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LOWER EXTREMITY REVIEW

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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.

LOWER EXTREMITY REVIEW
41 State St. • Suite 604-16 • Albany, NY 12207
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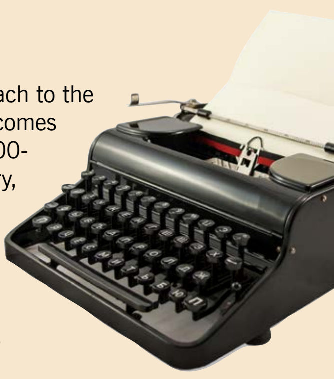

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PREDICTORS OF CAI IN SOCCER PLAYERS

Chronic ankle instability (CAI) is prevalent among soccer players, often resulting from recurrent ankle injuries (RAIs). Despite its impact on performance and long-term joint health, the associated risk factors remain insufficiently explored. This study aimed to identify the key risk factors for CAI among soccer players. A cross-sectional study was conducted among 310 soccer players from different professional sports clubs. The Arabic version of the Cumberland Ankle Instability Tool (Ar-CAIT) was used to assess ankle instability. Spearman's rho correlation and multiple linear regression were used to identify significant predictors of CAI. Additionally, structural equation modeling (SEM) was used to conduct mediation analysis and evaluate potential indirect effects. Spearman's correlation analysis revealed significant negative associations between Ar-CAIT scores and both BMI ($r = -0.158$, $P < 0.05$) and RAI ($r = -0.273$, $P < 0.01$), while training hours were positively correlated with Ar-CAIT scores ($r = 0.169$, $P < 0.05$). Multiple regression analysis confirmed that higher BMI ($\beta = -0.133$, $P = 0.017$) and a greater number of ankle injuries ($\beta = -0.285$, $P < 0.001$) were associated with lower Ar-CAIT scores, whereas increased training hours ($\beta = 0.140$, $P = 0.010$) were predictive of better ankle stability. Mediation analysis revealed that BMI and training hours partially mediate the relationship between RAI and Ar-CAIT scores. RAI, elevated BMI, and reduced training hours were significant predictors of CAI in soccer players. These findings emphasize the importance of implementing targeted injury prevention and rehabilitation strategies, particularly focusing on weight management and structured training programs to reduce CAI risk. Future longitudinal studies are required to explore the underlying mechanisms contributing to CAI development.

Source: *Alanazi A. Predictors of Chronic Ankle Instability Among Soccer Players. Medicina (Kaunas). 2025 21;61(4):555. doi: 10.3390/medicina61040555.*

HIGH-INTENSITY TRAINING VS. MODERATE-INTENSITY TRAINING IN SEDENTARY WOMEN

Regular physical activity is essential for improving cardiovascular health and overall well-being, yet many sedentary women struggle to meet exercise recommendations due to time constraints and low enjoyment. This study compared the effects of reduced-exertion high-intensity training (REHIT) and short moderate-intensity continuous training (SMICT) on functional capacity, resting heart rate (RHR), and activity enjoyment in sedentary women.

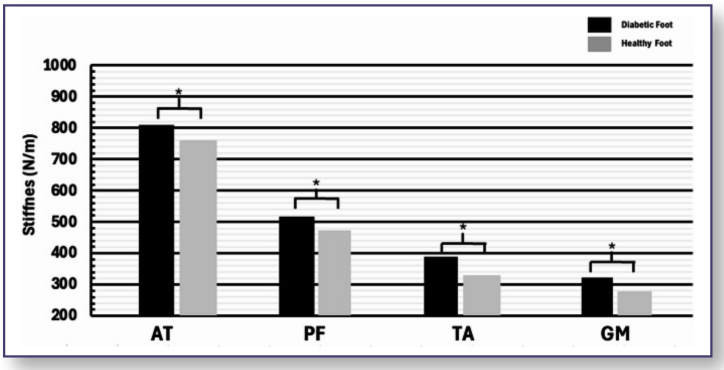
Thirty sedentary young women were randomly allocated to a: i) REHIT group ($n = 15$) or ii) SMICT group ($n = 15$) (2 sessions/week, 6 weeks) using a computer-generated random allocation sequence. Both groups performed an intervention on a cycle ergometer that included a warm-up (3 min at 50% of HRmax), the main part of the session, and a cool-down (3 min at 50% of HRmax). The main part in REHIT consisted of 20-40 sets divided in 2 maximum cycling sprints of all-out exercise at 100% of HRmax with an active rest of 3 min between them; while SMICT consisted of 6-12 min of moderate intensity exercise at 60-70% of HRmax.

Intragroup post-hoc analysis revealed that both groups improved their values in functional capacity and RHR ($P < 0.05$). Between-group comparison showed that REHIT group increased significantly functional capacity more than SMICT ($P = 0.002$). In addition, physical activity enjoyment scores were high in both groups without differences.

REHIT and SMICT are appropriate for improving functional capacity and RHR, as well as being perceived as enjoyable in sedentary young women. REHIT offers higher improvements in functional capacity.

Source: *Bahey El-Deen HA, Atef H, Muñoz-Gómez E, et al. Effects of reduced-exertion high-intensity training versus short moderate-intensity* *continuous training on biomarkers of mortality risk in sedentary women: A randomized clinical trial. J Bodyw Mov Ther. 2025;42:710-714. doi: 10.1016/j.jbmt.2025.01.056.*

MECHANICAL PROPERTIES OF ACHILLES TENDON AND PLANTAR FASCIA IN PATIENTS WITH HISTORY OF DFU



Stiffness (N/m) of Achilles Tendon, Plantar Fascia, and Tibialis Anterior in Diabetic and Healthy Feet. Stiffness (N/m) of the Achilles tendon (AT), plantar fascia (PF), tibialis anterior (TA), gastrocnemius medialis (GM), and gastrocnemius lateralis (GL) in the diabetic foot (DF) and healthy control (HC) groups. Statistically significant differences ($P < 0.05$) are marked with

Diabetic foot ulcers (DFU) are a major complication of diabetes, often leading to impaired mobility and increased risk of recurrence due to persistent biomechanical alterations. Understanding the mechanical properties of foot muscles, tendons, and fascia may provide insight into ulcer development, prevention and rehabilitation strategies. This study aimed to assess the biomechanical properties of the extrinsic foot muscles, Achilles tendon (AT), and plantar fascia (PF) in individuals with a history of DFU using myotonometry.

A total of 38 diabetic feet with a history of DFU (Wagner Grade 0-1) and 40 healthy controls (HC) were evaluated. The MyotonPRO device was used to measure muscle tone (Natural Oscillation Frequency, F), stiffness, and elasticity in the tibialis anterior (TA), gastrocnemius medialis (GM), gastrocnemius lateralis (GL), AT, and PF. Measurements were performed in standardized positions, with statistical comparisons made between groups using independent t-tests.

TA and GM showed significantly increased muscle tone and stiffness in the DFU group compared to HC ($P < 0.05$), whereas GL did not exhibit significant differences. Similarly, PF and AT stiffness were higher in the DFU group ($P < 0.05$), suggesting alterations in tissue load distribution. No significant differences in elasticity were observed between groups.

This study highlights persistent mechanical alterations in the TA, GM, AT, and PF in individuals with a history of DFU, despite ulcer healing. The increased stiffness and tone in these structures may contribute to abnormal foot loading patterns, potentially increasing the risk of ulcer recurrence. The findings emphasize the importance of early biomechanical assessment and targeted rehabilitation strategies, such as neuromuscular training, load redistribution, Achilles tendon stretching and custom orthotic interventions to mitigate mechanical dysfunction in diabetic foot patients.

Source: *Varol F, Ilez A, Aslan Y. Mechanical properties of extrinsic foot muscles, achilles tendon, and plantar fascia in patients with a history of diabetic foot ulcers. BMC Musculoskelet Disord. 2025 29;26(1):531. doi: 10.1186/s12891-025-08791-w.*

OPTIMIZED NERVE MANAGEMENT WITH ELECTRICAL STIM FOR LOWER EXTREMITY NEUROMA

Nerve injury is the most common complication following foot and ankle surgery, with painful neuroma reported in up to 10% of procedures. Current treatment often yields varying degrees of pain relief. Electrical stimulation (ES) through peripheral neuromodulation is an emerging technology associated with improvement in nerve related pain and acceleration of neural regeneration. This study assessed the short-term outcomes of combining nerve reconstruction techniques with ES in providing early pain relief for patients with symptomatic lower extremity neuromas.

Researchers describe a single-institution, prospective, cohort study including adult patients with lower extremity neuroma subjected to a nerve management procedure (neurolysis, targeted muscle reinnervation, or nerve allograft reconstruction) with concomitant peripheral nerve stimulator placement. Patients were treated postoperatively with ES (phase duration: 100 µs, pulse rate: 80 Hz) for 4 hours daily. Patient demographics, surgical details, and outcomes data were evaluated.

Eight female patients (mean age: 49 ± 13 years) were included. Peripheral nerve injuries were identified at the following locations: sural nerve (n = 5), medial plantar nerve (n = 1), tibial nerve (n = 1), superficial peroneal nerve (n = 2), and saphenous nerve (n = 1). Mean Brief Resilience Scale (BRS) was 3.11 ± 0.61. At 3 months postintervention, NRS Pain scores decreased from a mean of 8.5 ± 1.2 to 1.5 ± 1.2, PROMIS Pain

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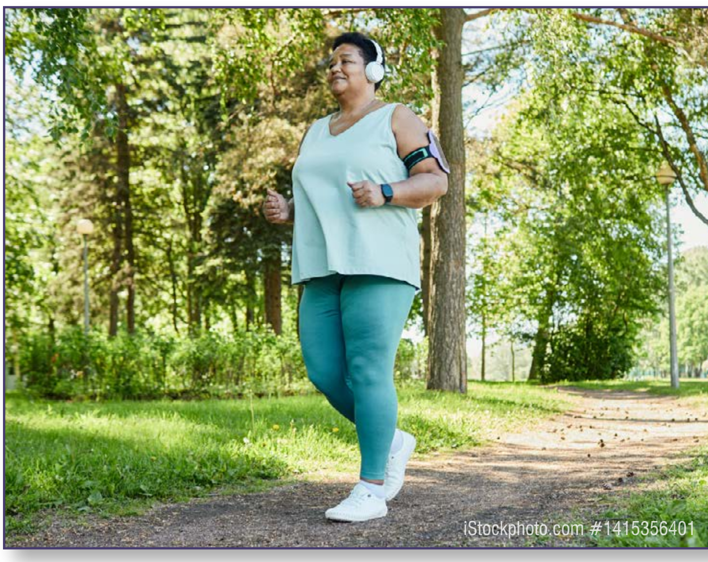
Interference scores decreased from 61.5 ± 3.4 to 53.7 ± 4.9, and PROMIS Pain Behavior scores decreased from 65.8 ± 3.5 to 56.1 ± 4.2.

Early results of optimized neurotherapy with electrical stimulation demonstrate improved short-term pain relief for patients with symptomatic lower extremity neuroma.

Source: *Chou J, Choi J, Cooper MT, Park JS, Chhabra AB, DeGeorge BR Jr. Early results of optimized nerve management with electrical stimulation for lower extremity neuroma. Ann Plast Surg. 2025 1;94(6S Suppl 4):S497-S501. doi: 10.1097/SAP.0000000000004380.*

IMPACT OF EXERCISE IN PATIENTS WITH DIABETIC PERIPHERAL NEUROPATHY



Diabetic peripheral neuropathy (DPN) is a common and serious complication of diabetes mellitus, affecting sensory, motor, and autonomic nerves. It increases the risk of foot ulceration and falls. Management typically involves preventive strategies like patient education, risk stratification, and regular foot screenings. Exercise plays a key role in enhancing glycemic control and nerve function, reducing the risk of DPN and related complications. This search was conducted in the following databases: Pubmed, Scopus, Cochrane Library, Embase, and SPORTDiscus, from the establishment of the database up to the search date. Researchers included systematic reviews and meta-analyses assessing exercise interventions in adults with type 1 or type 2 diabetes and DPN.

Fourteen reviews were included, examining the effects of various exercise interventions. Duration ranged from 1 week to 12 months, and studies were conducted in multiple countries. Some meta-analyses reported significant improvements in fasting glucose and HbA1c (n = 1) and neuropathic symptoms (n = 3). Outcome assessment tools included the Biodex system (n = 9), single-leg stance (n = 8), Berg Balance Scale (n = 11), and Timed Up and Go (n = 13) for balance; nerve conduction velocity (n = 8), MNSI (n = 6), and Total Symptom Score (n = 3) for nerve function; fasting glucose (n = 3) and HbA1c (n = 5) for glycemic control.

Exercise training appears to have potential benefits for certain aspects of DPN, neuropathic symptoms, and functional capacity. However, the effects on glycemic control, fall risk reduction, and ulcer prevention remain inconclusive, with significant variability in study outcomes.

Source: *Gracia-Sánchez A, López-Pineda A, Nouni-García R, Zúnica-García S, Chicharro-Luna E, Gil-Guillén VF. Impact of exercise training in patients with diabetic peripheral neuropathy: an umbrella review. Sports Med Open. 2025 15;11(1):75. doi: 10.1186/s40798-025-00863-4.*

YOUTH SOCCER LOWER EXTREMITY INJURIES PRESENTING TO US EDS IS DECREASING

Data from the National Electronic Injury Surveillance System were analyzed for soccer players ≤18 years old sustaining lower extremity injuries from January 2013 to December 2022. Patient data collected included age, sex, mechanism of injury, setting (practice vs game), diagnosis, lower extremity injury, and disposition. Raw data were used to calculate national estimates (NEs) based on the assigned statistical sample weight of each hospital. A total of 503,169 lower extremity injuries were diagnosed in US emergency departments (57.2% male; 42.8% female). On average, there was a decrease in 3,124 injuries per year from 2013 to 2022 (95% confidence interval, -5,324 to -925; P = .01) and 2,384 per year from 2013 to 2022 excluding 2020 (95% confidence interval, -3,452 to -1,315; P < .01). The ankle (NE = 196,592; 39.1%), knee (NE = 147,364; 29.3%), and foot (NE = 58,999; 11.7%) were the most commonly injured. The most common mechanisms of injury were not specified (NE = 188,653; 37.5%), ankle roll (NE = 71,992; 14.3%), and player-to-ground (NE = 581,90; 11.6%). The 2 most common diagnoses were strain/sprain (NE = 247,274; 49.1%), other/not stated (NE = 91,355; 18.2%), and contusion/abrasion (NE = 74,552; 14.8%). Youth lower extremity soccer injuries presenting to US emergency departments decreased from 2013 to 2022. Sex-specific

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analyses showed that there were significant differences in proportions of injuries between male and female participants for mechanism, diagnoses, and body parts injured. This study provides insight into the epidemiology of lower extremity youth soccer injuries presenting to US emergency departments over a 10-year period.

Source: *Chun AG, Snyder EM, Obana KK, et al. Youth soccer lower extremity injuries presenting to us emergency departments are decreasing: a 10-year analysis of national injury data. Arthrosc Sports Med Rehabil. 2025 1;7(3):101140. doi: 10.1016/j.asmr.2025.101140.*

LONG TERM OUTCOMES AFTER FLEXOR TENDON TENOTOMY OF THE DIABETIC FOOT

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Hammertoes are one of not the most common deformities that afflicts the diabetic foot and leads to increased risk of diabetic foot ulcers. Flexor tendon tenotomy treatment of the diabetic hammertoe has gained increased interest and is now recommended in international guidelines as a treatment of hammertoes to prevent diabetic foot ulcers. There is however no published data on the long-term outcomes following tenotomy treatment. The objectives of this study were to describe the demographics and long-term outcomes following tenotomy treatment of individuals with diabetes who had flexor tendon tenotomies of hammertoes. The follow-up study was performed at Steno Diabetes Center Copenhagen between January 1, 2020, and June 31, 2020. Participants had 1 visit where foot examination was performed by an orthopedic surgeon. Of the original 38 operated participants, 21 (55.3%) had died during the follow-up period, 1 (2.6%) had moved away, and 1 (2.6%) had the incorrect procedure performed originally. At follow-up (mean 149.7 months (±17)), age of the remaining 15 participants (86.7% male) was 66.6 years (±11.4), diabetes duration was 32.2 years (±13.3), all had neuropathy and 14 (93.3%) had palpable foot pulses. The 15 included participants had 22 toes tenotomized in the original study, of which 5 toes (22.7%) in 4 participants (26.7%) had recurrent hammertoe deformities. Of the 15 participants, 14 (93.3%) had incurred at least 1 ulcer during the observation period, and 8 (53.3%) had incurred an amputation. This study reports an undescribed risk of recurrence of deformities after tenotomies and supports that this population is at high risk of new ulcers and amputations.

Source: *Andersen JA, Rasmussen A, Frimodt-Møller M, Kirketerp-Møller K, Rossing P. Long term outcomes after flexor tendon tenotomy of the diabetic foot. Clin Med Insights Endocrinol diabetes. 2025 24;18:11795514251314787. doi: 10.1177/11795514251314787.*

MTPD DUE TO HADHA VARIANTS MASQUERADING AS CHARCOT-MARIE-TOOTH DISEASE

Mitochondrial trifunctional protein deficiency (MTPD) is an inherited disorder of fatty acid β-oxidation caused by mutations in HADHA or HADHB genes. It typically presents with cardiomyopathy or hepatic failure in early childhood; however, it may rarely present in adulthood with the neuromyopathic form. We describe a patient with MTPD with isolated neuropathy mimicking Charcot-Marie-Tooth disease (CMT) as the first and only presenting symptom. Clinical and electrophysiological examinations were conducted, including nerve conduction studies, needle electromyography, muscle and nerve biopsies. The diagnosis was confirmed with genetic testing and enzymatic analysis of cultured skin fibroblasts. Researchers report a 40-year-old man diagnosed with axonal CMT2 in childhood. He had pes cavus and hammer toes, mild distal lower limb weakness, and loss of vibration sense with areflexia. He later developed fatigability, improved exercise tolerance with alcohol and an episode of chest infection causing neurological decompensation without evidence of rhabdomyolysis. Neurophysiology showed non-length-dependent axonal sensorimotor neuropathy without myopathic features. Genetic testing confirmed that he was compound heterozygous for 2 HADHA variants, 1 of them novel, and enzymatic analysis of cultured skin fibroblasts confirmed MTPD. Researchers report a very rare isolated neuropathic phenotype of MTPD and confirm the pathogenicity of the novel variant c.1003G>A, p.(Glu335Lys). This case also highlights the need for HADHA and HADHB to be included in neuropathy gene panels as MTPD may present as CMT. Given that dietary management may prevent some complications of MTPD, achieving a diagnosis early is important.

Source: *Qaiser F, McHugh J, Mullins G, et al. Mitochondrial trifunctional protein deficiency due to hadha variants masquerading as charcot-marie-tooth disease. J Peripher Nerv Syst. 2025 ;30(3):e70048. doi: 10.1111/jns.70048.*

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Controlled Ankle Motion Walkers: Similar, but Not the Same

By Michael S. Ginzburg PsyD, CO; Rachel White CPO

Abstract

Controlled Ankle Motion walkers (CAMs) are prefabricated ankle-foot interventions commonly used to address a broad range of orthopedic and vascular diagnoses. Variants of these intervention types appear to have differing kinematic features despite being described by the same billing codes and regarded as belonging to the same intervention strategy. The relatively low application complexity, cost, and profit margins of these devices can place barriers to the detailed evaluation and device selection that would lead to optimal healthcare outcomes. Technical analysis of 4 commercially available and established CAM walkers revealed differing magnitudes of forefoot and heel rockers as well as a range of non-kinematic features that impact user acceptance and healthcare outcomes.

Introduction

Controlled Ankle Motion Walkers (CAMs) are below-the-knee, solid ankle interventions that address a wide range of orthopedic and vascular conditions[1]. Numerous manufacturers fabricate these interventions that can be grouped into 1 of 4 broad categories: full or low profile, pneumatic or non-pneumatic. A visual assessment, however, implies that many more than 4 variants are available on the market, each with its own target populations/diagnoses and non-kinematic considerations that impact intervention acceptance and efficacy. The goal of this technical analysis is not to promote one manufacturer/intervention over another, but rather to discuss the parameters to drive a recommendation for a particular intervention in a specific clinical consideration to be addressed.

Theoretical Orientation

This investigation was conducted from the Biopsychosocial Theory perspective.

Methods

Four nationally available manufacturers of full-profile pneumatic CAMs were selected for study and acquired in the same size. Novel, prototype, and diagnosis-focused interventions such as Achilles walkers were excluded. The interventions were selected as those that are available from established manufacturers and distributors and have been PDAC approved for an HCPC code. Each of these interventions could be provided to address the same injury/diagnosis despite the visual appearance of biomechanical differences between the interventions. The magnitude of the heel and the forefoot rockers were independently manually measured by 2 Certified Orthotists, and inquiries as to the magnitude of the rockers were made to the representatives of the manufacturers. The magnitude of the rockers was determined by measuring the length of the foot plate, determining a mid-point to establish a horizontal reference line. The high point of the forefoot and heel were marked, referencing the horizontal baseline with angular measurements obtained with a goniometer. Measurement discrepancies that exceeded 5% were addressed by a collaborative remeasurement by both clinicians until a consensus was reached. With overall small angular measurements involved and inter-rater reliability of goniometer measurements limited, a small error would lead to a large percentage differential with initial measurement variation greater than 5% initially seen in 50% of devices investigated and consensus reached in 100% of cases.

Results

- **Manufacturer 1:** Heel rocker 5 degrees, forefoot rocker 5 degrees. The manufacturer's data was not made available.
- **Manufacturer 2:** Heel rocker 10 degrees,

forefoot rocker 10 degrees. Manufacturer's data: 10 degree heel and forefoot rockers reported.

- **Manufacturer 3:** Heel rocker 20 degrees, forefoot rocker 14 degrees. Manufacturer's data: 20 degree heel, 15 degree forefoot.
- **Manufacturer 4:** Heel rocker 20 degrees, forefoot rocker 20 degrees. Manufacturer's data was not available.

Discussion

It appears important to emphasize that the devices studied are described by the same billing code and any of them could be prescribed/provided to the same patient case. Nonetheless, the greater magnitude of a heel rocker facilitates the first rocker of the gait cycle and decreases pressure bearing on the hindfoot over time[2], which would be advantageous for heel injuries/wounds, but offer limited benefit to midfoot or forefoot conditions. The forefoot rocker encourages/approximates the third rocker of gait and reduces pressure bearing on the forefoot over time[3]. Thus, each of the devices studied would offer differing performance at addressing hindfoot, midfoot, or forefoot conditions despite being described by the same billing code and deriving from the same 'family' of interventions intended to address the same diagnoses. Non-kinematic features that impact user acceptance and considerations for some diagnoses such as open toe vs. closed toe, rigid front shells vs. soft anterior overlap, window openings vs. total contact, strapping or buckling closure systems, were also evident.

Many of us who have been involved in device acquisition decisions have heard a sales professional describe their intervention as offloading better than the competition. It seems important to recognize that anti-gravity technologies and interventions have not been invented with true "offloading" not yet possible. These interventions do impact where the pressure of weight bearing is applied, and they can change the site and/or the timing of the application. How pressure-tolerant the target location of the shift may be is an indispensable component of a skilled evaluation. It is easy to appreciate that CAM walkers are a one-size-fits-many intervention that are inexpensive to purchase, low profit margin, low fitting complexity, making them amenable to 'stock-and-bill' strategies. Simultaneously, CAM walkers are removable, and real human users can take them off and reject them. A closed-toe total-contact variant is likely to offer benefit to an individual who benefits from mechanical protection, but an open-toe windowed design may increase user acceptance in hot climates and by individuals not needing the protection offered by those features.

Treatment Recommendations

Each of our patients is a human being who is facing a healthcare challenge. They will each have their own belief systems, expectations, prior experiences, resources, stressors, and cognitive attributions. Low profit margins of these interventions can add barriers to taking the time to evaluate the locations of the injury, patients' goals, prior interventions attempted, the terrain to be navigated, the tasks that need to be performed.

Proper evaluation and assessment of the patient, their diagnosis, comorbidities, and functional goals need to be provided to make the proper decision regarding which brand and style CAM walker to provide the patient. Not all CAM walkers are created equal, offering different forefoot and heel rockers that offload and load different areas of the foot/ankle. ler

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LEREXPO HIGHLIGHTS

Posting Principles: Rearfoot Mods that Actually Matter

By Karen A. Langone DPM

Orthotic prescription involves a nuanced understanding of various modifications designed to influence lower extremity biomechanics, particularly focusing on the rear foot, midfoot, and forefoot. For lower extremity clinicians, mastering these options allows for tailored patient solutions, enhancing stability, addressing discrepancies, and improving overall function. This article explores key orthotic modifications, drawing insights from clinical perspectives on their application and efficacy.

Influencing the Rear Foot: Stability and Control

The rear foot is a primary focus in orthotic design due to its pivotal role in gait and stability. A core component is the rear foot post, which is designed to provide greater stability as the orthotic device and the patient's foot contact the ground. Theoretically, this post aims to hold the calcaneus in a more desirable position. While some studies suggest that devices with less of a post might lose influence in this area, others indicate this isn't necessarily the case.

The material and construction of the device also play a significant role:

- **One-piece (Direct Milled) Devices:** When the shell and the rear foot post are made from a single cut of material, the device is considered a direct milled device. This construction makes the device more rigid, allowing it to be thinner while maintaining the same level of rigidity compared to two-piece designs.
- **Two-piece Devices:** In contrast, 2-piece devices have a rear foot post separate from the shell, often made of a different material with distinct characteristics.

The depth of the heel seat is another critical factor. As the heel cup depth increases, from a shallow cup to a deeper one, the ability to influence the calcaneus and the subtalar joint significantly improves. This deeper seating allows the heel to sit further within the device, theoretically enhancing its influence on the rear foot. Furthermore, low-profile rear foot posts can be combined with deeper heel seating to allow the device to fit effectively within shallower shoes.

An additional modification for rear foot control is medial skive. Described as "little hands" sticking up underneath the device, medial skive provides an additional correction aimed at moving the rear foot more laterally within the device.

Addressing Specific Clinical Challenges and Midfoot Support

Orthotic modifications extend beyond the rear foot to address specific patient challenges throughout the foot:

- **Heel Lifts:** These are commonly used to correct limb length discrepancies or to address issues linked to such discrepancies. For heel lifts exceeding 3/16 of an inch, it is recommended to taper them down into the midfoot, sometimes even making them full length on the device, to prevent the sensation of "falling off a cliff" for the patient. When integrating heel lifts into dress devices, labs often manipulate them to prevent the patient's foot from popping out of the shoe, though some labs may insist on adding a rear foot post, which can create fitment issues.
- **Heel Cushions:** These are beneficial for patients experiencing fat pad atrophy or those requiring extra cushioning or impact dampening. (While heel spur pads are offered by labs for comfort, their utility has been questioned given the typical shape of heel spurs.)
- **Flanges:** These can be valuable for conditions like posterior tibial dysfunction, where patients exhibit significant medial arch prolapse. Medial flanges are available in low, medium, and high profiles. However, flanges can be tricky to manage as patients often find them irritating and may not tolerate them despite adjustments to position or height. Clinically, flanges do not eliminate or completely control pronation; rather, studies suggest they influence the velocity of pronation, allowing the foot a better opportunity to stabilize as body weight is applied. Lateral flanges or clips are used to prevent lateral movement, sometimes in cases of chronic ankle sprains. Some clinicians, however, report limited success with these clips and flanges in practice, opting for other techniques.
- **Scaphoid Pad:** Added under the top cover, this pad is particularly helpful for patients with limited ankle dorsiflexion. It allows the clinician to reduce the arch height of the device while compensating with the

This article is a summary of Dr. Langone's presentation, "Posting Principles: Rearfoot Mods that Actually Matter" from the 2025 lerEXPO Biomechanics & Orthotic Innovation Summit 2025 on June 7, 2025. To view the full presentation with questions and answers—and see the agenda for the program, visit https://biomechanics.lerexpo.com. Continuing education credits are available for this and many of the lerEXPO programs.

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pad to ensure full arch contact when the patient stands. The scaphoid pad also serves as a "landing pad" and can alleviate discomfort when patients experience midfoot jamming against the device.

- **Arch Reinforcement:** Placed on the bottom of the device, arch reinforcement enhances stability, particularly for semi-flexible devices. It allows for greater influence on patient function without altering the overall flexibility of the orthotic.

Specialized Modifications and Padding Options

Further modifications address specific pathologies and comfort needs:

- **Cuboid Pad:** An "old school technique," the cuboid pad is positioned in the peroneal groove with the aim of encouraging the peroneus longus to fire sooner in the gait cycle. This, in turn, may help stabilize the first metatarsal head on the ground, which is crucial for addressing prolonged pronation.
- **Plantar Fascia Groove:** This modification can be incorporated into devices to accommodate painful fibromas. The groove can be marked on the patient's foot and applied by the lab within padding or even directly into the shell. A common approach involves using 1/8" padding with the groove cut out and then filled with 1/16" Poron, creating a slight depression.
- **Navicular Accommodation:** For patients whose naviculars bear weight, a shell accommodation can be created by "pocketing" the shell in that area. A technique involves using a 1/8" full device padding, cutting out the 1/8" pad in the accommodation area, and filling it with 1/16" Poron.
- **Padding:** Padding is crucial for patient comfort, especially when removing existing insoles from shoes, such as for runners. Padding can be applied in various ways:
  - **Firm Padding:** Can extend from the heel all the way to the toes.
  - **Softer Padding (Porons):** Can be full length or cut shorter.
  - **Length Adjustments:** For patients with significant bunion deformities or hammer toes, padding can be brought back to the sulcus length to provide more forefoot room. Alternatively, padding can end at the metatarsal length if no padding is desired underneath the forefoot.

The Cornerstone of Prescription: Comprehensive Patient Assessment

Determining the most effective orthotic prescription necessitates a thorough and holistic patient evaluation. It is essential to observe the patient walking, engaging in their sport, and analyzing their specific movement patterns. Clinicians

must not only examine the foot but also consider all influences from the entire superstructure to identify the best course of action for the individual patient. Gait analysis, particularly video gait analysis, is considered an essential part of the patient workup, providing invaluable insights into their biomechanics.

In conclusion, effective orthotic design hinges on a comprehensive understanding of available modifications and their biomechanical implications. By meticulously assessing patient needs through detailed observation and advanced analytical techniques, clinicians can prescribe custom orthotics that offer optimal stability, support, and comfort, ultimately enhancing patient function and mitigating pathology.

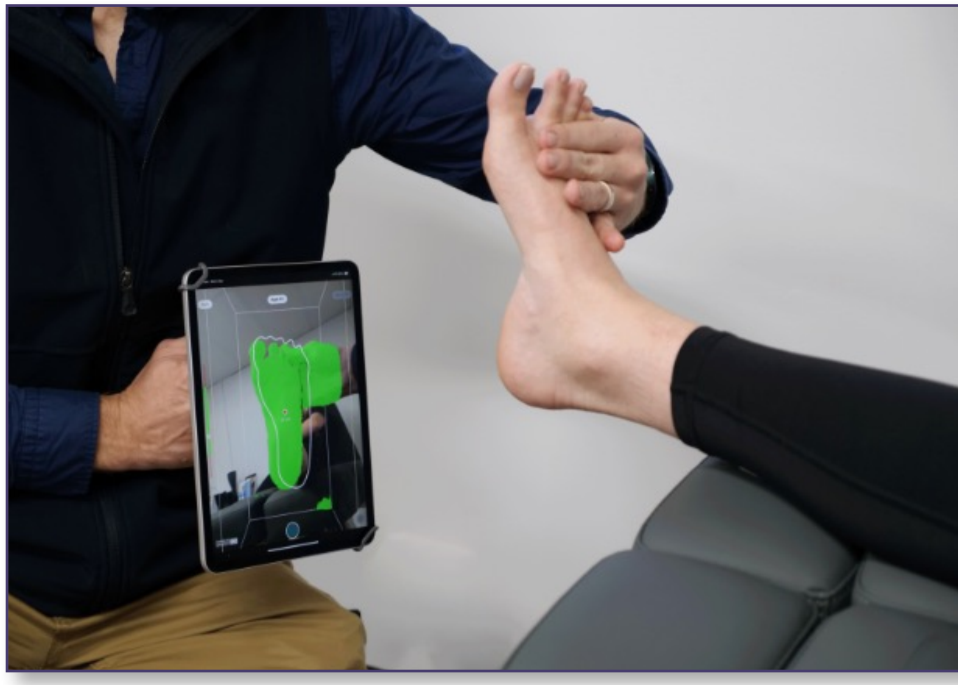
Dr. Karen Langone is a graduate of the New York College of Podiatric Medicine and completed her post-graduate training there as well. She is a diplomate of the American Board of Podiatric Medicine. She is a fellow of the American College of Podiatric Medicine. She is a Fellow of the American Academy of Podiatric Sports Medicine and Past President of the Academy. Dr. Langone is also a Fellow of the National Academy of Practitioners. She lectures extensively nationally and internationally at medical conferences, including at the American College of Sports Medicine, on topics in sports medicine. Dr Langone serves on the medical team for many athletic events including the 7 Day Race, the Boston Marathon, the New York City Marathon, the Easthampton Marathon, the Long Island Marathon and the Ground Zero medical team. She has been featured in numerous podiatry publications and other publications including Fitness magazine, The New York Times, Readers Digest, Chicago Tribune, San Francisco Chronicle, Newsday, Women's Adventure, Good Housekeeping, Scholastic, Woman's Day, ESPN Rise, and iVillage. Dr. Langone is in private practice for more than 30 years specializing in biomechanics.

Mastering Scanning Protocols: Why Technique is Everything

BY DR. DEAN HARTLEY *(Podiatrist & Adjunct Engineering Fellow–University of Queensland)*

Technique is not merely a procedural afterthought—it is the foundation of successful digital orthotic design. A well-executed scan captures the anatomical subtleties of the foot and lower limb in the intended corrected position, ensuring the final device conforms precisely to the patient's morphology. When done poorly, it introduces distortions that compromise fit, function, and ultimately, patient outcomes. This is where technology meets technique.

TrueDepth scanning, leveraging the front-facing camera of an iPad Pro or iPhone–and iPads equipped with Structure Sensor Pro attachments are rapidly becoming the industry standard for foot orthotic and above the ankle capture. These tools offer clinicians accessible, high-resolution scanning capabilities, but their effectiveness is contingent on effective scanning technique.



Using an iPad Pro with TrueDepth scanning in a supine suspended NWB position

Why Scan Quality Matters

A compromised scan, whether due to poor resolution, misalignment, or inadequate anatomical capture, can significantly affect the integrity of the final device resulting in potential manufacturing delays, the need for remakes or suboptimal patient outcomes. While digital cast correction can be performed, it is a compensatory measure and not a good substitute for a precise initial scan. Best practice dictates that well-balanced, anatomically aligned scans are provided to ensure best outcomes[3].

Tips for Effective 3D Scanning

- Choose the foot position required based on the assessment and diagnosis of the patient.
- Position can vary from STJ neutral to maximally everted/inverted depending on the patient's needs.
- 3 Point Contact with flatbed scanner/frame is ideal–1st and 5th metatarsal and heel.
- Balance the forefoot to rearfoot relationship within the scan to capture the most accurate foot morphology.
- Be consistent.
- Semi-weightbearing helps negate certain casting errors including forefoot supinates (flexible varus) and plantarflexed forefoot, while capturing soft tissue expansion.
- Labs need to know if scans are full weightbearing (FWB), non-weightbearing (NWB) and semi-weightbearing (SWB).

Weightbearing vs. Non-Weightbearing Scans

The degree of weightbearing during foot scanning has a significant impact on the morphological data captured. SWB scans more accurately reflect the functional alignment of the foot during gait, resulting in orthotic devices that better accommodate dynamic loading patterns and consistently produce more anatomically accurate design files. In contrast, NWB scans, while easier to perform, often produce narrower design files that necessitate post-processing adjustments, thereby increasing both fabrication time and cost[3].

Practical Setup Tips for Clinicians

Before You Scan:

- Practice with a colleague before scanning patients.
- Ensure correct setup to avoid fumbling during live appointments.

During Scanning:

- Follow the 90/90 Rule: Position the subtalar and talocrural joints at 90 degrees.
- Elevate the foot to capture the posterior heel.
- Use an adjustable chair: Align the patient's knee and hip for comfort and accuracy.
- Allow ample space around the patient for device movement.

Tools and Aids to Enhance Scanning

In clinical practice, scanning aids significantly improve the quality and consistency of digital captures. Scan plates are essential for SWB scanning, stabilizing the foot and aligning the forefoot and rearfoot for accurate modeling. We recommend their use for all custom foot orthoses and above-the-ankle scans, as they support reproducible positioning and minimize distortion.

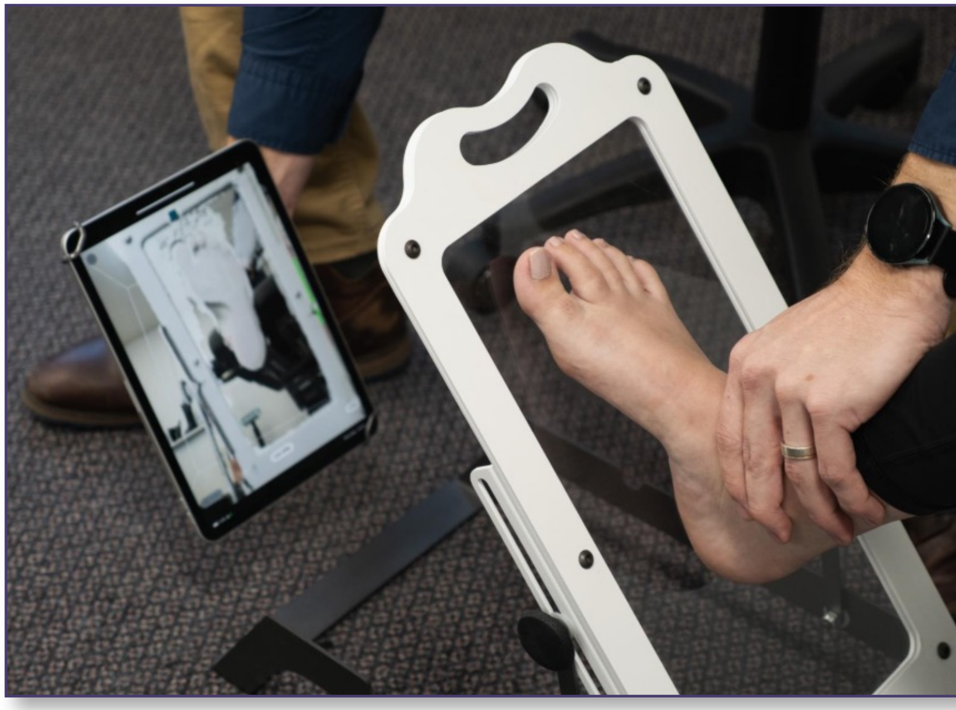
Scan mirrors are especially helpful when using TrueDepth scanning technology and enable the clinician to maintain an upright position of the scanning device, improving visibility and control during the capture process. This is particularly useful when scanning complex anatomical regions or when working in confined clinical spaces.

Hand straps offer ergonomic benefits by improving the mobility and handling of the scanning device, allowing smoother transitions around the limb and reducing clinician fatigue during longer scanning sessions. Together, these aids contribute to a more efficient and precise scanning workflow.

Conclusion: Technique is the New Gold Standard

As 3D scanning becomes the norm for orthotic prescription, the focus must shift from hardware to technique. The research suggests, regardless of the device used, the clinician's scanning method determines the accuracy of the final orthotic.

By mastering scanning protocols, using the right tools, and understanding the nuances of weight-bearing capture, clinicians can ensure optimal outcomes for their patients—every time[3]. ler



Doctor using a scan plate to capture an SWB scan

Dean Hartley is a Podiatrist and healthcare innovator with over a decade of experience in clinical practice, orthotic manufacturing, and allied health leadership. He co-founded Balance Podiatry, iOrthotics globally, and Healthia Limited, a publicly listed allied health organization. As Director, he leads iOrthotics Australia, The Orthotic Factory (Adelaide), iOrthotics USA and Performance Labs (New Jersey), driving advancement in orthotic manufacturing through 3D printing, digital workflows, and scanning technologies.

Dr. Hartley collaborates with leading universities and industry partners, holds an Adjunct Fellowship at The University of Queensland, and co-established the Healthia R & D Hub, advising on tech-enabled healthcare and private sector research.

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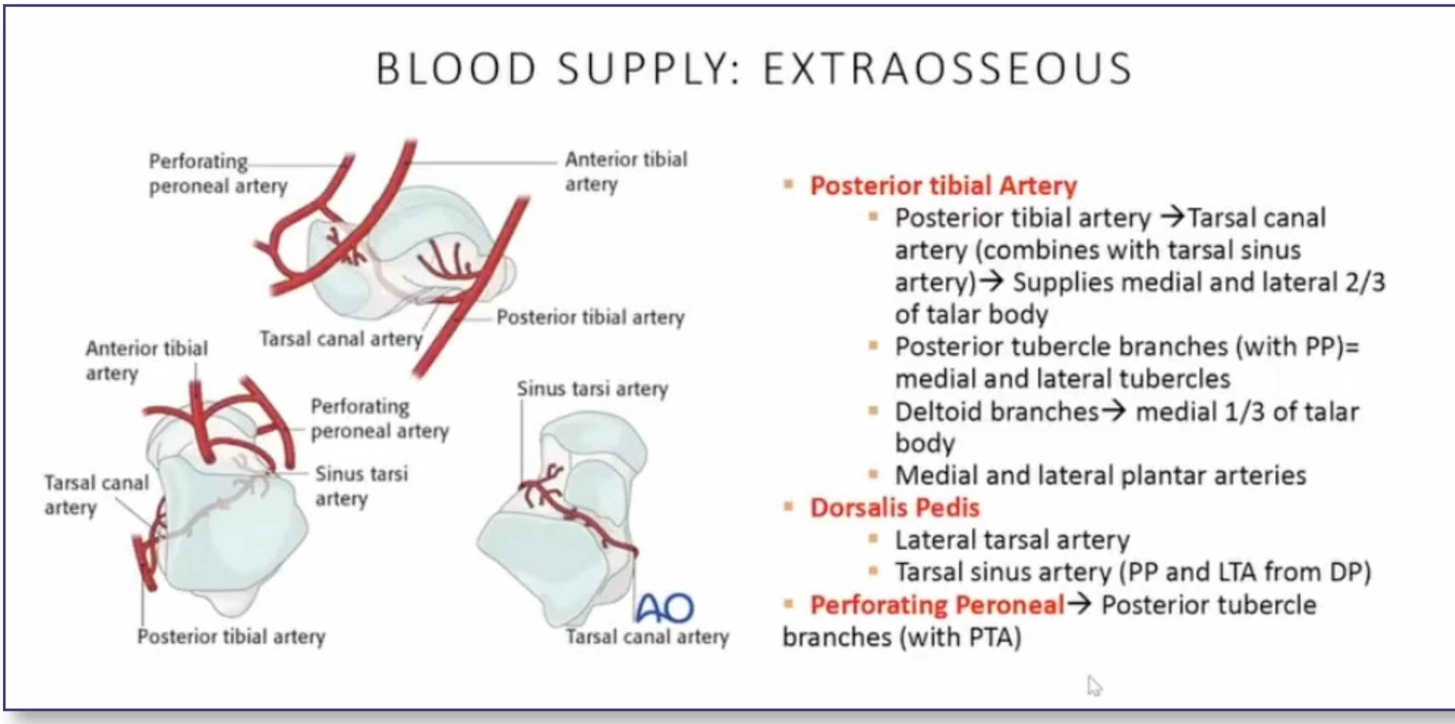
Avascular Necrosis After Talar Fracture ORIF in Podiatric Practice



BY CHRISTY M. KING DPM, FACFAS

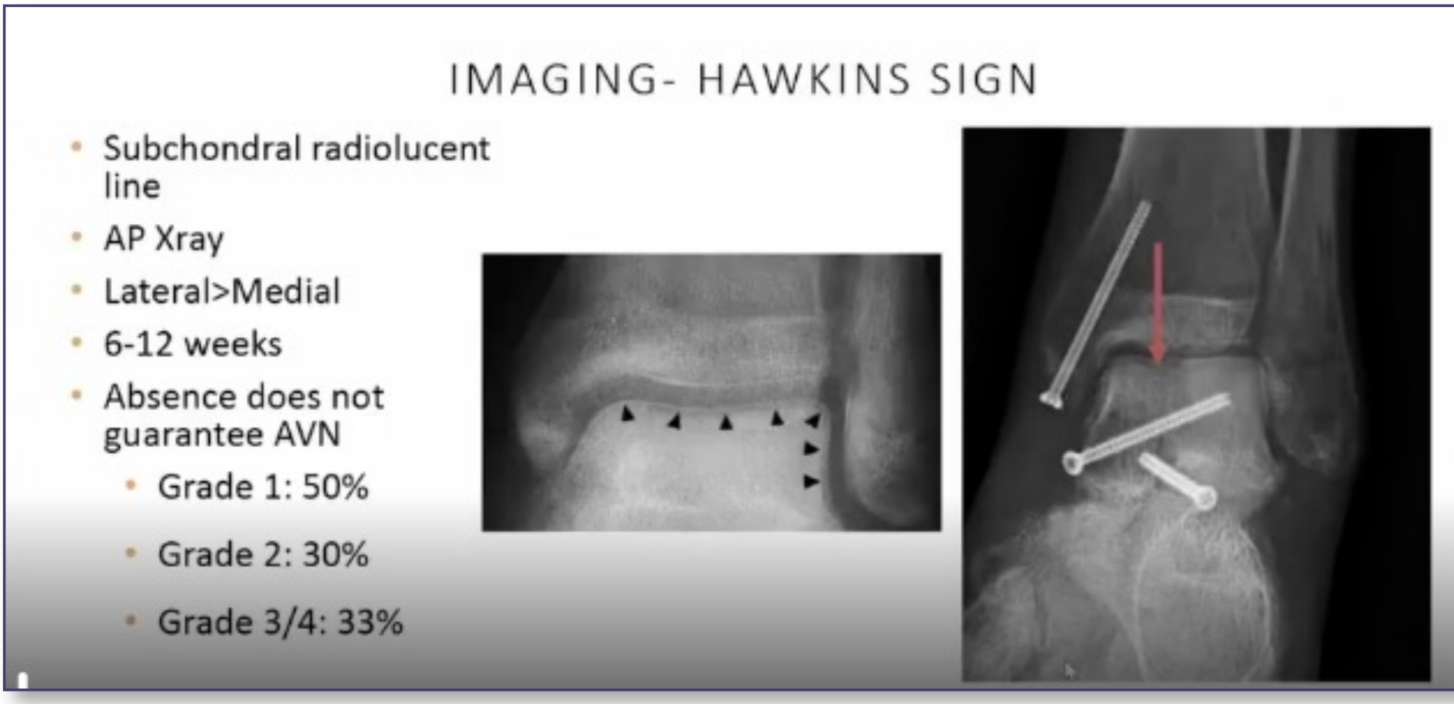
Avascular necrosis (AVN) of the talus presents one of the most complex and challenging problems in foot and ankle surgery, particularly in the aftermath of talar fractures. As podiatric specialists, understanding its nuances–from its unique anatomical predisposition to the evolving landscape of its management–is crucial for optimizing patient outcomes. My goal is to provide an insightful overview for clinicians, detailing diagnostic approaches, conservative and surgical interventions, and practical tips for navigating this formidable condition.

The Talus: An Anatomic Vulnerability

The talus is a truly unique bone, intricately designed to channel forces from the upper body to the intricate structures of our feet. Its susceptibility to AVN stems from several distinct anatomical features:

- **High Cartilage Content:** Approximately 60% of the talus is covered in cartilage, limiting areas for extraosseous blood supply penetration.
- **Limited Attachments:** Unlike most bones, the talus lacks muscle or tendon attachments, further restricting potential vascular access points.
- **Delicate Blood Supply:** While 3 main vessels supply the talus, they are much smaller, with a significant portion of the blood supply originating from the medial side. This makes the lateral side of the talus more prone to AVN. The intraosseous blood supply is even more intricate and variable, leading to diverse patterns of AVN within the bone.
- **Traumatic Onset:** Almost 75% of talar AVN cases are traumatic, directly linking the initial injury, such as a talar fracture with open reduction and internal fixation (ORIF), to the onset of bone death due to ischemia. The bone attempts to revascularize and reabsorb necrotic bone, but often fails due to inadequate blood supply, leading to sclerosis and eventual collapse.

This article is a summary of Dr. Kings's presentation, "AVN After Talar Fracture ORIF, Now What?" from the 2025 APMA Surgical Complications Virtual Seminar on January 18, 2025. To view the full presentation with questions and answers—and see the agenda for the program, visit https://apmasurgical.lerexpo.com . Continuing education credits are available for this and many of the lerEXPO programs.



Diagnosis and Staging: Pillars of Effective Management

Early and accurate diagnosis is paramount. X-rays remain the easiest initial tool to observe signs of revascularization, such as the Hawkins sign. The Hawkins sign, a subchondral radiolucent line, is most often seen on an AP X-ray, typically appearing 6 to 12 weeks post-injury. Its presence is a positive indicator of revascularization, though its absence does not guarantee AVN development.

For greater sensitivity, especially in early stages, MRI is invaluable. It can detect AVN with high accuracy and help evaluate the degree and location of involvement. CT scans are useful for visualizing cystic or sclerotic changes, and bone scintigraphy can assess osteoblastic activity.

Staging systems are critical for guiding treatment pathways:

- **Hawkins Classification:** This system categorizes talar fractures based on the number of dislocated joints. Unfortunately, Hawkins Type III (subtalar and ankle dislocation) and Type IV (subtalar, ankle, and talonavicular dislocation) fractures are associated with a nearly 100% chance of developing AVN. This underscores the importance of early and honest discussions with patients about the potential long-term course of their injury.
- **Fiscat Scaling:** Initially developed for femoral AVN, Fiscat scaling is also applicable to the talus, correlating imaging findings with clinical signs to inform treatment decisions.

Treatment Options: A Phased Approach

Management of talar AVN ranges from conservative strategies to complex surgical interventions, chosen based on the stage of AVN and patient presentation.

Conservative Therapies:

- **Non-weightbearing (NWB):** This is a highly effective initial therapy for early signs of sclerosis or poor vascularization. A landmark study by Canali and Kelly (1978) showed that nearly 9 months of NWB resulted in 90% good to excellent outcomes. Clinical Tip: I advise keeping patients non-weightbearing for approximately 3 months post-ORIF, allowing for range of motion around 6–8 weeks. If AVN is suspected, a trial of 3 months of NWB is recommended before considering more extensive interventions.
- **Partial Weightbearing (PWB):** This can be introduced in later stages, often with the aid of patellar weight-bearing braces or other offloading devices, as vascularization begins.
- **Extracorporeal Shockwave Therapy (ESWT):** This promising non-invasive option has shown benefit in early-stage (Fiscat 1–2) traumatic talar AVN. A 2010 study by Zhai demonstrated that ESWT improved AOFAS and VAS scores and decreased necrotic areas on imaging. Clinical Tip: If accessible, ESWT is a great adjunct for treatment, though more research in this area is needed.

Surgical Interventions:

- **Core Decompression**: While primarily supported by data from atraumatic AVN, it can be considered for stages 1 and 2, and possibly stage 3 without cortical collapse, to reduce intraosseous pressure and enhance revascularization. However, data supporting its efficacy in traumatic AVN is limited.
- **Bone Grafting:** Both vascularized and non-vascularized grafts can provide structural support and promote revascularization through creeping substitution. Non-vascularized grafts (eg, iliac crest) may offer structural support but not necessarily

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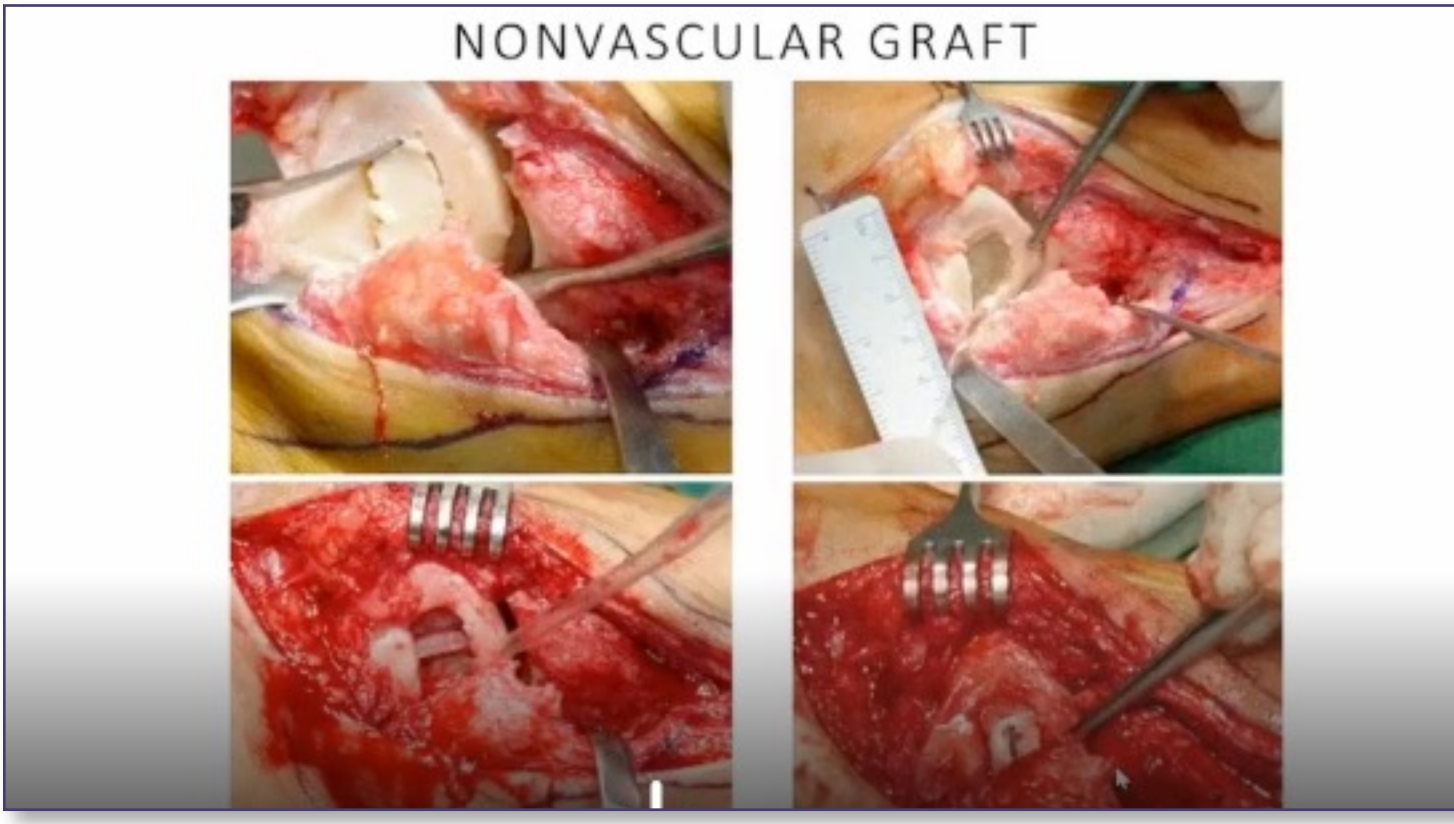

vascularization. Vascularized grafts (eg, pedicle from cuboid or calcaneal graft) are generally preferred for smaller, more superficial lesions (Hawkins/Fiscat 1–3) before true cortical collapse.

- **Hindfoot Fusions (Arthrodesis):** For cases involving true cortical collapse, hindfoot fusions have historically been considered the gold standard.
  – Tibiotalocalcaneal (TTC) fusions are common for extensive talar death, though they are surgically challenging with varied functional results and higher non-union risks.
  – Blair's fusion, involving sliding and fusing the distal anterior tibia to the talus neck and head, is another option, though historical pseudoarthrosis rates led to modifications with IM nails or vascular grafts.
  – Pantalar fusions can also be utilized, sometimes augmented with external fixators or IM nailing to improve structural support and vascular inflow. Clinical Tip: Remember that successful outcomes, even with fusions, may be defined as a braceable, stable, reasonably painless foot, rather than perfect anatomical union.
- **Talar Prosthesis**: This is an evolving and promising option. Partial talus prostheses have shown limited success, with total talus components generally recommended. Total talus prostheses can restore joint mobility, offer rapid pain relief, and may allow for shorter mobilization periods while preserving limb length.
- **Clinical Tip:** These customized implants often come with additional costs. There is growing interest in combining total talus prostheses with total ankle replacements, sometimes performed in a 2-stage technique with initial subtalar fusion to enhance blood supply.

Conclusion

The management of avascular necrosis of the talus remains a significant challenge for podiatrists. A comprehensive understanding of talar anatomy, meticulous diagnostic staging using imaging and classification systems, and a phased approach to treatment are critical. Initiating with conservative measures like prolonged non-weightbearing, complemented by newer modalities like extracorporeal shockwave therapy, offers hope for early-stage AVN. For advanced cases, while hindfoot fusions have traditionally been the mainstay, the advent of total talus prostheses presents an exciting and increasingly viable option, aiming to restore function and limb length. Early, honest discussions with patients about the high risk of AVN in severe talar injuries are paramount, preparing them for the potentially prolonged and complex course of recovery. Continued research, particularly into total talus prostheses and their long-term effects on adjacent joints, will undoubtedly further refine our approach to this challenging condition. ler

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Which Return-to-Sport Criteria Effectively Predict Reinjury Risk?

By Jack Shaw

Returning to a sport after an injury involves healing tissue while restoring strength, stability and confidence. Athletes face the challenge of balancing physical recovery with mental readiness, and their decisions carry significant implications for long-term health and the risk of reinjury. Understanding which criteria best predict successful outcomes helps clinicians support athletes effectively.

Functional Performance Tests for Measuring Readiness

Sports medicine specialists often use field-based screening tools to assess movement quality and readiness. Standard options include the Y Balance Test, Star Excursion Balance Test, Functional Movement Screen and Landing Error Scoring System. These provide practical and accessible alternatives to lab-based evaluations that help identify neuromuscular imbalances that may raise the risk of injury.

By measuring control and coordination, clinicians can design more targeted and effective rehabilitation programs. The results also guide injury prevention strategies in team settings and contribute to individualized RTS decisions grounded in measurable performance.

Strength and Symmetry Benchmarks for Recovery

Isokinetic strength is a key measure after anterior cruciate ligament reconstruction closely tied to function and reinjury risk. Clinicians assess knee extensor and flexor strength to evaluate neuromuscular control and stability, comparing limb torque to detect asymmetry.

After an ACL injury[1], it takes around 6 to 9 months to return to previous activity levels. Many specialists recommend waiting at least a full year before resuming competition to lower the chances of reinjury. Alternatively, recovery[2] after a lumbar spinal cord injury depends on the severity and location of the damage.

After anterior cruciate ligament reconstruction, running helps athletes gradually return to sport. It places high demands on the knee, which generates about 20%[3] of lower-limb power. These demands increase further as running speed rises. Six months post-surgery, many athletes still lack sufficient quadriceps strength to control knee flexion safely.

Some protocols suggest isokinetic testing at 4- and 6-months post-surgery, with a quadriceps limb symmetry index above 60% often considered sufficient to resume running. Monitoring strength recovery with these benchmarks helps guide safe progression and minimize complications during rehabilitation.

Biomechanical Insights to Support Safe Movement

Biomechanical asymmetries[4] after anterior cruciate ligament injury can increase the risk of secondary injury. Double-limb landing studies show reduced knee joint moments and ground reaction forces on the injured side, indicating stiffness and compensatory loading on the uninjured limb. Key risk markers like decreased knee extension moments, increased lateral trunk flexion, greater knee valgus, hip rotation, lower center of mass and prolonged ground contact have been linked to reinjury within a year, highlighting the impact of load distribution on outcomes.

Knee abduction angles[5] and movements are key predictors of anterior cruciate ligament injury. Higher abduction angles and moments increase anterior tibial translation and ACL load, thereby increasing the risk of injury. Reduced knee flexion combined with greater internal rotation and abduction further amplifies this risk during sports, while poor positioning on landing adds extra load, increasing the likelihood of injury.

Psychological Readiness for Confident Return

Returning to a sport is a physical milestone but also a psychological one. For example, spinal cord injuries can profoundly impact physical, mental, and social functioning, often requiring significant adjustments to daily life. These can lead to chronic pain, sensory deficits and an increased risk of depression. Many patients retain a high degree of independence by using coping strategies to adapt positively to their new circumstances.

Building on this connection between resilience and recovery, psychological readiness also plays a pivotal role in return-to-sport outcomes. It's often measured by the ACL-Return to Sport after Injury scale, which helps predict success independently of physical performance. Physical tests like hop tests and limb symmetry indices provide objective data but have limited predictive value when used alone.

Integrating psychological assessment with physical measures is crucial for conducting effective return-to-sport evaluations and implementing targeted interventions. Fear of reinjury can affect both mindset and movement, causing reduced intensity, avoidance of high-risk actions, and altered joint loading that can slow the recovery of strength and stability.

Addressing these barriers is essential. Incorporating psychological readiness into return-to-sport decisions can help identify at-risk athletes and guide targeted interventions to support their recovery. Combining validated physical and psychological criteria enables clinicians to make informed, evidence-based, and individualized decisions.

Move Toward Safer, Smarter Return to Sport

A triumphant return to sports relies on a combination of physical performance, strength and symmetry, biomechanical control, and psychological readiness. Using multiple assessments supports safer and more individualized decisions. Clinicians can combine objective tests with mental readiness to enhance recovery and performance. Overall, a balanced, evidence-based approach helps athletes return to play with confidence and resilience.

Jack Shaw is a New York–based journalist and senior editor at Modded, where he writes about the intersections of health, performance and technology. With a background in industry reporting, his work spans topics from biomechanics and sustainable design to innovations in workplace and athletic safety. In his writing, Jack brings a keen interest in how technology and environment shape human movement.

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The Ground Truth: Foot & Ankle Unlocked

***The Ground Truth: Foot & Ankle Unlocked* is a bold, monthly exploration of foot and ankle anatomy, biomechanics, and clinical pathology–where foundational science meets modern medicine.**

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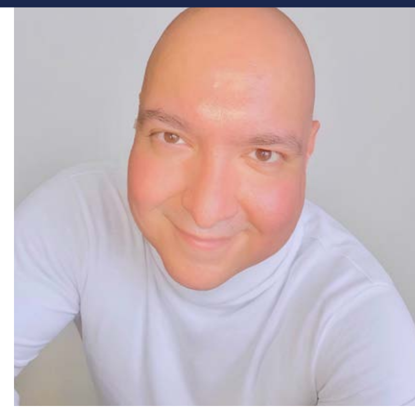

Pain Has an Address: Why Foot and Ankle Pain Is an Anatomical Story

Understanding Pain Not as a Symptom, But as Anatomy Speaking Directly to The Clinician

By Dr. Hooman Mir, DPM, MSci, FAPWCA

Pain in the foot and ankle is rarely a riddle. Patients may not know the name of a tendon, ligament, or nerve, but they almost always know where it hurts. They point with 1 finger, not their whole hand. They tell you whether it burns, stabs, aches, feels electric, or stiffens after rest. They can often tell you if the first few steps in the morning are the worst, or if it builds across the day, or if it "catches" at a particular angle. These are not vague impressions–they are anatomical messages. Pain speaks, and in the foot and ankle it speaks with striking precision that mirrors the architecture beneath the skin.

Modern practice can unintentionally muffle that message. We reach for quick labels–plantar fasciitis, ankle sprain, neuropathy–and then we prescribe injections, orthoses, NSAIDs, or a brace. But pain is not the diagnosis; it is the symptom of a specific structure under abnormal load or compression. If we do not identify the structure, we are not solving the problem–we are muting the alarm without putting out the fire. The foot and ankle, with 26 bones, 33 joints, more than a hundred ligaments, an intricate network of intrinsic and extrinsic muscles, and a dense plexus of sensory nerves confined to narrow fibro-osseous corridors, force us to return to first principles: the anatomy is the story, and pain is its language.

The Foot as a Map That Predicts Pain

The human foot is both scaffold and spring. It must be rigid enough to transmit force into the ground and elastic enough to store and release energy with each step. That dual demand is met by an interplay of joints that lock and unlock, ligaments that tension and slacken, and tendons that steer and stabilize. Small deviations–10 degrees of hindfoot valgus, a shortened gastrocnemius, attenuation of the spring ligament, narrowing of the tarsal tunnel–redistribute force and friction. Where that redistributed load lands, tissue protests.

Consider the heel. When a runner wakes with knife-like pain at the plantar medial calcaneal tubercle that eases with gradual walking, the body is telling a story about the plantar fascia and its enthesis. The microtears of a stiff overnight fascia stretch across their weakest link as the windlass mechanism engages. A different patient, pointing slightly more lateral and distal with burning and paresthesias that worsen in narrow shoes, is describing something else: entrapment of the inferior calcaneal nerve (Baxter's nerve) as it courses around the abductor hallucis and along the deep fascia. The 2 patients live in the same zip code; their "street addresses" differ by centimeters and by tissue type–collagenous fascia in 1, compressed nerve in the other. The treatment should differ just as precisely.

Pain mapping continues medially. Adult acquired flatfoot is not a generic "arch collapse." It begins as degenerative change in the posterior tibial tendon, progresses to failure of the spring ligament, and eventually stresses the deltoid complex and the subtalar joint. Early pain is felt along the tendon's distal course; as the deformity worsens, patients develop lateral impingement pain as the calcaneus everts and the lateral column is overloaded beneath the fibula. If one treats only the symptom at a single moment–an orthotic here, a steroid there–without naming where the cascade has moved anatomically, the plan will lag behind the disease.

On the lateral side, chronic ankle sprain is often anything but. Recurrent pain and a sense of giving way can reflect peroneus brevis split tears within a shallow retromalleolar groove, superior peroneal retinaculum injury with tendon subluxation, or sinus tarsi syndrome–synovial and ligamentous inflammation within the subtalar recess after inversion injury. These pathologies occupy discrete spaces. A patient who points behind the fibula and describes clicking with eversion is not asking for another ankle brace; they are asking the clinician to examine a tendon in a groove and a retinaculum under strain.

Pain Behavior is Biomechanics in Disguise

The timing of pain is as diagnostic as its location. Gait is an anatomic stress test that repeats thousands of times per day. Each phase highlights a different structure. At heel strike, the calcaneal fat pad, the cortical shell of the calcaneus, and the origin of the plantar fascia accept impact. If pain is maximal at initial contact, those structures move to the top of the list. Midstance demands controlled eversion and subtalar accommodation; posterior tibial tendon, spring ligament, and the midfoot joints carry the burden of stabilizing a flexible lever. Pain that builds through midstance signals failure of that support. Toe off loads the sesamoid apparatus, plantar plates, flexor hallucis longus, and Achilles tendon; pain with propulsion directs attention there. Pain that crescendos by day's end reveals fatigue and overuse in tendons and ligaments; pain worst on first step after rest reflects tightening and enthesis irritation. The body is telling you when a given structure fails under load; it is your task to translate which structure that timing implicates.

Even quality of pain encodes anatomy. Burning, tingling, and electric shocks implicate nerves or their sheaths. Deep, dull ache that is worse after activity and improves with rest suggests bone or joint, particularly osteoarthritic surfaces sharing load poorly. Sharp, well-localized pain with stretch or palpation is often fascial or tendinous, especially at an enthesis. A sense of "catching" with particular arcs of motion implies mechanical conflict–an impingement spur, synovial fold, or loose body. Pain with passive versus active motion, pain with resisted testing, and pain with specific positions (forced dorsiflexion provoking anterior ankle impingement, forced plantarflexion awakening posterior impingement around an os trigonum) refine the map further.

The Clinical Error We Keep Making

The most common error in the care of foot and ankle pain is to convert the symptom into the label, then treat the label. "Plantar fasciitis" becomes a bucket that captures fascial enthesopathy, fat pad atrophy, calcaneal stress injury, and multiple neural entrapments in the distal tarsal tunnel complex. A steroid injection into the wrong bucket numbs the story for a few weeks while the real pathology continues. "Chronic ankle sprain" becomes a blanket term that hides peroneal tendon tears, occult fractures of the lateral process of the talus, and persistent synovitis in the sinus tarsi. "Bunion pain" is corrected with elegant osteotomies while first ray hypermobility, pes planus, or gastrocnemius equinus–the drivers of overload–go unaddressed, setting the stage for recurrence.

The antidote to this pattern is anatomical honesty. Pain is not the end of the history; pain is the beginning of a conversation with tissue. If we treat pain generically, it returns. If we treat the structure that is suffering and the mechanics that overburden it, the pain resolves because its reason for existing has been removed.

Two Stories That Change How We Listen

A 52-year-old nurse presents with 6 months of heel pain. It is worst with the first steps in the morning and after her 12-hour shifts. She has tried a night splint and an orthotic with minimal relief. Examination reveals focal tenderness 1–2 cm distal to the plantar medial calcaneal tubercle. The windlass test is positive; dorsiflexion of the hallux tensions the fascia and reproduces her pain. Ultrasound shows a thickened fascia at the enthesis with hypoechogenicity. This is the canonical fasciopathy: a collagen scaffold frayed by cumulative load. Now consider a second patient: a 46-year-old retail worker with plantar fasciitis for 9 months. She has burning pain that radiates to the plantar lateral heel, worsens in narrow shoes, and sometimes shoots forward into the lateral plantar foot. Tinel's sign is positive at the abductor hallucis, and provocative eversion increases her symptoms. Ultrasound shows focal thickening of a small nerve branch deep to the fascia; the plantar fascia itself measures within normal range. Her pain was never fascial; it was neural. Both patients arrived with the same label. Only one was treated.

A second pair of patients illustrate the migration of pain with deformity. A 67-year-old man notes aching along the medial ankle and arch, worse by day's end, with a new difficulty performing a single-limb heel rise. He has a valgus hindfoot, forefoot abduction, and a "too many toes" sign. MRI demonstrates degeneration within the posterior tibial tendon. Months later, as the tendon fails and the spring ligament attenuates, his pain moves to the lateral ankle with a sense of pinching beneath the fibula. The structure that hurts has changed because the alignment has changed; lateral impingement is a downstream consequence of medial collapse. Now consider a 28-year-old basketball player with recurrent "ankle sprains." Despite bracing, he has posterolateral pain and a clicking sensation when he resists eversion. In clinic, the peroneal tendons subluxate with circumduction, and MRI confirms a split tear of the peroneus brevis within a shallow groove. His problem is not instability of the ankle joint; it is failure of a tendon and retinaculum in a tight space. The address matters.

Imaging as Confirmation, Not A Treasure Hunt

Imaging should follow anatomy; it should not try to find a diagnosis in the absence of an anatomic hypothesis. Ultrasound is unmatched for dynamic assessment of fascia, tendons, and superficial nerves; it is the clinician's stethoscope for the plantar heel and peroneal tendons. It answers focused questions: How thick is the fascia at the calcaneal origin? Does the inferior calcaneal nerve change caliber as it exits the deep fascia? Do the peroneal tendons subluxate with active movement? Radiographs, especially weight-bearing views, reveal alignment and arthrosis in ways supine MRI cannot–subtalar alignment, talonavicular coverage, midfoot joint space narrowing, first ray elevation. MRI offers exquisite detail for osteochondral lesions of the talus, impingement syndromes, plantar plate tears, and the marrow response to chronic overload. But without a map drawn from history and examination, imaging becomes a scatter of findings in search of a story. Each modality is most valuable when it is deployed to confirm a structure you already suspect from the patient's narrative.

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How Nerves Write in Fire and Tendons Write in Ache

The language of pain varies by tissue. Nerves, trapped in fibro-osseous tunnels and sheathed in connective tissue that can swell, write in lightning and fire. They produce paresthesias, tingling, and numbness with a spread that follows their branching–posterior tibial nerve through the tarsal tunnel into medial and lateral plantar distributions; interdigital nerves beneath the deep transverse intermetatarsal ligament out into the workspace. Tendons write in ache that sharpens with stretch or resisted motion; their pain is focal at entheses and sweeping along sheaths if paratenon is involved. Ligaments write in instability and apprehension, especially at end-range motion that challenges their check-rein function. Bone writes in deep ache–stress reaction and arthritic surfaces that hurt after load and diffuse slowly.

Learning to hear those voices is as important as memorizing attachments. In practical terms, it means asking patients to describe not just "where," but "what and when." It means palpating in millimeters, not centimeters. It means provoking the structure you think is guilty–windlass for fascia, Tinel's at the tarsal tunnel, single-limb heel rise for posterior tibial tendon, forced dorsiflexion for anterior impingement, plantarflexion for posterior impingement, resisted eversion for peroneals, drawer and tilt for ankle ligaments–and letting the structure answer.

The Role of Footwear, Surfaces, and Workload

Anatomy is not destiny; it is a set of tolerances that can be exceeded by environment and behavior. Footwear that narrows the forefoot compresses interdigital nerves; minimalist shoes expose calcaneal fat pads and plantar fascia to unfiltered impact; rigid high heels shift load to the metatarsal heads and sesamoids. Surfaces matter–concrete is less forgiving than track, treadmills alter stride, and cambered roads can torque ankles through repetitive valgus or varus control demands. Occupation shapes pathology. Nurses and retail workers report plantar heel pain not simply because they stand, but because they accumulate hours of midstance on unforgiving floors in footwear that may not address their foot posture. Runners exhibit predictable sequences of injury when weekly mileage outpaces tissue adaptation–Achilles insertional pain in the presence of a tight gastrocnemius, metatarsal stress reactions with sudden spikes in intensity, plantar fasciopathy during transitions to forefoot-strike patterns without graded strengthening of intrinsic muscles.

Misdiagnosis Patterns That Waste Time–and How to Avoid Them

Three patterns recur in clinics and deserve special attention. The first is "plantar fasciitis" that is not fascia. Baxter's nerve entrapment, fat pad atrophy, and calcaneal stress injury can mimic it. Careful localization (more lateral and distal for nerve), provocative testing (Tinel's at abductor hallucis), and ultrasound (nerve caliber, fascial thickness, fat pad integrity) separate them. Treating a nerve with a fascial injection is a recipe for delay.

The second is "chronic ankle sprain" that hides peroneal pathology or sinus tarsi syndrome. Patients who describe snapping or clicking behind the fibula with eversion, or who have pain to palpation in the sinus tarsi that feels like a deep bruise with inversion-eversion, need dynamic testing and targeted imaging. Tendon tears will not heal with more bracing, and sinus tarsi synovitis will not resolve with generic ankle rehab.

The third is bunion pain managed as if the first metatarsal were an isolated beam. First ray hypermobility, pes planus, and gastrocnemius equinus are common co-conspirators. If the ray drifts and the hindfoot collapses, the medial eminence is not the whole story; it is the visible symptom of an unstable construct. Osteotomies should be planned in a biomechanical context, and soft tissue balancing aims at restoring function, not merely image.

Why Anatomy Must Precede Intervention

Injections, orthoses, taping, physical therapy, shockwave, ablation, and surgery all have roles. None of them is a substitute for correct anatomical diagnosis. A custom orthotic that stabilizes a collapsing arch offloads the posterior tibial tendon and spring ligament; the same orthotic is irrelevant for a Morton's neuroma and counterproductive for a patient whose pain is an impingement spur. A steroid into a fasciopathic enthesis can be carefully considered; a steroid into a nerve entrapment may quiet inflammation without relieving compression. Shockwave may stimulate healing in recalcitrant fascial degeneration; it is unlikely to help a split tendon. Ablating a neuroma addresses a choke point; failing to decompress the deep transverse intermetatarsal ligament leaves a mechanical trap in place.

Operative intervention, when necessary, is anatomy in its most literal sense. Arthroscopic debridement of anterior ankle impingement removes a physical block to dorsiflexion; os trigonum excision and FHL release clear a posterior conflict. Spring ligament augmentation, calcaneal osteotomy, and tendon transfer rebalance forces in adult acquired flatfoot; peroneal groove deepening and retinacular repair restore a pulley's geometry. Cheilectomy in hallux rigidus relieves dorsal impingement and buys motion; fusion ends painful motion when cartilage is gone. Decisions are easy when the structure is named and hard when the label is vague.

Listening Like a Mapmaker

The clinicians who earn reputations for solving stubborn foot pain share an approach more than they share a trick. They listen for the time signature of pain, they palpate like cartographers, they test hypotheses at the bedside before they ever open the imaging viewer. They know that a positive windlass plus morning pain plus focal enthesis tenderness is fascia until proven otherwise; that paresthesias and Tinel's with a more lateral point implicate a nerve; that posterior tibial tendon weakness will reveal itself when a patient tries to rise on tiptoe and the heel refuses to invert. They map pain onto anatomy and then confirm with targeted imaging. Their plans sound unglamorous: load management here, a different orthosis there, a decompression rather than a "clean-up," an osteotomy to redirect force instead of an implant to mask symptoms. Their outcomes look like relief rather than magic.

A Brief Philosophical Detour: Pain as a Protective Truth

Pain has a bad reputation as the villain of clinical encounters. It is, in truth, a protective truth-telling mechanism. It forces a patient to stop before they tear what is only frayed; it pushes them to seek care before a nerve entrapment becomes irreversible damage; it motivates strengthening before a tendon surrenders in full. Our task is not to silence pain as quickly as possible; it is to understand the message and remove the cause. This attitude is not punitive; it is respectful. It treats the body as an intelligent system signaling its limits. Nowhere is that more evident than in the foot and ankle, where the economy of space and the volume of load leave little margin for error.

Pain is not mysterious, and it is rarely misleading. In the foot and ankle, pain tells the truth with an address. Our job is to read the street signs.

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VEITHsymposium: Where Innovation, Evidence, and Collaboration Converge

By Richard Dubin, Lower Extremity Review founder, publisher and CEO

In the world of medicine, there are few conferences that stand out to me because of the values they embody. VEITHsymposium (Vs) is one of those. It is so much more than just an informative conference. It is a pulse check on where vascular and endovascular medicine is, where it is headed, and what it takes to get there together to change lives.

Vs seamlessly blends deep clinical insight with real world application. It isn't just a simple showcase of the latest devices. It is a place where real connection comes alive. Where evidence meets experience, where new technologies are not only demonstrated, but challenged and evaluated through the lens of real patient outcomes by the clinicians who use them and could benefit from using them. At Vs, science isn't just talked about, it's alive.

Across the lecture halls and exhibit floors and in informal discussion, one theme continued to emerge: The future of patient care cannot be built by one specialty or one technology platform. It will be built by collaboration. Vascular surgeons, interventional radiologists, lymphatic specialists, wound care clinicians, podiatrists, imaging experts, orthopedic partners, and industry innovators need to work together from a shared place of purpose with the shared goal of not only the best outcomes for each patient, but growth for each clinician and discipline.

Make no mistake, the height of innovation was on full display. But this was not innovation for the sake of being new. These were practical advances made to be life changing and to make real life impact. Remote monitoring. Early diagnostic imaging. Workflow automation. Ultrasound-driven procedures. Minimally invasive techniques. Data supported decision making. The message is loud and clear: Good technology improves ability, but great technology improvs clarity and efficiency to drive better outcomes.

What made a palpable difference were sessions that welcomed genuine discussion. When clinicians can have real conversations about when to intervene, when not to, how to evaluate new technologies, long term outcomes, and how to build plans across specialties, real change is made for patient outcomes. These discussions didn't stop at how-to use the device, but continued to the system, the team, the patient experience, and the economic sustainability of care.

And what I saw emerge consistently across the conference was excellence. That's the only way to describe it. A group of people who strive for and desire excellence. It was no longer only about performing a successful intervention. It is about prevention, education, coordinated care, and long-term preservation. It is about using imaging not just to see, but to predict. It is about using data not just to measure, but to act. Ultimately it is about using platforms not just to inform, but to truly collaborate.

The value of a live, in-person gathering like Vs in a world inundated with webinars, virtual sessions, and on demand learning is the connection. The real-life collaboration. You can't fake that; you can't duplicate that. We can share data online. You can learn virtually. But what can't be passed through a computer screen is the stream of real-time perception, honest questions, collaborative thinking, and the authentic exchange of ideas between peers.

Vs reminds us all that the future of healthcare is not defined by technology, but by the willingness of leaders to be flexible and adapt to work across clinical borders. Progress does not happen in a vacuum. Real progress happens when the goal is shared vision. It happens when improving patient outcomes is at the center of every conversation.

The future of vascular and limb preservation care will not live inside silos. Conferences like Vs continue to prove that when you bring together education, evidence, innovation, and curiosity, you create something far more powerful than a meeting.

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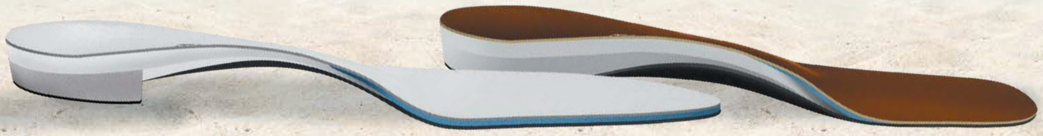

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Thank You to Our Authors and Readers from the Editor

By January Shoaf, LER Magazine Editor

Recently our publisher attended a conference where he was so impressed by the collaboration and the shared vision of the sponsor and all who attended. That's how I feel about my new position as LER editor. I am so amazed and inspired by the collaboration and warm welcome I've received. I could never have done it without all of you. I'm writing this as we have just finished Thanksgiving and I can say that I am truly feeling thankful. I want to take a moment to thank you all. To begin I couldn't have asked for a better mentor than my predecessor Janice Radak. She welcomed me to this position and taught me much more than just what you see on these pages. And our publisher, my boss, Rich Dubin. He is passionate about what he does, cares so deeply for his team and has genuine concern and love for the contributors and readers. I've been welcomed and embraced by an amazing team, Anthony Palmeri, Glenn Castle and Laura Hochnadel. I am truly thankful. What really drives home how wonderful it has been to be a part of this publication this past year is every interaction with the writers, contributors, readers and clinicians has been nothing but positive. So again, I say thank you. We literally could not do it without your dedication and contributions. Our tagline is collaborative care for better outcomes. And not only do we live it, but you all have made it true. So for that, we genuinely thank you. ler

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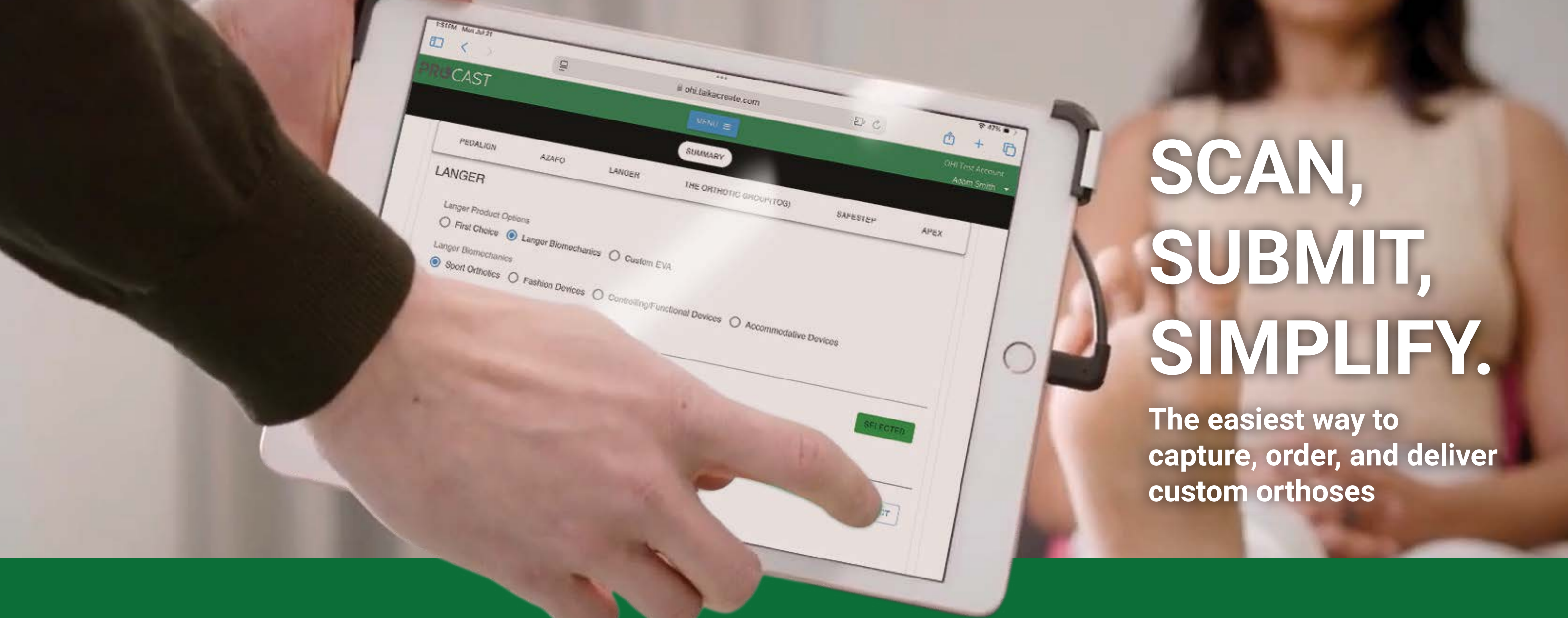

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PEDIATRIC SOFT EXOSKELETON MADE OF SMART MATERIALS

A next-generation lightweight, soft exoskeleton for children with cerebral palsy (CP) was developed to help children walk. The MyoStep addresses motor impairments that severely restrict children's participation in physical activities, self-care, and academic pursuits. Developed by a team from the National Science Foundation (NSF) University of Houston (UH) Building Reliable Advances and Innovation in Neurotechnology (BRAIN) Center, an Industry–University Cooperative Research Center (IUCRC), and TIRR Memorial Hermann, the project represents a significant advancement in the field of pediatric mobility aids, particularly for children with CP, said Jose Luis Contreras-Vidal, PhD, director of the NSF BRAIN Center and Hugh Roy and Lillie Cranz Cullen Distinguished Professor of Electrical and Computer Engineering.

The MyoStep soft exoskeleton addressing motor impairments caused by CP. Image courtesy of UH.

The team tailored the MyoStep to be lightweight, discreet, and tailored to fit seamlessly into the lives of children and their families. The wireless sensor network, embedded inside the smart and flexible fabrics, is the backbone of the suit, collecting and sending real-time data about the user's movements so the device knows when to assist their arms or legs. It also includes safety features such as temperature monitoring and emergency shutoff mechanisms. All electronics and actuators are fully isolated from the user's skin to prevent direct contact and reduce the risk of irritation or discomfort. Integrated temperature sensors continuously monitor the device's surface temperature, automatically deactivating the system if it exceeds safe limits to protect against overheating or burns. The various sensors in the network communicate with each other using Bluetooth technology.

Coordination across the ankle, knee, and hip was vital in producing the prototype. Continually improving how the ankle moves could make walking more efficient, allowing children to use less energy to walk.

AOPA ANNOUNCES 2026 BOARD OF DIRECTORS

The American Orthotic and Prosthetic Association (AOPA) has announced its 2026 Board of Directors. Elected by members, the board is representative of the membership and serves as the governing body, responsible for the supervision and direction of AOPA's mission. The executive committee consists of Kimberly Hanson, CPRH, who will serve as president, along with Rick Riley who becomes immediate past president and Matt Swiggum who moves to president-elect. Chris Nolan will continue to serve as treasurer. Joining them is Shane Wurdeman, PhD, CP, FAAOP(D), who was elected to serve as vice president.

Arlene Gillis, CP, LPO, Med, was elected to serve as clinician director. And new to the board of directors is Matt Bulow, CP, who was elected to serve as director-at-large.

They join fellow board members: Jeff Erenstone, CPO; Deanna Fish, MS, CPO; Adrienne Hill, MHA, CPO(L); Shane Kelly; Jim Kingsley; and Andrew Steele, CPO, MBA.

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Pro-Flex 3-blade technology enables a smooth, natural gait combined with comfort and control. Designed with enhanced durability, the low-profile fiberglass design provides exceptional mechanical power and range of ankle motion to reduce stress on its user's sound size. Other design aspects include reverse tapered technology that mimics natural ankle motion, a special heel bumper that absorbs high-impact shock, and a split toe and multi-axial format that makes it adaptable to uneven terrain. The prosthesis also features a removable, snap-on waterproof cover, a treaded sole for better grip, and a sandal-clamping toe.

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RESEARCHERS ENGINEER TREATMENT DESIGN SOFTWARE FOR MOVEMENT IMPAIRMENTS

Image of Fregly courtesy of Rice University.

Researchers led by Benjamin J. Fregly, PhD, a professor of mechanical engineering and bioengineering at Rice University, Houston, Texas, have developed a treatment design software that implements a personalized medicine approach for addressing impaired neuromusculoskeletal function. Called the Neuromusculoskeletal Modeling (NMSM) Pipeline, the software allows researchers to collaborate with clinicians to construct personalized neuromusculoskeletal computer models of individual patients (ie, digital twins) then use those models to design orthopedic surgery, physical therapy, or neurorehabilitation treatments that maximize each patient's functional outcome

Fregly and his team's work built on the functionality and reliability of an existing open-source musculoskeletal modeling software package called OpenSim developed by researchers at Stanford University, California. Their new open-source, MATLAB-based software package features 2 new state-of-the-art toolsets–a model personalization toolset and a treatment optimization toolset.

The model personalization toolset for creating "digital twins" of patients factors each patient's unique anatomy, physiology, and neural control properties to model their pretreatment movement data and numerical optimization to personalize an OpenSim musculoskeletal computer model, so it represents the patient's joint structure, muscle-tendon, neural control, and foot ground contact properties. By modeling these differences reliably, this toolset accounts for how a patient's unique characteristics should affect the design of the patient's clinical intervention.

The treatment optimization toolset combines a patient's personalized neuromusculoskeletal computer model with a different type of numerical optimization to predict how a patient's neural control and anatomy should be altered, or how an external device or implant should be designed or controlled to maximize the patient's movement function after treatment. This allows for fine-tuning the implementation of existing treatments or for identifying entirely new treatments that have not been identified previously.

The primary benefits of the NMSM Pipeline software are its extensive functionality, predictive capabilities, ease of use, and computational speed.

INSULIN + METFORMIN MAY BE A NEW DFU TREATMENT

Researchers from Michigan State University (MSU), East Lansing, and South Shore Hospital, Weymouth, Massachusetts, have uncovered that the combination of 2 common diabetes drugs—injectable insulin and orally administered metformin—increases the amount of metformin at the wound site. As metformin can accelerate wound healing, this could be welcome news for people who develop diabetic foot ulcers (DFUs). While analyzing wound exudate (the fluid the body moves and secretes to the site of an injury), researchers discovered the presence of metformin in patients who take the drug orally. The researchers then explored metformin's relationship to insulin. They found that for patients who take both insulin injections and oral metformin, the amount of metformin found in wounds significantly increases. It was previously believed that there was no interaction between insulin and metformin.

The researchers discovered that the combined use of insulin and metformin administered systemically significantly increased the concentration of metformin in the wound exudates (from 0.3% ± 0.0 to 3.1% ± 3.4; $P = 0.0049$). This work highlights the complexity of DFU exudate composition and underscores the potential for targeted metabolic profiling to develop personalized wound care strategies. Image courtesy of the researchers.

"Our study shows that there could be at least an indirect role of consuming both insulin and metformin in a way that metformin can end up in a wound area where it enhances the body's capacity to heal," said Morteza Mahmoudi, PHD, an associate professor in the department of radiology and precision health program in the MSU College of Human Medicine.

The team's findings may have immediate relevance to healthcare professionals treating patients with DFUs and biotech developers of wound dressings.

"Our findings can affect the way that clinicians approach healing chronic wounds," said Mahmoudi said. "Additionally, wound dressing developers need to consider the interactions of anything they put on top of wounds with exudates. Exudates can interact with the wound dressings and affect their safety and therapeutic efficacy. Additional research will be evaluating this."

WATER-RESISTANT LEATHER ORTHOTIC FOOTWEAR FOR WOMEN

Combining premium materials with advanced orthotic design, the Phoebe leather shoe marks a milestone for Revitalign® by Waco Shoe Company. Named WALKWELL™, this technology features articulated flex zones in both the heel and forefoot to enhance the shoe's flexibility, promoting a more natural gait and greater foot mobility for the wearer. Central to the shoe's design is Full Contact Comfort® offering 360-degree support throughout the foot and a deep heel cup provides stability, while a compression-molded EVA midsole delivers cushioning and versatility. The shoe features a ground contact rubber outsole, ensuring increased traction and durability on a variety of surfaces, making it ideal for walking and extended wear. The Phoebe features a contoured profile midsole through the forefoot and heel. It also has rubber contact points on the outsole for increased traction and ground contact, providing a secure and stable feel with every step.

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GAIT RETRAINING EASES PAIN, SLOWS CARTILAGE DAMAGE

At the beginning of the study, participants received a baseline MRI and walked on a force-sensitive treadmill while motion-capture cameras recorded their walking mechanics. Image courtesy of the Utah Movement Bioengineering Lab.

Researchers from the University of Utah (U of U), Salt Lake City; New York University; and Stanford University, California, have demonstrated the potential of gait retraining to relieve arthritic knee pain without drugs or surgery. The researchers were specifically looking at patients with mild-to-moderate osteoarthritis (OA) in the medial compartment of the knee, which tends to bear more weight than the lateral compartment. This form of OA is the most common, but the ideal foot angle for reducing load in the medial side of the knee differs from person to person depending on their natural gait and how it changes when they adopt the new walking pattern.

In their first 2 visits, participants received a baseline MRI and practiced walking on a pressure-sensitive treadmill while motion-capture cameras recorded their gait mechanics. This allowed the researchers to determine whether turning the patient's toe inward or outward would reduce load more, and whether a 5-degree or 10-degree adjustment would be ideal. This personalized analysis also screened out potential participants who could not benefit from the intervention, as none of the foot angle changes could decrease loading in their knees. Moreover, after their initial intake sessions, half of the 68 participants were assigned to a sham treatment group to control for the placebo effect. These participants were prescribed foot angles that were actually identical to their natural gait. Conversely, participants in the intervention group were prescribed the change in foot angle that maximally reduced their knee loading.

Participants from both groups returned to the lab for 6 weekly training sessions, where they received biofeedback that helped them maintain the prescribed foot angle while walking on the treadmill. After the training period, participants were encouraged to practice their new gait for at least 20 minutes a day, to the point where it became natural. Periodic check-in visits showed that participants were adhering to their prescribed foot angle within a degree on average.

After a year, all participants self-reported their experience of knee pain and had a second MRI to quantitatively assess the damage to their knee cartilage.

"The reported decrease in pain over the placebo group was somewhere between what you'd expect from an over-the-counter medication…," Uhlrich said. "With the MRIs, we also saw slower degradation of a marker of cartilage health in the intervention group, which was quite exciting."

LAVENDER- AND MAGNESIUM-INFUSED KINESIOLOGY TAPE

The KT® Soothe™ product line is designed to support pain relief and promote muscle recovery. KT Tape Soothe harnesses the power of lavender and magnesium to provide holistic wellness and multipurpose pain management for active individuals and athletes. KT Tape

Soothe with Lavender & Magnesium introduces a new level of muscle care by infusing KT's patented pre-cut strips and active cotton fabric with natural lavender essential oil and magnesium for an aromatherapeutic recovery experience. The hypoallergenic, latex-free formula works like the original KT Tape by lifting the skin to increase local blood flow for pain relief and support in muscles and joints. It provides up to 3 days of continuous support, helping to alleviate soreness while promoting relaxation and muscle recovery. Each package contains 20 pre-cut strips.

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OUTDOOR EXOSKELETON FOR ADVENTURE AND PERFORMANCE

The Hypershell X Ultra exoskeleton, powered by the advanced AI MotionEngine Ultra, adapts to a user's stride by sensing subtle shifts in motion and tailoring support accordingly. It features over 12 integrated sensors that continuously adapt to users' movements in real-time, delivering support when and where needed, resulting in smoother steps, reduced effort, and stability. Its M-One Ultra Motors provide a 39% reduction in physical exertion when cycling, 20% less physical exertion when walking, and a 63% increase in hip flexor endurance. The motors boast a 25% increase in power, reaching 1000 W. The long-lasting batteries provide 42,000 steps per battery. With 2 batteries included, the walking range extends to 60 km from the previous generation's 17.5 km. With the Hypershell+ App, users can switch modes, adjust power, and check their status via an Apple Watch. The device features 5 new intelligent modes, including Descent Assist, Cycling, Running+, and Snow.

Hypershell
support@hypershell.tech
hypershell.tech/en-us

SQAIRZ PICKLEBALL BECOMES THE FIRST SHOE APPROVED BY MEDICARE

The XRZ™ Pickleball Shoe by SQAIRZ is the first pickleball ball shoe to have been approved by Medicare for reimbursement, recognizing its design as performance-enhancing and proven to improve balance and reduce fall risk. SQAIRZ footwear is built around a patented geometry that optimizes connection between the foot and the ground. Each component contributes to both performance and protection. The roomy toe box geometry promotes natural toe splay, strengthening intrinsic foot muscles and enhancing sensory feedback. The heel and arch stabilizer prevents torsional twisting, improving postural control and joint alignment. Sta-Put™ silicone-gripped laces keep tension locked for comfort and reduced slippage. NRG-Foam™ Insole Technology delivers 14% higher energy return and 17% more cushioning than the leading aftermarket insole. This same technology that helps athletes can help individuals managing balance-related conditions, including diabetes, Parkinson's, neuropathy, or general instability.

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PIN-FREE ROBOTIC SURGERY–NEW ORTHOPEDIC TECHNOLOGY

Scientists at Saarland University's Homburg Campus, Germany, have developed a pioneering robot-assisted procedure for joint replacement surgery. Their approach removes the need for bone pins and external infrared cameras in procedures such as knee replacement surgery. Led by Professor Stefan Landgraeber, director of the department of orthopedics and orthopedic surgery at the University Medical Center, and research associate Philipp Winter, the project seeks to make orthopedic surgery both safer and less invasive.

Until now, the surgical robots deployed in orthopedic and trauma surgery have made use of bone pins–metal pins approximately 3.2 mm thick that are anchored directly into the bone. These pins allow the robot to determine the bone's exact position in the body using an infrared tracking system. However, this method carries risks, including bone fractures and damage to muscles or soft tissue. The new approach eliminates the need for the pins and for the external camera system. Instead, the robot uses its own built-in sensors. By precisely scanning a defined structure, such as a bone or a prosthesis, the robot can determine its spatial position and generate a 3D model of the surgical field. This process is further supported by x-ray images taken in 2 planes.

The key innovation lies in the robot's internal coordinate system, which determines its spatial relationship to the surgical object and replaces the need for infrared tracking. A patent application for the technology has already been filed.

Every Minute of Movement is Not Equal

New data using wearables shows 1 type counts up to 9× more.

A team led by Emmanuel Stamatakis followed 73,000 UK adults from the UK Biobank study, tracking their movement with wearable devices and linking it to major disease and death outcomes 8 years later on average.

EVERY MINUTE COUNTS... BUT SOME COUNT MORE

Outcome *For reducing risk of:*	Vigorous activity		Moderate activity		Light activity
T2D incidence	1 min	=	9.4 min	=	94 min
Cardiovascular mortality	1 min	=	7.8 min	=	72.5 min
Major adverse cardiovascular events	1 min	=	5.4 min	=	86.1 min
All-cause mortality	1 min	=	4.1 min	=	52.7 min

Data from: Biswas RK et al., (2025), *Nat Commun*, 16, 8315.

Jackson Fyfe, PhD *@jacksonfyfe*

Source: Biswas RK, Ahmadi MN, Bauman A, et al. Publisher Correction: Wearable device-based health equivalence of different physical activity intensities against mortality, cardiometabolic disease, and cancer. Nat Commun. 2025;16(1):9581. doi: 10.1038/s41467-025-65754-4.

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