Power Plate®

Scientific Validation

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To all the individuals who use Power Plate to help them achieve the innumerable healthcare benefits that engaging in regular exercise offers.

Contents

History

Vibration technology is not a new discovery. It has been around for centuries and has been applied as a physical therapy for just as long. It is only recently that the intuitive discoveries and crude mechanics from centuries ago have been updated and reinvestigated. And with increasing interest in this technology there will be additional developments in understanding the benefits produced by this exercise.

The concept of vibration therapy has been in application since ancient Greece where physicians used saws covered in cotton to transfer vibrations to specific parts of the body. There were no major advancements in the understanding or application of vibrations until 1880 when a number of different researchers began experimenting with the influence of vibrations. Most notably John Harvey Kellogg, M.D. created a device that could deliver either percussion or vibration to up to five people at the same time. His devices varied from chairs, platforms and bars, all used at his Battle Creek Sanatorium. Other researchers of this period were Gustav Zander, M.D.

While these scientists saw the benefit of vibrations, Professor W. Biermann of Germany was one of the firsts to truly study “cycloid vibrations” and “Rhythmic Neuromuscular Stimulation Method” in the 1960s. His studies are the foundation of today’s acceleration technology. Although there was no conclusive proof of this, it sparked much interest in the field of acceleration training. Soon after, Dr. Vladimir Nasarov tested and observed improvements in power and flexibility by applying Beirmann’s ideas in practical exercises and developed a vibration training program for athletes.

This acceleration training was used by the former Soviet Union in their space program in the 1960s. It was believed that the use of acceleration training mitigated the negative effects of microgravity suffered in space. This supposition, though largely unproven at the time, caused a surge of interest in the field of whole body vibration. In later years, vibration science was studied extensively and the results showed benefits for muscular strength, flexibility, power, circulation, and recovery. In the 1970s Dr. Nasarov further developed research on vibration and applied it to athletic training. Shortly after this, vibration was implemented by Soviet athletes to enhance performance training. Nasarov was the first to apply vibration to sport. He observed that range of motion increased and there was a shift in the pain threshold. Since these early studies on the effects of whole body vibration, there has been a rapid increase in interest and research. Vibration is now included in the genre of medical treatment, not just athletic training. Countless studies have shown that whole body vibration can positively affect flexibility, balance, body composition and muscle strength to name a few. And while more research is being conducted, whole body vibration has been shown to be an effective treatment for many degenerative diseases.

History of Power Plate

Power Plate was developed in the 90’s by Guus van der Meer, a Dutch Olympic trainer. After extensive study on the current vibration devices and treatments, van der Meer was unsatisfied and decided to create a different whole body vibration machine that could be used for more than just scientific research. He made a number of improvements on the existing technology. His improvements were directed to the machine’s aesthetic appeal, variation in frequency speed and amplitude, and use of the three dimensions of movement.

Introduction

Power Plate: Reflexive Stabilization

The mechanism, by which Power Plate works, lies within the principles of Reflexive Stabilization, Rapid Reflexive Response (R3), and the Tonic Vibration Reflex (TVR). At a subconscious, reflex level, WBV creates a systemic response to the displacement of our center of gravity (COG) simulating our body's instinctive adaptation to our unpredictable environment.

We define Reflexive Stabilization as: The cohesive function of the neuromuscular system in order to stabilize the body against gravity, ground reaction forces, mass and momentum, enhancing activation throughout the neuromuscular system.

All of movement is force production based on our ability to load and unload our entire system. Most importantly, all movement is proprioceptive functional feeding. Performing movement on Power Plate can result in significant improvement in neuromuscular communication, functional stability, enhanced circulation and production of recovery hormones. Greater neuromuscular activation enhances speed, strength, and power through subconscious chain reactivity.

Force Output

Reflexive stabilization intensifies synergistic muscle recruitment through harmonic vibration produced exclusively by Power Plate.

Power Plate (Harmonic vibration) moves in a precisely controlled triplanar formation, producing comfortable vibratory stimulus that is consistently challenging from one movement to the next.

Gravity is our best friend and our worst enemy. With every movement we perform, gravity rapidly drives our body toward the ground from the top down. In the same turn, gravity is our best friend, providing subconscious ground reaction forces (GRF) that stimulate our neuromusculoskeletal system in the Sagittal (forward and backward), Frontal (side to side), and Transverse (right rotation and left rotation) Planes (Gray Institute 2015). The greater the reflexive adaptation encouraged by Power Plate, the more authentic subconscious muscle memory (motor learning) develops.

Reflexes

- A reflex is a subconscious involuntary response to a stimulus resulting in a conscious voluntary action.
- Our reflexes are specific and predictable, most often purposeful and are highly adaptive.
- Reflexive stabilization creates subconscious adaptation within the human body through recurrent moments of neuromuscular stimulation eliciting a rapid motor response.
- With each harmonic oscillation, the body is stimulated to perform reflexive muscle reactions defined as Tonic Vibration Reflex (TVR).
- Power Plate's surface vibrates 25-50 times per second, resulting in corresponding reflexive muscle activation.

MDD
Medical Device Directive

From its founding in 2000, Power Plate has always been dedicated to advancements in whole body vibration, and puts a great emphasis on scientific validation. We want to share this knowledge with everyone who wishes to learn more about this innovative methodology. We will do our best to continue to update you with all new and relevant information. We will also use this research to help improve and refine our products, introduce new innovations in the field of whole body vibration, and continue to develop education and training materials so everyone can benefit from the best possible equipment and tools and enjoy optimal results.

Most recently, our emphasis on constantly improving our technology and finding new ways to apply vibrations in a purposeful manner has resulted in the company becoming a certified medical device manufacturer, under the European Medical Device Directive (MDD) legislation. This means that all Power Plate products are certified as safe, reliable and effective for use in a medical environment.

The booklet is intended as a resource for people who would like to know more about research on vibration training. It is categorised by effect, from acute to long term, while the subjects studied cover the full spectrum from elite athletes and healthy individuals, to special populations, such as those with a disability or medical condition.

The chapters ‘Professional Users of Power Plate ’ and 'Personal Users of Power Plate’ lists well known people and sports teams that have chosen Power Plate to help them reach their goals.

The Research chapters contain abstracts of all scientific articles or conference proceedings of research studies conducted with Power Plate as well as relevant literature reviews.

For the full articles and more background information you can check our website **powerplate.com** or contact your local Power Plate representative.

Professional Users Of Power Plate

National Teams

Argentina Rugby Team
China Badminton Team
China Gymnastics Team
China Kayaking Team
China Tae Kwon Do team
China Tennis Team
China Track & Field Team
China Volleyball Team
French Swin Team
French Ski Team
German Bobsled Team
German Football Team
German Ski Team
Pole France de Natation d'Antibes
Team GB
Turkish Football Team
Turkish Swim Team
South Africa Rugby Team
Welsh Rugby Team

Baseball, USA

Arizona Diamondbacks
Atlanta Braves
Baltimore Orioles
Boston Red Sox
Chicago Cubs
Chicago White Sox
Cleveland Indians
Colorado Rockies
Detroit Lions
Florida Marlins
Houston Astros
Kansas City Royals
LA Angels of Anaheim
Los Angeles Dodgers
Milwaukee Brewers
Minnesota Twins
New York Mets
New York Yankees
Oakland A's Athletics
Philadelphia Phillies
Pittsburgh Pirates
San Diego Padres
San Francisco Giants
Seattle Mariners
St. Louis Cardinals
Tampa Bay Rays
Texas Rangers
Toronto Blue Jays
Washington Nationals

Basketball, USA

Atlanta Hawks
Boston Celtics
Charlotte Bobcats
Chicago Bulls
Cleveland Cavaliers
Dallas Mavericks
Detroit Pistons
Golden State Warriors
Houston Rockets
Indiana Pacers
Los Angeles Clippers
Los Angeles Lakers
Miami Heat
Milwaukee Bucks
Minnesota Timberwolves
Memphis Grizzlies
New Jersey Nets
New Orleans Jazz
New York Knicks
Oaklahoma City Thunder
Orlando Magic
Philadelphia 76ers
Phoenix Suns
Portland Trailblazers
Sacramento Kings
San Antonio Spurs
Toronto Raptors
Washington Wizards

Elite Performance Centers

Chinese Sports Federation
European Golf Tour (Physiotherapy Bus)
European Ryder Cup Team (K-Club 2006 & Valhalla 2008)
EXOS (USA)
Jim McLean Golf School (USA)
National Cricket Academy (India)
Sport Hochschule Koln (Germany)

Football / Soccer teams

AFC Ajax (Netherlands)
Arsenal FC (UK)
Besiktas FC (Turkey)
Bolton FC (UK)
Chelsea FC (UK)
Chicao Fire (USA)
Clube Atletico Mineiro (Brazil)
Club de Futbol Pachuca (Mexico)
Club Deportivo Guadakajara (Mexico)
Club Tecos UAG Mexico (Mexico)
Club Necaza Mexico (Mexico)
DC United (USA)
Everton FC (UK)
Flamengo (Brazil)
Fulham FC (UK)
Galatarary FC (Turkey)
Goias (Brazil)
Kashima Antlers (Japan)
Kawasaki Frontale (Japan)
Kyoto Sanga FC (Japan)
Los Angeles Galaxy (USA)
Liverpool FC (UK)
Manchester City FC (UK)
Manchester United FC (UK)
Middlesbrough FC (UK)
Nagoya Grampus Eight (Japan)
Rangers FC (Scotland)
Sanfrecce Hiroshima (Japan)
Sociedade Esportive Palmeiras (Brazil)
Tottenham Hotspur FC (UK)
West Bromwich Albion FC (UK)

American Football, USA

Arizona Cardinals
Atlanta Falcons
Baltimore Ravens
Buffalo Bills
Carolina Panthers
Chicago Bears
Cincinnati Bengals
Cleveland Browns
Dalls Cowboys
Denver Broncos
Detroit Lions
Green Bay Packers
Houston Texans
Indianapolis Colts
Jacksonville Jaguars
Kansas City Chiefs
Miami Dolphins
Minnesota Vikings
New England Patriots
New Orleans Saints
New York Giants
New York Jets
Oakland Raiders
Philadelphia Eagles
Pittsburgh Steelers
San Francisco 49ers
San Diego Chargers
Seattle Seahawks
St. Louis Rams
Tampa Bay Buccaneers
Tennessee Titans
Washington Redskins

Personal Users of Power Plate

Serena Williams

"Off court training is as important to me as on court. With the Power Plate, I'm able to accelerate my off court training and maximize the benefits."

Serena Williams
U.S., Australian and Wimbledon tennis champion

"As a coach I am always searching for edges in performance. My teams and I have several years experience with vibration training, and I know the players and staff feel it truly makes a difference. I am delighted to work with Power Plate International, the leaders in vibration training and technology, not just because of their excellent product, but also as important, their comprehensive support, education and training which helps us get the best out of their machines."

Sir Clive Woodward
Rugby World Cup Winning Head Coach and Team GB Director of Sport, London 2012

"The positive research and acceptance by athletes, and coaches confirm Acceleration Training is integral to sports performance methodology. We have found Power Plate the absolute leader in enhancing acceleration through vibration training. Power Plate is the only choice for the elite athlete population as it works in multiple planes and dimensions of motion; has engineering solutions to create equality for all athletes plus the ability to safely and naturally progress and improve performance by adding external load. We use one Power Plate for every Power Rack at EXOS enabling us to use across our methodology from high performance to medical rehabilitation and regeneration. The Power Plate philosophy and commitment to education, research, engineering and thorough customer service is second to none. Do your due diligence and you too, will be convinced Power Plate is the best resource to meet your programs and athlete needs!"

Mark Verstegen
EXOS

"Personally and professionally, Power Plate has definitely contributed to a faster recovery from injury, increased strength and flexibility for everyone who has touched it since it arrived four years ago. In my 28 years as a collegiate strength and conditioning coach. I've never had one piece of equipment help so many and do so much. Thank you Power Plate!"

Ray Ganong
Head Strength Coach, Men's Basketball, University of Louisville Cardinals

"Introducing the Power Plate into my training schedule has had a significant and hugely positive impact. I love the versatility it offers; from stretching, strength and flexibility, to massage and relaxation, exercising on a Power Plate has added an exciting new dimension to my training programme."

Nick Dougherty
UK Championiship Golfer

" When you have an accident like I did, your life is completely turned upside down. Although I was very lucky and was able to be operated on, I lost all my muscle density and found it very hard to remain mobile and active. Power Plate training has been remarkable for my recovery and invaluable in building up my fitness level. It has given me back my strength and my life and provides me with instant relief. The first time I experienced it, I knew I had to have one. I used to walk like a 90 year old woman but now can walk with just a stick and can even dance!"

Marian Harris
56 year old car crash survivor

Rachel Weisz
English screen and theatre actress

"In my job, it is important I always look my best. With a busy schedule, it's not always easy to find the time to exercise. With the Power Plate, I can now do a quick full body workout at home to suit me. It is so quick and easy and I can see and feel the results."

Rachel Weisz
An English screen and theatre actress. Her film credits include roles as Evelyn "Evy" Carnahan-O'Connell in the films The Mummy and The Mummy Returns. In 2001, she starred opposite Hugh Grant in the hit About a Boy and continued to garner leading roles in Hollywood productions. Her performance in The Constant Gardener (2005) won her the Academy Award for Best Supporting Actress, along with other major motion picture awards.

"The band must be in peak physical form to withstand the demands of daily travel and nightly performances. The Power Plate is that key component in helping us feel and look our best. Taking it on the road made a big difference."

Sting
Sting and The Police, professional singers

"Having been in the training and fitness business for over 30 years I was skeptical when I first saw Power Plate and whole body vibration (WBV). Now I own a training and rehab studio that is exclusively WBV. In the 8 years I have trained people exclusively on WBV I have seen amazing, even miraculous things happen. People in chronic pain without pain, people with osteoporosis no longer with osteoporosis, athletes becoming super athletes and many people losing 50, 60, 80 pounds of bodyfat! WBV is the real thing, and Power Plate is head and shoulders the leading provider of WBV equipment."

Keith Spennewyn
MSc, Exercise Physiologist - ReVibe Fitness and Wellness

"We purchased two Power Plates back in 2012 and two more in the beginning of 2014; we are the only gym in the area that offers the product and have had several people join because of them. They have helped us grow our overall membership and also maintain our existing member base by offering a unique training modality that all of our members can use. We love having the Power Plates! "

Maria Potvin, General Manager
Powerhouse Gym

" Grant Roberts, my trainer for Million Dollar Baby, suggested I get a Power Plate because my schedule doesn't always allow the time I would like for exercise. I love that with the Power Plate, I can get a full workout at home in next to no time. I really am impressed with the machines ability to target and recruit specific muscles and improve my flexibility at the same time. It just feels good."

Hilary Swank
Oscar Winner, Actress

" It's so quick and easy, it's the perfect friend on set. After just 2 weeks of 20 minutes a day, the tone is really showing! It's the best piece of exercise equipment I have ever owned. Being an actress I can even have it in my trailer and work out in between scenes. I have the strongest legs I have ever had. I love it and highly recommend it."

Anna Louise Friel
A Golden Globe-nominated English actress from Rochdale, in Greater Manchester. She currently stars as Charlotte "Chuck" Charles, the female lead in the American television series Pushing Daisies.

"The dancers of The Royal Ballet find the Power Plate machine beneficial for warm-up, rehearsal and recovery. It is an effective tool for stretching, strengthening and relaxing muscle - three essential aspects to ensure a great performance."

Daryl Martin
Chartered Physiotherapist,
The Royal Ballet

Research - Fitness & Sport

Bazett-Jones, D., H. Finch, and E. Dugan.
Comparing the effect of various whole-body vibration accelerations on counter-movement jump performance. *Journal of Sports Science and Medicine.* Vol.7, pp: 144-150. 2008.

Abstract:
While it seems that whole body vibration (WBV) might be an effective modality to enhance physical performance, the proper prescription of WBV for performance enhancement remains unknown. The purpose of this study was to compare the immediate effect of various WBV accelerations on counter movement jump (CMJ) height, the duration of any effect, and differences between men and women. Forty-four participants (33 men, 11 women) participated in no less than four CMJ familiarization sessions and completed all vibration sessions. Participants performed a pre-test (three maximal CMJs), followed randomly by one of five WBV accelerations; 1g (no-WBV control), 2.16g, 2.80g, 4.87g, and 5.83g. Participants performed three maximal CMJs immediately, five, and 10 minutes following each 45 sec WBV session. The mean of the three performances was used and calculated as a percentage of the pre-vibration mean value.
A Repeated Measures Analysis of Variance (ANOVA; acceleration x time x gender) model was used to analyze the data. The two-way interactions of acceleration-gender ($p = 0.033$) and time-gender ($p = 0.050$) were significant. Women performed significantly better following the 2.80g ($p = 0.0064$) and 5.83g ($p = 0.0125$) WBV sessions compared to the 1g (control) session. Men, however, did not experience performance enhancing effects following any of the vibration sessions. While significant differences did not occur between time in either gender, the effects of the 45 sec WBV session in women were transient, lasting approximately five minutes.

During the prescription of WBV, gender should be considered given that the results of this study seem to indicate that men and women respond differently to WBV. The results of this study suggest that WBV might be a useful modality as applied during the pre-competition warm-up.

Boland, E., D. Boland, T. Carroll, and W.R. Barfield.
Comparison of the Power Plate and free weight exercises on upper body muscular endurance in college age subjects. International *Journal of Exercise Science.* Vol. 2(3), pp: 215-222. 2009.

Abstract:
The power plate (PP) is designed to reduce training time while providing a muscle stimulus that leads to positive changes in muscle mass. This study investigated the effect that training on the PP has compared to a free-weight (FW) program, on upper body endurance, defined as the number of push-ups completed at one time prior to failure. Following IRB approval a pre-test was used to assess push-up endurance in PP and FW cohorts. Each group exercised for six consecutive weeks, working out three times per week, on non-consecutive days performing five exercises of two sets of 8-12 repetitions. Twenty-two females and 2 males enrolled in the investigation. Eleven with a mean age of 22 years (20-24) participated in the PP cohort. Thirteen participated in the FW arm of the study with a mean age of 24.5 (20-29) years. Shapiro-Wilk found lack of data normality. Wilcoxon Rank Sum testing yielded statistically significant differences within groups. The FW comparison between pre and post test showed a p value of 0.016. The PP group pre to post test p value was 0.005. Non-parametric testing (Mann Whitney) found no statistical differences ($p=0.62$) between Group A (FW) and Group B (PP) on the push-up pre-test. The post-test comparing post testing differences between groups (PP and FW) found no statistical differences ($p=0.55$) in the push-up test. Subjects in both groups saw increases in upper-body endurance with statistically significant differences within groups.

Based on our findings the PP is a useful tool which enhances upper body muscle endurance.

Cormie, P., Deane, R., Triplett, N., and McBride, J.
Acute effects of whole body vibration on muscle activity, strength and power. *Journal of Strength and Conditioning Research.* Vol. 20(2), pp: 257–261. 2006.

Abstract:
The purpose of this study was to investigate the effects of a single bout of whole-body vibration on isometric squat (IS) and countermovement jump (CMJ) performance. Nine moderately resistance-trained men were tested for peak force (PF) during the IS and jump height (JH) and peak power (PP) during the CMJ. Average integrated electromyography (IEMG) was measured from the vastus medialis, vastus lateralis, and biceps femoris muscles. Subjects performed the 2 treatment conditions, vibration or sham, in a randomized order. Subjects were tested for baseline performance variables in both the IS and CMJ, and were exposed to either a 30-second bout of whole-body vibration or sham intervention. Subjects were tested immediately following the vibration or sham treatment, as well as 5, 15, and 30 minutes post-treatment. Whole-body vibration resulted in a significantly higher ($p \leq 0.05$) JH during the CMJ immediately following vibration, as compared with the sham condition. No significant differences were observed in CMJ PP; PF during IS or IEMG of the vastus medialis, vastus lateralis, or biceps femoris during the CMJ; or IS between vibration and sham treaments.
Whole-body vibration may be a potential warm-up procedure for increasing vertical JH. Future research is warranted addressing the influence of various protocols of whole-body vibration (i.e., duration, amplitude, frequency) on athletic performance.

Games, K., Sefton, J., and Wilson, A.
Whole-Body Vibration and Blood Flow and Muscle Oxygenation: A Meta-Analysis. *Journal of Athletic Training 2015*

Abstract:
Context: The use and popularity of whole-body vibration (WBV) has increased in recent years, but there is a lack of consensus in the literature about the effectiveness of the treatment.
Objective: To quantitatively examine the effects of WBV on muscle oxygenation and peripheral blood flow in healthy adults.
Data Sources: We searched Web of Science and PubMed databases and reference lists from relevant articles using the key terms whole body vibration, whole-body vibration, WBV, blood flow, peripheral blood flow, oxygenation, muscle oxygenation,circulation, circulatory, near infrared spectroscopy, NIRS, and power Doppler. Key terms were searched using single word and combination searches. No date range was specified.
Study Selection: Criteria for inclusion were (1) use of a commercially available WBV device, (2) a human research model, (3) a pre-WBV condition and at least 1 WBV experimental condition, and (4) reporting of unstandardized means and standard deviations of muscle oxygenation or peripheral blood flow.
Data Extraction: Means, standard deviations, and sample sizes were extracted from the text, tables, and figures of included studies. A total of 35 and 90 data points were extracted for the muscle-oxygenation and blood-flow meta-analyses, respectively. Data for each meta-analysis were combined and analyzed using meta-analysis software. Weighted, randomeffects meta-analyses using the Hedges g metric were completed for muscle oxygenation and blood flow. We then conducted follow-up analyses using the moderator variables of vibration type, vibration time, vibration frequency, measurement location, and sample type.
Data Synthesis: We found 18 potential articles. Further examination yielded 10 studies meeting the inclusion criteria. Whole-body vibration was shown to positively influence peripheral blood flow. Additionally, the moderators of vibration type and frequency altered the influence of WBV on blood flow. Overall, WBV did not alter muscle oxygenation; however, when the measurement site was considered, muscle oxygenation increased or decreased depending on the location.
Conclusions: Acute bouts of WBV increase peripheral blood flow but do not alter skeletal muscle oxygenation. Vibration type appears to be the most important factor influencing both muscle oxygenation and peripheral blood flow.

Delecluse, C., M. Roelants, and S. Verschueren.
Strength Increase after Whole-Body Vibration Compared with Resistance Training. *Medicine & Science in Sports & Exercise.* Vol. 35, No. 6, pp: 1033-1041. 2003.

Abstract:
Purpose: The aim of this study was to investigate and to compare the effect of a 12-wk period of whole-body vibration training and resistance training on human knee-extensor strength.
Methods: Sixty-seven untrained females (21.4 ± 1.8 yr) participated in the study. The whole-body vibration group (WBV, N = 18) and the placebo group (PL, N = 19) performed static and dynamic knee-extensor exercises on a vibration platform. The acceleration of the vibration platform was between 2.28 g and 5.09 g, whereas only 0.4 g for the PL condition. Vibration (35–40 Hz) resulted in increased EMG activity, but the EMG signal remained unchanged in the PL condition. The resistance-training group (RES, N = 18) trained knee extensors by dynamic leg-press and leg-extension exercises (10–20 RM). All training groups exercised 3x wk. The control group (CO, N = 12) did not participate in any training. Pre- and postisometric, dynamic, and ballistic knee-extensor strength were measured by means of a motor-driven dynamometer. Explosive strength was determined by means of a counter-movement jump.
Results: Isometric and dynamic knee-extensor strength increased significantly ($P \leq 0.001$) in both the WBV group (16.6 ± 10.8%; 9.0 ± 3.2%) and the RES group (14.4 ± 5.3%; 7.0 ± 6.2%), respectively, whereas the PL and CO group showed no significant ($P \leq 0.05$) increase. Counter-movement jump height enhanced significantly ($P \leq 0.001$) in the WBV group (7.6 ± 4.3%) only. There was no effect of any of the interventions on maximal speed of movement, as measured by means of ballistic tests.

Conclusions: WBV, and the reflexive muscle contraction it provokes, has the potential to induce strength gain in knee extensors of previously untrained females to the same extent as resistance training at moderate intensity. It was clearly shown that strength increases after WBV training are not attributable to a placebo effect.

Lamont, H.S., J.T. Cramer, D.A. Bemben, R.L. Shehab, M.A. Anderson, and M.G. Bemben.
Effects of 6 weeks of periodized squat training with or without whole-body vibration on short-term adaptations in jump performance within recreationally resistance trained men. *The Journal of Strength and Conditioning Research. Vol. 22(6), pp: 1882-1893.* 2008.

Abstract:
The purpose of this study was to examine the effects of a 6-week, periodized squat training program, with or without whole-body low-frequency vibration (WBLFV), on jump performance. Males ranged in age from 20 to 30 years and were randomized into groups that did squat training with (SQTV, n = 13) or without (SQT, n = 11) vibration, or a control
group (CG, n = 6). Measures of jump height (cm), peak power (Pmax), Pmax per kilogram of body mass (Pmax/kg), and mean power were recorded during 30-cm depth jumps and 20-kg
squat jumps at weeks 1 (pretraining), 3 (midtraining), and 7 (posttraining). No significant group differences were seen for 30-cm depth jump height between weeks 1 and 7 ($p > 0.05$).
Trial three (W7) measures were greater than those for trial two (W3) and trial one (W1) ($p < 0.05$). Significant group differences were seen for 20-kg squat jump height, with SQTV. SQT between weeks 1 and 7 ($p < 0.05$). Significant trial differences were seen, with W7 . W3 . W1 ($p < 0.05$) as well as for 30-cm depth jump Pmax percent change (W7 . W3 and W1 $p < 0.05$). A significant trial effect was seen for 20-kg squat jump Pmax (W7 . W1, $p < 0.05$) and 20-kg squat jump Pmax/kg percent change (W7 . W3 . W1, $p < 0.05$). The addition of vibration to SQTV seemed to facilitate Pmax and mean power adaptation for depth jumps and Pmax for squat jumps, although not significantly ($p > 0.05$).

Stretch reflex potentiation and increased motor unit synchronization and firing rates may account for the trends seen. Baseline squat strength, resistance training experience, and amplitude, frequency, and duration of application of WBLFV seem to be important factors that need to be controlled for.

Lamont, H.S., J.T. Cramer, D.A. Bemben, R.L. Shehab, M.A. Anderson, and M.G. Bemben.
Effects of a 6-week periodized squat training program with or without whole-body vibration on jump height and power output following acute vibration exposure. *Journal of Strength and Conditioning Research*. Vol. 23(8), pp: 2317-2325. 2009.

Abstract:
The purpose of this study was to examine the effects of a 6-week, periodized squat training program with (SQTV) or without (SQT) whole-body low-frequency vibration (WBLFV) on acute improvements in jump height and power output over 3 separate testing occasions. Participants ranged in age from 18 to 30 years and were randomized into 1 of 3 groups (CG, or control group, n = 6; SQTV, n = 13; or SQT, n = 11). SQTV and SQT performed Smith machine back squat training twice per week with 3 to 5 sets of 55 90% of the 1-repetition maximum (1RM). The SQTV group also received WBLFV (50 Hz; 2–6-mm amplitude) during the 6-week training period before training (30 seconds, 2–4-mm amplitude) and between sets (3 bouts lasting 10 seconds each). Two 30-cm depth jumps and two 20-kg squat jumps were performed after an acute vibration protocol during weeks 1, 3, tand 7. Jump height (cm), peak power (Pmax), peak power per kilogram of body mass (Pmax/kg), and mean power (Pav) were recorded for the depth and squat jumps. Although there were no group by trial interactions, percent change in Pmax for the squat jump was greater ($p < 0.01$) for the SQTV group than for the SQT group post WBLFV. In addition, the percent change scores for jump height and Pmax/kg for the depth jump were greater ($p < 0.05$) for SQTV than for SQT following WBLFV exposure.

WBLFV during the 6-week squat training program resulted in greater acute improvements in power output and jump height for both jump conditions compared to SQT alone.

Roelants, M., S. Verschueren, C. Delecluse, O. Levin, and V. Stijnen.
Whole body vibration induced increase in leg muscle activity during different squat exercises. *Journal of Strength and Conditioning Research. Vol. 20(1), pp: 124–129.* 2006.

Abstract:
This study analyzed leg muscle activity during whole-body vibration (WBV) training. Subjects performed standard unloaded isometric exercises on a vibrating platform (Power Plate): high squat (HS), low squat (LS), and 1-legged squat (OL). Muscle activity of the rectus femoris, vastus lateralis, vastus medialis, and gastrocnemius was recorded in 15 men (age 21.2 ± 0.8 years) through use of surface electromyography (EMG). The exercises were performed in 2 conditions: with WBV and without (control [CO]) a vibratory stimulus of 35 Hz. Muscle activation during WBV was compared with CO and with muscle activation during isolated maximal voluntary contractions (MVCs). Whole-body vibration resulted in a significantly higher ($p < 0.05$) EMG root-mean-square compared with CO in all muscle groups and all exercises (between +39.9 ± 17.5% and +360.6 ± 57.5%). The increase in muscle activity caused by WBV was significantly higher ($p < 0.05$) in OL compared with HS and LS.

In conclusion, WBV resulted in an increased activation of the leg muscles. During WBV, leg muscle activity varied between 12.6 and 82.4% of MVC values.

Paradisis, G., and E. Zacharoqiannis.
Effects of whole-body vibration training on sprint running kinematics and explosive strength performance. *Journal of Sports Science and Medicine.* Vol. 6, pp: 44-49. 2007.

Abstract:
The aim of this study was to investigate the effect of 6 wk of whole body vibration (WBV) training on sprint running kinematics and explosive strength performance. Twenty-four volunteers (12 women and 12 men) participated in the study and were randomised (n = 12) into the experimental and control groups. The WBV group performed a 6-wk program (16-30 min/d, 3 times a week) on a vibration platform. The amplitude of the vibration platform was 2.5 mm and the acceleration was 2.28 g. The control group did not participate in any training. Tests were performed Pre and post the training period. Sprint running performance was measured during a 60 m sprint where running time, running speed, step length and step rate were calculated. Explosive strength performance was measured during a counter movement jump (CMJ) test, where jump height and total number of jumps performed in a period of 30 s (30CVJT). Performance in 10 m, 20 m, 40 m, 50 m and 60 m improved significantly after 6 wk of WBV training with an overall improvement of 2.7%. The step length and running speed improved by 5.1% and 3.6%, and the step rate decreased by 3.4%. The countermovement jump height increased by 3.3%, and the explosive strength endurance improved overall by 7.8%.

The WBV training period of 6 wk produced significant changes in sprint running kinematics and explosive strength performance.

Roelants, M., C. Delecluse, M. Goris, and S. Verschueren.
Effects of 24 weeks of whole body vibration training on body composition and muscle strength in untrained females. *International Journal of Sports Medicine.* Vol. 25, pp: 1-5. 2004.

Abstract:
The aim of this study was to investigate and to compare the effect of 24 weeks “whole body vibration” training and fitness training on body composition and on muscle strength. Forty-eight untrained females (21.3 ± 2.0 yr) participated in the study. The whole body vibration group (N = 18) performed unloaded static and dynamic exercises on a vibration platform (35 – 40 Hz, 2.5 – 5.0 mm; Power Plate®). The fitness group (N = 18) followed a standard cardiovascular (15 – 40 min) and resistance training program including dynamic leg press and leg extension exercises (20 – 8 RM). Both groups trained 3 times weekly. The control group (N = 12) did not participate in any training. Body composition was determined by means of underwater weighing. Additionally 12 skinfolds were assessed. Isometric (0°/s) and isokinetic (50°/s, 100°/s, 150°/s) knee-extensor strength was measured by means of a motor-driven dynamometer (Technogym®). Over 24 weeks there were no significant changes ($p > 0.05$) in weight, in percentage body fat, nor in skinfold thickness in any of the groups. Fat free mass increased significantly in the whole body vibration group (+2.2%) only. A significant strength gain was recorded in the whole body vibration group (24.4 ± 5.1%; 5.9 ± 2.1%; 8.3 ± 4.4%; 7.6 ± 1.5%) and in the fitness group (16.5 ± 1.7%; 12.0 ± 2.7%; 10.4 ± 2.3%; 10.2 ± 1.9%) at 0°/s, 50°/s, 100°/s and 150°/s respectively.

In conclusion, 24 weeks whole body vibration training did not reduce weight, total body fat or subcutaneous fat in previously untrained females. However, whole body vibration training induces a gain in knee-extensor strength combined with a small increase in fat free mass. The gain in strength in comparable to the strength increase following a standard fitness training program consisting of cardiovascular and resistance training.

Serravite, D.H., D. Edwards, E. Skidmore, and J.F. Signorile.
Acute effect of frequency, amplitude and load changes on oxygen consumption during whole body vibration. *Poster presentation presented at the annual meeting of the ACSM.* 2008.

Abstract:
WBV has been shown to increase oxygen consumption (VO2); however, limited data exist concerning the exercise protocols that elicit the highest VO2 during WBV.
PURPOSE: To examine differences in VO2 resulting from frequency, amplitude and external load variations during and after WBV. METHODS: Ten physically active males, 27.22 ± 4.79 yrs; 81.41 ± 10.03 kg, not currently training, took part in the study. VO2 was collected during nine different exercise protocols performed on separate days. A 12hr fast preceded each visit. The testing involved three phases: resting (sitting for 15 min), exercise (active squats for 8 min), and recovery (sitting for 15 min). During the exercise phase, six 30s sets of active squatting were performed with one min of passive recovery between sets. Squatting speed was set at one squat per 3 seconds, controlled by matching the sound of a metronome. The nine different training protocols were the combination of two variables: load (no load, 20% and 40% of body weight) and vibration (0Hz, 0mm (NV); 35Hz, 2-3mm (35L); 50Hz, 5-6mm (50H)). The external load was added at the shoulder using a standard backpack and sand bag weights. Testing order was randomized and tests days were separated by at least 48 hours. RESULTS: Repeated measures analysis revealed a frequency x load x phase interaction, p=.001. When separate analyses where done by training phase, no significant differences where found at baseline. During exercise there was a significant vibration x load interaction (p = .001). Examining vibration conditions we found that during NV, 40%BW produced significantly higher VO2 than 20% or 0%BW (p < .001); during 35L, 40% and 20%BW produced significantly higher VO2 than 0%BW (p < .001); and at 50H, 40%BW produced significantly higher VO2 than 20%BW (p = .003) or 0%BW (p = .001) and 20%BW produced significantly higher VO2 than 0%BW (p = .014). Analysis by load revealed that at 20%BW, NV produced significantly lower VO2 than 50H (p = .046) or 35L (p = .040). Post exercise there was a significant main effect for load (p < .001), with VO2 at 40%BW being significantly higher than 20%BW (p = .007) and 0 %BW (p = .001), and VO2 at 20% BW producing significantly higher VO2 than 0%BW (p = .012). Analysis across time showed that during recovery minutes one and two, 40%BW produced significantly higher VO2 than 20% (p<.01) or 0%BW (p < .05), and VO2 at 20%BW was greater than at 0%BW (p < .02). During minute three, 40%BW (p = .010) and 20%BW (p = .007) produced significantly higher VO2 than 0%BW; while for minute four, 40%BW produced a significantly higher VO2 than 20%BW (p = .012) and 0%BW (p = .001).
CONCLUSION: For WBV to effectively increase oxygen consumption, an external load is required. However, WBV significantly increases oxygen consumption under moderate loading conditions making it an effective tool for increasing caloric output in persons with low fitness levels who would use these lower loads during training.

Research - Health & Wellness

Vissers, D., A. Verrijken, I. Mertens, C. van Gils, A. van de Sompel, S. Truijen, and L. van Gaal.
Effect of long-term whole body vibration training on visceral adipose tissue: A preliminary report. *Obesity Facts. The European Journal of Obesity.* Vol. 3(2). 2010..

Abstract:
Aim: To determine the effect of whole body vibration (WBV), combined with caloric restriction, on weight, body composition and metabolic risk factors in overweight and obese adults.
Methods: A randomized, controlled study with a 6-month intervention period and a 6-month 'no intervention' follow-up. 61 of the 79 participants completed the study. Data were collected at baseline and at 3, 6 and 12 months in the control group (CONTROL), the diet only group (DIET), the diet plus fitness group (FITNESS) and the diet plus WBV group (VIBRATION).
Results: Weight decreased significantly in all three intervention groups. Only FITNESS and VIBRATION managed to maintain a weight loss of 5% or more in the long term.

Visceral adipose tissue (VAT) changed most in VIBRATION: –47.8 ± 41.2 and –47.7 ± 45.7 cm^2 after 6 and 12 months respectively compared to CONTROL (–3.6 ± 20.5 or +26.3 ± 30.6 cm^2), DIET (–24.3 ± 29.8 or –7.5 ± 28.3 cm^2) and FITNESS (–17.6 ± 36.6 or –1.6 ± 33.3 cm2) ($p < 0.001$).

Conclusions: Combining aerobic exercise or WBV training with caloric restriction can help to achieve a sustained long-term weight loss of 5–10%. These preliminary data show that WBV training may have the potential to reduce VAT more than aerobic exercise in obese adults, possibly making it a meaningful addition to future weight loss programs.

Bautmans, I., E. van Hees, J. Lemper, and T. Mets.
The feasibility of whole body vibration in institutionalized elderly persons and its influence on muscle performance, balance and mobility: a randomized, controlled trial. *BMC Geriatrics. Dec; 5:17.* 2005.

Abstract:
Background: Fatigue or lack of interest can reduce the feasibility of intensive physical exercise in nursing home residents. Low-volume exercise interventions with similar training effects might be an alternative. The aim of this randomised controlled trial was to investigate the feasibility of Whole Body Vibration (WBV) in institutionalised elderly, and its impact on functional capacity and muscle performance.
Methods: Twenty-four nursing home residents (15 female, 9 male; mean age 77.5 ± 11.0 years) were randomised (stratification for age, gender and ADL-category) to 6 weeks static WBV exercise (WBV+, N = 13) or control (only static exercise; N = 11). Outcome measures were exercise compliance, timed up-and-go, Tinetti-test, back scratch, chair sit-and-reach, handgrip strength and linear isokinetic leg extension.
Results: At baseline, WBV+ and control groups were similar for all outcome variables. Twenty-one participants completed the program and attended respectively 96% and 86% of the exercise sessions for the WBV+ and control groups. Training-induced changes in timed up-and-go and Tinetti-test were better for WBV+ compared to control ($p = 0.029$ for timed up-and-go, $p = 0.001$ and $p = 0.002$ for Tinetti body balance and total score respectively). In an alternative analysis (Worst Rank Score & Last Observation Carried Forward) the differences in change remained significant on the Tinetti body balance and total score. No other significant differences in change between both groups were observed.

Conclusion: In nursing home residents with limited functional dependency, six weeks static WBV exercise is feasible, and is beneficial for balance and mobility. The supplementary benefit of WBV on muscle performance compared to classic exercise remains to be explored further.

Bastian, J., C. Trittel, and W. Franz.
Vibrationstraining nach vorderer Kreuzbandplastik. *Deutsche Zeitschrift fur Sportmedizin. Vol. 56, no. 7/8, pp: 228.* 2004.

Abstract:
Background: A major problem after reconstruction of the anterior cruciate ligament of the knee is the weakness of the M. quadriceps femoris. The aim of this study was to examine the effects of an additional whole body vibration (WBV) on a platform training in these patients. Different positive effects of this kind of training are still investigated: Whole body vibration leads to an increased co-activation of lower extremity extensor and flexor muscles, positive effects on joint stabilization, increased blood flow.
Methods and Results: The WBV group trained two times weekly for ten weeks with beginning in the third week posttreatment. The results show, that the group with additional WBV-training had six weeks postoperative no significant reduction of the muscle thickness 10 and 20 cm proximal the patella as the control group did. As a second effect, these group reached more contentness.

Conclusion: An additional whole body vibration exercise is an effective training after acl-reconstruction in young patients and sportsmen.

Bogaerts, A., C. Delecluse, A. Claessens, W. Coudyzer, S. Boonen, and S. Verschueren.
Impact of Whole-Body Vibration Training Versus Fitness Training on Muscle Strength and Muscle Mass in Older Men: A 1-Year Randomized Controlled Trial. *Journal of Gerontology: Medical Sciences. Vol. 62A, No. 6, pp: 630–635.* 2007.

Abstract:
Background. This randomized controlled study investigated the effects of 1-year whole-body vibration (WBV) training on isometric and explosive muscle strength and muscle mass in community-dwelling men older than 60 years.
Methods. Muscle characteristics of the WBV group (n¼ 31, 67.3 6 0.7 years) were compared with those of a fitness (FIT) group (n ¼ 30, 67.4 6 0.8 years) and a control (CON) group (n ¼ 36, 68.6 6 0.9 years). Isometric strength of the knee extensors was measured using an isokinetic dynamometer, explosive muscle strength was assessed using a counter movement jump, and muscle mass of the upper leg was determined by computed tomography.
Results. Isometric muscle strength, explosive muscle strength, and muscle mass increased significantly in the WBV group (9.8%, 10.9%, and 3.4%, respectively) and in the FIT group (13.1%, 9.8%, and 3.8%, respectively) with the training effects not significantly different between the groups. No significant changes in any parameter were found in the CON group.

Conclusion. WBV training is as efficient as a fitness program to increase isometric and explosive knee extension strength and muscle mass of the upper leg in community-dwelling older men. These findings suggest that WBV training has potential to prevent or reverse the age-related loss in skeletal muscle mass, referred to as sarcopenia.

Bogaerts, A., S. Verschueren, C. Delecluse, A. Claessens, and S. Boonen.
Effects of whole body vibration training on postural control in older individuals: A 1 year randomized controlled trial. *Gait & Posture. Vol. 26, pp: 309–316.* 2007.

Abstract:
his randomized controlled trial investigated the effects of a 12 month whole body vibration training program on postural control in healthy older adults. Two hundred and twenty people were randomly assigned to a whole body vibration group (n = 94), a fitness group (n = 60) or a control group (n = 66). The whole body vibration and fitness groups trained three times a week for 1 year. The vibration group performed exercises on a vibration platform and the fitness group performed cardiovascular, strength, balance and stretching exercises.
Balance was measured using dynamic computerized posturography at baseline and after 6 and 12 months. Whole body vibration training was associated with reduced falls frequency on a moving platform when vision was disturbed and improvements in the response to toes down rotations at the ankle induced by the moving platform.
The fitness group showed reduced falls frequency on the moving surface when vision was disturbed.

Bogaerts, A.C.G., C. Delecluse, A. L. Claessens, T. Troosters, S. Boonen, and S.M.P. Verschueren.
Effects of whole body vibration training on cardiorespiratory fitness and muscle strength in older individuals (A 1-year randomised controlled trial). *Age and Ageing. Vol. 38(4), pp: 448-454.* 2009.

Abstract:
Background: whole body vibration (WBV) training appears to be an efficient alternative for conventional resistance training in older individuals. So far, no data exist about the vibratory effect on cardiorespiratory fitness.
Objectives: this randomised controlled trial assessed the effects of 1-year WBV training on cardiorespiratory fitness and muscle strength in community-dwelling adults over the age of 60.
Methods: a total of 220 adults (mean age 67.1 years) were randomly assigned to a WBV group, fitness group or control group. The WBV group exercised on a vibration platform, and the fitness group performed cardiovascular, resistance, balance and stretching exercises. The control group did not participate in any training. Heart rate was measured during a single WBV session. Peak oxygen uptake (VO2peak) and time-to-peak exercise (TPE) were measured during progressive bicycle ergometry. Muscle strength was assessed by a dynamometer.
Results: heart rate increased significantly during WBV training. After 1 year, VO2peak, TPE and muscle strength increased significantly in the WBV and fitness groups. Both training groups improved similarly in VO2peak and muscle strength. The fitness group improved significantly more in TPE than the WBV group.

Conclusion: WBV training in community-dwelling elderly appears to be efficient to improve cardiorespiratory fitness and muscle strength.

Fjeldstad, C., I.J. Palmer, M.G. Bemben, and D.A. Bemben.
Whole-body vibration augments resistance training effects on body composition in postmenopausal women. *Maturitas.* Vol. 63, pp: 79-83. 2009.

Abstract:
Age-related changes in body composition are well-documented with a decrease in lean body mass and a redistribution of body fat generally observed. Resistance training alone has been shown to have positive effects on body composition, however, these benefits may be enhanced by the addition of a vibration stimulus. Objective: The purpose of this study was to determine the effects of 8 months of resistance training with and without whole-body vibration (WBV) on body composition in sedentary postmenopausal women.
Methods: Fifty-five women were assigned to resistance only (RG, n = 22), vibration plus resistance (VR, n = 21) or non-exercising control (CG, n = 12) groups. Resistance training (3 sets 10 repetitions 80% strength) was performed using isotonic weight training equipment and whole-body vibration was done with the use of the power plate (Northbrooke, IL) vibration platform for three times per week for 8 months. Total and regional body composition was assessed from the total body DXA scans at baseline (pre) and after 8 months (post) of training.
Results: In the VR group, total % body fat decreased from pre- to post-time points ($p < 0.05$), whereas, the CG group had a significant increase in total % body fat ($p < 0.05$). Both training groups exhibited significant increases in bone free lean tissue mass for the total body, arm and trunk regions from pre to post ($p < 0.05$). CG did not show any changes in lean tissue.

Conclusion: In older women, resistance training alone and with whole-body vibration resulted in positive body composition changes by increasing lean tissue. However, only the combination of resistance training and whole-body vibration was effective for decreasing percent body fat.

Frank, H., B. Moos, A. Kaufmann, and A. Herber.
Anti Cellulite Untersuch. *SANADERM Professional Clinic for Skin Illnesses and Allergies, Bad Mergentheim, Germany.* 2003.

Abstract:
The test subjects were divided into three groups. One group trained exclusively on the Power Plate, another performed additional cardio-exercises and the third group, serving as a control group, did not perform any training at all.
All of the subjects were tested and measured at the beginning of the study. The data compiled were their measure of cellulite, the VO2-max (maximum oxygen volume used per minute during physical exertion), the circumference of their calves, posterior and upper leg as well as Biospace measurements such as body fluids, muscle mass, fat free body mass, total body weight and the fat percentage. All measurements were repeated after 3 and 6 months.
The results were as follows:
In the most important parameter (the degree of cellulite) an average reduction of 25,68 percent was achieved in the Power Plate group, after a total of 11 hours of Power Plate training (in sessions of 10 minutes over a period of 6 months).
In the group performing additional cardio-exercises the average reduction achieved was 32,30 percent, after a total of 40 hours of training (in sessions of 45 minutes over a period of 6 months). In the control group no significant changes were observed.
Both in the Power Plate group and the additional cardio-group, a slight reduction in all of the Biospace measurements could be detected, however these changes were not significant. In the control group, though this was a very small number of people, a slight increase in Biospace measurements was observed, specifically in the fat percentage (av. 2,3 percent).
A relatively clear reduction in the size of the posterior, the major problem zone for cellulite, is most impressive in both the Power Plate group (around 3,17 percent) and the additional cardio-group (around 3,44 percent), while sizes remained practically unchanged with the control group. In the VO2max data a clear increase of about 7,69 percent was observed in the Power Plate group, which entails a measurable advance in physical fitness.
Cellulite is firstly an aesthetical problem. This is why the degree of cellulite should be considered the most important factor in judging the effectiveness of Power Plate training.

Reviewing the results of this research we consider the Power Plate an effective method to clearly diminish the degree of severity of cellulite without any negative side effects.

Carols, Christi, Pilar S. Collaso, Sara Marquez, Nuria Garatachea, and Maria J. Cuevas.
Whole-body vibration training increases physical fitness measures without alteration of inflammatory markers in older adults. *Journal of Human Hypertension (2014) 28, 118–122; doi:10.1038/jhh.2013.59; published online 4 July 2013.*

*A*bstract
This study investigated in older adults whether whole-body vibration (WBV) training results in significant increases of physical fitness measures without alterations in markers of inflammation. Sixteen volunteers completed a WBV programme 3 d.wk–1 during 9 weeks. The programme consisted of lower and upper-body unloaded static and dynamic exercises.Training improved significantly several tests which evaluate physical fitness, such as 30-s chair stand, arm curl or chair sit and reach test. There was a significant increase in maximal voluntary isometric contraction (MVIC) between pre- and posttraining conditions. Muscle power values, reached at 20, 40 and 60% MVIC, were also significantly greater after training. However, mRNA or protein levels for C-reactive protein, interleukin-6, interleukin-1β, tumour necrosis factor-α and interleukin-10 did not significantly differ from basal values.

Our data confirm the usefulness of WBV training for counteracting the loss of muscle strength associated with sarcopenia in older adults and show that WBV training could be a safe training method which induces no inflammatory effects.

Figueroa, A, Kalfon, R., Madzima, T., and Wong, A.
Whole-body vibration exercise training reduces arterial stiffness in postmenopausal women with prehypertension and hypertension. Menopause: The Journal of The North American Menopause Society Vol. 21, No. 2, pp. 131/136

Abstract
Objective: The purpose of this study was to examine the impact of whole-body vibration (WBV) exercise training on arterial stiffness (pulse wave velocity [PWV]), blood pressure (BP), and leg muscle function in postmenopausal women.
Methods: Twenty-five postmenopausal women with prehypertension and hypertension (mean [SE]; age, 56 [1] y; systolic BP, 139 [2] mm Hg; body mass index, 34.7 [0.8] kg/m2) were randomized to 12 weeks of WBV exercise training (n = 13) or to the no-exercise control group. Systolic BP, diastolic BP, mean arterial pressure, heart rate, carotid-femoral PWV, brachial-ankle PWV, femoral-ankle PWV (legPWV), leg lean mass, and leg muscle strength were measured before and after 12 weeks.
Results: There was a group-by-time interaction (P G 0.05) for arterial stiffness, BP, and strength as brachial-ankle PWV (j1.3 [0.3] m/s, P G 0.01), legPWV (j0.81 [0.22] m/s, P G 0.01), systolic BP (j12 [3] mm Hg, P G 0.01), diastolic BP (j6 [2] mm Hg, P G 0.01), and mean arterial pressure (j9 [3] mm Hg, P G 0.01) decreased and as strength increased (21.0% [2.2%], P G 0.001) after WBV exercise training compared with no change after control. Heart rate decreased (j3 [1] beats/min, P G 0.05) after WBV exercise training, but there was no interaction (P 9 0.05). Leg lean mass and carotid-femoral PWV were not significantly (P 9 0.05) affected by WBV exercise training or control.

Conclusions: Our findings indicate that WBV exercise training improves systemic and leg arterial stiffness, BP, and leg muscle strength in postmenopausal women with prehypertension or hypertension. WBV exercise training may decrease cardiovascular and disability risks in postmenopausal women by reducing legPWV and increasing leg muscle strength.

Joosen, M., J. Sluiter, C. Joling, and M. Frings-Dresen.
Evaluation of the effects of a training programme for patients with prolonged fatigue on physiological parameters and fatigue complaints. *International Journal of Occupational Medicine and Environmental Health. Vol. 21(3), pp: 237-246.* 2008.

Abstract:
Objectives: Complaints of prolonged fatigue are considered as a major health problem, as it can affect daily functioning and may lead to work disability. To increase knowledge about the effectiveness of interventions focussing on fatigued patients, a study was designed to evaluate an established training programme for patients with prolonged fatigue.
Materials and Methods: Eighteen patients who reported fatigue to be one of their major health complaints and who were suffering from functional impairments attended a training programme of six weeks, three times a week. The training consisted mainly of physical endurance training, relaxation therapy and breathing exercises in rest. At baseline, time- and frequency-domain measures of heart rate variability (HRV) and respiration rate measurements were recorded during rest and dur¬ing recovery after bicycle exercise. Furthermore, fatigue complaints were assessed with the Checklist Individual Strength (CIS). These measurements were repeated at three weeks and six weeks from baseline.
Results: After three weeks, HRV increased significantly in rest — SDNN, i.e. standard deviation of normal beat-to-beat intervals (p = 0.02), very low frequency (p = 0.04) and low frequency (p = 0.04) — and showed a positive trend in the remaining HRV components. No significant HRV changes during recovery were found. Respiration rate decreased significantly after six weeks during rest (from 11.8, SD = 4.65 to 8.1, SD = 2.57 b×min-1) and during recovery (from 15.1, SD = 4.90 to 10.4, SD = 2.97 b×min-1). In all patients, CIS scores decreased after six weeks training (from 106, SD = 13.3 to 78, SD = 21.8, p = 0.001).

Conclusions: The results suggest that a six-week training programme has a beneficial effect on physiological and subjective parameters in patients with severe complaints of fatigue.

Melnyk, M., B. Kofler, M. Faist, M. Hodapp, and A. Gollhofer.
Effect of a Whole-Body Vibration session on knee stability. *International Journal of Sports Medicine. Vol. 29(10), pp: 839-844.* 2008.

Abstract:
The aim of the study was to investigate the effect of WBV on stretch reflexes involved in knee joint control. We evoked stretch reflexes of the hamstring muscles by inducing an anterior tibial translation during standing in 23 healthy subjects which were divided into a control and an intervention group. WBV with a frequency of 30 Hz and a vertical amplitude of 4mmwas induced by an uniformly oscillating platform. The WBV session lasted 60 seconds and was repeated twice. Short (SLR) and medium latency responses (MLR) of the hamstring muscles and maximum tibia translation were assessed using surface EMG and linear potentiometers. While there were no significant changes in latency, the size of the lateral and medial hamstring SLR was significantly increased after WBV (p = 0.039 and p = 0.043, respectively). No significant differences were found for the hamstring MLR size after WBV. Maximum tibial translation was significantly decreased after WBV (p = 0.031).

Our results suggest that single WBV exposure has a positive effect on knee joint stability as a short-term adaptation on neuromuscular level. This appears to be directly associated with an increase of hamstring SLR size in response to the anterior tibial movement which may cause the decrease in anterior tibial translation.

Moezy, A., G. Olyaei, M. Hadian, M. Razi, and S. Faghihzadeh.
A comparative study of whole body vibration training and conventional training on knee proprioception and postural stability after Anterior Cruciate Ligament reconstruction. *British Journal of Sports Medicine. Vol. 42(5). pp: 373-378.* 2008.

Abstract:
Objective: To determine the effect of whole body vibration training program (WBVT) in comparison with conventional training (CT) program on knee proprioception and postural stability after anterior cruciate ligament (ACL) reconstruction.
Methods: Twenty athletes with unilateral ACL reconstruction were randomly assigned in two groups; WBVT and CT, all participants received 12 sessions of WBVT or conventional training. Absolute error in joint repositioning test in two target angles (30° and 60°) with Biodex dynamometer, bilateral dynamic postural stability (anteroposterior, mediolateral and overall stability indices) with Biodex Stability System were measured pre and post intervention.
Results: The improvement of postural stability in the WBVT group was significantly greater than CT group ($p \leq 0.05$). The p values of the changing scores of open overall, open anteroposterior, open mediolateral, closed overall, closed anteroposterior and closed mediolateral stability indices were respectively 0.002, 0.010, 0.0001, 0.001, 0.0001, and 0.046.
In addition, there were significant differences in all averages of absolute angular error at 60° and 30 ° between WBVT and CT groups in both knees (p values were respectively 0.001, 0.001, 0.0001), with exception , the healthy knees, at 30 ° target position which was not significant ($p = 0.131$).

Conclusions: Whole body vibration training improved proprioception and balance in ACL reconstructed athletes.

Ness, L.L., and E.C. Field-Note.
Effect of whole-body vibration on quadriceps spasticity in individuals with spastic hypertonia due to spinal cord injury. *Restorative Neurology and neuroscience. Vol. 27, pp: 623-633.* 2009.

Abstract:
Purpose: Individuals with spinal cord injury (SCI) often have involuntary, reflex-evoked muscle activity resulting in spasticity. Vibration may modulate reflex activity thereby decreasing spasticity. This study suggests feasibility of using whole-body vibration (WBV) to decrease quadriceps spasticity in individuals with SCI.
Methods: Participants were individuals (n = 16) with spastic quadriceps hypertonia due to chronic SCI (> 1 year). Quadriceps spasticity was measured by gravity-provoked stretch (Pendulum Test) before (initial) and after (final) a 3 day/week, 12-session WBVintervention. In addition, differences between immediate (immediate post-WBV) and delayed (delayed post-WBV) withinsession effects were quantified. Finally, we assessed response differences between subjects who did and those who did not use antispastic agents.
Results: There was a significant reduction in quadriceps spasticity after participation in a WBV intervention that persisted for at least eight days. Within a WBV session, spasticity was reduced in the delayed post-WBV test compared to the immediate post-WBV test. The WBV intervention was associated with similar changes in quadriceps spasticity in subjects who did and those who did not use antispastic agents.

Conclusions: Vibration may be a useful adjunct to training in those with spasticity. Future studies should directly compare the antispastic effects of vibration to those of antispastic agents.

Ness, L.L., and E.C. Field-Note.
Whole-body vibration improves walking function in individuals with spinal cord injury: A pilot study. *Gait & Posture. Vol. 30(4), pp: 436-440.* 2009.

Abstract:
Injury to the central nervous system often results in impairments that negatively affect walking function. Prior evidence suggests that vibration may improve walking function. The purpose of this study was to determine whether repeated use of whole-body vibration (WBV) is associated with improvements in walking function in individuals with spinal cord injury (SCI). Subjects were 17 individuals with chronic (≥1 year), motor-incomplete SCI. Subjects were tested before and after participation in a 12-session (3days/week for 4 weeks) intervention of WBV. We assessed change in walking function via 3D motion capture, with walking speed as the primary outcome measure. We also assessed the influence of the WBV intervention on secondary gait characteristics, including cadence, step length, and hip-knee intralimb coordination. Walking speed increased by a mean of 0.062 ± 0.011 m/s, a change that was statistically significant ($p < 0.001$). The WBV intervention was also associated with statistically significant increases in cadence, and both the stronger and weaker legs exhibited increased step length and improved consistency of intralimb coordination. Changes in cadence and step length of the stronger leg were strongly correlated with improvements in walking speed. The improvement in walking speed observed with the WBV intervention was comparable to that reported in the literature in association with locomotor training. This magnitude of change has been identified as being clinically meaningful, even in non-clinical populations.

These findings suggest WBV may be useful to improve walking function with effects that may persist for some time following the intervention.

Otsuki, T., Y. Takanami, W. Aoi, Y. Kawai, H. Ichikawa, and T. Yoshikawa.
Arterial stiffness acutely decreases after whole-body vibration in humans. *Acta Physiologica. Vol. 194(3), pp: 189-194.* 2008.

Abstract:
Background: Increased arterial stiffness is a well-established cardiovascular risk factor. Mechanical stimuli to artery, such as compression, elicit vasodilation and acutely decrease arterial stiffness. As whole-body vibration (WBV)-induced oscillation is propagated at least to lumbar spine, WBV mechanically stimulates abdominal and leg arteries and may decrease arterial stiffness. WBV is feasible in vulnerable and immobilized humans. Therefore, it is worthwhile to explore the possibility of WBV as a valuable adjunct to exercise training.
Aim: The aim of this study was to investigate the acute effects of WBV on arterial stiffness.
Methods: Ten healthy men performed WBV and control (CON) trials on separate days. The WBV session consisted of 10 sets of vibration (frequency, 26 Hz) for 60 s with an inter-set rest period of 60 s. Subjects maintained a static squat position with knees bent on a platform. In the CON trial, WBV stimulation was not imposed. Blood pressure, heart rate and brachial-ankle pulse wave velocity (baPWV), an index of arterial stiffness, were measured
before and 20, 40 and 60 min after both trials. Results and conclusion: Heart rate and blood pressure did not change from baseline after both trials. Although baPWV did not change in the CON trial (baseline vs. after 20, 40 and 60 min; 1144 ± 35 vs. 1164 ± 41, 1142 ± 39, and 1148 ± 34 cm/s), baPWV decreased 20 and 40 min after the WBV trial and recovered to baseline 60 min after the trial (1137 ± 28 vs. 1107 ± 30, 1108 ± 28, and 1128 ± 25 cm/s).

These results suggest that WBV acutely decreases arterial stiffness.

Roelants, M., C. Delecluse, and S. Verschueren.
Whole-Body-Vibration Training Increases Knee-Extension Strength and Speed of Movement in Older Women. *Journal of the American Geriatric Society. Vol. 52, pp: 901-908.* 2004.

Abstract:
Objectives: To investigate the effects of 24 weeks of whole-body-vibration (WBV) training on knee-extension strength and speed of movement and on counter-movement jump performance in older women.
Design: A randomized, controlled trial.
Setting: Exercise Physiology and Biomechanics Laboratory, Leuven, Belgium
Participants: Eighty-nine postmenopausal women, off hormone replacement therapy, aged 58 to 74, were randomly assigned to a WBV group (n = 30), a resistance training group (RES, n = 30), or a control group (n = 29).
Intervention: The WBV group and the RES group trained three times a week for 24 weeks. The WBV group performed unloaded static and dynamic knee-extensor exercises on a vibration platform, which provokes reflexive muscle activity. The RES group trained knee-extensors by performing dynamic leg-press and leg-extension exercises increasing from low (20 repetitions maximum (RM)) to high (8RM) resistance. The control group did not participate in any training.
Measurements: Pre-, mid- (12 weeks), and post- (24 weeks) isometric strength and dynamic strength of knee extensors were measured using a motor-driven dynamometer. Speed of movement of knee extension was assessed using an external resistance equivalent to 1%, 20%, 40%, and 60% of isometric maximum. Counter-movement jump performance was determined using a contact mat.
Results: Isometric and dynamic knee extensor strength increased significantly ($P < .001$) in the WBV group (mean ± standard error 15.0 ± 2.1% and 16.1 ± 3.1%, respectively) and the RES group (18.4 ± 2.8% and 13.9 ± 2.7%, respectively) after 24 weeks of training, with the training effects not significantly different between the groups ($P = .558$). Speed of movement of knee extension significantly increased at low resistance (1% or 20% of isometric maximum) in the WBV group only (7.4 ± 1.8% and 6.3 ± 2.0%, respectively) after 24 weeks of training, with no significant differences in training effect between the WBV and the RES groups ($P = .391$; P5.142). Countermovement jump height enhanced significantly ($P < .001$) in the WBV group (19.4 ± 2.8%) and the RES group (12.9 ± 2.9%) after 24 weeks of training. Most of the gain in knee-extension strength and speed of movement and in counter-movement jump performance had been realized after 12 weeks of training.

Conclusion: WBV is a suitable training method and is as efficient as conventional RES training to improve knee-extension strength and speed of movement and counter-movement jump performance in older women. As previously shown in young women, it is suggested that the strength gain in older women is mainly due to the vibration stimulus and not only to the unloaded exercises performed on the WBV platform.

Andrew P. Koutnik, Alexei Wong, Roy Kalfon, Takudzwa A. Madzima, Arturo Figueroa
Acute passive vibration reduces arterial stiffness and aortic wave reflection in stroke survivors. *Eur J Appl Physiol (2014) 114:105–111.*

Abstract:
Purpose Impaired leg arterial stiffness (pulse wave velocity,PWV) and vasodilatory function are found after stroke. Acute passive vibration (PV) decreases leg PWV (leg-PWV) and pressure wave reflection (aortic augmentation index, aAIx) in healthy men. Our objective was to evaluate the effects of acute PV on aAIx and PWV in the paretic and non-paretic sides in stroke survivors. Methods Eleven stroke survivors (4 females) were randomized to either no-PV (control) or PV (25 Hz and 2 mm amplitude) trials on two separated visits. Following 20 min of supine rest with legs on a vibration platform, blood pressure, PWV, and aAIx were gathered before 10 continuous minutes of control or PV. Measurements were repeated at post-5, post-15, and post-30 min after control or PV. Results L egPWV and brachial-ankle PWV (baPWV, systemic stiffness) in paretic and non-paretic sides along with aAIx were significantly ($P < 0.05$) decreased from baseline at post-5 min after PV compared with control. At post-15 min, paretic and non-paretic legPWV remained significantly lower than baseline, but only non-paretic legPWV was different from control. We noted correlations between changes in paretic legPWV and changes in paretic baPWV ($r = 0.47$, $P = 0.028$) and aAIx ($r = 0.51$, $P = 0.017$) at post-5 min.

Conclusions Acute PV applied to the legs of stroke survivors reduces systemic arterial stiffness and aortic wave reflection due to a reduction in leg arterial stiffness, which last longer in the non-paretic than in the paretic leg.

Figueroa, A., Gill, R., Sanchez-Gonzalez, M.
Whole-body vibration attenuates the increase in leg arterial stiffness and aortic systolic blood pressure during post-exercise muscle ischemia. *Eur J Appl Physiol*.

Abstract
Exercise with whole-body vibration (WBV) decreases brachial-ankle pulse wave velocity (baPWV), a marker of systemic arterial stiffness. To examine the effect of WBV on arterial responses, 12 young men underwent three experimental trials: (1) no-exercise control (CON), (2) static squat with WBV, and (3) static squat without WBV (no-WBV). Bilateral baPWV and femoral-ankle PWV (faPWV), carotid-femoral PWV (cfPWV), augmentation index (AIx), first (P1) and second (P2) systolic peaks, aortic systolic blood pressure (aSBP), and heart rate (HR) were assessed at rest, during 4-min post-exercise muscle ischemia (PEMI) on the left thigh, and 4-min recovery. During PEMI, right faPWV increased (P\0.05) after no-WBV and did not change after CON and WBV. Right baPWV, P2, and aSBP increased (P\0.05) after both exercise trials, but the increase was lower (P\0.05) after WBV than no-WBV. The increases in cfPWV (P\0.05), AIx (P\0.05), P1 (P\0.01), and HR (P\0.05) were similar in both trials during PEMI. During recovery, right faPWV and baPWV remained similar than rest after WBV and CON, but remained elevated (P\0.05) after no-WBV. Aortic SBP, P1, and P2 remained elevated (P\0.05) in both exercise trials during recovery, but the levels were lower (P\0.05) than PEMI. Left faPWV and baPWV were reduced (P\0.05) from rest in the three trials. CfPWV, AIx, and HR returned to resting levels in both exercises. WBV prevents the increases in faPWV and attenuates the increase in baPWV and aSBP induced by post-static squat muscle ischemia due to an attenuated P2 response.

Vissers, D., J-P Baeyens, S. Truijen, K. Ides, C-C Vercruysse, and L. van Gaal.
The effect of whole body vibration short-term exercises on respiratory gas exchange in overweight and obese women. *The Physician and Sportsmedicine, Vol. 37(3), pp: 88-94.* 2009.

Abstract:
Aims: To assess the effect of whole body vibration on oxygen uptake and carbon dioxide production among overweight and obese women.
Methods: In a controlled randomized trial, anthropometric measurements were taken in 20 adult overweight women. Ventilation of oxygen, carbon dioxide, and heart rate were measured using a portable gas-analysis system. After each exercise, a Borg's scale score was assessed. Exercises were performed on a vibration platform with a frequency of 35 Hz and with the intensity set on "high" (amplitude of 4 mm). Two dynamic exercises (squatting and calf raises) and one static exercise (standing) were performed during 3 minutes with and without vibration in a randomized order, with 10 minutes rest between exercises. Mean values of the third minute of exercise were compared.
Results: Ventilation of oxygen and carbon dioxide were consistently, significantly higher in the exercises with vibration compared with the exercises without vibration. Borg's scale scores only showed a significant difference between calf raises with and without vibration.

Conclusion: The addition of whole body vibration to both static and dynamic exercises appears to significantly increase oxygen uptake in overweight and obese women. More research is needed to determine the physiological pathway and clinical relevance of this increase.

Daniel Robbins, Clare Elwell, Alfonso Jimenez and Mark Goss-Sampson
Localized muscle tissue oxygenation during dynamic exercise with whole body vibration. *Journal of Sports Science and Medicine (2012) 11, 346-351.*

Abstract
Despite increasing use of whole body vibration during exercisean understanding of the exact role of vibration and the supporting physiological mechanisms is still limited. An important aspect of exercise analysis is the utilisation of oxygen, however, there have been limited studies considering tissue oxygenation parameters, particularly during dynamic whole body vibration (WBV) exercise. The aim of this study was to determine the effect of adding WBV during heel raise exercises and assessing changes in tissue oxygenation parameters of the lateral gastrocnemius using Near Infra Red Spectroscopy (NIRS). Twenty healthy subjects completed ten alternating sets of 15 heel raises (vibration vs. no vibration). Synchronous oxygenation and motion data were captured prior to exercise to determine baseline levels, for the duration of the exercise and 20 sec post exercise for the recovery period. Both vibration and no vibration conditions elicited a characteristic increase in deoxyhaemoglobin and decreases in oxyhaemoglobin, total haemoglobin, tissue oxygenation index and normalised tissue haemoglobin index which are indicative of local tissue hypoxia. However, the addition of vibration elicited significantly lower ($p < 0.001$) depletions in oxyhaemoglobin, total haemoglobin, normalised tissue haemoglobin index but no significant differences in deoxyhaemoglobin. These findings suggest that addition of vibration to exercise does not increase the cost of the exercise for the lateral gastrocnemius muscle, but does decrease the reduction in local muscle oxygenation parameters, potentially resulting from increased blood flow to the calf or a vasospastic response in the feet. However, further studies are needed to establish the mechanisms underlying these findings.

A Figueroa, R Kalfon, TA Madzima and A Wong
Effects of whole-body vibration exercise training on aortic wave reflection and muscle strength in postmenopausal women with prehypertension and hypertension. *Journal of Human Hypertension (2014)*

Abstract:
Increased wave reflection (augmented pressure (AP) and augmentation index (AIx)) and reduced muscle strength may increase cardiovascular risk in postmenopausal women. We evaluated the effects of whole-body vibration exercise training (WBVET) on aortic haemodynamics and leg muscle strength. Twenty-eight postmenopausal women (age, 56±3 years; brachial systolic blood pressure (SBP) 138±12mmHg; body mass index, 33.9±3.7 kgm_2) were randomized to 6 weeks of WBVET (n1/415) or no-exercise control groups. Aortic SBP, diastolic blood pressure (DBP), pulse pressure (PP), AP, AIx, tension time index (TTI, myocardial oxygen demand) and leg press muscle strength were measured before and after 6 weeks. WBVET significantly (Po0.05) decreased aortic SBP (B10mmHg), DBP (B5mmHg), PP (B5mmHg), AP (B5mmHg), AIx (B10%) and TTI (B311mmHg s per minute), while increased muscle strength (B9%) compared with no changes after control. Changes in AP and leg muscle strength were correlated (r1/4 _0.58, P1/40.02). Our data demonstrated that WBVET reduced pressure wave reflection magnitude and aortic blood pressure in postmenopausal women with prehypertension or hypertension. Our study suggests that WBVET may decrease cardiovascular risk in postmenopausal women by improving wave reflection and muscle strength.

Xin Li, Xue-QiangWang, Bing-Lin Chen, Ling-Yan Huang, and Yu Liu
Whole-Body Vibration Exercise for Knee Osteoarthritis: A Systematic Review and Meta-Analysis. *Evidence-Based Complementary and Alternative Medicine (2015)*

Abstract:
Objectives. To assess the effects of WBV exercise on patients with KOA. Methods. Eight databases including Pubmed, EMBASE, Cochrane Library, CINAHL, Web of Science, the Physiotherapy Evidence Database, CNKI, and Wanfang were searched up to November 2014. Randomized controlled trials (RCTs) of WBV for KOA were eligible. The outcomes were pain intensity, functional performances, self-reported status, adverse events, and muscle strength. A meta-analysis was conducted. Results. Five trials with 168 participants provided data for the meta-analysis. No significant difference was shown in pain intensity and self-reported status betweenWBV and other forms of exercise. Improvement in functional performance (evaluated by BBS;WMD, 2.96; 95% CI, 1.29 to 4.62; = 0.0005) was greater inWBV group, but the other parameters of functional performance (including 6MWT and TGUG) revealed no statistically significant difference. Adverse events were only reported in one trial and no significant difference was discovered in muscle strength.The overall quality of evidence was very low.
Conclusion. Currently there is only limited evidence that suggested that WBV is effective in the treatment of KOA. Large, well-designed RCTs with better designs are needed.

Dan Robbins, Priya Yoganathan and Mark Goss-Sampson
The influence of whole body vibration on the central and peripheral cardiovascular system. *Clin Physiol Funct Imaging (2013)*

Abstract:
The purpose of this study was to investigate the physiological changes of the cardiovascular system in response to whole body vibration during quiet standing and identify whether there is a greater influence on the central or peripheral cardiovascular system. Twenty healthy participants (12 male and 8 female) were assessed over two separate testing sessions for changes in peripheral skin tempera- ture, peripheral venous function, blood flow velocity in the dorsalis pedis artery, blood pressure and heart rate during quiet standing with 40 Hz 19 mm synchronous vibration. Vibration exposure totalled 5 min in 1 min increments with 5 min recovery during each testing session. There were no significant changes in heart rate, blood pressure or peripheral skin temperature. Significant results were obtained for blood flow velocity with increases from 05 + 02 cms 1 at baseline to 1 + 02 cms 1 during vibration, returning to baseline levels during the recovery period. Due to the absence of changes in heart rate, blood pressure or lower leg and foot temperature, the change in blood flow velocity can be attributed to changes in peripheral vascular function. The results suggest a high level of sensitivity of the peripheral vascular system to vibration exposure; therefore, further studies should be completed to ascertain the physiological mechanisms underlying the effects of vibration on the peripheral vascular system.

Masaki Takadau, khiro Sekiya'. Young-Jiro Jut, Takeshi Muneta
Examination of the usefulness of whole body vibration training for functional improvement after total knee arthroplasty. *Japanese Journal of Rehabilitation*

We investigated the effectiveness of whole body vibration (WBV) after total knee arthroplasty (TKA). Patients were divided into the intervention group (WBV group n 15) and the control group (n= 15). As WBV intervention, we used a power plate (Power Plate International) at an frequency of 30 Hz at low amplitude. Postoperative physical therapy was performed five days a week by both groups. WBV was added before physiotherapy and done in 3 sets of 2 minutes in the first 1 week after surgery with sitting position. WBV was done in 2 sets of 30-second static squat and dynamic calf raise position after 1 week. Evaluation was performed preoperatively and postoperative at 2 weeks. We measured 7 items ; 10 in walking time. Timed Up and Go Test, climbing stairs time, perceived pain when climbing stairs, knee flexion and extension ranges of motion, and knee extensor strength. For statistical examination. The Mann-Whitney tl test was used. There was a significant difference in the pain. This suggests that WBV intervention reduces pain during the early phase after TKA.

Amano, H., Kuroda, S., Kanda, H., Shino, K., Nakata, K.
Immediate effect of whole body vibration training for dynamic balance of healthy adult volunteers. *Japan Clinical Sports Medicine Journal*

Abstract:
The purpose of this study was to clarify the immediate effect of whole body vibration training in comparison with conventional training on postural stability. (Material and Methods) Twelve healthy volunteers were randomly assigned in two groups WBV and CTL, all participants received 12 sessions of training with (WBV group) or without (CTL group) whole body vibration. Static and dynamic postural stability (single-leg standing with closed eye SS, forward single-leg drop jump F-SDJ, and lateral single-leg drop jump L-SDJ) with Force Plate were measured pre and post exercise at ses-sion 1, 6, and 12, respectively. (Results) The static and dynamic postural stability in the WBV group was significantly improved. In particular, at session 12 of the SS, session 6 of the L-SDJ, and sessions 6 and 12 of the F-SDJ and L-SDJ, total length of the centroid track was improved between the pre and post session. There were no significant differences between the WBV and CTL groups for the static postural stability.

Conclusion: WBV was effective in improving the balancing ability in healthy volunteers. In particularly, more difficult balancing was improved at an earlier stage.

Epilogue

Power Plate has achieved international recognition for its contribution to the fields of sports, wellness, rehabilation and medicine. The use of vibration technology continues to grow exponentially in both the fitness and medical communities.

The overwhelming support for Power Plate, from leading scientific researchers, performance institutes, world-famous athletes and everyday users shows that its effects are increasingly acknowledged and validated. This groundswell of support from so many different people means that even the sceptics can no longer ignore the irrefutable effects of vibration technology.

Vibration technology is a science with a rich future ahead of it, both in the sports and medical fields, to help increase performance and improve quality of life.

For more information or to share your thoughts with us, please contact us: info@powerplate.com

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