Ligament Reconstruction Hart J et al. J Athl

Train. 2014 Nov-Dec; 49(6): 733–739.

After ACL reconstruction, patients who performed rehabilitation exercises immediately after cryotherapy experienced greater strength gains than those who performed cryotherapy or exercises alone

Comparison the effects of pressurized salt ice packs with water ice packs on patients

following total knee arthroplasty Liying Pan et al Int J Clin Exp Med 2015;8(10):18179-18184

A compressing pack with -18 degree C cold worked better than standard ice and water for pain and swelling.

Time-course of changes in inflammatory response after whole-body cryotherapy multi exposures following

severe exercise. Pournot H. et al. PLoS One. 2011;6(7):e22748.

IL-1b (Post 1 h) and CRP (Post 24 h) levels decreased and IL-1ra (Post 1 h) increased following cryotherapy, supporting the decrease in pro-inflammatory cytokines activity, and increase in anti-inflammatory cytokines.

Why Vibration and Cryotherapy Together

Cryotherapy reduces inflammation but also persistently reduces blood flow. Vibration vasodilates, cancelling the vasoconstriction effect while adding pain relief and separating muscle fibers to reduce stiffness. An increased number

of residual cross-bridges between myosin heads and actin is thought to largely contribute to this exercise-induced increased stiffness (Proske and Morgan, 2001) which vibration addresses. Why vibration instead of electrostim

Electrostim doesn't increase blood flow, because it is the pulsatile vibration that mimics rapid heart rate, releasing nitric oxide and vasodilating. Electrostim doesn't cause muscle twitching in the amplitude and frequency that actual

motion does. *J Athl Train.* 2012 Sep-Oct;47(5):498-506.

High frequency vibration, but not electrostim, improved physical function and reverses hypotrophy of quads *Int J Rehabil Res.* 2017 Jul 18

This is probably because electrostim doesn't promote hormonal repair gene expression.

