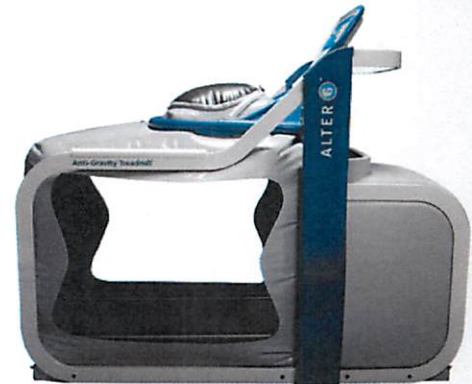


Summary of Clinical Research Involving The AlterG Anti-Gravity Treadmill®

By Dev K. Mishra, M.D.
Chief Medical Officer, AlterG Inc.
September 1, 2015



At AlterG, we are committed to proper scientific investigation of the potential clinical and athletic performance benefits of using our device. We are pleased to have multiple studies in clinically relevant areas currently underway by independent researchers at highly reputable institutions in the U.S. and Internationally.

Due to the large expansion of the number of installed AlterG Treadmills worldwide, many independently produced studies are proceeding without the knowledge of our company. We encourage researchers to make us aware of concluded studies for inclusion in future Research Summaries.

WHAT'S NEW:

- New published clinical research showing effectiveness of the AlterG Anti-Gravity Treadmill in muscular dystrophy, rehabilitation after total knee arthroplasty, high intensity interval speed training, and osteoarthritis
- New basic science research in cardiovascular and pulmonary physiology, including safe cardiovascular response for elderly individuals exercising after total knee arthroplasty
- An interesting first reported measurements of reduced markers of articular cartilage turnover using AlterG Anti-Gravity Treadmill walking.
- EMG comparison of AlterG Anti-Gravity Treadmill vs deep water running
- Multiple prospective clinical studies are continuing data acquisition, including a Level 1 RCT in rehabilitation after total knee arthroplasty.
- Initiating a large randomized trial of AlterG Anti-Gravity Treadmill vs pharmacologic cardiac stress testing in patients unable to do standard cardiac stress testing
- Additional user produced case studies were added to the website, bringing the total number of studies to 45.
- Additional Clinical Protocols were added to the website, now with 11 protocols.

Afzal, A, Kral, JG, Lazar, JM et al: The Effect Of Lower Body Weight Support On Arterial Wave Reflection in Healthy Adults. *Journal of The American Society of Hypertension* 8(6) (2014) 388–393

- Studied cardiovascular responses to AlterG Anti-Gravity Treadmill body weight support in 25 healthy males as a prelude to future studies in heart failure patients
- Heart rate decreased, mean arterial pressure unchanged, systolic pressure unchanged, diastolic pressure slight but not significant decrease

Berthelsen, MP, Husu, E, Christensen, SB, Prahm, KP, Vissing, J, Jensen, BR: Anti-Gravity Training Improves Walking Capacity and Postural Balance in Patients with Muscular Dystrophy. *Neuromuscul Disord* (2014), <http://dx.doi.org/10.1016/j.nmd.2014.03.001>

- Prospective training program for severely affected muscular dystrophy patients who are unable to do conventional exercise due to weakness
- Improvements in walking distance and dynamic postural balance in all patients
- Supported use of AlterG Anti-Gravity Treadmill as a safe and effective training modality for severely affected individuals with muscular dystrophy

Bugbee, WD, Colwell, CC, D'Lima, DD, et al: Use of An Antigravity Treadmill for Rehabilitation After Total Knee Arthroplasty. Presented at Ista 2013, and In Press: *Am J Orthop*.

- Prospective pilot study of 29 patients undergoing total knee arthroplasty
- Demonstrated safety and efficacy, with improvements in KOOS, TUG, and pain scores
- High level of compliance by patients with outstanding acceptance from physical therapists
- Foundation for large scale randomized clinical trial which is now underway

Buono, MJ et al: Alterations in the Rate of Limb Movement Using a Lower Body Positive Pressure Treadmill Do Not Influence Respiratory Rate or Phase III Ventilation. *Biomed Res Int*. 2015;2015:618291

- Physiologic study of ventilation correlated to walking speed

Denning, WM, Winward, JG, Pardo, MB, Hopkins, JT, Seeley, MK: Body Weight Independently Affects Articular Cartilage Catabolism. *Journal of Sports Science and Medicine* (2015) 14, 290-296

- In this interesting observational study, the authors measured serum cartilage oligomeric matrix protein (COMP)- a measure of cartilage catabolism. Participants were measured at their baseline unloaded condition, others were measured with a weighted vest adding 40% body weight, and others were measured on the AlterG Anti-Gravity Treadmill at -40% body weight
- Cardiovascular responses were also measured through heart rate and perceived exertion
- Changes to COMP were noted immediately during exercise
- Walking with unadjusted BW and increased BW resulted in measureable articular cartilage catabolism (via serum COMP); however, walking with decreased BW did not
- It is believed that sustained increases in COMP indicates cartilage breakdown
- AlterG Anti-Gravity Treadmill body weight support for walking may potentially benefit individuals who wish to simultaneously minimize knee joint load and maintain cardiovascular response

Gojanovic, B, Shultz, R, Feihl, F, Matheson, G: Overspeed HIIT In Lower Body Positive Pressure Treadmill Improves Running Performance. *Med Sci Sports Exerc*. 2015 May 15. [Epub ahead of print]

- The authors performed a 4 week prospective high intensity interval training program to assess improvements in running speed in trained high level runners
- Participants were randomized to standard treadmill training vs 10% body weight support on the AlterG Anti-Gravity Treadmill
- The 4 week HIIT protocol improved field performance, VO2 max, and submaximal heart rate
- The authors state that AlterG HIIT is an effective method to improve running performance while reducing potentially injurious joint loading seen in standard full body weight HIIT

Hatimiya, NS, Luke, AC: Utility of Offloaded Running Gait Retraining in a Runner with Medial Knee Osteoarthritis and A Varus Thrust: A Case Report. Presented at SWACSM 2013.

- Case report of a 57 y.o. male experienced marathon runner with severe knee pain and varus thrust from medial knee osteoarthritis.
- He undertook a 14 week training program on the AlterG Anti-Gravity Treadmill
- At conclusion of the training program, his pain was negligible when running at full body weight and 3-D gait analysis showed improvements in his varus thrust
- He was successfully able to run a marathon without pain at 4 months after training on the AlterG Anti-Gravity Treadmill

Lathan, C, Myler, A, Bagwell, J, Powers, CM, Fisher, BE: Pressure-Controlled Treadmill Training in Chronic Stroke: A Case Study with AlterG. *JNPT* 2015;39: 127-133

- Case study of 81 year old man, 14 months post stroke with poor ambulation and balance
- Trained 4x per week for 4 weeks
- Improved walking speed, stride length, walking kinematics, and reduced fall risk

McNeill, DKP, DeHeer, HD, Bounds, RG, Coast, JR: Accuracy of Unloading with The Anti-Gravity Treadmill. *J Strength Cond Res.* 2015 Mar;29(3):863-8

- This technical note shows that there is less than 5% difference between predicted and actual unloading with the most commonly used body weight unloading percentages from 90% to 40%

McNeill, DKP, Kline, JR, DeHeer, HD, Coast, JR: Oxygen Consumption of Elite Distance Runners on An Anti-Gravity Treadmill. *Journal of Sports Science and Medicine* (2015) 14, 333-339

- Measurement of V02 in elite distance runners across a number of speeds and body

- The results were consistent with prior research, which found that while running on an AlterG Anti-Gravity Treadmill 1) metabolic cost significantly decreases with increasing levels of BWS, 2) metabolic cost significantly increases with increasing velocity, and 3) there is attenuation in the decrease in metabolic cost as BWS increases.

- Outcomes in this study are consistent with previous studies performed in non-elite runners

Mercer, JA, Applequist, B, Masumoto, K: Muscle Activity During Running with Different Body Weight Support Mechanisms: Aquatic Environment Versus Body Weight Support Treadmill. *J Sport Rehabil.* 2014 Nov;23(4):300-6.

- Muscle activation in water is dependent on running style
- No difference in muscle activation of gastroc and tibialis anterior with any deep water running style vs. AlterG Anti-Gravity Treadmill
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Peeler, J, Christian, M, Cooper, J, Leiter, J, MacDonald, P: Managing Knee Osteoarthritis: The Effects of Body Weight Supported Physical Activity on Joint Pain, Function, and Thigh Muscle Strength. *Clin J Sport Med.* 2015 Jan 30. [Epub ahead of print].

- 12 week prospective non-randomized clinical trial
- Participants reported significant improvements in knee joint pain and function and demonstrated significant increases in thigh muscle strength.
- Significant reductions in acute knee pain during full weight bearing treadmill walking and required dramatically less LBPP support to walk pain free on the treadmill.
- Data suggest that an LBPP-supported low-load exercise regimen can be used to significantly diminish knee pain, enhance joint function, and increase thigh muscle strength, while safely promoting pain-free walking exercise in overweight patients with knee OA.

Sainton, P, Nicol, C, Cabri, J, Barthelemy, J, Berton, E, Chavet, P: Influence of short-term unweighting and reloading on running kinetics and muscle activity.. *Eur J Appl Physiol* (2015) 115:1135–1145

- Confirmed results from other studies demonstrating maintenance of normal muscle firing patterns with body weight support, except for reduced activity during push-off phase
- Also noted that muscle firing patterns revert to pre-exercise within 3 minutes of fullreloading

Smoliga, JM, Wirfel, LA, Paul, D, Doarnberger, M, Ford, KR: Effects of Unweighting and Speed on In-Shoe Regional Loading During Running on a Lower Body Positive Pressure Treadmill. *Journal of Biomechanics* 48(2015) 1950–1956

- Observational biomechanics study evaluated specific loading across the foot using in-shoe sensors
- Foot loading patterns were preserved at 80% to 100% body weight, but patterns shifted towards forefoot loading at increasing levels of body weight support

Webber, SC, Horvey, KJ, Yurach Pikaluk, MC, Butcher, SJ: Cardiovascular Responses In Older Adults with Total Knee Arthroplasty at Rest and with Exercise on a Positive Pressure Treadmill. *Eur J Appl Physiol* 2014 114:653-662.

- Observational study of cardiovascular responses to AlterG exercise after unilateral total knee arthroplasty
- Demonstrated cardiovascular safety of AlterG exercise in this population
- Older adults with TKA demonstrated lower heart rate, systolic blood pressure, oxygen consumption and minute ventilation levels when walking under lower body positive pressure conditions.
- AlterG exercise enabled TKA patients to walk at faster speeds and/or to tolerate greater incline which may be important in the rehabilitation of these patients

Published Studies:

Early studies provide the foundation for the biomechanics of running and walking on the AlterG. They also show that for each individual a “metabolic prescription” can be achieved, thus maintaining metabolic load while reducing the ground reaction forces. More recent studies have focused on clinical rehabilitation topics. The principles shown here can be applied to a wide variety of medical and athletic rehabilitation settings. Here are summary findings:

- Jogging at 4.5mph with 50% body weight support produces the same knee joint reaction force as walking with full body weight
- For any given walking or running speed, weight support reduced metabolic demand by the individual
- For any given amount of weight support, metabolic demand can be increased by increasing walking or running speed
- Ground reaction forces are reduced at all levels of weight support
- Surface EMG electrode activity shows that muscle firing patterns and gait mechanics are maintained for all levels of weight support and speeds.
- Anti-gravity muscles show reduced activation with weight support
- Weight support causes no significant change in Heart Rate, Systolic BloodPressure, Diastolic Blood Pressure and Mean Arterial Pressure
- Individuals who use Heart Rate to create exercise regimens can continue to do so on the AlterG and they should expect a similar metabolic demand from body weight support as with unsupported exercise
- Dramatic improvements in gait mechanics are seen in children with cerebral palsy who use the AlterG for exercise
- AlterG exercise is very well tolerated by individuals with knee osteoarthritis, and results in a reduction in knee pain when ambulating off the AlterG. An average of 12% body weight support is needed to produce pain relief.

- Gait and functional improvements are seen in several adult neurologic conditions such as Parkinson's Disease and muscular dystrophy

Berthelsen, MP, Jensen, BR, et al: Anti-gravity Training Improves Walking Capacity and Postural Balance In Patients With Muscular Dystrophy. *Neuromuscul Disord* (2014), <http://dx.doi.org/10.1016/j.nmd.2014.03.001>

- Prospective training program for severely affected muscular dystrophy patients who are unable to do conventional exercise due to weakness
- Improvements in walking distance and dynamic postural balance in all patients
- Supported use of AlterG Anti-Gravity Treadmill as a safe and effective training modality for severely affected individuals with muscular dystrophy

Buono, MJ et al: Alterations in the Rate of Limb Movement Using a Lower Body Positive Pressure Treadmill Do Not Influence Respiratory Rate or Phase III Ventilation. *Biomed Res Int*. 2015;2015:618291

- Physiologic study of ventilation correlated to walking speed

Christian M: Managing knee osteoarthritis: the effects of anti-gravity treadmill exercise on joint pain and physical function. University of Manitoba Master's Thesis Dissertation.

<http://mspace.lib.umanitoba.ca/handle/1993/8580>

- 25 obese adults with moderate knee osteoarthritis pain participated in a 12 week AlterG exercise program, twice a week for 25 minutes each session
- A mean level of 17.9% LBPP (i.e. 16.1 kg) was effective in reducing knee joint pain during initial walking
- Strength levels for the quadriceps and hamstring muscle groups increased significantly following the 12-week program
- Significant improvements were found in all KOOS subscales, indicating a reduction in knee OA symptoms and improvement in functional abilities

- Knee pain during walking significantly decreased, with some participants experiencing complete pain relief. Pain was reduced to a point where the addition of LBPP support was no longer required to reach minimal pain levels

- This thesis is being prepared for publication in a peer-reviewed journal

Evans, JM et al: Cardiovascular regulation during body unweighting by lower body positive pressure. *Aviat Space Environ. Med.* 2013, 84:1140-1146

- Investigated specific role of sympathetic control of cardiovascular function with lower body positive pressure

Evans, J., Shapiro, R., Moore, F.: Segmental Volume and Cardiovascular Responses to Changes in Body Position at Rest and During Walking Under Normal and Reduced Weight Conditions. *J Gravitational Physiology*, 2011.

- Authors also measured pressure in mmHg at various body weight reductions for each subject. Pressure required will of course vary by subject's weight and body mass, but roughly 30-40mm Hg pressure is needed for a 20% reduction in body weight.
- Fluid shifts from the legs to the abdomen and thorax with lower body positive pressure support. There was a slight increase in systolic blood pressure, no change in diastolic blood pressure, slight decrease in heart rate, all of which can be expected with the fluid shift.

Figueroa, M.A., Manning, J., Escamilla, P.: Physiological Responses to the AlterG Anti-Gravity Treadmill. *International Journal of Applied Science and Technology* Vol. 1 No. 6; November 2011

- Removal of up to 20% bodyweight did not alter metabolic responses (VO2, HR, RER) during jogging. Prescribed cardiovascular training intensities can be achieved with a reduction in ground reaction forces in individuals who are overweight, obese or injured.

Figueroa, MA, Wicke J, Manning J, Escamilla P, Santillo N, Wolkstein J, Weis M: Validation of ACSM Metabolic Equations in an Anti-Gravity Environment: A Pilot Study. *International Journal of Applied Science and Technology* Vol. 2 No. 7; August 2012

- The American College of Sports Medicine established equations used to predict V02 for individuals walking or running at 100% body weight
- The current study was designed to measure actual V02 with body weight support on the AlterG at 100%, 90%, and 80% body weight
- Measured V02 with body weight support was significantly less than predicted for the 100% body weight condition, thus the ACSM equations cannot be used accurately on the AlterG

Gojanovic B, Cutti P, Shultz R, Matheson GO: Maximal Physiologic Parameters During Partial Body-Weight Support Treadmill Testing. *Med Sci Sports Exerc* 2012 Apr 24.

- V02 is maintained on the AlterG at speeds relevant to the elite runner. Previous studies on other treadmills questioned whether the elite runner could maintain V02 with body weight support.
- Overspeed running mechanics are maintained
- The AlterG offers the additional advantage over conventional training of reduced joint impact forces, theoretically preserving joint health over the long-term

Gojanovic, B, Shultz, R, Feihl, F, Matheson, G: Overspeed HIIT in Lower Body Positive Pressure Treadmill Improves Running Performance. *Med Sci Sports Exerc*. 2015 May 15. [Epub ahead of print]

- The authors performed a 4 week prospective high intensity interval training program to assess improvements in running speed in trained high level runners
- Participants were randomized to standard treadmill training vs 10% body weight support on the AlterG Treadmill
- The 4 week HIIT protocol improved field performance, V02 max, and submaximal heart rate
- The authors state that AlterG HIIT is an effective method to improve running performance while reducing potentially injurious joint loading seen in standard full body weight HIIT

Grabowski, Alena and Kram, Rodger: Effects of Velocity and Weight Support on Ground Reaction Forces and Metabolic Power During Running.

J Appl Biomech 24:288-297, 2008.

This study was performed at the University of Colorado, and validated several core

Grabowski, Alena: Metabolic and Biomechanical Effects of Velocity and Weight Support Using a Lower Body Positive Pressure Device During Walking. *Archives of Physical Medicine and Rehabilitation*, 91:951-957, 2010.

This study uses similar methods to the running study by Dr. Grabowski referenced above but now focusing on individuals during walking. Proof of basic principles during walking is very important for the post-injury, post-operative, and other groups who would not be expected to run on the AlterG.

- Many combinations of velocity and BW resulted in similar aerobic demands, yet walking faster with weight support lowered peak GRFs compared to normal weight walking.
- Manipulating velocity and weight support during walking with the AlterG may be a highly effective strategy for rehabilitation, recovery following surgery, and gait re-training.

Hoffman, M.D., Donaghe, H.E.: Exercise Responses During Partial Body-Weight Supported Treadmill Walking and Running in Healthy Individuals. *Arch Phys Med & Rehab*, 2011

- For walking up to 3.5mph: a 25% reduction in body weight requires approximately a 0.5 mph increase in walking speed for the same V02.
- For running up to 9.0mph: a 25% reduction in body weight requires a 3mph increase in running speed for the same V02.
- Relationship between HR and V02 is not changed with support, thus runners who use HR as an indicator of training intensity can continue to do so on AlterG with weight support.

Kostas, VI, Evans, JM et al: Cardiovascular Models Of Simulated Moon and Mars Gravities: Head Up Tilt vs Lower Body Unweighting. *Aviat Space Environ. Med* 85(4) 414-419. 2014

- Compared lower body positive pressure on AlterG Anti-Gravity Treadmill to head-up tilt for fluid volume shifts, cardiac output, blood pressure, heart rate

- LBPP consistently shifts fluid from lower extremities to the thorax
- Cardiac output maintained, systolic blood pressure increases, stroke volume decreases
- LBPP advantageous over HIT if dynamic activity is necessary

Kurz, M., Corr, B., Stuberg, W., Volkman, K., Smith, N.: Evaluation of Lower Body Positive Pressure Supported Treadmill Training for Children with Cerebral Palsy *Pediatr Phys Ther.* 2011 Fall;23(3):232-9. PubMed PMID: 21829114

- LBPPS treadmill training resulted in significant changes in the walking spatiotemporal kinematics and balance. After training the children had a faster preferred walking speed, spent less time in double support, more time in single support, had improved overall balance, and improved walking balance. Furthermore, there was a trend for increased strength of the lower extremity anti-gravity musculature.
- LBPPS treadmill training utilizing the AlterG is an effective treatment for improving the walking biomechanics and balance of children with CP. The AlterG offered other advantages over conventionally used harness systems and was very well accepted by the children.

Kurz MJ, Stuberg W, DeJong SL (2011). Body Weight Supported Treadmill Training Improves The Regularity of The Stepping Pattern in Children with Cerebral Palsy. *Developmental Neurorehabilitation*, 2011; 14(2):87-93.

- AlterG improved the rhythmical control of the stepping kinematics, preferred walking speed, step length and gross motor function score. The improvements in the regularity of the stepping kinematics were strongly correlated with changes in the preferred walking speed, step length and gross motor function score.

Lazaro R, Raymond G, Chun J, Spencer B, Megazzi A, Siegel E, Schempp A: The Effects of Lower Body Positive Pressure Treadmill Training on Balance, Mobility and Lower Extremity Strength of Community Dwelling Older Adults. Presented at the Annual Meeting of the California Physical Therapy Association, Santa Clara, CA, Sept. 28-29, 2012.

- 10 healthy women, average age 70, participated in an 8 week AlterG exercise study
- All women in this series demonstrated improvements in balance, mobility, and lower extremity strength
- This study provides the foundation for follow-on studies focused on specific physical impairments

Liebenberg, J., Scharf, J., Forrest, D., Dufek, J., Masumoto, K., Mercer, J.A.: Determination of Muscle Activity During Running at Reduced Body Weight *J Sports Sciences* 29(2): 207-214, 2011

- The purpose of this study is to investigate how lower extremity muscles are influenced by body weight (BW) support during running at different speeds. Reducing BW leads to a reduction in muscle activity with no changes in muscle activity patterns.

McNeill, DKP, DeHeer, HD, Bounds, RG, Coast, JR: Accuracy of Unloading with The Anti-Gravity Treadmill. *J Strength Cond Res.* 2015 Mar;29(3):863-8

- This technical note shows that there is less than 5% difference between predicted and actual unloading with the most commonly used body weight unloading percentages from 90% to 40%

McNeill, DKP, Kline, JR, DeHeer, HD, Coast, JR: Oxygen Consumption of Elite Distance Runners on an Anti-Gravity Treadmill. *Journal of Sports Science and Medicine* (2015) 14, 333-339

- Measurement of V02 in elite distance runners across a number of speeds and body weight support levels
- The results were consistent with prior research, which found that while running on an AlterG Anti-Gravity Treadmill, 1) metabolic cost significantly decreases with increasing levels of BWS, 2) metabolic cost significantly increases with increasing velocity, and 3) there is attenuation in the decrease in metabolic cost as BWS increases.
- Outcomes in this study are consistent with previous studies performed in non-elite runners

Mercer, JA, Applequist, B, Masumoto, K: Muscle Activity During Running with Different Body Weight Support Mechanisms: Aquatic Environment Versus Body Weight Support Treadmill. *J Sport Rehabil.* 2014 Nov;23(4):300-6.

- Muscle activation in water is dependent on running style
- No difference in muscle activation of gastroc and tibialis anterior with any deep water running style vs. AlterG Anti-Gravity Treadmill
- No difference in muscle activation of rectus femoris in deep water running with high knee style and AlterG Anti-Gravity Treadmill

Mercer, JA: Muscle Activity While Running At 20% - 50% Of Normal Body Weight. *Res Sports Med* October 2012

- EMG activity of rectus femoris, biceps femoris, gastrocnemius, and tibialis anterior
- Increased speed at any given body weight support level increased muscle activity for all groups
- Increased body weight support at any given speed decreased muscle activity of the rectus, gastroc, and tibialis anterior but had no significant effect on the biceps femoris

Mercer, JA, Applequist, B, Masumoto, K: Muscle Activity During Running With Different Body Weight Support Mechanisms. *Med Sci Sports Exerc* 2012 (44:5) S572

- Compared EMG activity of lower extremity muscles with deep water running and AlterG body weight support, as well as different running styles
- Showed no significant differences in rectus femoris and biceps femoris activity as long as stride frequency was equalized using cross country running style
- Showed increased rectus femoris activity in high knee running style in deep water running

Moran MF, Sullivan AB, Rickert BJ: Effect of Body Weight Support on Spatiotemporal Running Mechanics. *Med Sci Sports Exerc* 2012 (44:5) S572

- Evaluated stride rate and stride length with varying levels of AlterG body weight support in experienced runners

- With increasing support stride rate decreases and stride length increases
- Runners wishing to use AlterG training to translate to overground training may consider using a metronome on the AlterG to maintain stride rate

Patil, S., Steklov, N., Bugbee, W.D., Goldberg, T., Colwell, C.W., D'Lima, D.: Antigravity Treadmills are Effective in Reducing Knee Forces. *J Orthop Res.* 2012 Dec 13. doi: 10.1002/jor.22272. [Epub ahead of print] PMID: 23239580 [PubMed - as supplied by publisher]

- The e-Knee study from Scripps Clinic La Jolla shows a direct correlation between knee joint vertical reaction force as a function of AlterG body weight support, treadmill speed, and incline. An equation relating these variables is provided by the authors.
- Jogging at 4.5mph with 50% body weight support provides the same vertical knee joint reaction force as walking with full body weight.
- Able to reduce ground reaction force for walking and running in proportion to the amount of unweighting
- AlterG body weight supported activity is placed within the context of other daily and sports activities previously studied by the authors.

Peeler, J, Christian, M, Cooper, J, Leiter, J, MacDonald, P: Managing Knee Osteoarthritis: The Effects of Body Weight Supported Physical Activity on Joint Pain, Function, and Thigh Muscle Strength *Clin J Sport Med.* 2015 Jan 30. [Epub ahead of print]

- 12 week prospective non-randomized clinical trial
- Participants reported significant improvements in knee joint pain and function and demonstrated significant increases in thigh muscle strength.
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- Data suggest that an LBPP-supported low-load exercise regimen can be used to significantly diminish knee pain, enhance joint function, and increase thigh muscle strength, while safely promoting pain-free walking exercise in overweight patients with knee OA.

Raffalt, PC, Hovgaard-Hansen, L, Jensen, BR: Running on a Lower-Body Positive Pressure Treadmill: VO2max, Respiratory Response, and Vertical Ground Reaction Force. *Research Quarterly for Exercise and Sport*, 84, 213–222, 2013

- Possible to achieve VO2max with body weight unloading
- Ground reaction forces reduced
- Significant increase in time to exhaustion with AlterG training
- Improves running economy

Sainton, P, Nicol, C, Cabri, J, Barthelemy, J, Berton, E, Chavet, P: Influence of Short-Term Unweighting and Reloading on Running Kinetics and Muscle Activity. *Eur J Appl Physiol* (2015) 115:1135–1145

- Confirmed results from other studies demonstrating maintenance of normal muscle firing patterns with body weight support, except for reduced activity during push-off phase
- Also noted that muscle firing patterns revert to pre-exercise within 3 minutes of full reloading

Saxena, A., Granot, A.: Use of an Anti-Gravity Treadmill in The Rehabilitation of The Operated Achilles Tendon: A Pilot Study
J Foot Ankle Surg. 2011 Sep-Oct;50(5):558-61.

- Individuals are able to perform closed chain walking and jogging early on in the postoperative period after Achilles tendon repair, maintaining a training effect in spite of partial weight bearing
- Authors proposed 85% BW as a benchmark to return patients to unsupported training

Saxena, Amol: Review Article titled “Strategies for Rehab After Achilles Tendon Surgery” was published in Lower Extremity Review Online, September, 2011: <http://www.lowerextremityreview.com/article/strategies-for-rehab-after-achilles-tendon-surgery>

Smoliga, JM, Wirfel, LA, Paul, D, Doarnberger, M, Ford, KR: Effects of Unweighting and Speed on In-Shoe Regional Loading During Running on a Lower Body Positive Pressure Treadmill. *Journal of Biomechanics* 48(2015)1950–1956

- Observational biomechanics study evaluated specific loading across the foot using in-shoe sensors
- Foot loading patterns were preserved at 80% to 100% body weight, but patterns shifted towards forefoot loading at increasing levels of body weight support

Takacs, J, Leiter, J: Lower Body Positive Pressure: an Emerging Technology in The Battle Against Knee Osteoarthritis? *Clin Interv Aging.* 2013; 8: 983–991.

- Study evaluated pain responses to exercise for individuals with knee osteoarthritis on AlterG Anti-Gravity Treadmill
- Pain relief consistently achieved, on average required 12% body weight support

Webber, SC, Horvey, KJ, Yurach Pikaluk, MC, Butcher, SJ: Cardiovascular Responses in Older Adults with Total Knee Arthroplasty at Rest and With Exercise on a Positive Pressure Treadmill. *Eur J Appl Physiol* 2014 114:653-662.

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