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LOWER EXTREMITY REVIEW
October 22 / volume 14 / number 10

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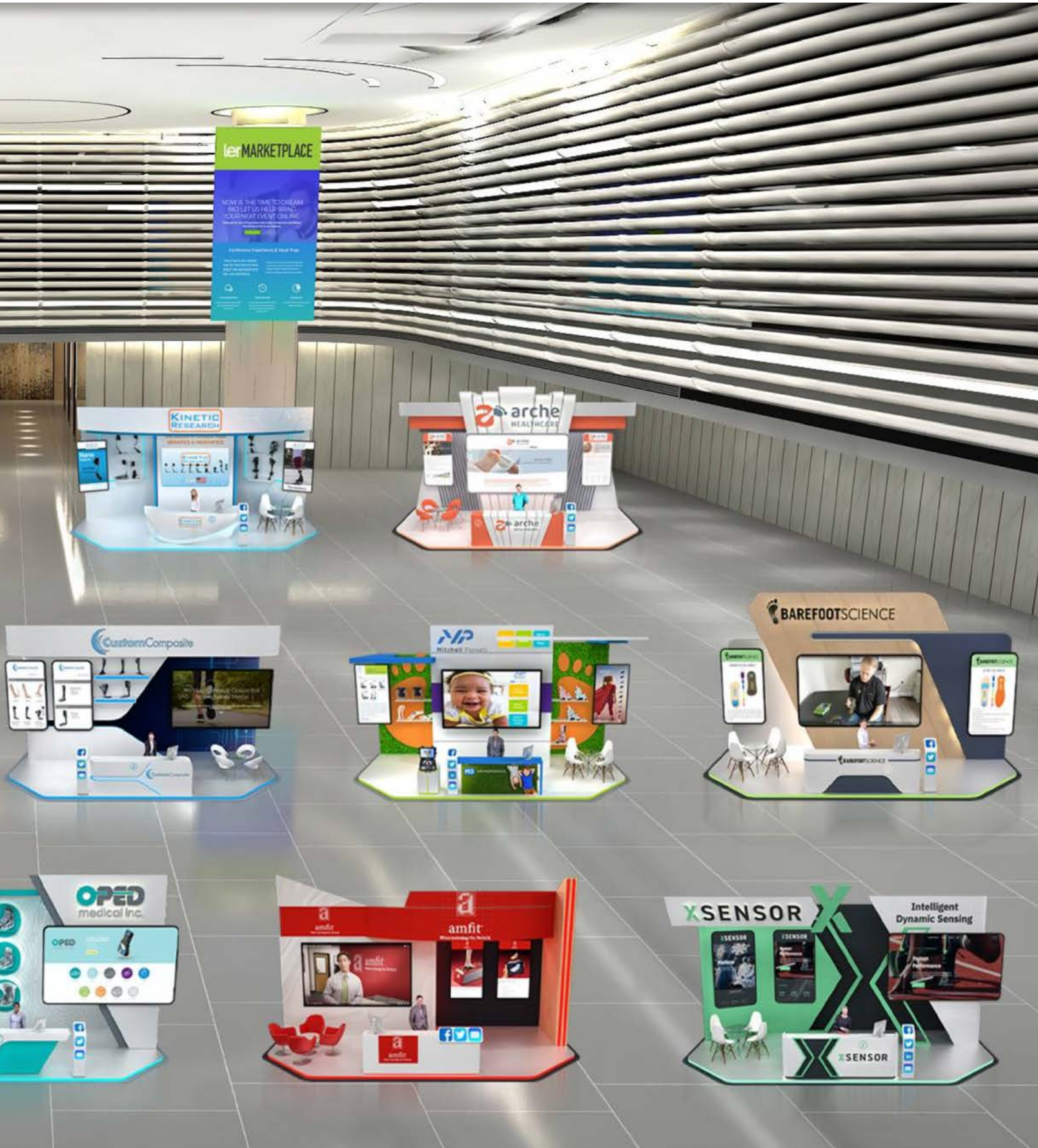

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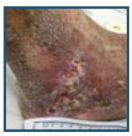

Pentoxifylline is often thought of as a vasodilator, but the drug's MOA is to increase red and white cell filterability and decrease whole blood viscosity, platelet aggregation, and fibrinogen levels.

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Lower Extremity Review

Lower Extremity Review informs healthcare practitioners on current developments in the diagnosis, treatment, and prevention of lower extremity injuries. LER encourages a collaborative multidisciplinary clinical approach with an emphasis on functional outcomes and evidence-based medicine. LER is published monthly, except for a combined November/December issue and an additional special issue in December, by Lower Extremity Review, LLC.

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Showcasing evidence and expertise across multiple medical disciplines to build, preserve, and restore function of the lower extremity from pediatrics to geriatrics.

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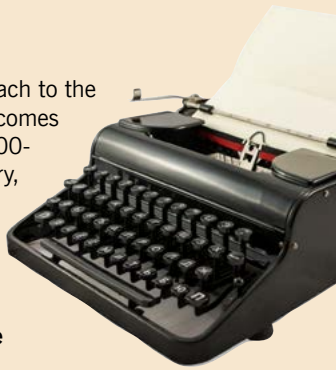

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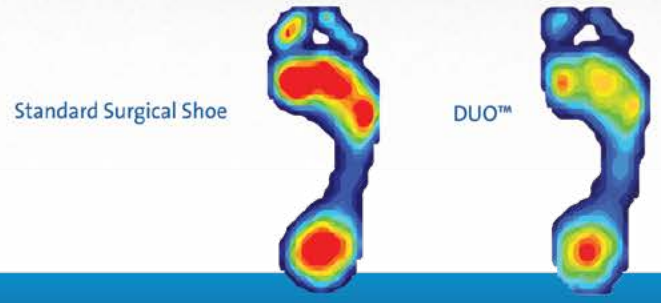

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Guest **Perspective**

The High Cost of Physical Inactivity

By Cedric X. Bryant, PhD, FASCM

In its *Global Status Report on Physical Activity 2022*, the World Health Organization (WHO) offers its first assessment on the progress made in implementing the 20 policy recommendations outlined in its *Global Action Plan on Physical Activity 2018-2030: More Active People for a Healthier World*, which targeted the creation of more active societies, environments, people, and systems.

Unfortunately, what this assessment finds is that progress toward the stated goal of a 15% relative reduction in physical inactivity by 2030 is slow and unequal, a reality only worsened by the COVID-19 pandemic, which stalled many initiatives and negatively impacted policy implementation. This, in turn, widened the inequities in opportunities for engaging in physical activity in many communities.

As Dr. Tedros Adhanom Ghebreyesus, the Director-General of WHO, states in the foreword to the Global Status Report, "This must change – and change fast."

If governments don't take urgent action to encourage more physical activity among their populations, the WHO states that, between 2020 and 2030, almost 500 million people will develop heart disease, diabetes, or other noncommunicable diseases attributable to physical inactivity. And, these conditions will cost the world US$ 27 billion annually.

Consider the following rundown of statistics from data gathered from 194 countries:

- Less than 50% of countries have a national physical-activity policy, of which less than 40% are operational.
- Only 30% of countries have national physical activity guidelines for all age groups.
- While nearly all countries report a system for monitoring physical activity in adults, 75% of countries monitor physical activity among adolescents and less than 30% monitor physical activity in children under 5 years old.
- In policy areas that could encourage active and sustainable transport, only just over 40% of countries have road design standards that make walking and cycling relatively safe options.

Another area of concern centers on data and other indicators that can be used to measure progress, such as access to parks and walking paths. While some countries have that data, others do not, making it very difficult to track something as fundamental as infrastructure changes that encourage movement. If there is no data, there is often no accountability and too little action taken.

The new report calls for countries to prioritize physical activity as a means to improve health and address noncommunicable diseases, and to integrate physical activity into all relevant policies. In addition, the report encourages the development of tools and training to improve future implementation.

What Can Health Coaches and Exercise Professionals Do to Help?

Among the guiding principles of the Global Action Plan is "equity across the life course," which is meant to address disparities in physical-activity participation by age, gender, disability, pregnancy, socioeconomic status, and geographic location by creating opportunities for physical activity for all people. This is, of course, a foundational tenet of the American Council on Exercise and an area where ACE Certified Professionals can make a real impact in their communities. Another guiding principle is "evidence-based practice," which is also a foundational element of ACE's work.

While health coaches and exercise professionals may not be able to directly influence policy decisions or the creation of safe environments for physical activity, they can certainly help address the strategic objective to "create healthy people." The goal in this area is to create and promote access to opportunities and programs to help people of all ages and abilities to engage in regular physical activity as individuals, families, and communities, which aligns with the work ACE Certified Professionals do every day.

Cedric Bryant, PhD, FACSM, is president and chief science officer of the American Council on Exercise (ACE). ACE focuses on the development of strategies to deliver exercise-science and behavior-change education in ways that are engaging and compelling, recruiting more people to become exercise professionals and health coaches and overseeing the development of programs that ACE-Certified Professionals® can utilize to help people adopt and sustain healthier lifestyles. This article is an edited version of a blog post and is reprinted with permission. To learn more about ACE, visit acefitness.org.

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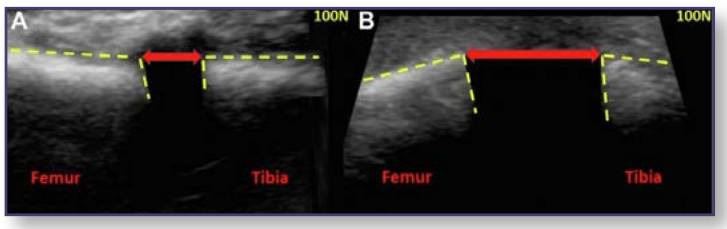

Figure. Ultrasound images of the medial compartment of the left knee taken at 20° of flexion with a portable ultrasound probe positioned perpendicular to the medial joint line over the medial collateral ligament. The medial tibiofemoral distance was calculated by measuring the distance between the articular margins (indicated by dashed yellow lines) of the medial femoral condyle and the medial tibial plateau. (A) Ultrasound image demonstrating medial tibiofemoral distance under 100 N of valgus force in an intact knee. (B) Ultrasound image demonstrating increased medial tibiofemoral distance under 100 N of valgus directed force after transection of the deep medial collateral ligament and posterior oblique ligament.

The purpose of this cadaveric study was to quantify the severity of medial knee injuries based on medial compartment gapping as measured by stress ultrasonography.

Methods: In 8 cadaveric knees, the distance between the medial tibial and femoral condyles was measured using ultrasonography. These measurements were obtained in the intact state and repeated after open sequential transection of the superficial medial collateral ligament (sMCL), deep medial collateral ligament (dMCL), posterior oblique ligament (POL), and arthroscopic transection of the anterior cruciate ligament (ACL). Knees were evaluated at 0° and 20° of knee flexion using the Telos device under 0 N and 100 N of valgus force. Receiver operating characteristic curve analysis and the DeLong test were used to determine whether measurements could distinguish between successive severity of MCL injury after identifying the optimal cutoff value for each injury state.

Results: Of the 8 cadaveric knees in this study, 3 were male and 5 were female; mean age was 58 ± 11 years (range 48–82 years). When measured using ultrasonography at 20° knee flexion with valgus load, the medial tibiofemoral distance significantly increased with increasing severity of medial knee injury (P values ranging from .049 to <.001). Optimal cutoff values for distinguishing between an intact knee and sMCL injury were 8.3 mm (area under the curve [AUC] = 0.98), between sMCL and dMCL injury 9.9 mm (AUC = 0.89), dMCL and POL 16.7 mm (AUC = 0.88), and POL and ACL 18.6 mm (AUC = 0.84). When the study authors compared combined intact and sMCL-transected stages with dMCL-transected stage, optimal cut-off point to differentiate stable from unstable injuries was equal to13.8 mm of medial tibiofemoral distance (AUC = 0.97; sensitivity = 100%; specificity = 94.1%).

Conclusions: Dynamic ultrasonographic assessment can accurately quantify the severity of medial knee ligament injury based on medial compartment gapping without the need for radiation and at point of care in multiple clinical settings. This study found medial tibiofemoral distance >13.8 mm at 20° knee flexion under valgus force indicates the presence of dMCL injury with a diagnostic accuracy of 0.97. (ler)

Source: *Bhimani R, Lubberts B, DiGiovanni CW, Tanaka MJ. Dynamic ultrasound can accurately quantify severity of medial knee injury: a cadaveric study. Arthrosc Sports Med Rehabil. 2022;4(5):e1777-e1787.*

FUNCTIONAL BENEFITS, SAFETY OF PR-FAMPRIDINE IN MULTIPLE SCLEROSIS

MOBILE and ENHANCE were similarly designed randomized trials of walking impaired adults with relapsing-remitting or progressive multiple sclerosis (MS) who received placebo or 10 mg prolonged-release (PR)-fampridine twice daily for 24 weeks. Both studies showed sustained and clinically meaningful improvement in broad measures of walking and balance over 24 weeks of PR-fampridine treatment.

The objective of this study was to evaluate the functional benefits and safety of PR-fampridine versus placebo using a post hoc integrated efficacy analysis of MOBILE and ENHANCE data.

Methods: Data from the intention-to-treat (ITT) populations of MOBILE and ENHANCE studies were pooled in a post hoc analysis based on the following outcome measures: 12-item MS Walking Scale (MSWS-12), Timed Up and Go (TUG) speed, Berg Balance Scale (BBS), MS Impact Scale physical impact subscale (MSIS-29 PHYS), EQ-5D utility index score, visual analogue scale (VAS), and adverse events. The primary analysis was the proportion of people with MS (PwMS) with a mean improvement in MSWS-12 score (≥8 points) from baseline over 24 weeks. A subgroup analysis based on baseline characteristics was performed.

Findings: In the ITT population (N = 765; PR-fampridine, n = 383; placebo, n = 382), a greater proportion of PR-fampridine–treated PwMS than placebo-treated PwMS achieved a clinically meaningful improvement in the MSWS-12 scale over 24 weeks (44.3% versus 33.0%; p < 0.001). PR-fampridine MSWS-12 responders demonstrated greater improvements from baseline in TUG speed, BBS score, MSIS-29 PHYS score, and EQ-5D utility index and VAS scores versus PR-fampridine MSWS-12 non-responders and placebo. Subgroup analyses based on baseline characteristics showed consistency in the effects of PR-fampridine.

Conclusion: The pooled analysis of MOBILE and ENHANCE confirms previous evidence that treatment with PR-fampridine results

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in clinically meaningful improvements in walking, mobility and balance, self-reported physical impact of MS, and quality of life and is effective across a broad range of PwMS. ler

Source: *Hupperts R, Gasperini C, Lycke J, et al. Efficacy of prolonged-release fampridine versus placebo on walking ability, dynamic and static balance, physical impact of multiple sclerosis, and quality of life: an integrated analysis of MOBILE and ENHANCE. Ther Adv Neurol Disord. 2022;15:17562864221090398.*

EXERCISE RECOMMENDATIONS TO COUNTERACT IATROGENIC DISEASE

Exercise to counteract the undesirable side effects of standard medical care is gaining increasing attention in the literature. For example, exercise would include resistance training for patients receiving corticosteroid treatment to counteract the associated proximal myopathy and osteopenia not fully addressed by bisphosphonates, or neutralizing the adverse effects of energy-restricted diets in obesity or protein-restricted diets in chronic renal failure. An excellent target group where both resistance and aerobic exercise can play a significant role would be older men with steroid-dependent chronic lung disease, in whom harmful combinations of pulmonary cachexia, malnutrition, tobacco use, steroid myopathy, and osteoporosis produce profound wasting, osteoporotic fractures, and impaired exercise tolerance. Aerobic training will improve functional status in this clinical cohort but is insufficient to address musculoskeletal wasting. The major geriatric syndromes for which exercise may be beneficial as a preventive or prevention strategy are listed in Table 1, along with the postulated mechanisms of exercise benefit and the specific modality of exercise most relevant for these outcomes.

For more on exercise recommendations in older adults, see "International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines" on page 41. ler

Source: *Izquierdo M, Merchant RA, Morley JE, et al. International exercise recommendations in older adults (ICFSR): Expert Consensus Guidelines. J Nutr Health Aging. 2021;25(7):824-853.*

Table 4. Exercise and geriatric syndromes

Geriatric syndromes	Considerations for the prescription	Recommended exercise modality
Frailty and Sarcopenia	• Resistance and power training: 2 to 3 sessions per week, combining slower and faster (power training) muscle actions at intensities of 40 – 80 % of 1RM. • Functional exercises e.g., standing from a chair with progressive increases in loading/speed • Balance and gait exercises progressing in complexity: line walking, tandem foot standing, standing on one leg, heel-toe walking.	• Resistance training • Power training • Balance exercises • Gait retraining • Multicomponent exercise
Falls/Mobility impairments	• Resistance training aimed to improve muscle strength and power. • Balance and gait exercises progressing in complexity: line walking, tandem foot standing, standing on one leg, heel-toe walking. • Dual task exercises including dual task gait and resistance exercises (serial numbers, naming animals, etc). • Adapted Tai Chi exercises progressing in complexity. • Dance interventions may improve adherence.	• Resistance training • Balance exercises • Gait retraining/dual task training • Multicomponent exercise • Dance interventions • Tai Chi exercises
Cognitive impairment	• High-intensity resistance training combined with power training aimed to improve cognitive and functional abilities. • Walking may reduce the risk of dementia. • Dual task exercises may be beneficial to cognitive function. • Use of mirror techniques rather than complex oral instructions. Use of haptic support. • Considerations of emotional aspects such as reassurance, respect, and empathy.	• Walking • Aerobic training • Resistance training • Dual-task training

NAIL PSORIASIS AND OLDER ADULTS PIC FOLLOWS

Psoriasis is known to involve the nails in nearly 90% of affected patients and can cause significant changes to the nails including pitting, onycholysis, subungual hyperkeratosis, discoloration, and onchomycosis. Like other autoimmune diseases, treatment for nail psoriasis (NP) must be customized to the individual. Common treatments include steroid creams, vitamin D analogue, steroid injections, nail removal, and for severe cases, systemic treatments. With its bimodal age incidence–peaking at age 30–39 and 60–69 years, it becomes an important disease in older adults. Yet it is unclear if therapeutic safety and efficacy data from clinical trials for NP is applicable to this patient group.

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Photo Credit: Psoriasis and Psoriatic Arthritis Alliance

In a recent Letter to the Editor in the *International Journal of Dermatology*, 2 physicians from the Department of Dermatology at Weill Cornell Medicine in New York, reported on a subanalysis of a systematic review looking at the ethnoracial composition of NP patients in randomized clinical trials. Their findings show that patients over age 65 are not fully represented in clinical trials, with the average percentage of older adults participating in the studies was 5.8%. Key challenges to study participation were age, comorbidities, and the receipt of systemic therapy.

In calling for the need to include older adults in clinical trials, the authors noted the need for specific population-based subanalyses for efficacy, safety, toxicity, and drug interactions.

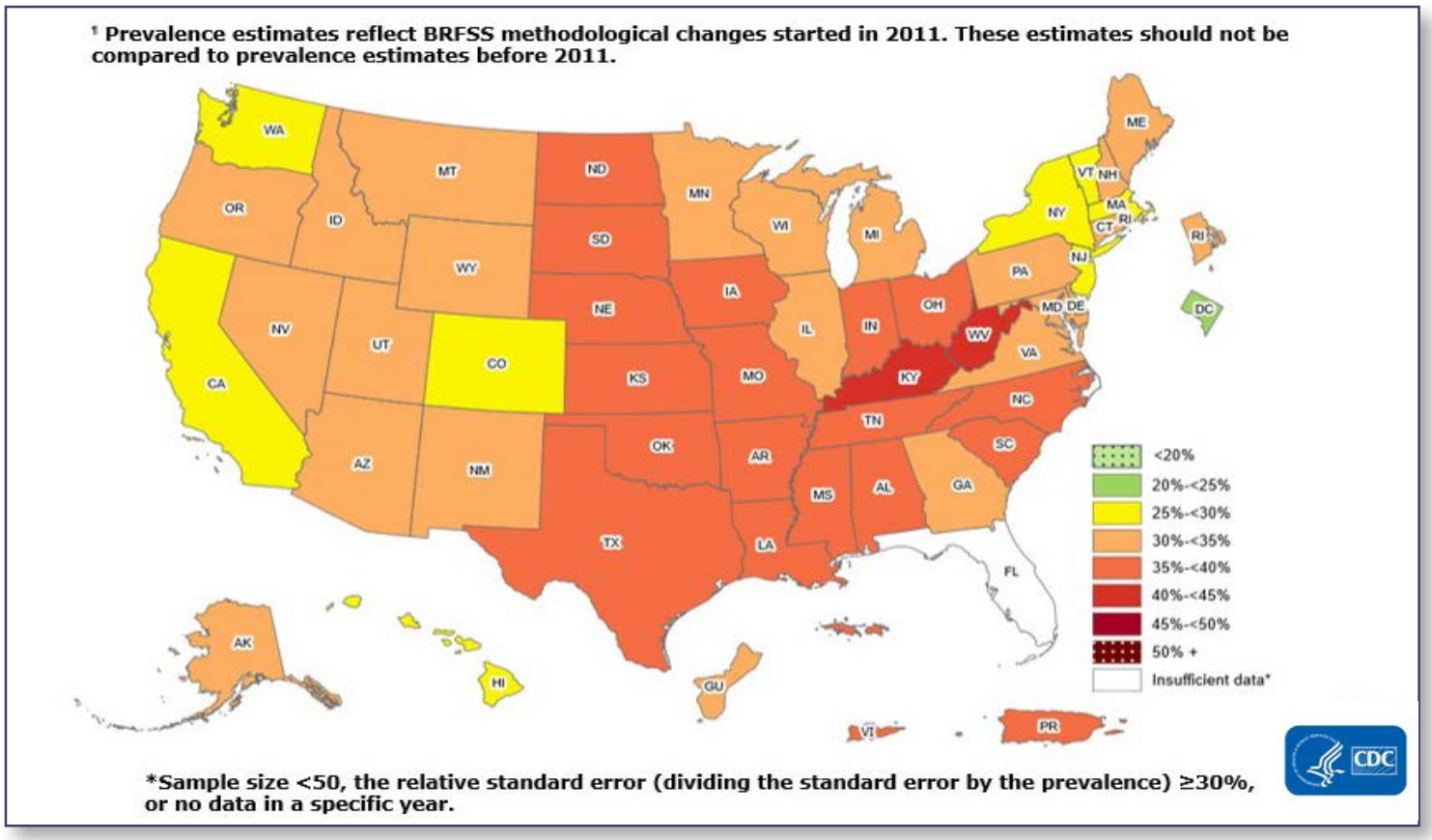
Source: *Ricardo JW, Lipner SR. Where are the older adults? Age distribution of nail psoriasis randomized clinical trials' participants: a systematic review. Int J Derm. 2022;61:c363.*

ADULT OBESITY RATES CONTINUE TO CLIMB

Nineteen states and 2 territories* have at least 35% of residents with adult obesity–more than doubling the number of states with a high obesity prevalence since 2018–according to data from the Centers for Disease Control and Prevention (CDC). The 2021 Adult Obesity Prevalence Maps also highlight the need to address disparities in obesity across states and racial and ethnic populations, through increased access to obesity prevention and treatment.

Combined data from 2019–2021 show the number of states and territories with an obesity prevalence of 35% or higher varies widely across race and ethnicity:

- American Indian or Alaska Native adults: 31 states
- Asian adults: 0 states



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- Black adults: 36 states and the District of Columbia
- Hispanic adults: 27 states and Guam
- White adults: 10 states

State-based adult obesity prevalence by race, ethnicity, and location is based on self-reported height and weight data from the Behavioral Risk Factor Surveillance System.

Adults with obesity are at increased risk for many other serious health conditions such as heart disease, stroke, type 2 diabetes, some cancers, severe outcomes from COVID-19, and poor mental health. Additionally, many people with obesity report being stigmatized because of their weight.

"This report illustrates the urgent need for making obesity prevention and treatment accessible to all Americans in every state and every community," said CDC acting principal deputy director, Debra Houry, MD, MPH. "When we provide stigma-free support to adults living with obesity, we can help save lives and reduce severe outcomes of disease."

*The 19 states and 2 territories are: Alabama, Arkansas, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, West Virginia, Puerto Rico, and the US Virgin Islands. ler

***Note:** CDC encourages the use of respectful images and person-first language (eg, "adults with obesity" or "adults have obesity") and not "obese adults" when discussing obesity and other chronic diseases.*

TUG TEST RESULTS CAN INFORM PREVENTION RX IN FRAIL ELDERLY

As older people become frail, they tend to fall more easily. Moreover, women have a higher rate of falls than men. However, effective strategies to avoid elderly women falling are lacking. The Timed Up and Go (TUG) test is a well-known indicator of falling tendency. This study clarifies the motor elements related to the TUG test according to the degree of weakness in older outpatients to specify exercise intervention to improve weakness and prevent falls. Participants were 145 female outpatients who visited the Locomo-Frail outpatient clinic in Japan, classified into 3 groups (robust, prefrail, and frail, according to the definition of the Japanese Cardiovascular Health Study. Vertical ground reaction force parameters were measured for all participants when they stood up from a chair, walking speed, and the TUG test. Results showed that walking speed is related to the TUG test in the robust group; balance ability is related to the TUG test in the prefrail group; and instantaneous force is related to the TUG test in the frail group. These results suggest that weakness can be improved by performing exercise interventions of balance and instantaneous force elements in the prefrail and frail groups, respectively. ler

***Source:** Hirano Y, Matsui Y, Nemoto T, Ota S, Yamada Y, Arai H. Change in ground reaction force parameters according to the frailty level of older women in the Timed Up and Go test. Nagoya J Med Sci. 2022;84(2):418-432. doi: 10.18999/nagjms.84.2.418.*

RECOMMENDATIONS FOR TARGETED STRENGTH TRAINING IN RHEUMATOID ARTHRITIS

A recently published scoping review of strength training recommendations for patients with rheumatoid arthritis included numerous suggestions for encouraging patients. Of note for LER readers:

- Adaptive devices such as padded gloves, wrist orthoses, shoes, and insoles can be use used to lessen pain associated with joint deformities.
- Adaptive devices can be used to reduce pain during exercise (eg padded gloves when holding weights, elevated blocks under the heels during squats, adapted shoes or insoles). ler

***Source:** Wu ML, Ma JS, Tsui K, Hoens AM, Li LC. Tailoring strength training prescriptions for people with rheumatoid arthritis: a scoping review. Am J Lifestyle Med. Sept 2022 OnlineFirst. DOI: 10.1177/15598276221125415.*

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MENISCAL TEARS AND RETURN TO SPORT RATE

Meniscal injuries represent the most common pathology affecting the knee, often limiting return to sporting activities secondary to pain and disability. In meniscal deficient patients, meniscal allograft transplantation (MAT) procedure may be considered. Return to sport (RTS) rate, predictors of successful RTS, and patient-reported outcomes in athletic patients undergoing MAT are largely unknown. This narrative review sought to better understand RTS rates, predictors of RTS success or failure, and patient-reported outcomes following MAT via existing literature.

The authors found that:

- RTS rates following MAT are generally favorable in the athletic population.
- Appropriate graft sizing, secure graft fixation, younger age, and the absence of articular cartilage injury are associated with improved RTS success.
- Presence of focal chondral defects, osteoarthritic changes, limb malalignment, concomitant procedures performed at the time of MAT, and ligamentous instability are associated with failed RTS.
- Significant improvements in patient-reported outcomes were appreciated when compared to pre-operative values.

The study authors concluded that MAT is a viable treatment option for athletic, meniscal deficient patients. Future investigations of high methodologic quality that evaluate long-term outcomes, graft survivorship, and athletic performance following MAT are warranted to better understand the influence and efficacy of MAT in athletic patients.

Source: *Knapik DM, Evuarherhe A, Kaiser JT, Wagner KR, Darwish R, Condron NB, Cole BJ. Return to sport and patient satisfaction in athletic populations following meniscal allograft transplantation: a narrative review. J Cartilage Joint Preserv. 2022;2(3):100073. DOI:10.1016/j.jcjp.2022.100073.*

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The Utility of Pentoxifylline to Treat a Chronic Venous Leg Ulcer: A Case Report

By Windy Cole, DPM, CWSP

The relationship between calf-pump insufficiency and ulceration has long been established.[1] The accompanying venous hypertension is associated with histologic and hemodynamic alterations in capillary and lymphatic microcirculation that result in pathophysiologic changes in the tissues.[1] Capillary leak, fibrin deposition, erythrocyte and leukocyte sequestration, thrombocytosis, and inflammation combine to produce impaired oxygenation of the skin and deep tissues.[2] Over time, non-treated venous hypertension will produce the clinical signs of edema, skin hyperpigmentation, subcutaneous tissue fibrosis, and will result in venous leg ulcer (VLU) formation.[2]

Venous leg ulcers are a common disabling condition that are difficult to treat and often recur.[1] These wounds can take months and even years to heal. The hallmark of VLU treatment is the use of high-level compression bandages or garments to provide support to the lower extremity venous system.[1] Primary dressings are utilized to manage exudate, prevent infection, and optimize the wound environment. Studies have shown that while compression therapy increases healing in VLUs, a proportion of these wounds remain unhealed.[1] Therefore additional therapies are needed in patients suffering from recalcitrant VLUs.

Current literature suggests that pentoxifylline can improve outcomes in patients suffering from chronic VLUs.[3] Pentoxifylline is a xanthine derivative known to influence microcirculatory blood flow and oxygenation of ischemic tissues.[4] This medication is often used in the treatment of peripheral vascular disease.[5] Pentoxifylline is often thought of as a vasodilator, but the drug's MOA is to increase red and white cell filterability, and decrease whole blood viscosity, platelet aggregation and fibrinogen levels.[6] Pentoxifylline has been shown to have utility in supporting wound healing of chronic venous ulcers with or without compression therapy.[7]

Figure 1

Figure 2

Herein, we will describe a case report of a chronic VLU recalcitrant to multiple wound therapies that demonstrated a positive response to the addition of pentoxifylline therapy. Patient is an 84-year-old Caucasian female with a history of a chronic venous leg ulcer for 5 years on the left lower extremity. Other past medical history includes peripheral vascular disease (PVD), venous stasis dermatitis, varicose veins, hyperthyroidism, coronary artery disease (CAD), edema, scoliosis, mitral valve prolapse, hypertension, degenerative joint disease (DJD), and Raynaud's syndrome.

Upon intake, the wound was noted to be full thickness with a slough-covered base and irregular borders illustrating epibole. There was moderate serosanguineous drainage noted and wound measurements were 2.6cm x 3.0cm x 0.2cm. Non-pitting edema was noted in the lower leg (Figure 1). Patient was referred to vascular surgery and had a venous ablation and phlebectomy performed. But the VLU continued to worsen. Additionally, multiple wound care treatments were used throughout the course of therapy which included the use of silver dressings, collagen, alginates, cortisone cream, oral antibiotics, and Manuka honey combined with compression bandages. During this time the patient's wound failed to progress. Patient was referred to a local dermatologist for evaluation and was told she would have to learn to "live with it." Due to the diligence of our clinician, an additional referral to another dermatologist was obtained for a second opinion. As a result, the patient was started on pentoxifylline and within a month the wound measurements and peri-wound tissue quality was markedly improved (Figure 2).

Conclusion

This case report illustrated the utility of pentoxifylline as an adjunct treatment to compres-

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sion bandaging and local wound care in the treatment of a recalcitrant venous ulcer. Most adverse effects associated with this medication are gastrointestinal disturbances.[8] Pentoxifylline should not be used in nursing mothers or in patients with renal failure. A Cochrane review of VLU trials investigating the use of pentoxifylline as an adjunctive therapy to support wound healing suggested 400 mg tablet taken 3 times per day did increase the chance of VLU resolution.[7] It has been theorized that the fibrolytic action of pentoxifylline is the mechanism of action for the drug's utility in VLU healing, although further investigation is needed to determine the true mechanisms by which pentoxifylline works on venous ulcers.

Acknowledgement: Case was submitted by Scott Casinger, NP.

Windy Cole, DPM, CWSP, is an adjunct professor and Director of Wound Care Research at Kent State University College of Podiatric Medicine. Dr Cole also serves as the National Director of Professional Development and Clinical Education for Woundtech. She is board certified by the American Board of Foot and Ankle Surgery and the American Board of Wound Management. She is a wound care advocate on the forefront of wound research and was the 2020 World Union of Wound Healing Silver Medal Award recipient for her work in Technology-driven Research. And she is a member of the LER Editorial Advisory Board.

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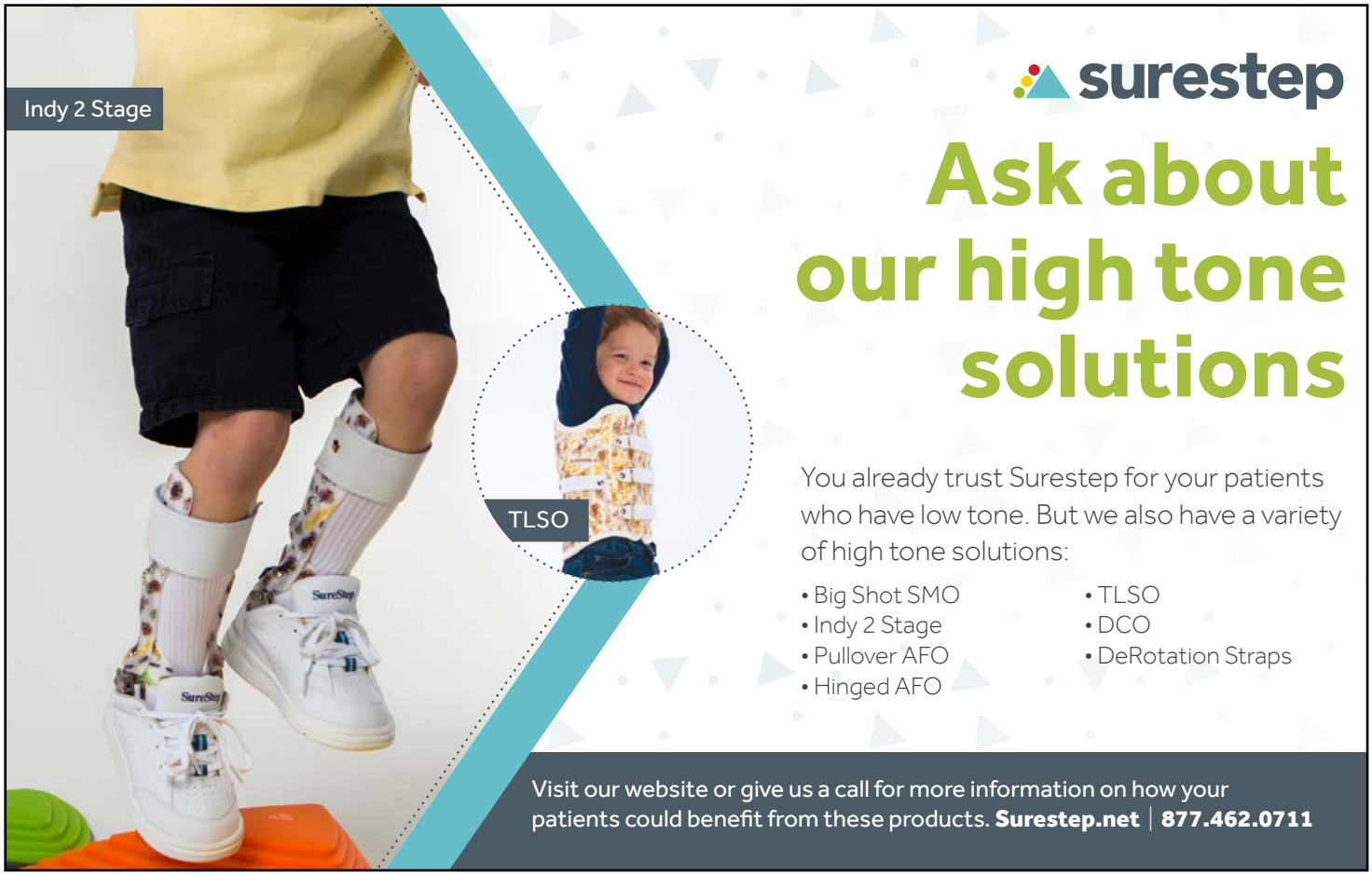

LEREXPO CONVERSATIONS

Load Resolution in Runners II: Vibration's Role

By Simon Bartold

In Part I, we looked at some of the great paradigms of injury prevention that have underpinned the running shoe industry for more than 40 years: overpronation/motion control and cushioning. Did these paradigms stand up to scientific scrutiny? The evidence would appear to be no. So, where else should we be looking? In Part II we will examine the nature and effect of vibration on human systems during running and pose a possible alternative explanation for running-related injury and performance.

Let's have a look at what else—besides overpronation/motion control and cushioning—might be involved, because in relation to the link between injury and load… the answer has got to lay elsewhere.

So if it's not motion control, or cushioning, then what might it be?

- We need to understand that midsole geometry is the key.
- Technical foams are here to stay.
- Having a shoe that's very lightweight is important.
- We've moved away from rigid footwear as a control strategy to increase flexibility.
- We've moved away from this concept of footwear segmentation.

Figure A shows the Salomon Predict on the bottom that I was very involved in, and then Brooks did the Aurora. You can see these are heavily decoupled shoes. Look at the Predict's whole back segment. This is a 2-piece upper where the whole back segment is extremely flexible. In fact, it was not built in a running shoe factory. It was built in the factory that builds the Victoria's Secrets bras. Yes, it was built in a bra factory because obviously they're experts at form-fitting. So, the Predict is extremely flexible, extremely decoupled, and the same with the Aurora. This is possibly the way of the future.

Figure A: Now we're looking at shoes like this: Salomon Predict on the bottom and Brooks Aurora on top.

What Should the Model Shoe Look Like?

Geometry, not additional support components, are the most important things. We've got to focus not on whether a runner is pronating or supinating, in other words, frontal plane. We've got to try to figure out how the runner moves forward, in other words, forward transition. How do you get from contact to propulsion most efficiently, economically, and effectively? That's got to be the focus. We've got to change our focus away from pronation and supination.

So cushioning is not so much about injury prevention due to impacts, but rather it's more about comfort. And we know that comfort equals performance and most likely affects fatigue. And when we talk about fatigue, we're going to change gears here a bit because fatigue in injury may well be the smoking gun and the thing that we really

*lerEXPO hosted the recent "Pedorthic Runners Forum: A Science-Based Approach to Pedorthic Care of Runners and High-Performance Athletes." During the 5-hour CEU program, Simon Bartold, the noted sports podiatrist from Australia, gave a presentation titled, Load Resolution in Runners: What Really Matters… This edited transcript presents the second half of his talk, which focused on vibration as a potential mechanism of injury prevention, despite being one of the least investigated in the scientific literature. Part I focused on overpronation/motion control and cushioning as mechanisms of failed injury prevention. Find that article in our September issue starting on page 33. To hear the entire lecture plus other speakers from the event, check out **lerEXPO.com/past-events**/.

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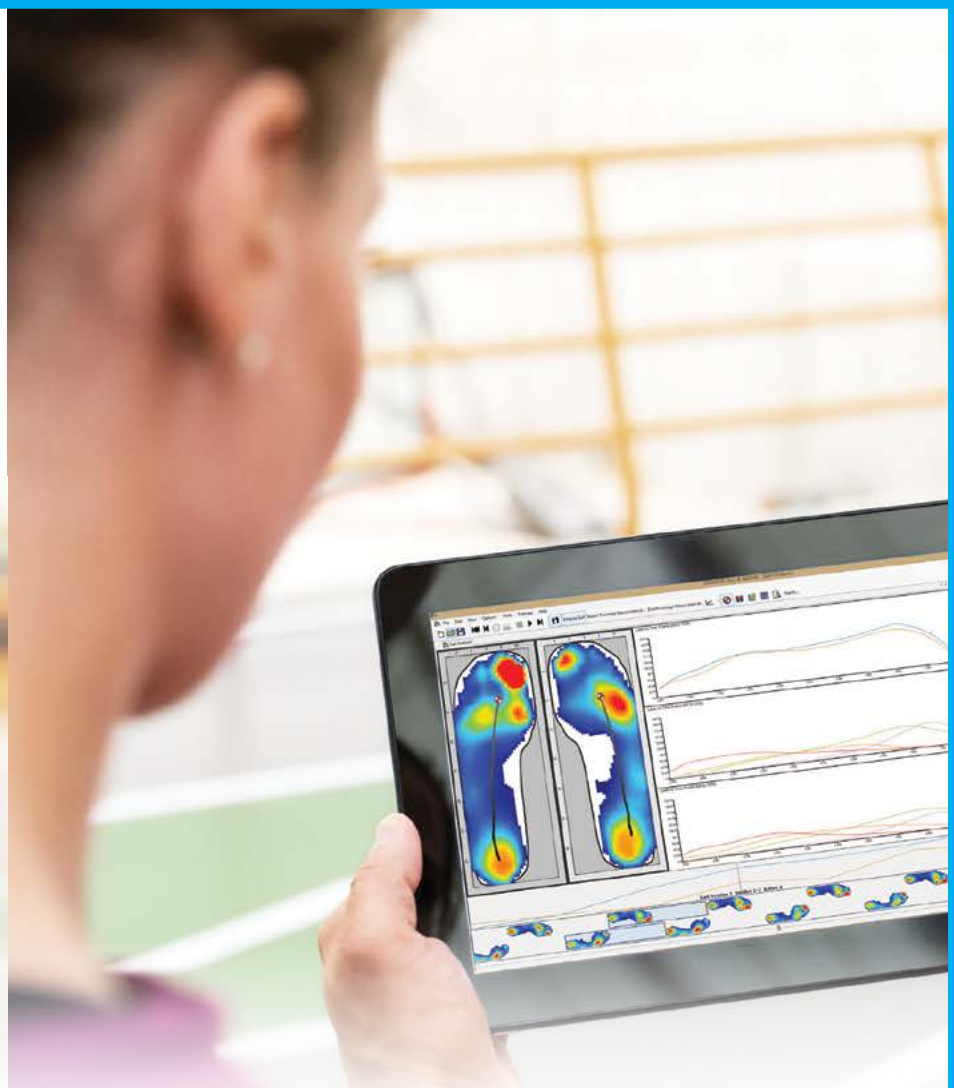

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do need to have a look at. It's something that's under-researched and not very well understood.

Vibration is like a great black hole in footwear research, although it probably is responsible for around 20% of all input load–think about things like pressure, impact force accelerations, things like that. Vibration accounts for about 20% of all impact load.

Put simply, the human body is a vibrating system: While you're sitting there listening to me, I'm talking to you, creating a shockwave that's going into your ear, and it's creating a vibration amongst the little bones in your ear that are allowing your brain to interpret it as a sound signal. Meanwhile, you're vibrating. You're reacting with the chair. Believe it or not, that's what's happening.

So the impact force generates an input signal which is a shockwave, and the response to this shockwave when you run is a muscle adaptation, the so-called muscle tuning, and it varies completely from athlete to athlete.

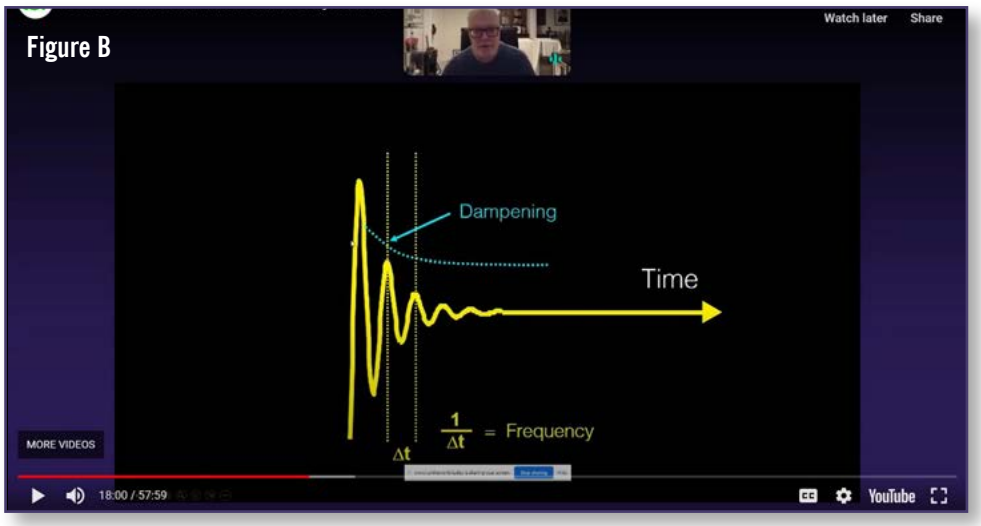
When you've got the frequency of input of the vibration, in other words the frequency of the interaction between the shoe and your body, if that equals the frequency of vibration of the tissue, then we have something called resonance, and resonance is a bit of an issue because when that happens, we try to focus on attenuating or dampening the input vibration.

Vibration exists in both the amplitude domain and also a frequency domain. We don't want to affect them both: We want to try to reduce the amplitude and widen the frequency if we possibly can (Figure B).

There are a couple of things we can look at:

- Kurtosis is basically shock, and this looks at the amplitude of the vibration which we measure with an axial tibial accelerometer (Figure C top)
- Perhaps more important, again using accelerometer, is to look at the frequency of the vibration which is measured by using something called the Power Spectral Density (Figure C bottom)

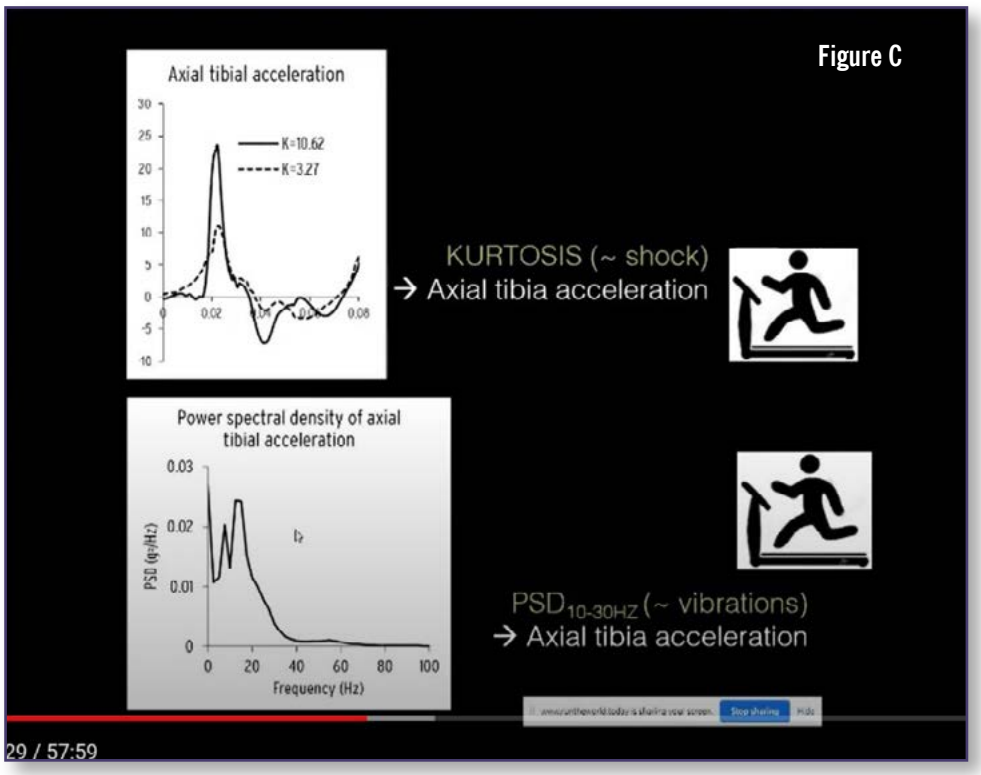
Using these, we can convert the accelerometer data into the frequency of the vibration. Frequency is simply the number of vibration



waves that pass a fixed place in a second and is measured in Hertz. In other words, if you've got a frequency of 300 Hz, it means that you've got 300 vibrations going by in 1 second.

There are 2 main ways that we can influence or dampen or attenuate vibration. The first is by muscle contraction (more on that later). The second main way we can do it is with footwear. But if we're going to use footwear to reduce vibration, we've got a conundrum. Take the Achilles tendon for example. This tissue vibrates–probably between 10 and 30 Hertz. Now we've got this shoe called the Asics Gel- Kayano® 29. This shoe costs almost $300 in Australia and it's a very good shoe. But what if, and I'm not saying it does, but what if this shoe just happened to vibrate at 10 to 30 Hertz?

If that were the case, then [the Achilles tendon and the shoe] would match and we would have resonance. We've all experienced vibration resonance: When you've got a baseball bat, or here in Australia a cricket bat, and you hit the ball off the sweet spot, and you get that nasty sensation coming through the bat into



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your hands. That is resonance. That's when the input vibration of the ball matches the input vibration of the baseball bat, and you get resonance.

This resonance can happen with footwear. If the shoe matches the vibration frequency of the tissue, you get resonance, and when you get resonance, you're far more likely to get injury, which is what we want to avoid if we possibly can. So, we have to try to shift either the frequency of the shoe or the frequency of the tissue in 1 direction or another.

Now the inter-relationship between muscle preactivation, fatigue, stiffness, effective mass, and tibial acceleration are complicated. It may well be that when Nike introduced the Vaporfly Next%® into the Ineos 1:59 challenge with the great Eliud Kipchoge in Vienna a couple of years ago, where he was the first man to go under 2 hours for the marathon distance of 26.1 miles, it may well be that somehow Nike either willingly or unknowingly cracked this nut of vibration and the link to fatigue. [The Vaporfly, Figure D] has this very unusual setup of these ZoomX foam pads in the forefoot, a massive rocker, huge amounts of foam, and the foam is very, very high energy-return and energy-storage foam. So something a bit strange is definitely going on with this shoe.

If you don't believe me, watch the video of Kipchoge crossing the Ineos 1:59 finish line and ask yourself:

This guy has just gone 1:59:40 over the distance of 26.1 miles for the unofficial prize, does he look fatigued to you? Because he doesn't look fatigued to me. He looks like he could turn around and run 26 miles back in the other direction; he looks as fresh as a daisy as he finishes the finish line. [This video can be viewed in the program on lerEXPO.com] Now I've seen other athletes like Ryan Hall. When he became the fastest American marathoner, he looked like he was going to die when he went over the finish line. Marathoners typically look absolutely exhausted, but Kipchoge doesn't. Granted, this was a very staged event, of course, and every nuance of the event was determined. However, I do think the footwear is certainly playing a role in this and there's something quite extraordinary going on there.

Figure D

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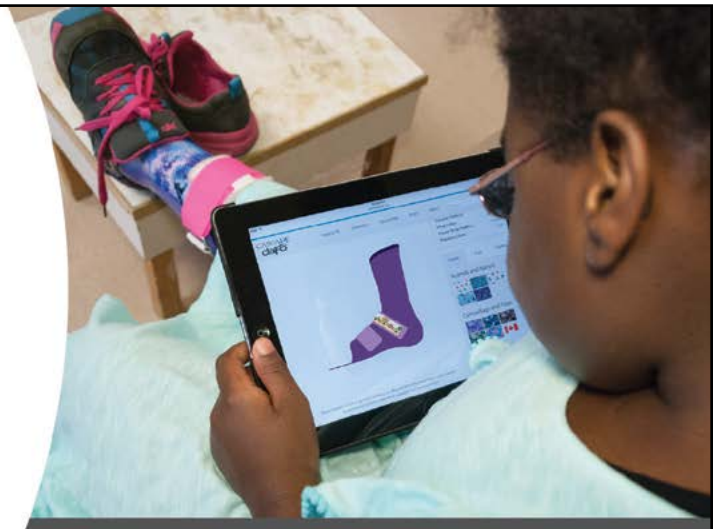

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Understanding Vibrations

We need to understand there are good vibrations and there are bad vibrations. When we look at good vibrations, these are physical forces: they result in maintenance or gain of bone mass. We've got Wolff's law which shows these forces drive the healthy adaptation of bone structure. If we look at the great Rafael Nadal (Figure E), and I ask you, which is his dominant limb? It's very easy for you to look at a picture like this and say, well obviously it's his left arm because you can see the adaptation that's occurred. It's obvious his bone mass is completely different between the 2 forearms. If we were able to look inside, we could see osteopenic versus normal bone. There's bone adaptation occurring here as a direct result of load. And this is the reason we have 2 groups who are very vulnerable to bone loss. First is swimmers, particularly distance swimmers, who spend so much time in the water, which is a pretty much gravity-free environment. They have to be doing weight-bearing activities that stress bone to maintain their bone mass. Second is astronauts. They have treadmills up in space so they can engage in activities that will stress bone and allow them to maintain their bone mass.

And then there are bad vibrations. When you watch the video of this fellow operating vibrating machinery, you can see his arms wobbling as the vibrations go throughout his system. You can see he's smiling. By smiling, he's contracting the muscles of his face and you can see there is nothing happening–no wobbling on his face. But when he stops smiling and relaxes his face muscles, you can start to see the vibrations–the wobbling–coming all through his face all the way to the top of his head.

Figure E

People who habitually operate vibrating machinery do get some fairly significant issues, in particular a very fairly well documented condition called hand-arm vibration syndrome (Figure F, top). It's like a fairly severe

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form of Raynaud's phenomenon, with some nerve and muscle damage. In this magnetic resonance angiography (Figure F, bottom), we see a complete occlusion of the ulnar artery which is what's causing the fingers to go white, because the blood's not getting down there, so we know for certain that as a result of vibration, we get nerve and muscle damage.

We've also got bone injury and have recorded specifically stress fracture as a result of vibration. Unfortunately, at the moment we've only recorded that in rabbits, but it would seem fairly likely that we can draw a fairly strong dashed line to injury from vibration in humans, and this is why we think vibration is so incredibly important.

At Salomon, when I was there from 2014 until 2020, we spent a lot of time looking at the average transmissibility of shock or vibration through 24 tissues from the toes right up through the cervical vertebrae. Figure G shows different color codes for different tissues. If it's in the negative, it means you've got no transmissibility of vibration at all. If it's in the positive, you've got the vibrations being transmitted to the tissue now.

If we look at this group of positive bars where we're getting fairly obvious large transmissibility of vibration through the system, it equates to the part of the human body in the red-tint box. You should ask yourself, isn't this the area where we see most injury occurring in runners? The answer is yes, most runners get injured in the tissues below the knee, with a very high focus for injuries around the metatarsals, the bones of the foot, the heel, going all the way up to the knee. This graph, then, beautifully demonstrates why we think vibration might be very important.

Adding to this, one of our biomechanists was also able to track the vibration frequency of all these tissues at work as well, and that's why we know that the Achilles tendon vibrates at about 10 to 30 Hertz.

In Summary

Obviously we need to change things up and look at how we might be able to change footwear, heavily decoupling here to try to look at independent support platforms. In the Salomon Predict, we could demonstrate a reduction in vibration in the shoe and also say quite confidently that a very, very flexible, highly decoupled shoe was at least as stable or more stable than shoes that were marketed as stability shoes.

In summary, I think we need to be focusing a lot more on input vibration, looking at both the frequency and the amplitude, because we think these may be the most important biomechanical variables. Having spent 40 years looking at loading rates and the first impact peak of runners and trying to reduce that without success, it's time to shift our focus somewhere else and we really need to be looking at that in relation to running performance, running footwear, and running-related injury. ler

Simon Bartold, an internationally renowned podiatrist, is a performance footwear consultant, researcher, educator, mentor, and innovator who currently works with Xblades footwear. His award-winning website, BartoldClinical.com, offers online clinical education in sports medicine of the lower extremity and footwear design.

Figure F

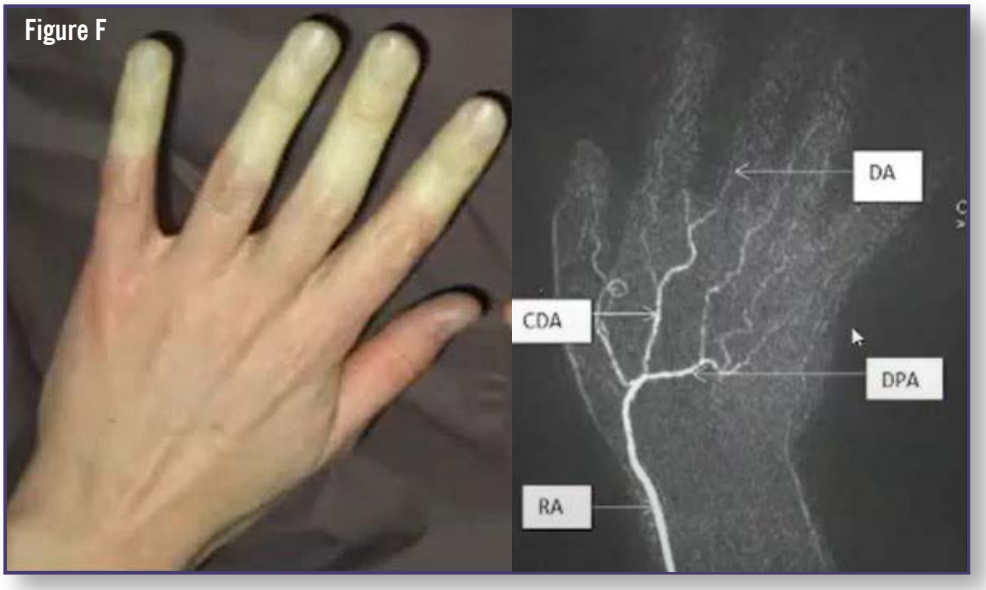
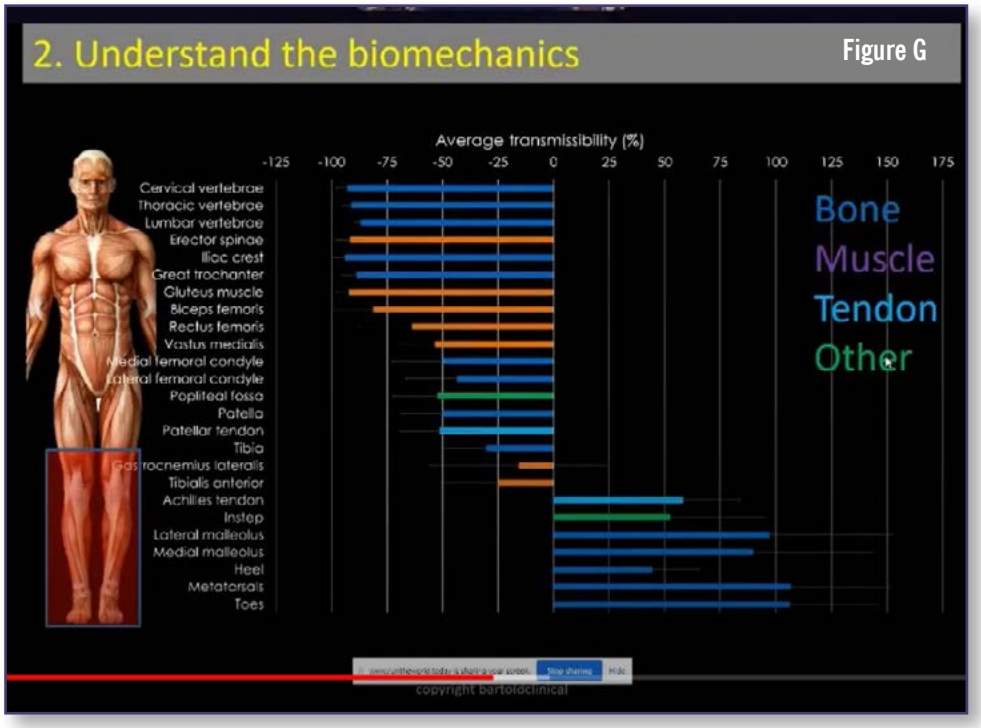


Figure G



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MD, FAAC

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DO, MPH, PhD

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DPM

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Amanda Meszaros
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James McGuire
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Windy Cole
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Matthew Regulski
DPM, FFPM RCPS (Glasg)

Robert Conenello
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Ian Griffiths

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MD

Tracey Vlahovic
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AGENDA

- SURGERY: Medial Column Biomechanics and Surgical Implications
- Huge E&M Changes Are Here! Now!
- SURGERY: Treatment of Navicular Fractures in Athletes
- BIOMECHANICS: Out of the Box
- WOUND CARE: The Role of Artificial Intelligence in Wound Management
- SURGERY: Midfoot Arthrodesis-Clinical Pearls and Cases
- ORTHOBIOLOGICS: Fundamental Concepts and Terms
- SURGERY: Complications in First Ray Surgery
- POD MED: Podiatric Dermatology Pearls you can use on Monday
- WOUND CARE: Management of soft tissue defects of the heel
- Limb Salvage Expert Panel Discussion
- SURGERY: Minimally Invasive Surgical Techniques of the First Ray
- SURGERY: Principles & Practice of Pediatric Flatfoot
- Endocrinology Expert Panel Discussion
- SURGERY: Endoscopic Calcaneoplasty (What? Why? How?)
- SURGERY: Application Of Anatomage In Surgical Amputation Medicine
- BIOMECHANICS: Should we consider color when prescribing foot orthoses?

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A Scoping Review of Heel Fat Pad Syndrome

By Alison H. Chang, Steven Zartov Rasmussen, Asger Emil Jensen, Thomas Sørensen, and Michael Skovdal Rathleff

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Clinical commentaries and expert opinions have suggested that aging, injury, repetitive or prolonged overloading (eg, endurance runners), overweight, improper footwear, steroid injection, and comorbidities (eg, diabetes, rheumatic diseases) may negatively impact the structure and function of the heel fat pad. Prior investigations have focused on plantar fasciopathy, although heel fat pad syndrome (HFPS) seems to be a common cause of plantar heel pain. These proposed risk factors and structural changes may be part of the etiology of HFPS; however, it is unclear if this information is based on high-quality evidence. Universally agreed diagnostic parameters for HFPS is critical for standardized inclusion and exclusion criteria in epidemiological studies and clinical trials.

A systematic overview on evidence-based knowledge of HFPS is greatly needed to fill the gaps and inform clinical practice and future research directions. Therefore, the researchers aimed to identify and synthesize the prevalence, etiology and diagnostic criteria, and conservative management of HFPS.

Methods

A comprehensive search was conducted in May 2021 and updated in April 2022, using MEDLINE, Scopus, Cinahl, EMBASE, Cochrane Library, SPORTDiscus, and PEDro and ClinicalTrials.gov and the World Health Organization's International Clinical Trials Registry Platform (ICTRP) for pertinent registrations. Abstracts, conference proceedings, and bibliographies in relevant systematic reviews (if available) were hand searched for possible inclusions.

Included participants were men and women of any age with heel fat pad pain as well as those with heel fat pad pain plus diagnoses of diabetes mellitus or rheumatoid arthritis. Among the exclusion criteria were studies of heel fat pad biomechanics, morphologies in healthy individuals, participants with a clinical diagnosis of plantar fasciopathy (defined as localized tenderness at the medial calcaneal tuberosity and morning first-step heel pain that abates after a brief period of walking), and participants with unspecified plantar heel pain without differentiating between plantar fasciopathy and HFPS.

The researchers included all study types and designs describing the prevalence; etiology and diagnostic criteria; and non-pharmacological, non-surgical interventions for HFPS, such as exercise therapy (aerobic, neuromuscular, and strength/resistance), stretching/flexibility program, movement training, manual therapy, foot orthotics, shoe insert, footwear modification/recommendation, taping, electrotherapeutics, therapeutic ultrasound, therapeutic laser, shockwave therapy, and cryotherapy. There were no restrictions on the recruitment setting (eg, clinic, hospital, gym, school, home) in which the interventions were performed.

Results

Only 7 studies met the inclusion/exclusion criteria with varied study designs and mixed scientific rigor. The study design of the included articles was mostly on the lower hierarchy of evidence pyramid: single case study (n = 1), case series (n = 1), case–control (n = 2), retrospective medical record review (n = 1), quasi-experimental intervention (n = 1); therefore, potentially introducing high risk of bias.

Based on these results, a knowledge gap for this condition was identified: frequent inattention to distinguishing HFPS from plantar fasciopathy when describing plantar heel pain, and an

This article has been excerpted from "What do we actually know about a common cause of plantar heel pain? A scoping review of heel fat pad syndrome." *Journal of Foot and Ankle Research. 2022;15:60.* doi.org/10.1186/s13047-022-00568-x. Editing has occurred, including the renumbering of tables, and references have been removed for brevity.
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Continued on page 36

Continued from page 35

absence of robust clinical trials to support the commonly recommended conservative management of HFPS. HFPS may be the second leading cause of plantar heel pain, based on 2 studies. Several differentiating pain characteristics and behaviors may aid in diagnosing HFPS vs. plantar fasciopathy. Thinning heel fat pad confirmed by ultrasonography may provide imaging corroboration. Randomized controlled trials (RCTs) assessing the efficacy of viscoelastic heel cups or arch taping for managing HFPS do not exist.

HFPS is a distinct pathology contributing to plantar heel pain; its etiology and diagnostic criteria are poorly understood. Clinical practice guidelines or decision support platforms (eg, UpToDate) for plantar heel pain emphasize the importance of differentiating HFPS from plantar fasciopathy and propose conservative treatment options despite scant supporting research. Conservative treatment options to manage HFPS include rest, activity modification, icing, analgesics, low-dye arch taping, and viscoelastic heel cups. However, there is limited evidence on the effectiveness of these recommended approaches. Nor have these studies been systematically examined.

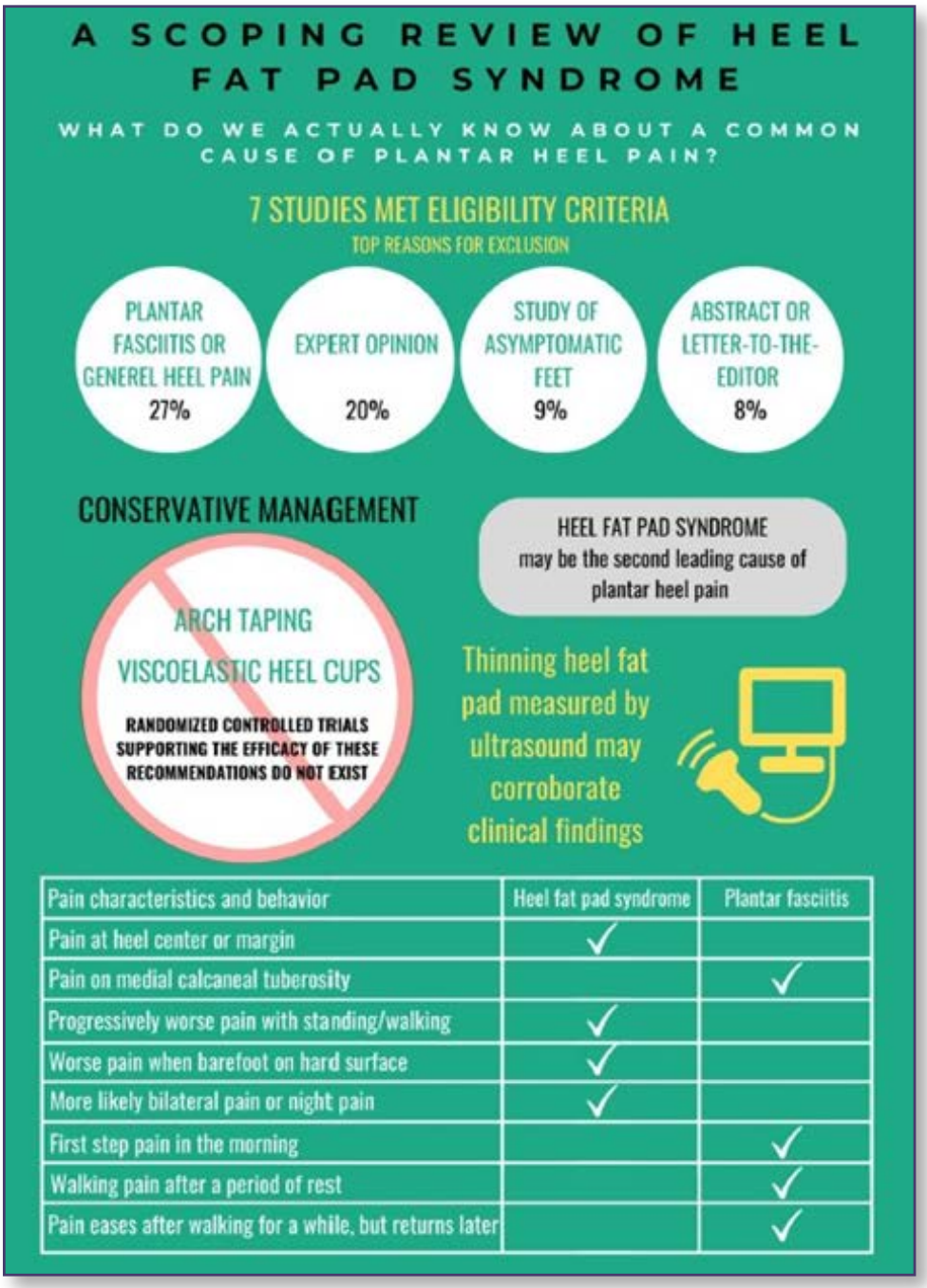

Figure 1. Summary findings of the scoping review.

Discussion

One prospective population-based cohort study (The Feet First Study by Dunn et al) published nearly 20 years ago showed that HFPS is a common foot problem in U.S. community dwelling older adults with a 4.2% prevalence rate, second to plantar fasciopathy (6.9% prevalence rate). The prevalence of HFPS did not differ between sexes but was significantly higher in Hispanic/Latino than in White or African/Black Americans.

This finding was echoed by a retrospective record review of patients diagnosed with plantar heel pain in South Korea. HFPS was diagnosed by the following criteria: less than 3mm heel fat pad thickness assessed by ultrasound, pain at heel center or margin, worsening pain when barefoot or after a long period of standing. Plantar fasciopathy was diagnosed by tenderness on the medial calcaneal tuberosity and an ultrasonic hypoechoic fusiform-shaped swelling ≥4mm thickness at the origin of plantar fascia. In this sample, 53% had plantar fasciopathy; 15% had HFPS, 10% had pes cavus, 9% had HFPS plus plantar faciopathy, 5% had pes planus, 4% had plantar fibromatosis, 2% had plantar fascia rupture, 2% had neuropathy or small shoe syndrome.

Despite HFPS having a distinct pathology and the appearance that it may be the second-most frequent cause of plantar heel pain, many investigators combined participants with HFPS and plantar fasciopathy in their study sample. This oversight may have contributed to a lack of evidence-based treatment options for this condition. The current conservative treatment recommendations of this condition are mostly anecdotal. Future clinical trials with robust study designs are greatly needed.

Damage or irritation to the heel fat pad could be caused by acute trauma (eg, a single high-impact landing) or chronic overuse (eg, repetitive or excessive jumping, running, or

Continued on page 39

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Continued from page 36

walking on hard surfaces). Fat pad atrophy is often associated with aging, rheumatological conditions, diabetes, or obesity. An accurate diagnosis of HFPS is critical for timely management. Based on Yi and colleagues' work from 2011, key differentiating pain characteristics and behaviors between HFPS and plantar fasciopathy are summarized in a table of Figure 1.

Comparing patients with vs. without HFPS seen in a podiatry care center, Lopez-Lopez and colleagues (2019) found that ultrasound-measured unloaded heel fat pad thickness was significantly lower in those with HFPS (7.23 ± 1.39 vs. 10.36 ± 1.78 mm, $P = 0.001$, Cohen's $d = 1.959$). The reduced thickness was more pronounced in women than men. Among women, the thickness discrepancy was 7.09 ± 1.44 (with HFPS) vs. 10.13 ± 1.68 mm (without HFPS). Among men, the thickness discrepancy was 7.37 ± 1.33 vs. 8.58 ± 3.43 mm. Applying the area under the Receiver Operating Curve (ROC) for identifying optimal thickness cutpoint for predicting negative HFPS, they determined a threshold of ≥ 8.77 mm for no heel pain, with a sensitivity value of 85.5% and a specificity value of 82.2%.

Another study by Kanatli et al (2019) found no relationship between heel fat pad properties (heel pad thickness, compressibility, and pressure distribution) and the presence of HFPS. Heel pad properties were compared between patients with HFPS vs. younger healthy medical students with a lower BMI and lower proportion of women. Heel pad thickness in loaded and unloaded conditions were measured by radiographs. Unloaded heel pad thickness was 20.45 ± 2.89 mm (HFPS) vs. 19.55 ± 2.52 (healthy); loaded heel pad thickness was 14.02 ± 3.38 mm (HFPS) vs. 11.81 ± 2.84 (healthy). Heel pad compressibility, defined as the ratio of loaded to unloaded thickness, did not differ between groups (0.69 ± 0.14 in HFPS vs. 0.60 ± 0.11 in healthy). Peak barefoot heel plantar pressures during normal-speed walking were quantified using a pressure-recording platform embedded in the walkway. No between-group differences in peak pressure were observed.

In a case series of 9 patients with HFPS by Balius et al (2021), ultrasound and/or MRI detected pathological heel fat pad morphologies were qualitatively described, including atrophy, fibrosis, edema, and defects in the fat pad septa with fluid in the surrounding tissues. Quantitatively by ultrasound, the unloaded and loaded heel fat pad thickness was 19.8 ± 2.9mm and 12.3 ± 2.9mm, respectively; the compressibility index was 0.60 ± 0.09.

In addition to clinical presentations, ultrasonography and magnetic resonance images (MRIs) have been used to corroborate and confirm the diagnosis of HFPS.

In addition to clinical presentations, ultrasonography and magnetic resonance images (MRIs) have been used to corroborate and confirm the diagnosis of HFPS. Ultrasound quantified fat pad thickness ≤ 9mm may be predicative of HFPS. Contrarily, another study reported no thickness difference between HFPS and healthy controls. An important caveat of this null finding—in this observational case–control study, the disparate age, body mass index (BMI), and sex distribution between the case and control groups were unaccounted for in statistical analyses, potentially biasing study findings. The wide range (12–29mm) of heel fat pad thickness in healthy adults may have complicated the effort to benchmark fat pad thickness as a diagnostic criterion. According to the Physical Stress Theory, thicker fat pad may be present in taller/heavier persons or in endurance athletes who frequently load their heel. Healthy men had thicker fat pad than women. BMI or sex may need to be factored into fat pad thickness interpretation of these studies. Some studies computed fat pad compressibility index, operationalized as the ratio of loaded to unloaded thickness, to ascertain tissue stiffness. A lack of standardized compressive force applied by the ultrasound probe to simulate loaded condition precludes across-study comparisons. Although less economical, practical, and convenient than ultrasonography, MRI could provide more nuanced morphological assessment and qualitatively characterize heel fat pad atrophy, fibrosis, edema, and septal defects.

Viscoelastic heel cups and arch taping have been recommended for conservative management of HFPS. However, the researchers were unable to find even a single randomized controlled trial to substantiate the efficacy of these treatment strategies for HFPS. In contrast, they identified 2 recent systematic reviews and meta-analyses on the efficacy of foot orthoses for treating plantar fasciopathy. Low-dye arch taping has been shown to reduce the first-step pain in high-quality clinical trials and supported by clinical experts and patients as a reasonable first-line management for symptoms during weightbearing activities. Their search yielded 2 interventional studies for HFPS: a single case and a quasi-experimental study. In a 33-year-old man with bilateral HFPS, heel pain decreased after 1-month and 3-month application of silicone gel heel cups. Low-dye taping and low-dye plus figure-of-8 taping provided pain relief by 2 to 3 points on a 0–10 numeric pain rating scale when compared to barefoot walking. In the absence of a control group, the change in self-reported pain observed in this study could be a result of regression-to-the-mean phenomenon or placebo effects. This review brings to light the dire need for RCTs with scientific rigor to support evidence-based recommendations in conservative management of HFPS.

Conclusion

In the limited evidence that was reviewed, it appears that HFPS may be the second leading cause of plantar heel pain. Several differentiating pain characteristics and behaviors may aid in diagnosing HFPS vs. plantar fasciopathy. Thinning heel fat pad quantified by ultrasound may provide imaging corroboration of HFPS. The researchers have identified a substantial knowledge gap for this condition, frequent inattention to distinguishing HFPS from plantar fasciopathy when describing plantar heel pain, and a glaring absence of robust clinical trials examining the efficacy of commonly recommended conservative management of HFPS.

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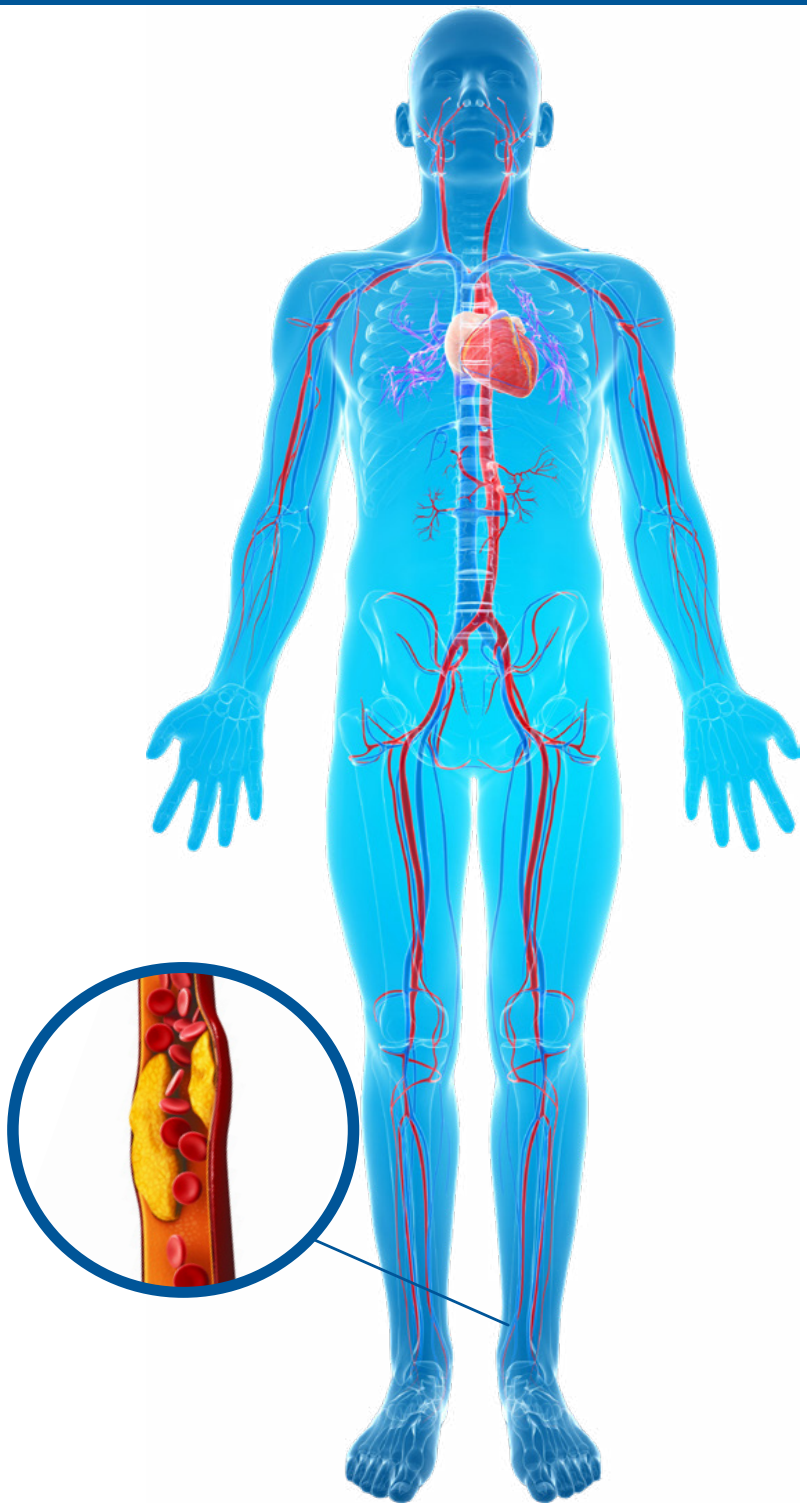

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International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines

The human aging process is universal, ubiquitous, and inevitable. Every physiological function is being continuously diminished. Aging and a sedentary lifestyle are associated with declines in muscle function and cardiorespiratory fitness, resulting in an impaired capacity to perform daily activities and maintain independent functioning. However, in the presence of adequate exercise/physical activity (PA) these changes in muscular and aerobic capacity with age are substantially attenuated. Additionally, both structured exercise and overall PA play important roles as preventive strategies for many chronic diseases, including cardiovascular disease, stroke, diabetes, osteoporosis, and obesity; improvement of mobility, mental health, and quality of life; and reduction in mortality, among other benefits. Notably, exercise intervention programs improve the hallmarks of frailty (low body mass, strength, mobility, PA level, energy) and cognition, thus optimizing functional capacity during aging. In these pathological conditions, exercise is used as a therapeutic agent and follows the precepts of identifying the cause of a disease and then using an agent in an evidence-based dose to eliminate or moderate the disease.

Prescription of PA/structured exercise should therefore be based on the intended outcome (eg, primary prevention, improvement in fitness or functional status, or disease treatment), and individualized, adjusted, and controlled like any other medical treatment. In addition, in line with other therapeutic agents, exercise shows a dose-response effect and can be individualized using different modalities, volumes, and/or intensities as appropriate to the health state or medical condition.

Importantly, exercise therapy is often directed at several physiological systems simultaneously, rather than targeted to a single outcome as is generally the case with pharmacological approaches to disease management. There are diseases for which exercise is an alternative to pharmacological treatment (such as depression), thus contributing to the goal of deprescribing of potentially inappropriate medications (PIMS). There are other conditions where no effective drug therapy is currently available (such as sarcopenia or dementia), where exercise may serve a primary role in prevention and treatment. Therefore, this consensus statement provides an evidence-based rationale for using exercise and PA for health promotion and disease prevention and treatment in older adults. Exercise prescription is discussed in terms of the specific modalities and doses that have been studied in randomized controlled trials for their effectiveness in attenuating physiological changes of aging, disease prevention, and/or improvement of older adults with chronic disease and disability. Recommendations are proposed to bridge gaps in the current literature and to optimize the use of exercise/PA both as a preventive medicine and as a therapeutic agent.

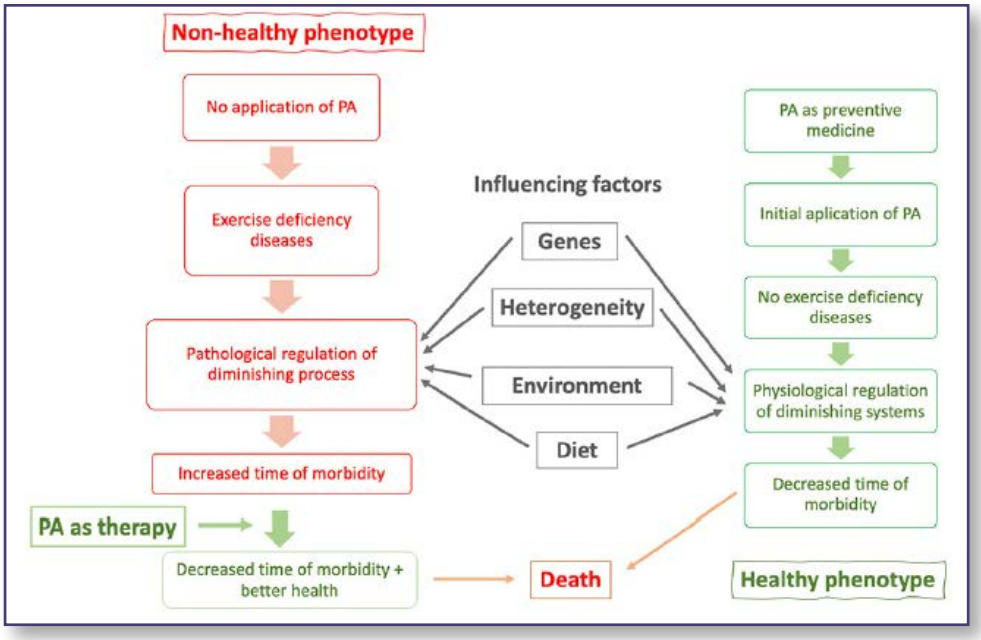

Figure 1. The left-hand side shows the application of PA as a therapeutic agent to pathologies that have developed because of a lack of exercise. This side reflects pathological, not physiological changes. The effects of these pathologies can be ameliorated by PA. The right-hand side shows the application of PA as preventative medicine and the maintenance of effective but diminishing physiological function. This side is investigated by the science of physiology and ageing. Both sides are in constant decremental change because of the inherent ageing process. The center shows major effectors of both pathological and physiological processes. PA = physical activity.

Physical activity and exercise for health promotion, disease prevention, and treatment in older adults

The world population is aging, and adults ≥ 65 years old are projected to double in number to ~ 1.5 billion in 2050. Due to a concurrent increase

This article has been excerpted from Izquierdo M, Merchant RA, Morley JE, et al. International Exercise Recommendations in Older Adults (ICFSR): Expert Consensus Guidelines," from the *Journal of Nutrition, Health & Aging.* 2021;25(7):824-853. Editing has occurred, including the renumbering of tables, and references have been removed for brevity. Use is per CC BY.

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Continued from page 41

Table 1. Exercise recommendations for optimal ageing and maintenance of functional capacities in older adults

	Resistance Training	Aerobic Exercise Training	Balance Training
Frequency (days per week)	2 – 3	3 – 7	1 – 7
Volume	1–3 sets of 8–12 repetitions, 8–10 major muscle groups	20 – 60 minutes / session	1 – 2 sets of 4 – 10 different exercises emphasizing static and dynamic postures
Intensity	Start at 30-40% of 1RM and progress to heavier loads of 70–80% 1 RM (15–18 on Borg Scalea) 1-3 min rest between sets Power training at 40 – 60% of 1RM	12–14 on Borg Scale[a] (55–70% heart rate reserve or maximum exercise capacity)	Progressive difficulty as tolerated[b] Narrowing the base of support Perturbation of ground support Decrease in proprioceptive sensation Diminished or misleading visual inputs Movement of the centre of mass of the body away from the vertical or stationary position Dual tasking: adding a cognitive distractor or secondary physical task while practising a balance task
Specific Physiological adaptations	• Strength • Power • Hypertrophy • Endurance • Maximal aerobic capacity	• Maximal aerobic capacity • Sub-maximal endurance • Cardiac contractility/stroke volume • Peripheral oxygen extraction • Arterial stiffness • Heart rate variability	• Dynamic stability
Exercise examples	• Multiple and single joint exercises (free weights and machine) with slow to moderate lifting velocity • Bench press and squat • Knee extensions and knee curls • Exercise selection can be varied through alterations in body posture, grip, hand and foot stance, unilateral vs bilateral exercises • Once body weight no longer serves as a sufficient source of overload, additional resistance can be provided by machines or free weights as needed to ensure progression.	• Dancing • Cycling • Hiking • Jogging / long distance running • Swimming • Walking with change in pace and direction • Treadmill walking • Stair climbing • Step-ups • Seated stepping • Recumbant cycling May start with 5-10 mins and progress to 15-30 mins. The intensity is proportional to heart rate and/or perceived exertional scales if on B blockers or has pacemaker and can be increased from moderate to vigorous depending on fitness.	• Tai Chi • Standing yoga or ballet movements • Tandem walking • Standing on one leg, stepping over objects, climbing slowly up and down steps • Turning • Standing on heels and toes, walking on a compliant surface such as foam mattresses • Maintaining balance on a moving vehicle, such as a bus or train • Dual-tasking: adding cognitive distractor while maintaining balance Many conditions in older adults require balance training before aerobic exercise/ gait retraining

a. Original Borg Scale of Perceived Exertion from 6 (easy) to 20 (maximal); b. Intensity is increased by decreasing the base of support [e.g., progressing from standing on two feet while holding on to the back of a chair to standing on one foot with no hand support); by decreasing other sensory input (e.g., closing eyes or standing on a foam pillow); by perturbing the centre of mass (e.g., holding a heavy object out to one side while maintaining balance, standing on one leg while lifting the other leg out behind the body, or leaning forward as far as possible without falling or moving feet); or by dual-tasking (adding a secondary cognitive [e.g., naming animals] or physical (e.g. juggling) task while tandem walking].

in life expectancy, people ≥ 80 years of age are projected to triple in number between 2019 and 2050 to 426 million. Population aging impacts many sectors, including healthcare, quality of life (social), retirement, and caregiving, and most importantly, is associated with an age-related burden of non-communicable chronic diseases and disability. The human aging process is universal, ubiquitous, inevitable, and decremental. Every physiological function is being continuously diminished. At around 20–30 years of age humans have acquired all the physiological development that they will attain. From that stage the aging process commences, although the rate of change is heterogeneous. This process will continue up to 6 or 7 decades ending in death. There is a range between 2 distinct phenotypes of aging, shaped by patterns of living—experiences and behaviors, and in particular by the presence or absence of 'healthful' levels of PA and exercise (ie, a sedentary lifestyle). In this consensus, the terms 'physical activity' and 'exercise' should be interpreted as follows: PA is any bodily movement produced by skeletal muscles that significantly increases energy expenditure. The intensity and duration of PA can vary substantially. Exercise is a subcategory of PA that is planned, structured, and repetitive, in which bodily movements are performed with or without the explicit intent of improving or maintaining of 1 or more components of physical fitness (ie, aerobic capacity, muscle strength power, and endurance, balance, coordination, and flexibility).

Table 1 details the consensus panel's exercise recommendations for optimal aging and maintenance of functional capacities in older adults. (See also page 13, Major Geriatric Syndromes for Which Exercise May Be Beneficial as a Preventive.)

Of particular import for LER readers:

Gait training recommendations. Several trials investigating the effects of exercise interventions on gait ability (velocity and stability) in older individuals with frailty have yielded conflicting results. Whereas some studies showed

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improvements in gait ability after the physical training period, others found no improvement. Interestingly, the bulk of studies demonstrating improvements in gait ability utilized multicomponent exercise programs, while others used only resistance exercises or a combination of aerobic training and yoga. Gait ability is a strong predictor of survival in older adults and its maintenance should be prioritized in the oldest-old. Aerobic exercises such as walking with changes in pace and direction, treadmill walking, step-ups, and stair climbing, among others, are valuable modalities to achieve aerobic fitness adaptations and gait and mobility improvements. Weight bearing aerobic activities that simulate real-life activities are preferable whenever possible. For those patients with severe arthritis or balance impairment, aquatic exercise, seated steppers, or recumbent cycles may be more tolerable alternatives. Generally, however, if someone cannot support their body weight independently, the initial priority should be resistance (strength and power) training, as well as balance training, before moving to ambulation and other forms of weight bearing aerobic exercise. The duration of the exercise component may start at 5–10 minutes (or less) during the first weeks of training and progress to 20–30 minutes in the long term. The intensity of this exercise component is generally proportional to heart rate and can be increased from moderate to vigorous as fitness and confidence improve. If the heart rate can no longer function as an accurate measure of exercise intensity due to arrhythmias, beta-blockers, or functioning pacemakers, clinicians can use perceived exertion scales instead. If cognitive impairment precludes the use of subjective perceived exertion, observer-rated perceived exertion (respiratory rate, ability to talk, sweating, or facial expression) can be substituted.

Effects of PA/exercise interventions on falls

Multicomponent exercise programs including combinations of resistance training, balance and/or gait retraining; less commonly, resistance exercise alone, or an alternative exercise intervention such as Tai Chi or dance programs have been shown to reduce falls in older adults. Aerobic training alone, by contrast, has been shown to increase falls and fracture risk. Based on the evidence that such multicomponent exercise interventions are more effective in improving most, if not all, of the frailty syndrome hallmarks (ie, poor balance, reduced muscle strength, poor gait ability, and increased incidence of falls), it is the recommended strategy for this condition. Current evidence, however, on reducing falls with physical training among community-dwelling older adults with cognitive impairment (ie, any stage of Alzheimer's disease and related dementias, or mild cognitive impairment) is insufficient at this time to inform evidence-based recommendations or treatment decisions for clinical practice.

Gait ability is a strong predictor of survival in older adults and its maintenance should be prioritized in the oldest-old.

Conclusions

Insufficient PA/exercise and excess sedentary behaviors are potent risk factors for all-cause and cardiovascular mortality, obesity, sarcopenia, frailty, and disability, among other chronic diseases associated with aging. Being physically active and having a healthy diet (coupled with no smoking and moderate alcohol consumption and the maintenance of appropriate body mass) are integral to maintaining health and well-being at all ages. Exercise and PA offer clinical benefits across a wide range of diseases and disabilities with no upper age limit. An appropriate exercise prescription should be included in all healthcare recommendations in the effort to enhance functional independence, psychological well-being, and quality of life through the promotion of exercise for all older adults, whether fit or frail, of any age. PA (including structured exercise participation) influences key drivers of aging even in the oldest-old, including chronic inflammation, mitochondrial dysfunction, myokine release, autophagy, oxidative damage, and insulin-like growth factor signaling. Exercise and PA improve physical function and quality of life, and reduce the burden of non-communicable chronic diseases and premature overall mortality including cause-specific mortality from cardiovascular disease, cancer, and chronic lower respiratory tract diseases. The beneficial effects of exercise are global (ie, acting at both the physiological multisystem and functional capacity level). Exercise interventions are currently more useful than pharmacological interventions that target single systems (eg, inflammation or anabolic hormones) for managing frailty. Declines in muscle function and cardiorespiratory fitness with aging result in impaired ability to perform daily activities and maintain Independence. Accordingly, the treatment of frailty should be focused on improvement in overall functionality, complementary to the diagnosis and treatment of specific diseases. Exercise is medicine, and the prescription of PA/structured exercise should therefore be based on the intended outcome (eg, primary prevention, improvement in fitness or functional status, or disease treatment), and should be individualized, and controlled like any other medical treatment. The prescription of exercise for health-related outcomes must consider not only dose-response relationships with volume and intensity, but also modality-specific adaptations which are requisite for certain outcomes to be achieved. Since most patients will present with more than 1 disease, an efficient prescription to optimize both safety and efficacy is mandatory as described in this consensus statement. Importantly, beyond its practical benefits, long-term physical exercise results in less harm among older adults than maintaining usual activity levels or usual care, independent of participants' age, physical function, or cognition status at baseline. Considering the accumulated evidence of the benefits of exercise in frail older adults over many decades, it is not justifiable to not prescribe physical exercise to these individuals, and 1 of the main challenges for the future is to integrate exercise programs as a mandatory part of the care of pre-frail/frail older patients in all hospital, outpatient, and aged care settings. ler

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Lower Extremity Injuries Involving The United States Rail Transportation System

By Mathias B. Forrester, BS

Thousands of people have United States (US) rail transportation industry jobs, and millions travel by US rail each year. Injuries may occur to employees, passengers, and others who may interact with the rail transportation system. The objective of this study was to characterize lower extremity injuries involving the rail transportation system.

Methods: An analysis was performed of lower extremity injuries reported to the US Federal Railroad Administration during 2000-2021.

Results: A total of 46,765 lower extremity injuries were identified. The annual number of lower extremity injuries decreased from 2,881 in 2000 to 1,307 in 2021. The patient age distribution was: 2.3% 0-19 years, 12.7% 20-29 years, 20.4% 30-39 years, 23.1% 40-49 years, 23.7% 50-59 years, and 12.0% 60 years or older. In 47.2% of the reported cases, the person was walking, getting off, or stepping down just before the injury, and in 46.8%, the person slipped, fell, or stumbled. Half (50.0%) of the lower extremity injuries occurred beside the track, in a rail car, on stairs, alongside of on-track equipment, or at a work station. The most commonly reported injuries were 42.3% sprain or strain, 23.2% bruise or contusion, 14.6% fracture, and 8.8% laceration or abrasion.

Conclusions: The number of lower extremity injuries reported to the Federal Railroad Administration declined during 2000-2021. The majority of patients injured were age 30-59 years. The most commonly reported injuries were sprain or strain, bruise or contusion, fracture, and laceration or abrasion. Almost half of the injuries involved the person slipping, falling, or stumbling.

According to the United States (US) Bureau of Labor Statistics Current Employment Statistics (CES), in December 2020 there were 144,500 jobs in the US rail transportation industry.[1] In 2017, approximately 4.7 million passengers travelled on Amtrak's long-distance routes.[2]

Injuries may occur not only to rail transportation employees and passengers but also to others who may interact with the rail transportation system.[3-8] The objective of this study was to characterize lower extremity injuries involving the rail transportation system.

Methods

This study used data downloaded from the US Department of Transportation Federal Railroad Administration (FRA) website at https://safetydata.fra.dot.gov/OfficeofSafety/publicsite/on_the_fly_download.aspx. US railroads are required to report information on accidents and incidents including casualties to persons (i.e., deaths and non-fatal injuries to all types of persons and occupational illnesses involving railroad employees) to the FRA. The FRA collects and analyzes the data on these accidents and incidents.[9] Record-specific data are publicly available but are de-identified; therefore, the study is exempt from institutional review board approval.

This study included all reports in the FRA casualty (injury) database during 2000-2021where the Location text field included the code 3 (Leg or foot). The variables examined were year and month, injured person's age, type of injured person, actions just before injury, event which caused injury, specific location of person at time of injury, state, nature of injury, specific body part, and fatality. The description of the data fields and the definition of the codes used in the fields can be found at https://railroads.dot.gov/forms-guides-publications/guides/618055a-injuryillness-continuation-sheet-effect-612011-54kb and at https://safetydata.fra.dot.gov/publicObjects/accinccodes.pdf. The distribution of cases by the variables was calculated.

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Table 1. Injured person characteristics of lower extremity injuries, Federal Railroad Administration, 2000-2021

VARIABLE	NUMBER	PERCENT
PERSON AGE (YEARS)		
0-5	78	0.2
6-12	246	0.5
13-19	748	1.6
20-29	5,939	12.7
30-39	9,539	20.4
40-49	10,816	23.1
50-59	11,066	23.7
60-69	3,849	8.2
70+	1,754	3.8
Unknown	2,730	5.8
TYPE OF PERSON		
Worker on duty - employee	27,567	58.9
Passenger on train	7,833	16.7
Non-trespassers - on railroad property	5,361	11.5
Trespassers	2,854	6.1
Contractor - other	1,241	2.7
Employee not on duty	988	2.1
Worker on duty - contractor	827	1.8
Non-trespassers - off railroad property	65	0.1
Worker on duty – volunteer	21	0.0
Volunteer – other	8	0.0
TOTAL	46,765	

Results

A total of 46,765 lower extremity injuries were identified, representing 21.8% of the 214,390 total injuries. Figure 1 (page 55) presents the annual number of lower extremity injuries. The annual number of lower extremity injuries declined from 2,881 in 2000 to 1,307 in 2021 with the largest decline of 32.3% observed between 2019 and 2020. Injuries occurred evenly throughout the year: there were 11,862 (25.4%) lower extremity injuries in January-March, 11,529 (24.7%) in April-June, 12,100 (25.9%) in July-September, and 11,274 (24.1%) in October-December.

Table 1 shows the distribution of lower extremity injuries by characteristics of the person injured. Only 2.3% of the injuries involved children (0-19 years); 67.2% of the persons were age 30-59 years. For those persons with a reported age, the mean age was 44.5 years (range 1-99 years). At least 62.9% of the persons were rail transportation employees or workers. When the circumstances of the injury were examined (Table 2), the highest proportion of persons were walking just before the injury followed by getting off and stepping down. The most common events involved the person slipping, falling, or stumbling. The highest proportion of lower extremity injuries occurred beside the track followed by in a rail car, on stairs, alongside of on-track equipment, and at a work station (Table 3).

Table 4 shows the distribution of lower ex-

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Table 2. Circumstances of lower extremity injuries, Federal Railroad Administration, 2000-2021

VARIABLE	NUMBER	PERCENT
ACTIONS JUST BEFORE INJURY		
Walking	14,606	31.2
Getting off	3,981	8.5
Stepping down	3,484	7.5
Standing	2,138	4.6
Getting on	2,126	4.5
Riding	1,690	3.6
Descending	1,487	3.2
Sitting	1,465	3.1
All other/Unknown	15,788	33.8
EVENT WHICH CAUSED INJURY		
Slipped, fell, stumbled, other	10,786	23.1
Slipped, fell, stumbled, etc. due to object, e.g., ballast, spike, material, etc.	3,885	8.3
Slipped, fell, stumbled, etc. due to irregular surface, e.g., depression, slope, etc.	3,207	6.9
Slipped, fell, stumbled, etc. due to climatic condition (rain, snow, ice, etc.)	3,056	6.5
Lost balance	2,585	5.5
Overexertion	2,200	4.7
Struck by object	2,109	4.5
Highway-rail collision/impact	1,583	3.4
Struck by on-track equipment	1,521	3.3
Struck against object	1,454	3.1
Stepped on object	1,449	3.1
Bodily function/sudden movement, e.g., sneezing, twisting	1,182	2.5
Struck by falling object	1073	2.3
Slipped, fell, stumbled, etc. on oil, grease, other slippery substance	953	2.0
Other	9,722	20.8
TOTAL	46,765	

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Table 3. Incident location of lower extremity injuries, Federal Railroad Administration, 2000-2021

VARIABLE	NUMBER	PERCENT
SPECIFIC LOCATION OF PERSON AT		
time of injury		
Beside track	7,031	15.0
In rail car	4,427	9.5
On stairs	3,995	8.5
Alongside of on-track equipment - on ground	3,984	8.5
At work station	3,966	8.5
On platform	3,469	7.4
On track	2,366	5.1
Other	14,432	30.9
Unknown	3,095	6.6
STATE (MOST COMMON)		
New York	6,848	14.6
Illinois	4,531	9.7
New Jersey	3,490	7.5
Pennsylvania	3,313	7.1
California	3,158	6.8
Texas	2,673	5.7
TOTAL	46,765	

tremity injuries by type of injury. The highest proportion of injuries was sprain or strain followed by bruise or contusion, fracture, and laceration or abrasion. The most commonly injured parts of the lower extremity were the knee and ankle. Fatality was reported in 72 (0.2%) of the cases.

Discussion

The annual number of lower extremity injuries declined 38.7% from 2000 to 2019 and 54.6% from 2000 to 2021. US rail transportation employment declined from 206,700 jobs in January 2000 to 144,500 jobs in December 2020, and the industry lost 40,000 jobs between November 2018 and December 2020.[1] This decline in jobs may account for at least some of the decline in lower extremity injuries observed. The largest

Table 4. Type of lower extremity injuries, Federal Railroad Administration, 2000-2021

VARIABLE	NUMBER	PERCENT
TYPE OF INJURY		
Sprain or strain	19,786	42.3
Bruise or contusion	10,849	23.2
Fracture (broken bone)	6,824	14.6
Cut/laceration or abrasion	4,094	8.8
Amputation	1,358	2.9
Other	3,835	8.2
BODY PART		
Knee	17,507	37.4
Ankle	10,928	23.4
Lower leg	8,468	18.1
Foot (general)	4,915	10.5
Upper leg	2,821	6.0
Toes	1,167	2.5
Heel	353	0.8
Unknown	606	1.3
TOTAL	46,765	

annual decline (32.3%) was observed between 2019 and 2020. This was likely due to the COVID-19 pandemic. A national emergency regarding COVID-19 was declared on March 13, 2020, and various states began to enact stay-at-home orders and close or restrict schools, businesses, parks, playgrounds, and other facilities in March 2020. In subsequent months, stay-at-home orders, closures, and restrictions were lifted or modified, although this varied from state to state.[1,10] During April and May 2020, rail transportation employment experienced a loss of 10,000 jobs, a quarter of the loss experienced from November 2018 to December 2020.[1]

Approximately two-thirds of the patients were age 30-59 years. Since most of persons injured were rail transportation employees or workers, it may be that the majority of employees or workers were age 30-59 years. Alternately, it may be that persons age 30-59 years were more likely to experience a lower extremity injury.

Almost half (47.2%) of the persons were walking, getting off, or stepping down just before the injury, and 46.8% involved the person

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slipping, falling, or stumbling. Half of the lower extremity injuries occurred beside the track followed by in a rail car, on stairs, alongside of on-track equipment, or at a work station. This information may be useful for identifying those persons most at risk of lower extremity injuries associated with the railroad industry and creating education and prevention activities to reduce risk of these injuries.

The most frequently reported lower extremity injuries were sprain or strain, bruise or contusion, fracture, and laceration or abrasion. In many instances, these types of injuries might be considered relatively minor and not require healthcare management such as hospitalization. However, information on the management of these injuries was not available in the FRA casualty database.

This study has limitations. It is based on data included in the FRA casualty database. Lower extremity injuries to rail transportation employees, passengers, or others who interact with the railroad industry that were not included in the database would not be included. Furthermore, although the database contains a Narrative field for providing additional details on the injury, this field is often blank or contains very little information. So analyses were limited to the other data fields.

In conclusion, the number of lower extremity injuries reported to FRA declined during 2000-2021, particularly during the COVID-19 pandemic. The majority of patients injured were age 30-59 years, and most were employees on duty. The most commonly reported injuries were sprain or strain, bruise or contusion, fracture, and laceration or abrasion. Almost half of the injuries involved the person slipping, falling, or stumbling. ler

Mathias B. Forrester, BS, is an independent researcher in Austin, Texas. Now retired, he previously performed public health research for various university and government programs for 34 years.

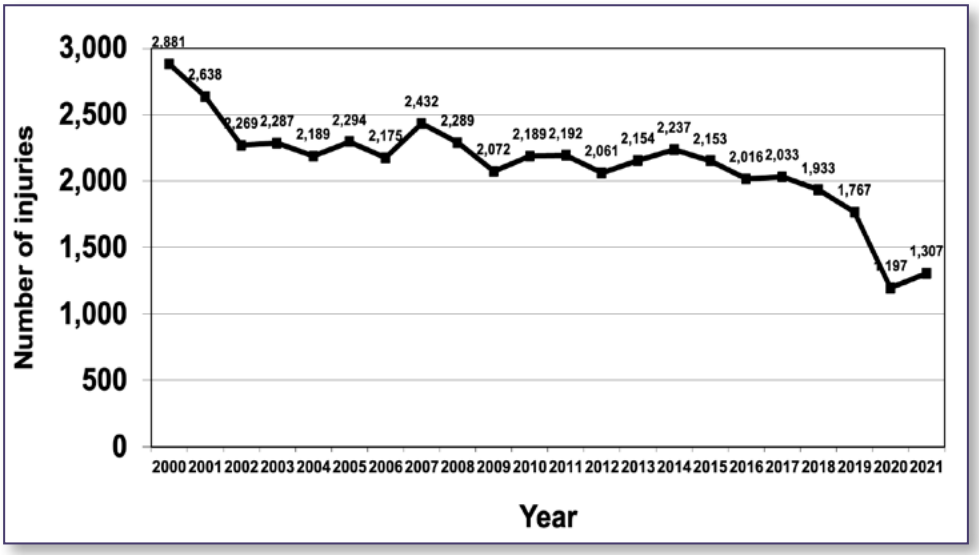

Figure 1. Annual number of lower extremity injuries reported to the Federal Railroad Administration

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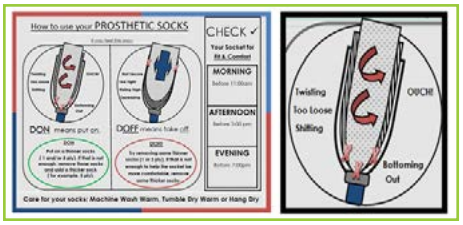
jbrds, a new children's footwear brand anatomically designed to support foot structure and activity requirements at 4 distinct stages of a child's physical development, has launched its first product line of Stand2Walk shoes for ages 9–18 months. The shoes were designed by podiatrist and foot and ankle surgeon Jay LeBow, DPM. The Stand2Walk patent-pending design uniquely supports the lateral column and developing cuboid bone while stabilizing the heel. This combination of support and stability promotes the healthy development of a child's foot. jbrds created Stand2Walk footwear for children with the following features that make it easier for babies to stand, balance, and walk: injection-molded support cage (patent pending), Velcro strap, sock-like upper, suede outsole, and 0-drop outsole. The shoes are available in 6 colors.

jbrds
866/537-0447
jbrds.com

SOLUTION TO PROSTHETIC SOCKS MANAGEMENT

Veterans and other people with lower limb amputations who wear prostheses often experience fluctuations in residual limb volume. They adjust for the resulting changes in fit and comfort of their prosthetic sockets throughout the day using prosthetic socks of varying thickness. However, this can be difficult for a recent amputee to manage. Too few or too many socks can create increased pressure on the end of the limb, making it difficult to determine when to add or remove socks. Incorrect use of socks can lead to skin damage and serious complications, such as non-healing wounds.

To address this issue, Billie Savvas Slater, MA, Ed, CCRC, developed the Prosthetic Sock Management Tool (PSMT). Slater is a research health science specialist and innovation specialist at the Veterans' Administration in Minneapolis, MN, and the senior research study coordinator for the Minneapolis Adaptive Design and Engineering (MADE) Program.



The PSMT is to be used by VA prosthetists to help educate their patients on the proper use of prosthetic socks following lower limb amputation and then by the patients as they manage their use of prosthetic socks. It consists of several different components, including a multi-zippered bag with 3 pouches for storage of socks of different thicknesses, an infographic on both proper sock usage and care, instructional videos, and reminders for fit checks

COPPER-ENHANCED DIABETIC SOCKS

AVAL ACTIVE Diabetic socks protect feet by using drymax fiber technology, which mechanically lifts sweat off the skin, transferring it to the sock's moisture-attracting outer layer, to provide a drier, more hygienic environment for the skin and toenails than do wet-wicking fiber socks. These socks also reduce or eliminate skin tears or blisters caused by wearing wet socks. AVAL CASUAL Diabetic socks employ

ultra-soft polyester fibers and are designed to be worn by diabetics whose feet never sweat or for times when a diabetic's feet are not sweating. The entire foot of AVAL ACTIVE and CASUAL Diabetic socks are enhanced with Cupron Copper Technology to inhibit fungal and yeast growth, while helping keep socks odor free. They also have easy stretch, non-binding legs, a seamless toe, and dense protective padding that reduces pressure underfoot, while not adversely affecting shoe fit. Available in Mini-Crew, ¼-Crew, and Crew heights.

AVAL
805/239-2555
avalsocks.com

"GROWING SHOES" GET A FACELIFT

What started as a post-university trip to see the world has turned into a 10-year (and going strong) endeavor that has distributed over 350,000 pairs of expandable shoes to children living in poverty in over 100 countries around the world.

Idaho native Kenton Lee became aware of the needs of these children when working at an orphanage in Kenya in 2007. He noticed many children were barefoot or had the fronts of their shoes cut out to accommodate their growing feet. Upon his return home, he rallied a group of friends, and they began building prototypes in his garage. They also started the nonprofit organization Because International™ to serve as the structure to distribute The Shoe

That Grows.

In 2012, the first 100 pairs of "The Shoe That Grows" were distributed. The shoes had snaps on the sides, toes, and heels that allowed them to be adjusted to "grow" 5 foot sizes. Since the beginning, the shoes have also grown in design and functionality, such as the switch to straps rather than snaps. The latest iteration was unveiled in 2021 and had undergone rigorous testing in the manufacturing facility and in the field, prior to advancing to full production status. The new version consists of a single injection-molded piece, whereas the original was comprised of 8 parts stitched and glued together. And the shoes are only offered in black now, rather than pink, tan, or blue, to meet school dress codes.

To learn more about The Shoe That Grows, visit becauseinternational.org.

POWER PLATE INSOLE

Forward Motion/JM Orthotics are excited to offer the Power Plate insole, providing doctors with a medical-grade prefabricated solution for their patients. The Power Plate insole is designed to assist propulsion and enhance performance by gathering and releasing kinetic energy with every step. Made from a proprietary PRx Graphite™, the power plate is available in multiple rigidities, allowing users to maximize recovery time and provide protection against most foot injuries. Simply insert the Power Plate under the factory shoe insole to produce an immediate and surprising boost to walking, running, and jumping ability. Common medical uses include: post-operative recovery, sprain protection, support for TMA, Morton's toe, hallux limitus, toe joint pain, arthritis in the foot and toe, and other mobility-limiting foot injuries.

Forward Motion Medical/JM Orthotics
800/301-5835
jmorthotics.com

UARIZONA GRANTED $3.4M TO STUDY RAPID KNEE DETERIORATION

Researchers at the University of Arizona (UArizona) Arthritis Center are undertaking a study that seeks to identify determinants of rapid knee deterioration thanks to a $3.4 million grant from the National Institutes of Health (NIH). C. Kent Kwoh, MD, director of the UArizona Arthritis Center and chief of the Division of Rheumatology in the UArizona College of Medicine—Tucson's Department of Medicine, part of UArizona Health Sciences, will lead the 5-year study, using funding from the National Institute of Arthritis and Musculoskeletal and Skin Diseases, a division of the NIH.

Researchers plan to start by describing distinctive paths of knee symptoms and structural deterioration over time in 10,000 study participants between the ages of 45 and 90. They hope to identify novel measures of knee structure on X-rays to help predict who experiences rapid knee deterioration, as well as the need for knee replacement in the future. This work has the potential to improve the way new treatments for knee osteoarthritis (OA) are evaluated by identifying patients who are most likely to benefit; improving the way knee structure is measured; and contributing to the understanding of the different types of damage that lead to debilitating knee OA.

RECHARGEABLE, PORTABLE, PNEUMATIC COMPRESSION DEVICE

REVIVE™ is a rechargeable, portable, pneumatic compression device used to gently massage muscle tissues to promote lymphatic uptake, thereby removing inflammatory byproducts associated with hard workouts, extended periods of standing or sitting, and swelling. Through overlapping chambers with highly controlled pressure throughout the treated area, REVIVE devices offer true and customizable graduated compression. The devices are offered in 2 models: the M4 pneumatic pump console has Bluetooth connection and full customizability for treatment times and pressures, and the M2 offers simplicity while allowing control of treatment time and compression. The garments are made of materials that are easy to clean and biocompatible. Each console includes 2 leg garments and an industry-leading battery that provides up to 8 hours of use per charge. Arm, half vest with arm, calf boots, full pants, and core garments are also available.

Mueller Sports Medicine
800/356-9522
muellersportsmed.com

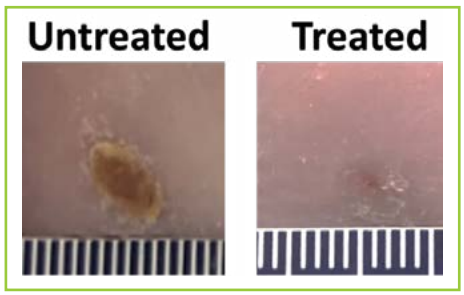
RB8 RECUMBENT BIKE

NuStep announced the launch of the RB8 Recumbent Bike, which features an inclusive design to accommodate users of varying fitness levels and functional abilities. It is also the third NuStep product to feature integrated

sensor technology and real-time biofeedback. Two models are available. Easy to access and easy to use, the RB8PRO delivers an effective lower body workout that is easy on the joints. Intuitive workout apps engage and motivate users, while real-time feedback tracks their performance. The RB8PRO accommodates users up to 500 lbs. while the PR8MAX has an extra-wide seat and accommodates users up to 600 lbs. Both models offer a low step-through design, have a low starting force with coast in reverse and 15 levels of resistance, and have contact heart rate handles. The seats have a 360-degree swivel (locks every 45 degrees).

NuStep
833/214.3472
nustep.com

WATER-BASED GEL FOR DRESSING DIABETIC WOUNDS



Chronic wounds in people with diabetes are the leading cause of nontraumatic lower limb amputation because existing treatments cannot overcome the obstacles to healing, such as chronic inflammation, abnormal skin cell functions and delayed growth of new blood vessels. Jianjun Guan, PhD, professor of mechanical engineering and materials science in the McKelvey School of Engineering at Washington University in St. Louis, is developing a new wound dressing to overcome those obstacles and lead to faster wound healing.

To overcome the obstacles, Guan and his team will control the transforming growth factor beta 1 (TGFß1)/p38 pathway using a new wound dressing, which is composed of a water-based hydrogel and a peptide-based TGFß receptor inhibitor. The dressing, which is liquid when applied to the wound and solid at body temperature, would gradually release the inhibitor to block the TGFß1/p38 pathway to decrease tissue inflammation and improve migration of healthy skin cells to the wound, which would lead to growth of new blood vessels. Additionally, the hydrogel in the wound dressing would scavenge reactive oxygen species in the wounds, further decreasing inflammation.

In early experiments, Guan and his team found no difference in healing when the wound dressing was applied to wounds on normal mice. However, when applied to wounds on diabetic mice, they saw a big improvement. After applying a single dose of the wound dressing into wounds in young diabetic mice, the wounds completely closed at day 14. Wounds that were treated only with the hydrogel or were untreated were reduced to roughly half of their original size.

AFO/KAFO DOCUMENTATION CHECKLIST PUBLISHED

CGS, the Jurisdiction B and C Durable Medical Equipment Medicare Administrative Contractor, created an Ankle-Foot/Knee-Ankle-Foot (AF/KAFO) Orthosis Documentation Checklist to help suppliers confirm they have all required documentation. The checklist includes standard written orders, delivery documentation, and medical records, as well as online resources that are helpful when submitting claims.

To access the checklist, go to www.cgsmedicare.com/pdf/dme_checklists/afo_kafo.pdf.

TOPICAL ANALGESICS

Parker Laboratories has expanded its analgesics line with the addition of its Helix CBD Therapy Cream, CBD Clinical Cream, and Tri-Active Therapy Cream to its Helix line. Manufactured in the U.S., and exclusively sold to consumers through chiropractors, physical therapists, fitness professionals, and other pain care practitioners, these new formulations have been tested to ensure safety, effectiveness, and consistency. Helix Tri-Active Therapy Cream delivers 3 active ingredients in 1 pain relief solution: methyl salicylate, menthol, and camphor at 12.5%, 7.4%, and 3.2% respectively. It also contains arnica, ilex, and tangerine oil. Helix CBD Therapy and Clinical Creams contain 7.4% menthol (active ingredient), plus CBD, arnica, ilex, and tangerine oil. All Helix pain relief products offer smooth consistency, allowing for easy application and optimal absorption.

Parker Laboratories
973/276-9500
helix4pain.com

RESEARCHERS DEVELOPING MAGNET-BASED PROSTHETIC CONTROL SYSTEM

Massachusetts Institute of Technology (MIT) researchers have developed a sophisticated

Using a simple set of magnets, MIT researchers have come up with a sophisticated way to monitor muscle movements, which they hope will make it easier for people with amputations to control their prosthetic limbs. Image courtesy of the researchers.

way to monitor and measure muscle movements using magnets, which they hope will make it easier for people with amputations to control their prostheses in a way that more closely mimics natural limb movement. Their approach is called magnetomicrometry. This strategy takes advantage of the permanent magnetic fields surrounding small beads implanted in a muscle. Using a credit card–sized, compass-like sensor attached to the outside of the body, the system can track the distances between the 2 magnets. When a muscle contracts, the magnets move closer together, and when it flexes, they move further apart.

In a study last year, the researchers showed that this system could accurately measure small ankle movements when the beads were implanted in the calf muscles of turkeys. In 1 of the new studies, the researchers set out to see if the system could make accurate measurements during more natural movements. To do that, they created an obstacle course of ramps for the turkeys to climb and boxes for them to jump on and off. The researchers used their magnetic sensor to track muscle movements during these activities and found that the system could calculate muscle lengths in less than a millisecond.

In the second study, the researchers found that the magnets did not generate tissue scarring, inflammation, or other harmful effects. Nor did the implanted magnets alter the turkeys' gaits, suggesting they did not cause discomfort. Additionally, it was shown that the implants remained stable for 8 months and did not migrate toward each other if they were implanted at least 3cm apart.

AUTO-SHIATSU FITNESS ROLLER

The Serenity Roller offers self-rolling, auto-shiatsu massage to help with muscle warm-up, recovery, and relaxation. It is designed to ease sore, tender, and aching muscles and joints; to accelerate muscle recovery; and to provide relaxation and self-myofascial release. The Serenity Roller has 3 main offerings, which can be used individually or in tandem. Auto-Rolling incorporates shiatsu massage automatically, which works tension and spasms out of muscles, relaxing the body and increasing blood flow. Serenity features 48 massage roller balls for deep tissue massage. Serenity has a powerful vibration motor with 3 frequencies of vibration. It uses quiet glide technology and a 24V brushless high-torque motor so that the working dB is just 35dB to 55dB. The heat therapy function is provided by unidirectional carbon heating to ease muscle tension, ease stress, and promote blood circulation.

Dr Massage Roller
drmassageroller.com

THERMAL NEUROMODULATION PAIN MANAGEMENT

The Soovu™ wearable thermal neuromodulation device was designed to relieve moderate to severe chronic, musculoskeletal, and menstrual pain. Patented HeatWave™ technology delivers pulsed heat at high temperatures to the skin safely and comfortably for effective, targeted pain relief via 2 wearable, discreet, and rechargeable heat pods that deliver soothing relief within the first 5 minutes of use and hours of reduced pain. Users apply an adhesive ring to painful areas of the body and then attach the heat pod to the ring. The wearer uses the associated mobile app to select 1 of 3 pain relief programs and to adjust the temperature and treatment duration. The device is US Food and Drug Administration–cleared and registered, and available without a prescription.

Soovu Labs
soovu.com

DO YOU HAVE A NEW PRODUCT OR NEWS?

We want to hear about your new product, news, or innovation! We want to hear from you! Please send information to Laura@LERmagazine.com

SPRINTING TECHNIQUE & HAMSTRING STRAIN INJURIES

Reference: Kalema et al. JSMS 2021

Designed by @YLMSportScience KINESPORT

~20 experts (academic/researcher, physiotherapist, strength and conditioning coaches and sprint coaches) brainstormed, sorted and rated the components of sprinting technique to consider in a hamstring strain injury prevention strategy

The statements rated above the overall mean for importance and confidence indicating high priority for action to be taken were:

1 Training prescription

- Low exposure to max running speed
- Inappropriate load management & programming
- Low exposure to the different phase of HSR*
- Fatigue
- Lack of sport specific running technique in training
- Poor ability to adapt to external load
- Inability to adapt to musculotendinous stress / strain during HSR

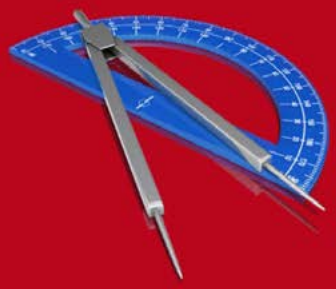
2 Neuromuscular & tendon properties

- Improper eccentric control of the hamstrings during the swing phase
- Lack of hamstring eccentric strength during the swing phase

3 Kinetics parameters

- Reduced hip extensors force generation

4 Kinematics parameters/technical skills



Images provided by PresenterMedia

- Overstriding pattern
- Lack of Lumbopelvic control
- Improper hip and knee joint coordination in late swing
- Excessive anterior pelvic tilt during HSR
- Excessive back kicking of the recovery leg
- Lack of trunk control
- Improper frontside mechanics

5 Hip mechanics was identified as the 5th cluster but none of its statement was identified with a high level of priority

**HSR: high-speed runing*

Source: Kalema RN, Duhig SJ, Williams MD, Donalson A, Shield AJ. Sprinting technique and hamstring strain injuries: A concept mapping study. J Sci Med Sport. 2021;25(3):209-215.

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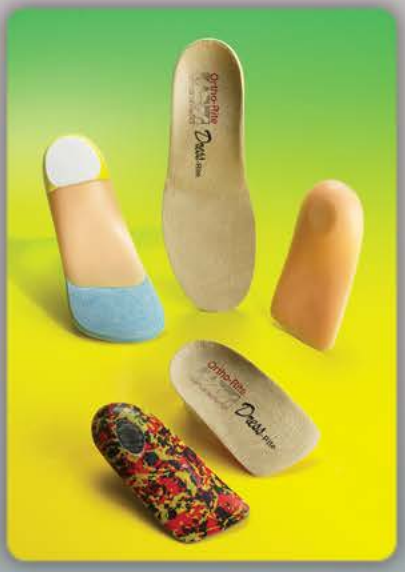

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