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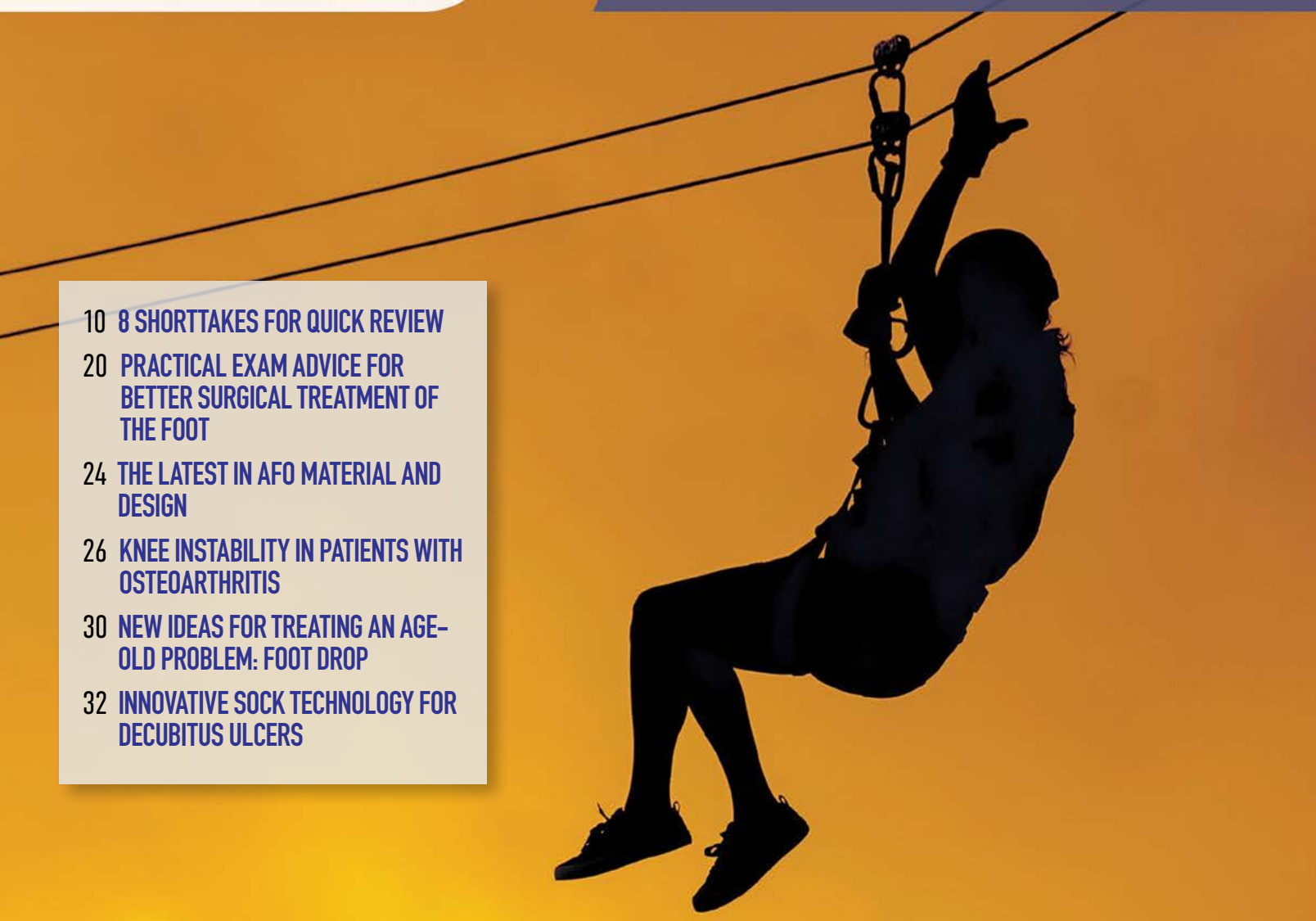
LOWER EXTREMITY REVIEW
January 26 / volume 18 / number 1

Ziplining Injuries in the US



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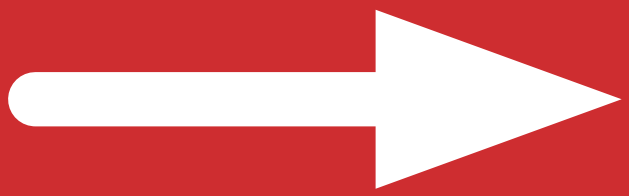

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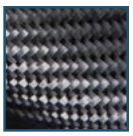

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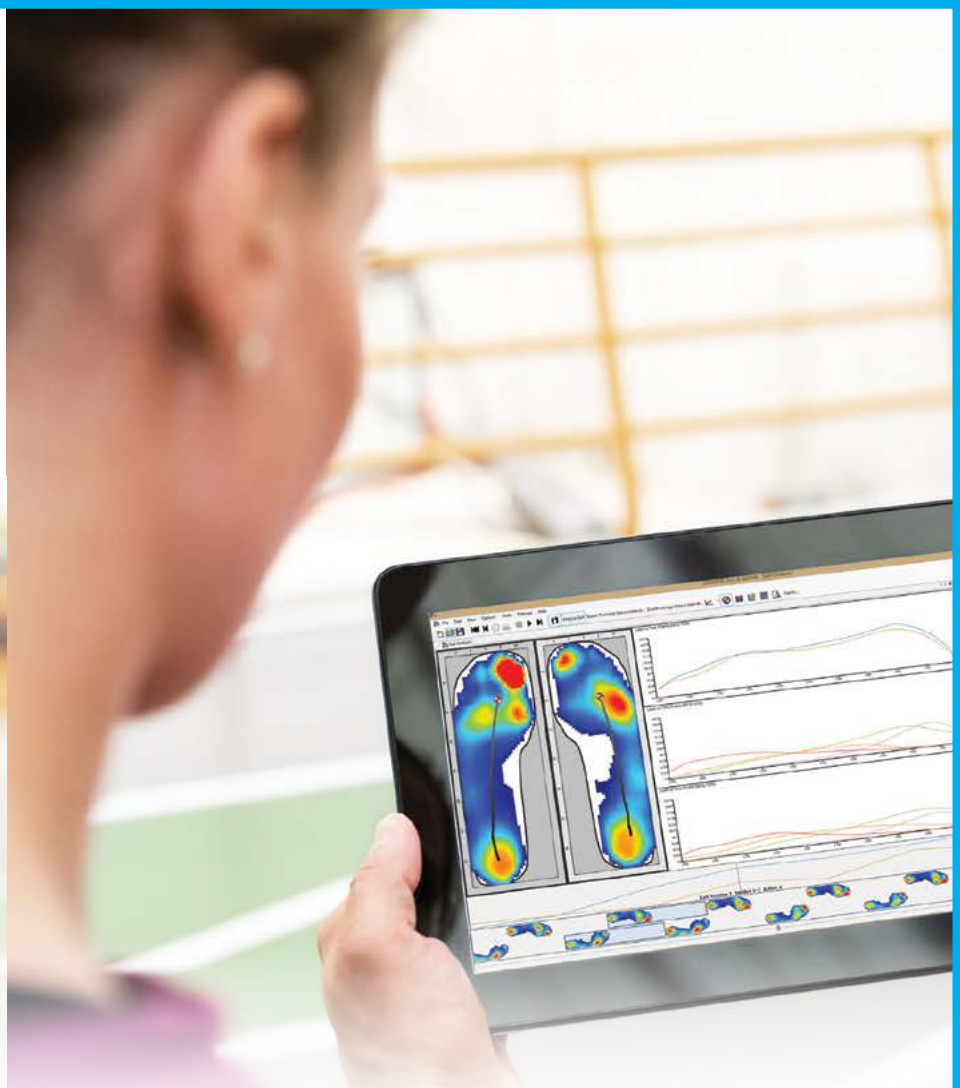

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Lower Extremity Review informs healthcare practitioners on current developments in the diagnosis, treatment, and prevention of lower extremity injuries. LER encourages a collaborative multidisciplinary clinical approach with an emphasis on functional 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.

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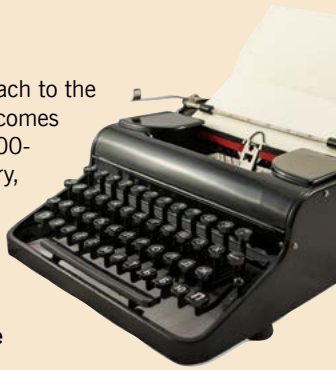

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HOW DO US NAVY SERVICE MEMBERS' PHYSICAL TESTS CHANGE AFTER ACHILLES TENDON REPAIR?

Achilles tendon ruptures are common injuries among adults that can cause substantial pain and disability. While prior studies have reported on return-to-play rates in athletes, limited data exist regarding functional outcomes within a military population.

A retrospective analysis of data from 2014–2020 from outpatient Military Health System Medical Data Repository and Physical Readiness Information Management System. The study included 1057 Navy personnel who had Achilles tendon rupture and operative repair. Service members had cardiovascular physical readiness test assessments from before and after surgery. Cardiovascular test split into 4 subgroups: those who biked before and after Achilles tendon rupture (35% [156 of 451]), those who ran (28% [127]), those who ran before Achilles tendon rupture but transitioned to another activity (32% [144]), and those who performed an alternative test (5% [24]). The study cohort was predominantly male (94.4%) with a mean age of 33 years.

Individuals performed worse on their physical readiness tests after Achilles tendon rupture compared to preinjury scores for the biking subgroup (10 seconds; $P = 0.02$) and the running subgroup (41 seconds; $P < 0.001$). Eighty-five percent (132 of 156) maintained or improved their physical readiness scores after Achilles tendon rupture for the biking subgroup, in contrast to 74% (106 of 144) for the run-to-another subgroup and 69% (88 of 127) for the running subgroup. There were between 0% (0) and 1.5% (2) physical readiness test failures after Achilles tendon repair.

These findings can help surgeons counsel active individuals. Runners undergoing Achilles tendon repair may run more slowly (approximately 41 seconds on a 1.5-mile run); however, this tends to improve over time. ler

Source: Vitha A, Robinson M, MacGregor A, Janney C. Return to running after achilles tendon repair: how do us navy service members' physical readiness tests change after undergoing an achilles tendon repair? Clin Orthop Relat Res. 2025 1;483(11):2012-2018. doi: 10.1097/CORR.0000000000003590.

PREDICTING DIABETIC PERIPHERAL NEUROPATHY WITH PLANTAR PRESSURE ANALYSIS (MACHINE LEARNING)

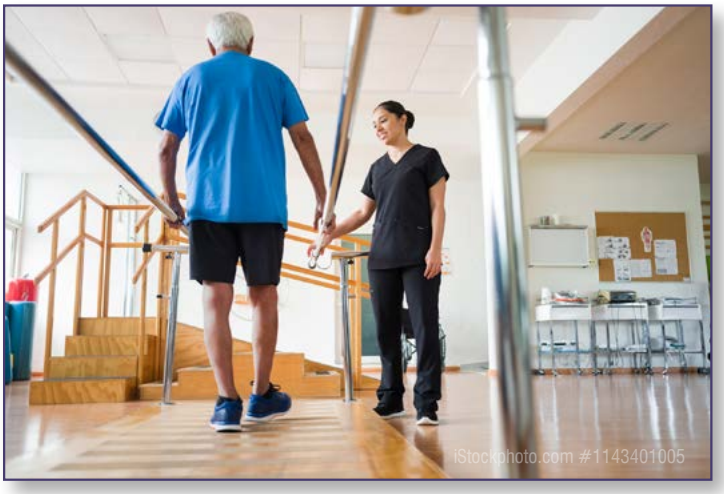
Diabetic foot Ulceration (DFU) is a severe complication of diabetic foot syndrome, often leading to amputation. In patients with neuropathy, ulcer formation is facilitated by elevated plantar tissue stress under insensate feet. This study presents a plantar pressure distribution analysis method to predict diabetic peripheral neuropathy. The Win-Track platform was used to gather clinical and plantar pressure data from 86 diabetic patients with different degrees of neuropathy. An automated image processing algorithm segmented plantar pressure images into forefoot and hindfoot regions for precise pressure distribution measurement. Comparative analysis of static and dynamic assessment showed that static analysis consistently outperformed dynamic methods. Gradient boosting achieved the highest accuracy (88% dynamic, 100% static), with random forest and decision tree also performing well. Explainable AI techniques (SHAP, Eli5, anchor explanations) provided insights into feature importance, enhancing model interpretability. Additionally, a foot classification system based on the forefoot-hindfoot pressure ratio categorized feet as flat, regular, or arched. These findings support the development of improved diagnostic tools for early neuropathy detection, aiding risk stratification and prevention strategies. Enhanced screening can help reduce DFU incidence, lower amputation rates, and ultimately decrease diabetes-related mortality. ler

Source: Sheikh MM, Balachandra M, V G N, Maiya AG. Predicting diabetic peripheral neuropathy through advanced plantar pressure analysis: a machine learning approach. Sci Rep. 2025 1;15(1):20962. doi: 10.1038/s41598-025-07774-0.

REVIEW OF NONPHARMACOLOGICAL INTERVENTIONS FOR BASIC SKILLS IN OLDER ADULTS

This study aims to synthesize existing evidence on the effectiveness of nonpharmacological interventions designed to increase the intrinsic capacity (IC) of community-dwelling older adults.

An umbrella review of systematic reviews from 2015 to October 31, 2024 was conducted. The review included 5 databases. Eligible studies



were systematic review and meta-analysis (SRMAs) that included any type of research aimed at enhancing IC in community-dwelling older adults (aged ≥60 years). The interventions covered 7 domains: locomotion, vitality, cognitive function, psychological health, sensory function, sleep, and continence.

Out of 6407 initially identified articles, 29 SRMAs comprising 400 studies with a total sample size of 43,849 participants were included. Mobility-focused interventions were the most studied among the 7 domains of IC. Moderate to low-quality evidence supports the effectiveness of intrinsic foot muscle strengthening and gait/muscle training for improving locomotor functions in older adults with frailty or acute functional decline. Nonpharmacological interventions targeting cognitive and psychological functions ranked second in the volume of available evidence. No effective sensory or continence interventions were identified. Overall, interventions have demonstrated varying effectiveness, with impacts ranging from moderate to very low across the domains of IC.

This umbrella review highlights the effectiveness of mobility/muscle strength training for improving locomotor function among frail older adult or those experiencing functional decline. However, the evidence for interventions targeting other IC domains remains limited, particularly for sensory function, and continence management. Future research should prioritize high-quality trials evaluating interventions in these areas to develop evidence-based guidelines for improving overall IC and promoting healthy aging in older adults. ler

Source: Lo Y, Su H, Chuenchomnoy C, et al. Umbrella review of nonpharmacological interventions for intrinsic capacity in older adults. Ageing Res Rev. 2025;108:102742. doi: 10.1016/j.arr.2025.102742.

MUSCLE STRENGTHENING EXERCISES FOR FOOT AND ANKLE

Foot and ankle muscle strengthening exercises are common interventions for many musculoskeletal conditions that are associated with pain and limited function in the lower limb. Science offers many strengthening exercises but has been criticized for not adhering to best practice. A systematic search of peer-review journal articles was conducted. Exercises were grouped according to primary movement and a general exercise descriptor. To compare to best practice, each program's prescription parameters of frequency, intensity, and time were compared to the American College of Sports Medicine's (ACSM) guidelines.

Of the included studies, most were randomized controlled trials, and the most common participants were healthy adults. Across all studies, a total of 300 foot and ankle exercises were prescribed. The most common strengthening exercise category involved ankle plantar flexion (25% of 300 exercises), followed by plantar foot intrinsics (16%). The most common prescription of strengthening exercises included 3 sets (37%) of 10 repetitions (38%) performed 3 times per week (34%), often without a prescribed load (66%). Prescribed sets per muscle group met ACSM recommendations for novice lifters in 93% of studies. Load intensity (for increasing muscle strength) was prescribed at the recommended dose of 60% of 1 repetition maximum or greater in only 2% of exercises.

Researchers found that the studies predominantly included ankle plantar flexion and plantar foot intrinsic muscle strengthening exercises, typically prescribed at 3 sets of 10 repetitions, 3 times per week. When compared to best practice recommendations, load intensity in exercise prescription is commonly less than recommended. Researchers propose using established best-practice exercise prescription guidelines like those from the ACSM. ler

Source: Osborne J, Menz H, Whittaker G, Cotchett M, Landorf K. Muscle strengthening exercises for the foot and ankle: a scoping review exploring adherence to best practice for optimizing musculoskeletal health. J Foot Ankle Res. 2025;18(2):e70040. doi: 10.1002/jfa2.70040.

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KNEE CREPITUS AND OSTEOARTHRITIS IN YOUNG ADULTS FOLLOWING TRAUMATIC KNEE INJURY

Knee crepitus, the audible crackling or grinding noise during knee joint movement, has been proposed as an early clinical indicator of structural osteoarthritis (OA). One year following anterior cruciate ligament reconstruction (ACLR), 112 participants self-reported the presence and/or absence of knee crepitus using an item from the Knee Injury and Osteoarthritis Outcome Score (KOOS). Patellofemoral and tibiofemoral osteoarthritis features (ie, cartilage lesions, osteophytes, and bone marrow lesions) were assessed from magnetic resonance imaging scans at 1 and 5 years after ACLR. Self-reported outcomes were assessed with 2 KOOS subscales (pain and quality of life [QoL]). Poisson regression evaluated the relationship between self-reported crepitus and the presence/worsening of structural osteoarthritis features. General linear models explored the relationship between crepitus and self-reported outcomes. Self-reported crepitus was associated with full-thickness patellofemoral cartilage lesions 1 year after ACLR (prevalence ratio 2.70, 95% confidence interval [CI] 1.41–6.39) but not the risk of worsening structural osteoarthritis features between 1 and 5 years after ACLR. Those with crepitus reported worse pain (β = -6.42, 95% CI -10.47 to -2.36), QoL (β = -10.39, 95% CI -18.58 to -2.20), and function (β = -5.49, 95% CI -10.92 to -0.06) 1 year after ACLR but greater improvement in pain and function between 1 and 5 years. Self-reported knee crepitus was associated with the presence of full-thickness patellofemoral cartilage defects 1 year after ACLR but was not associated with a greater risk of worsening structural osteoarthritis features up to 5 years after ACLR. One year after ACLR, those with crepitus reported worse pain, knee-related QoL, and function.

Source: Couch JL, Patterson BE, Crossley KM, et al. Knee crepitus and osteoarthritis features in young adults following traumatic knee injury. Arthritis Care Res (Hoboken). 2025. doi: 10.1002/acr.25637.

VOLLEYBALL-ASSOCIATED LOWER EXTREMITY INJURIES AMONG ADULT ATHLETES

The mean age of volleyball athletes has increased over the past decade, raising concern for musculoskeletal injuries. To evaluate epidemiologic trends, diagnoses, and mechanisms of volleyball-related lower extremity injuries within different adult age groups. Data on volleyball-associated lower extremity injuries in patients ≥19 years of age was analyzed from the National Electronic Injury Surveillance System between January 1, 2013, and December 31, 2022. Data collection included body location, final diagnosis, mechanism of injury, and disposition. Hospital sample weights were used to calculate national estimates. Patients were divided into either 20 to 39, 40 to 59, or ≥60 age groups. The mean patient age vwas 33.3 ± 11.2 years. Across all age groups, the most injured body parts were the ankle (36.0%), knee (32.7%), and lower leg (12.9%). The 20 to 39 age group experienced the greatest incidence of injuries from impact with the floor (national estimate [NE], 17,198; 37.4%). Additionally, this age group experienced the greatest incidence of dislocation (NE, 2379; 5.2%). The 40 to 59 age group had the highest proportion of injuries secondary to nonjumping noncontact movements (NE, 1781; 10.3%). The ≥60 age group had the highest proportion of injuries secondary to noncontact jumping movements (NE, 145; 8.5%). This study demonstrates that older volleyball athletes are at risk for lower extremity injuries, specifically affecting the ankle, knee, and lower leg. Younger adults sustain injuries more frequently from trauma, whereas older adults from noncontact injuries. Clinicians may consider this study to provide more age-specific recommendations to decrease the overall incidence and significance of volleyball-related lower extremity injuries.

Source: Lee PM, Snyder EM, Obana KK, Lee LSK, You JK, Trofa DP. Volleyball-associated lower extremity injuries among adult athletes of different ages: a comprehensive analysis of national data from 2013 to 2022. Orthop J Sports Med. 2025;13(8):23259671251358391. doi: 10.1177/23259671251358391.

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ONE VERSUS 2 SCREW FIXATION IN MIS FOR HALLUX VALGUS

Radiographs demonstrating single-screw (left) and dual-screw (right) fixation following minimally invasive distal metatarsal osteotomy for hallux valgus correction.

Minimally invasive surgery (MIS) for hallux valgus has evolved significantly, with ongoing debate about optimal fixation methods. Fourth-generation techniques typically use 2 metatarsal screws; however, single screw fixation may reduce operative time, radiation exposure, and cost. This systematic review compares clinical outcomes, radiographic results, and complications between 1- and 2-screw metatarsal fixation in minimally invasive hallux valgus correction. Risk of bias was assessed using the Risk Of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool. Primary outcomes included radiographic parameters (Hallux Valgus Angle (HVA), Intermetatarsal Angle (IMA), Distal Metatarsal Articular Angle (DMAA)) and clinical outcomes American Orthopaedic Foot & Ankle Society Score (AOFAS), Visual Analog Scale (VAS), Manchester-Oxford Foot Questionnaire (MOXFQ)). Secondary outcomes included operative details, complications, and revision surgery rates. Five studies met inclusion criteria: 2 clinical (n = 153 patients, 162 feet) and 3 biomechanical studies. Clinical studies showed comparable radiographic correction and patient-reported outcomes between fixation methods. Single screw fixation demonstrated significantly shorter operative time and reduced fluoroscopy exposure. Hardware-related complications requiring removal were higher in 2-screw groups (32% vs. 3% in one study; 1.9% vs. 0% in another). Biomechanical studies revealed that single screw fixation may provide insufficient rotational stability, while 2-screw configurations demonstrated improved construct stability. Current evidence suggests that single screw fixation may reduce radiation exposure, surgical time, and hardware removal rates, but offers reduced biomechanical stability compared to a 2-screw construct in patients undergoing minimally invasive hallux valgus surgery. Current evidence is insufficient to establish definitive recommendations, and fixation strategy should be individualized based on deformity characteristics and patient factors.

Source: Lewis TL, Fletcher L, Vulcano E, et al. One versus two screw fixation in minimally invasive hallux valgus surgery: a systematic review. Cureus. 2025 Nov 27;17(11):e97907. doi: 10.7759/cureus.97907.

TREATMENT-INDUCED DIABETIC NEUROPATHY: A CASE REPORT ON A YOUNG T1 PATIENT

Treatment-induced diabetic neuropathy (TIND), also known as insulin neuritis, is a rare but important complication that can occur after rapid correction of chronic hyperglycemia in patients with long-standing diabetes. It manifests as acute, severe neuropathic pain with autonomic dysfunction despite improved glycemic control. Chronic neuropathic pain, which arises from peripheral or central nervous system dysfunction, includes a broad spectrum of conditions such as diabetic neuropathy, trigeminal neuralgia, spinal cord injury, post stroke pain, and radiculopathy. However, TIND remains underrecognized and frequently misdiagnosed. This case report presents a 25-year-old male with type 1 diabetes who experienced 2 distinct episodes of treatment-induced diabetic neuropathy following periods of rapid glycemic improvement at a tertiary pain management center in the United States. The first episode occurred in 2019 after initiation of intensified insulin therapy, and the second in 2023 following insulin pump placement. Both episodes were characterized by severe bilateral lower extremity burning and stabbing pain despite normal imaging and electrodiagnostic studies. His pain management required a multimodal strategy incorporating pharmacologic therapy (gabapentinoids, antidepressants, and opioids), psychological support, physical therapy, and interventional pain management with lumbar sympathetic blocks. TIND should be considered in patients with unexplained neuropathic pain following glycemic correction. A gradual approach to glycemic control may mitigate its severity. Multimodal pain management, including pharmacotherapy, physical therapy, psychological support, and interventional techniques, plays a crucial role in optimizing outcomes for these patients.

Source: Lee SJ, Pandya J, Gattu K, Wright T. Treatment-induced diabetic neuropathy: a case report on multimodal pain management in a young patient with type 1 diabetes. Cureus. 2025;17(12):e99918. doi: 10.7759/cureus.99918.

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Zipline-Related Lower Extremity Injuries Treated at Hospital Emergency Departments

By Mathias B. Forrester, BS

Abstract

Background: Using ziplines has gained popularity as a form of outdoor recreation. However, using or being in proximity to ziplines may result in injury. The objective of this study was to describe zipline-related lower extremity injuries treated at hospital emergency departments (EDs).

Methods: Data were from the National Electronic Injury Surveillance System (NEISS), a database of consumer product- and activity-related injuries collected from a representative sample of approximately 100 U.S. hospital EDs. National estimates are calculated from database records according to the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample. Cases were all records during 2000–2024 with zipline-related injuries treated during 2000–2024 where the most severe diagnosis involved the lower extremity. The distribution of estimated zipline-related lower extremity injuries was determined for selected variables.

Results: Of an estimated 7,962 zipline-related lower extremity injuries treated at U.S. hospital EDs, 0.7% were treated during 2000–2004, 3.8% during 2005–2009, 21.3% during 2010-2014, 31.5% during 2015–2019, and 42.7% during 2020–2024. The most severe diagnosis was 31% fracture, 22.1% contusion or abrasion, 21.8% strain or sprain, 7.1% laceration, and 18.1% all other or not stated. The location of the incident was 72.5% place of recreation or sports, 7.8% home, 3.6% school, 1.3% other public property/street or highway, and 14.8% not recorded. The mechanism of the injury was 32.9% fall, 31.1% collision or hit, 17.4% other mechanism, and 18.6% unknown mechanism.

Conclusion: Zipline-related lower extremity injuries increased during the last 25 years. Roughly equal proportions of lower extremity injuries were due to falls and collisions or hits. While most of the injuries occurred at a place of recreation or sports, injuries also occurred at home or school. The information in this study may be useful for the creation and implementation of strategies to reduce the risk of zipline-related lower extremity injuries.

A zipline is a horizontal rope, wire, or beam with a mechanical system that allows a person to slide along the rope, wire, or beam by hanging beneath it.[1] Ziplines can range from something as simple as a piece of wire and a clothesline pulley to complex assemblies containing cables, attachments, trollies, computer control systems, hydraulics, motors, and sophisticated braking systems.[2] Using ziplines has gained popularity as a form of outdoor recreation.[3] As of 2020, there were over 400 commercial ziplines in the U.S. that provided more than 70 million rides annually.[2,3]

Using or being in proximity to ziplines may result in injury, the most common being fractures, soft tissue injuries, strains and sprains, lacerations, and concussions and closed head injuries.[4,5] Deaths have been reported with zipline use.[1,2,4]

Published research on zipline-related injuries is limited. The objective of this study was to describe zipline-related lower extremity injuries treated at hospital emergency departments EDs. One previous study reported that 24% of all zipline-related injuries involved the lower extremity.[5]

Methods

This study used data from the National Electronic Injury Surveillance System (NEISS database available at https://www.cpsc.gov/cgibin/NEISSQuery/home.aspx). The author has previously described the NEISS database in Lower Extremity Review.[6] To summarize, NEISS collects data on consumer product- and

activity-related injuries from a probabilistic sample of the EDs of approximately 100 U.S. hospitals. National estimates are calculated from database records according to the sample weight assigned to each case based on the inverse probability of the hospital being selected for the NEISS sample.[7,8] The data are publicly available and de-identified, so the study is exempt from institutional review board approval. Several previously published studies used NEISS data to examine zipline-related injuries;[4,5] however, neither study focused on lower extremity injuries.

Zipline-related injuries reported to NEISS were identified using criteria similar to that used in a prior study.[5] The Narrative text fields (a text field that summarizes the circumstances of the injury) for all records during 2000–2024 were searched for the following letter groups: (1) "zip" and "line," "lini," "cord," "swing," or "wire" or (2) "fly" and "fox." The Narrative fields of the resulting subset of records were then individually reviewed by the author to verify that the record involved a zipline-related injury. At the same time, the mechanism of the injury as stated in the Narrative was identified and assigned of the following categories: fall, collision or hit (including being hit by a part of the zipline), other, and unknown. If a person fell and then collided with something, the mechanism was categorized as a fall. If the person collided with something and then fell, the mechanism was categorized as a collision or hit.

The following variables were examined: affected body part, most severe diagnosis (type of injury), patient disposition, mechanism of injury, location of the incident, year and month of treatment, and patient age and gender. The NEISS database contains multiple fields for documenting the diagnosis and/or affected body part; however, only 2 fields were used consistently throughout the study period: Diagnosis (a numeric field for coding the most severe diagnosis) and Body_Part (a numeric field for coding the body part associated with the most severe diagnosis). (All diagnoses are supposed to be documented in the Narrative, but this is not performed in a consistent manner.) Therefore, only the Diagnosis and Body_Part numeric fields were used to analyze the diagnosis and affected body part. The study was limited to those zipline-related injuries where the Body_Part field included codes for parts of the lower extremity.

Table 1. Zipline-related lower extremity injuries treated in United States hospital emergency departments, National Electronic Injury Surveillance System, 2000-2024, by body part and most severe diagnosis.

BODY PART	FRACTURE		CONTUSION OR ABRASION		STRAIN OR SPRAIN		LACERATION	
	Est	%	Est	%	Est	%	Est	%
Lower leg	924	37.5	868	49.4	0	0.0	345	60.9
Ankle	993	40.3	236	13.4	1,052	60.7	0	0.0
Foot	284	11.5	359	20.4	261	15.0	15	2.7
Knee	66	2.7	279	15.9	239	13.8	41	7.3
Upper leg	79	3.2	15	0.8	181	10.4	77	13.5
Toe	120	4.9	0	0.0	0	0.0	88	15.6
Total	**2,466**		**1,756**		**1,733**		**566**	

Est = Weighted estimate (sum of the Weight numeric field in the National Electronic Injury Surveillance System database). The numbers in the Weight field are not whole numbers but include decimals. As a result of rounding to whole numbers when performing analyses, the sum of the estimates for a given variable might not equal the total. The Consumer Product Safety Commission considers an estimate unstable and potentially unreliable when the estimate is <1,200.

Analyses were performed using Microsoft 365 Access and Excel (Microsoft Corporation, Redmond, WA). For the selected variables, the distribution of the national injury estimates was determined. National injury estimates were calculated by summing up the values in the Weight numeric field in the NEISS database. The US Consumer Product Safety Commission (CPSC), which operates the NEISS, considers an estimate unstable and potentially unreliable when the estimate is <1,200.[7]

Results

An estimated 7,962 zipline-related injuries were treated at U.S. hospital EDs during 2000–2024 where the most severe diagnosis affected the lower extremity. This represented 17.1% of the estimated 46,572 such injuries affecting all body parts. There were 58 (0.7%) zipline-related lower extremity injuries treated during 2000–2004, 300 (3.8%) during 2005–2009, 1,696 (21.3%) during 2010–2014, 2,504 (31.5%) during 2015–2019, and 3,403 (42.7%) during 2020-2024. There were an estimated 749 (9.4%) injuries treated in December-February, 1,900 (23.9%) in March-May, 3,646 (45.8%) in June-August, and 1,667 (20.9%) in September-November.

The patient age distribution was 112 (1.4%) 0–5 years, 2,909 (36.5%) 6–12 years, 821 (10.3%) 13–19 years, 886 (11.1%) 20–29 years, 562 (7.1%) 30–39 years, 1,211 (15.2%) 40–49 years, 603 (7.6%) 50–59 years, 731 (9.2%) 60–69 years, and 126 (1.6%) 70 years and older. The patients were 4,783 (60.1%) female and 3,179 (39.9%) male.

The location of the incident was 5,768 (72.5%) place of recreation or sports, 623 (7.8%) home, 283 (3.6%) school, 106 (1.3%) other public property/street or highway, and 1,181 (14.8%) not recorded. The mechanism of the injury was 2,616 (32.9%) fall, 2,478 (31.1%) collision or hit, 1,386 (17.4%) other, and 1,481 (18.6%) unknown.

The affected body part was 2,651 (33.3%)

Continued on page 18

Continued from page 17

lower leg, 2,538 (31.9%) ankle, 1,147 (14.4%) foot, 1,055 (13.2%) knee, 362 (4.6%) upper leg, and 208 (2.6%) toe. The most severe diagnosis was 2,466 (31.0%) fracture, 1,756 (22.1%) contusion or abrasion, 1,733 (21.8%) strain or sprain, 566 (7.1%) laceration, and 1,441 (18.1%) all other or not stated. Table 1 shows the distribution of estimated zipline-related lower extremity injuries by body part and most severe diagnosis. While the highest proportion of fractures involved the ankle followed by the lower leg, the highest proportion of contusions or abrasions involved the lower leg followed by the foot. Most strains or sprains involved the ankle followed by the foot, and the majority of lacerations involved the lower leg followed by the toe. Table 2 provides the distribution of estimated zipline-related lower extremity injuries by mechanism of injury and most severe diagnosis. While the highest proportion of fractures and strains or sprains resulted from falls, most contusions or abrasions and lacerations resulted from collisions or hits.

The patient disposition was 7,261 (91.2%) treated or examined in the ED and released, 543 (6.8%) treated and admitted for hospitalization (within same facility), 147 (1.8%) treated and transferred to another hospital, 6 (0.1%) held for observation (includes admitted for observation), and 5 (0.1%) left without being seen or left against medical advice.

Table 2. Zipline-related lower extremity injuries treated in United States hospital emergency departments, National Electronic Injury Surveillance System, 2000-2024, by mechanism of injury and most severe diagnosis.

MECHANISM OF INJURY	FRACTURE		CONTUSION OR ABRASION		STRAIN OR SPRAIN		LACERATION	
	Est	%	Est	%	Est	%	Est	%
Fall	1,160	47.1	397	22.6	794	45.8	0	0.0
Collision or hit	625	25.3	909	51.8	65	3.7	386	68.2
Other	392	15.9	123	7.0	516	29.7	0	0.0
Unknown	288	11.7	327	18.6	358	20.7	180	31.8
Total	**2,466**		**1,756**		**1,733**		**566**	

Please see footnote in Table 1.

Discussion

This study found that the estimated number of zipline-related lower extremity injuries treated at U.S. hospital emergency departments increased over the 25-year study period. This might be expected since ziplining has increased in popularity in the U.S.[3] It is also consistent with several prior studies of all zipline-related injuries using NEISS data that likewise observed an annual increase in injuries.[4,5] Continued monitoring of zipline-related lower extremity injuries may be useful to determine whether this trend continues.

The lower extremity injuries were seasonal, with 46% of the estimated injuries treated in June-August and only 9% in December-February. A previous study also noted a seasonal trend, with 91% treated in April-October, peaking in July.[5] Although some ziplines can be found indoors, it is likely that most are used outdoors—and thus more likely to be used during the warmer months. Similarly, children are more likely to use ziplines during the summer, when they are out of school and have more free time.

While the highest proportion (37%) of patients were aged 6–12 years, the next highest proportion (15%) involved patients in the 40–49-year age group. Younger school-aged children might be the age group most likely to use ziplines, or, at least, use them in such a way that they may become injured. That people in their 40s accounted for the next highest proportion of injuries is more difficult to explain. People in this age group may be more likely than other adults to use ziplines or be injured while using the devices.

Most of the patients with zipline-related lower extremity injuries were female, a pattern found in the prior study that examined all zipline-related injuries among people of all ages.[5] It may be that females are more likely to use ziplines or use them in a manner that leads to injury.

Although 72% of the lower extremity injuries occurred at a place of recreation or sports, 8% occurred at home and another 4% at school. This suggests that strategies to reduce the risk of zipline-related injuries should not only focus on commercial facilities that offer ziplining or public places, such as public parks, where ziplines may be found but should also include schools and people who may be likely to have ziplines on their own property.

Although falls accounted for the highest proportion (33%) of lower extremity injuries, collisions or hits accounted for almost as many (31%). In one of the previous studies of zipline-related injuries involved people of all ages, 77% of the injuries were due to falls and 13% to collisions,[5] and in the prior study that involved only children aged 0-17 years, 86% were due to falls and 14% due to impact with another surface.[4]. Of the 46,572 zipline-related injuries treated during 2000-2024 affecting all body parts, 28,477 (61.1%) involved falls, 9,131 (19.6%) collisions or hits, 4,006 (8.6%) other mechanisms, and 4,958 (10.6%) an unknown mechanism. This suggests that lower extremities are less likely than other body parts to be injured in falls and more likely to be injured in collisions or hits. This may need to be taken into consideration when trying to implement strategies to prevent zipline-related lower extremity injuries. A strategy that reduces the risk of falls but not collisions or hits, or vice versa, may have differential impact on injuries to different body parts.

The most injured body parts were the lower leg and ankle, together accounting for almost two-thirds of the estimated injuries. The

most common serious diagnosis was fracture, followed by contusion or abrasion, strain or sprain, and laceration–patterns observed in the previous studies of zipline-related injuries using NEISS data.[4,5] The present study found that the diagnoses differed by both affected body part and mechanism of injury. As mentioned previously, the risk of injury to a particular body part may differ by the injury mechanism. Similarly, the risk of a particular type of injury (diagnosis) may differ by both the injury mechanism and body part.

The most common types of injury observed in this study–fractures, contusions or abrasions, strains or sprains, and lacerations–might not be expected to usually require extensive medical intervention. This is consistent with the observation that most of the patients were treated or examined at the ED and released. The prior zipline-related injury studies using NEISS data observed a similar pattern of patient disposition.[4,5]

This study has limitations. To identify cases, all records where the Narrative fields contained particular letter groups were first selected and then the Narrative field for each record was reviewed to determine whether the injury was zipline-related. The study would not include any records with zipline-related injuries that did not include the letter groups of interest or clearly indicated that the injury was zipline-related.

In addition, a person injured by a zipline may experience multiple injuries of the same or multiple body parts. This study was limited to the data fields that coded the single most severe diagnosis and affected body part because these were the only fields that consistently documented diagnosis and affected body part throughout the entire study period. Thus, a higher proportion of patients may have experienced lower extremity injuries.

Furthermore, only the author selected the records for inclusion in the study and assigned the mechanism of injury. Moreover, the study only included those patients treated at hospital EDs. Examination of patients treated elsewhere would provide a more complete understanding of zipline-related lower extremity injuries.

In conclusion, zipline-related lower extremity injuries increased during the last 25 years. The highest proportion of injuries involved children aged 6-12 years, and most of the patients were female. Roughly equal proportions of lower extremity injuries were due to falls and collisions or hits. While most of the injuries occurred at a place of recreation or sports, injuries also occurred at home and school. The information in this study may be useful for the creation and implementation of strategies to reduce the risk of zipline-related lower extremity injuries. ler

Mathias B. Forrester, BS, is an independent researcher in Austin, Texas. Now retired, he has performed public health research for various universities, government programs, and other organizations for 40 years.

References

1. Hanway S. Injuries and investigated deaths associated with playground equipment, 2009–2014. US Consumer Product Safety Commission, August 2016. https://www.cpsc.gov/s3fs-public/Injuries%20and%20Investigated%20Deaths%20Associated%20with%20Playground%20Equipment%202009%20to%202014_1.pdf . Accessed December 9, 2025.
2. Adamson I. Zip line injuries, risks, and safety. Robson Forensic, March 24, 2020. https://www.robsonforensic.com/articles/zip-line-safety-expert. Accessed December 9, 2025.
3. Vianna C. Zipline industry statistics. Xola, July 4, 2023. https://www.xola.com/articles/zipline-industry-statistics/. Accessed December 9, 2025.
4. Leeper CM, McKenna C, Gaines BA. Homemade zipline and playground track ride injuries in children. *J Pediatr Surg*. 2017;52(9):1511-1515.
5. Billock RM, Anderegg JJ, Mehan TJ, Chounthirath T, Smith GA. Zipline-related injuries treated in US EDs, 1997-2012. *Am J Emerg Med*. 2015;33(12):1745-1749.
6. Forrester MB. Pickleball-related injuries involving the lower extremity treated in emergency departments. Lower Extremity Review. 2021;13(5):24-30.
7. United States Consumer Product Safety Commission. National Electronic Injury Surveillance System (NEISS). https://www.cpsc.gov/Research--Statistics/NEISS-Injury-Data/Explanation-Of-NEISS-Estimates-Obtained-Through-The-CPSC-Website. Accessed December 9, 2025.
8. United States Consumer Product Safety Commission. NEISS Coding Manual. January 2025. https://www.cpsc.gov/s3fs-public/JANUARY-2025-NEISS-CPSC-only-Coding-Manual-Rev-1.pdf. Accessed December 9, 2025.

LEREXPO HIGHLIGHTS

Practical Biomechanical Exam: Information That Actually Drives Better Conservative and Surgical Treatment

By Patrick DeHeer, DPM FACFAS, FFPM RCPS (Glasg)

Non-Weight-Bearing Examination

The non-weight-bearing examination is the foundation of a comprehensive biomechanical assessment. It allows the clinician to evaluate intrinsic structure, available joint range of motion, and inherent pathomechanics without the confounding influence of body weight and compensation. Isolating individual joints and segments in an unloaded state is critical for identifying pathology, determining deformity correctability, and establishing a reliable baseline that informs all subsequent clinical decision-making. Understanding the foot and ankle in this state allows for more accurate interpretation once the patient is standing and walking.

Ankle Joint Range of Motion

The ankle joint functions around a triplanar axis that deviates significantly from the cardinal planes—approximately 82° from the sagittal plane, 8° from the transverse plane, and 20–30° from the frontal plane. Because of this orientation, dorsiflexion and plantarflexion represent the primary observable motions.

Normal total ankle range of motion is approximately 65–75°, typically consisting of 10–20° of dorsiflexion and 40–45° of plantarflexion.

Functional requirements vary by activity. Normal gait requires only about 30° of total ankle motion, whereas stair climbing and incline walking demand substantially more—often 37–56°.

Clinical Interpretation

- **Decreased dorsiflexion** suggests anterior ankle impingement or an osseous block.
- **Decreased plantarflexion** may indicate posterior impingement, including os trigonum pathology.
- **Absent motion** is highly concerning and typically reflects advanced osteoarthritis or prior ankle arthrodesis.

Equinus Assessment (Silfverskiöld Test)

The Silfverskiöld test remains a cornerstone of the biomechanical exam, primarily for distinguishing gastrocnemius from gastro-soleal equinus. However, its role has evolved. While essential for documentation, it should no longer be used in isolation to dictate the choice between tendo-Achilles lengthening and gastrocnemius recession.

The traditional "Root method," which places the subtalar joint in neutral, has demonstrated poor inter- and intra-rater reliability and should be considered outdated. An evidence-based alternative emerged in 2017.

Gatt et al. demonstrated superior reliability using a maximal supination technique. Dayton et al. corroborated these findings radiographically, showing that the tibiotalar angle remains unchanged between pronated and supinated foot positions—confirming that observed differences in motion are due to soft-tissue restriction rather than osseous alignment.

Evidence-Based Technique

1. Position the patient prone or supine.
2. Maximally supinate the foot to lock the midtarsal joint.
3. With the knee fully extended, dorsiflex the hindfoot and measure motion.
4. Repeat with the knee flexed.

While often labeled "ankle dorsiflexion," this motion more accurately represents hindfoot dorsiflexion, as ankle and subtalar motion cannot be clinically isolated.

Pathologic equinus is defined as –5° or less of dorsiflexion with thve foot maximally supinated and the knee extended.

Functionally, normal gait requires 10–20° of dorsiflexion during the second rocker. When this is unavailable, compensation occurs. Proximal compensation may include excessive knee and hip flexion or increased lumbar lordosis. More commonly, compensation occurs distally as sagittal-plane collapse through the midfoot—often at the naviculocuneiform joint—placing pathologic stress on the posterior tibial tendon and spring ligament.

Subtalar Joint Range of Motion

Subtalar joint (STJ) assessment is critical, particularly for distinguishing flexible from rigid

This article summarizes Dr. DeHeer's presentation, "Practical Biomechanical Exam: Information That Actually Drives Better Conservative and Surgical Treatment," delivered at the 2025 No-Nonsense Seminar (March 7–9). To view the full presentation with audience questions and answers—and to see the complete agenda for the 3-day program—visit https://nononsense2025.lerexpo.com. Continuing education credits are available for this and many other lerEXPO programs.

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flatfoot deformities. Normal motion consists of approximately 25–30° of inversion and 5–10° of eversion, for a total arc of 30–40°.

A key clinical question—especially in cavus evaluation—is whether the heel can evert to perpendicular. This single finding is often more surgically relevant than the Coleman block test. Failure to evert suggests a rigid deformity that may be better treated with subtalar arthrodesis rather than osteotomies.

STJ axis position has significant implications. A medially deviated axis predisposes to pronation and arch collapse, whereas a laterally deviated axis reinforces cavus mechanics.

Decreased STJ motion is commonly seen following ankle arthrodesis and after Evans calcaneal osteotomy, which has been shown to reduce STJ motion by approximately 30%.

Midtarsal Joint Examination

With the heel neutralized to lock the subtalar joint, the forefoot is assessed through all 3 planes of motion. This serves as an effective screening tool for midfoot arthritis and tarsal coalitions, including naviculocuneiform coalition.

First Ray Examination

The first ray—comprising the first metatarsocuneiform and naviculocuneiform joints—moves along a triplanar axis approximately 45° from both sagittal and frontal planes.

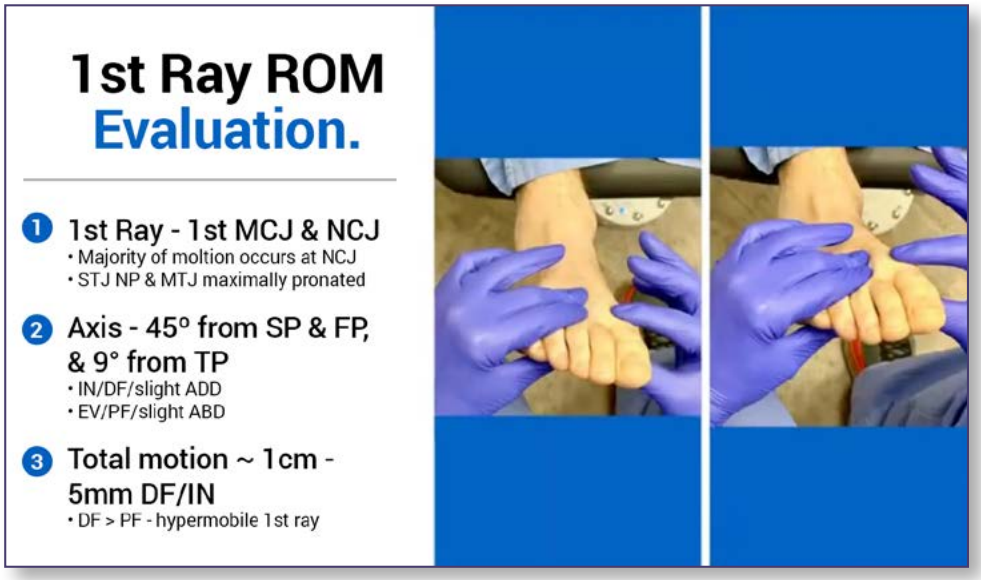
Technique

1. Place the subtalar joint in neutral.
2. Maximally pronate the midtarsal joint to lock it.
3. Stabilize rays 2–5.
4. Move the first ray dorsally and plantarly.

Normal motion is less than 1 cm, with relatively equal dorsal and plantar excursion. Hypermobility is defined by excessive dorsal motion relative to plantar motion.

Windlass Activation Test (Non-Weightbearing)

Passive hallux dorsiflexion is added to the first-ray exam to engage the windlass mechanism. Stabilization of the first ray indicates an intact windlass.



This finding directly impacts flatfoot surgical planning. An intact windlass favors medial column correction with a Cotton osteotomy. Persistent motion despite hallux dorsiflexion indicates windlass incompetence.

Forefoot-to-Rearfoot Evaluation

With the subtalar joint neutral and the midtarsal joint locked, the plane of the metatarsal heads is compared to the calcaneal bisection.

Feature	Forefoot Supinatus	Forefoot Varus
Nature	Acquired	Congenital
Tissue	Soft tissue	Osseous
Correctability	Reducible	Rigid
Orthotic Strategy	Intrinsic posting	Extrinsic posting

Failure to fully correct a flexible forefoot supinatus converts it into a rigid, iatrogenic forefoot varus. Compensation then shifts proximally—often to the ankle—risking deltoid ligament failure and ankle valgus. For this reason, some surgeons intentionally slightly overcorrect to forefoot valgus intraoperatively.

First Metatarsophalangeal Joint Motion

Non-weight-bearing dorsiflexion should exceed 65°. During weight-bearing, this decreases to approximately 20–40° due to blocked first-ray plantarflexion. A useful rehabilitation pearl is comparing hallux dorsiflexion to that of the second toe to provide patients with a clear visual benchmark.

Weight-Bearing Examination

Weight-bearing assessment reveals the functional consequences of previously identified pathomechanics. Static observations provide context for dynamic gait analysis.

Standardized Stance

Patients should stand in the Saltzman–El-Khoury "straight position"—feet parallel and shoulder-width apart—for consistency and reliability.

Resting Calcaneal Stance Position

Heel position is observed posteriorly and documented qualitatively as mild, moderate, severe, or maximally everted/inverted.

Medial Arch

Arch height is assessed visually and documented as increased or decreased (mild to collapsed).

Heel Rise Testing

- **Double-limb heel rise:** Assesses plantarflexion strength and hindfoot reducibility.
- **Single-limb heel rise:** Isolates posterior tibial tendon function. Inability to perform

indicates advanced flatfoot pathology.

Hubscher Maneuver

Passive hallux dorsiflexion during stance assesses windlass function. A positive test recreates the arch and inverts the heel. Patients must remain relaxed to avoid false results.

Dynamic Gait Analysis

Gait analysis synthesizes all prior findings and is indispensable to accurate diagnosis.

Technique

- Examiner seated low.
- Patient walks toward and away multiple times.
- Smartphone video allows slow-motion review.
- Evaluate each limb independently.

Rocker System Overview

- **First rocker:** Anterior group eccentrically controls foot slap.
- **Second rocker:** Posterior tibial, intrinsics, peroneus longus, and soleus eccentrically stabilize and slow tibial progression.
- **Third rocker:** Gastrocnemius contraction engages the windlass, locking Chopart's joint while the peroneus longus stabilizes Lisfranc's joint.
- **Swing phase:** Anterior group clears the foot; peroneus brevis prepares for heel strike.

Common Pathologic Gait Patterns

Antalgic, apropulsive, calcaneal, steppage, scissoring, in-toeing, hemiplegic, and toe-walking patterns each provide diagnostic clues.

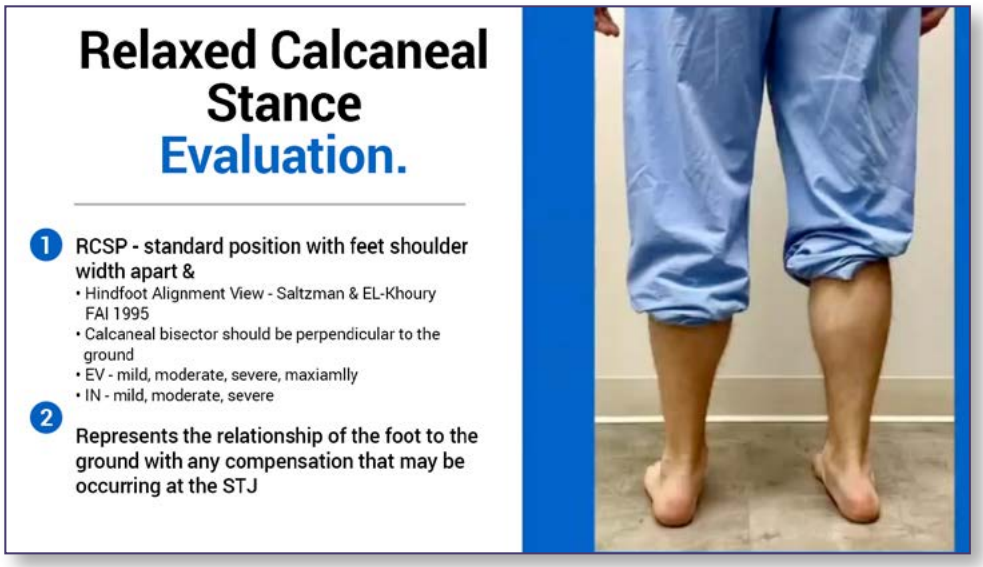
Special Considerations

Limb Length Inequality

Weight-bearing long-leg radiographs are the gold standard. Tape measurements are unreliable and should not guide treatment.

Shoe Wear Analysis

Outsole wear, toe-box creasing, and insole pressure patterns often reveal chronic compensation strategies.



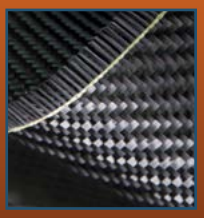
Conclusion

Dynamic gait analysis is not optional—it is central to high-level biomechanical evaluation. The ability to integrate static findings with real-time movement distinguishes true diagnosticians from technicians and directly drives better conservative and surgical outcomes.

Patrick A. DeHeer, DPM, is a board-certified podiatric surgeon and pediatric specialist with extensive experience in complex foot and ankle pathology. He is in private practice and serves patients at Hoosier Foot & Ankle. Dr. DeHeer completed his podiatric medical degree at the Dr. William M. Scholl College of Podiatric Medicine, residency training in Indianapolis, and a fellowship in foot and ankle arthroscopy. He is double board-certified and serves as team podiatrist for the Indiana Pacers and Indiana Fever. He is the founder of Step-by-Step Haiti and Foot Aid and has completed over 25 international medical missions.

EMERGING DEVELOPMENTS IN AFOS

What Podiatrists Need to Know About Carbon Composite AFOs



By Keith Loria

Advances in ankle-foot orthoses (AFOs) are revolutionizing how podiatrists, physical therapists and O&P clinicians support lower-limb mobility and rehabilitation. In this 3-part series, we explore the latest evidence, cutting-edge materials, and innovative design strategies that are shaping the future of AFOs. This short series offers a look at how today's breakthroughs are improving function, comfort and compliancy in the lower extremity world. Check back each month for the next installment.

Carbon composite ankle foot orthoses (AFOs) are reshaping how clinicians think about lower-extremity bracing. Long viewed as devices reserved for advanced gait abnormalities, these newer AFOs are increasingly becoming primary tools for podiatrists managing neuromuscular conditions, diabetic complications, chronic instability and post-traumatic recovery.

Their rapid expansion into podiatric care is tied not only to performance, but also to advances in material science that allow far more control over stiffness, alignment, comfort and function than traditional thermoplastic designs.

To appreciate how carbon composite AFOs fit into podiatric practice, it helps to understand the engineering changes driving these improvements. Modern composites are built from layers of carbon, glass, Kevlar or other fibers embedded in a resin matrix, and these elements contribute to the device's behavior. The orientation of the fibers determines where the structure will flex, where it will remain rigid, and how it will store and release energy. The resin affects the toughness and durability, influencing whether the device holds its shape during thousands of steps.

Personalized Solutions

As carbon composites have become more sophisticated, orthotists can now vary stiffness across different regions of the AFO, controlling how the device behaves during loading, push-off, and swing–something thermoplastics simply cannot match.

According to Eric Weber, LCPO, FAAOP, who co-chairs the American Academy of Orthotists & Prosthetists' Lower Limb Orthotic Society, this ability to fine-tune performance is one of the most meaningful developments of the last decade. He notes that clinicians can now design a brace around the specific functional objective: whether they aim to assist motion, restrict harmful movement, accommodate deformities, realign the limb, or correct a biomechanical problem.

When the materials and layering are selected deliberately, the resulting AFO no longer functions as a rigid shell but as a dynamic tool that integrates with the patient's gait.

Spencer Keane, DPM, a podiatrist with Northern Illinois Foot & Ankle Specialists noted advances in carbon composite AFO design has allowed a lighter and stronger supportive device.

"This aids in the functionality of the device and ultimately patient compliance," he said. "They fit in patients' shoes better and go more unnoticed than the previous larger bulky braces."

Additionally, because these devices offer a lightweight design that fits into typical footwear, they are excellent at providing energy return.

"There are different levels of support and flexibility to support the amount of lift and assist," Keane said. "These items can be stocked in the office for same day dispensing, so the patient can achieve immediate results."

Why Material Science Matters in Clinical Outcomes

This shift in material capability translates directly into more efficient, comfortable and predictable movement. Because composites can store and return energy, they reduce the workload on weakened muscles and help maintain smoother ankle progression throughout the gait cycle.

"The ability to orient fibers so some regions are strong and others are more flexible gives us control over how the AFO behaves throughout the gait cycle," Weber said.

Patients often report reduced fatigue, more natural forward progression and greater stability during daily activities. The thinner profiles achievable with today's composites also make these devices easier to fit into a wider range of footwear, which is a major consideration for podiatrists trying to balance function with real-world usability.

Another advantage is durability. Traditional plastics fatigue over time, especially under repetitive loads. Carbon composites maintain their structural integrity far longer because they distribute stress across multiple layers. The result is a more consistent stiffness profile over the life of the device and fewer unexpected failures. For podiatrists treating patients who will require bracing for years–sometimes for life–this reliability becomes central to long-term outcomes.

At the same time, enhanced structural control allows orthotists to design braces that align more closely with human anatomy. Strut position, footplate curvature and shank angle can be tailored to improve alignment and support natural knee motion. When these factors line up properly, the device supports the patient's gait rather than fighting it, improving comfort and reducing the risk of compensatory movement patterns. ler

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STEP BY STEP
Advancing Clinical Outcomes One Step at a Time

STEP BY STEP is a new column in which each installment I will present a detailed case study focused on the assessment of gait abnormalities. The intention is to thoroughly explore these gait deviations, consider their potential implications for patient mobility and quality of life, and discuss possible interventions that may improve outcomes.

Your insights and feedback are encouraged and valued throughout the examination of each case study. Additionally, if you have relevant cases you would like to share, you are invited to submit them for review and discussion as part of this ongoing series.

Knee Instability in Osteoarthritis

By Pamela K Hale, CPO

Gait, refers to the manner in which a person walks, is fundamental not only to physical health but also to overall quality of life. Achieving a near-normal gait pattern when providing rehabilitative care is crucial for several reasons: optimizing biomechanical efficiency, improved minimizing secondary health issues, enhancing psychological well-being, and improving social integration.

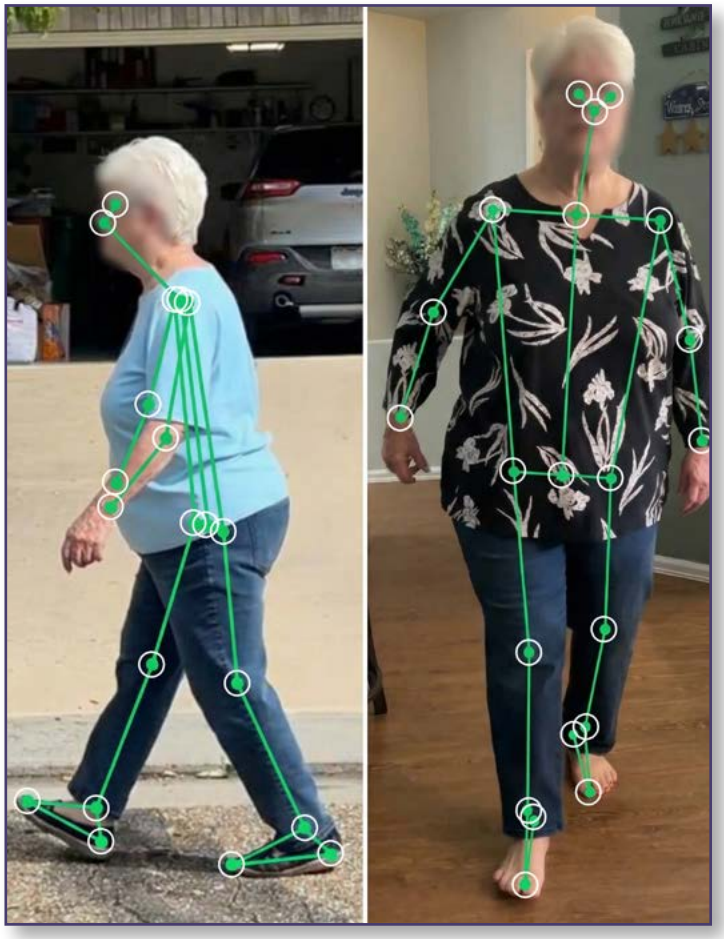
CASE 1: Knee Instability and Osteoarthritis

Fitzgerald, et al[1] concluded that, "a substantial proportion of individuals with knee OA report episodes of knee instability during activities of daily living. Instability affects physical function beyond that which can be explained by contributions from other impairments such as knee pain, range of motion, and quadriceps strength. Knee instability is a problem that should be specifically addressed in rehabilitation programs and may require interventions beyond those that address pain, joint motion, and muscular strength, to maximize the effectiveness of rehabilitation for individuals with knee OA."

JS is a patient diagnosed with osteoarthritis (OA) affecting her left knee. She reported significant lifestyle changes due to her condition, including the necessity to sell her house. This decision was prompted by her inability to manage physical challenges such as the slight elevation in her backyard, stairs leading to the basement, and walking distances greater than 15 feet at a time.

JS's primary limitation was not pain, but rather a persistent fear of her knee "giving out," which contributed to her concern about potential falls. Despite having experienced episodes where her knee did "give out" and having fallen as a result, she did not qualify as a candidate for knee replacement. This was primarily because she did not report significant pain, although she exhibited radiographic evidence of medial compartment osteoarthritis, loss of function due to fatigue and fear, reduced mobility, limited range of motion for knee extension, and genu varum.

During ambulation, JS demonstrated a notably slow gait. She frequently reached for walls to support herself while walking, underscoring her instability and apprehension about falling.



Terminal Stance Left Leg. The VISION app uses AI to identify the joint position

To gain a clearer understanding of JS's gait abnormalities and knee instability, a video recording was obtained capturing her walking from both the coronal (front/back) and sagittal (side) views. This visual assessment allows for detailed observation of her movement patterns, providing valuable insight into the specific deviations and challenges she faces during ambulation.

To further evaluate JS's gait abnormalities and knee instability, the Orthelligent® VISION Gait Analysis application[2] by OPED was utilized. This advanced assessment tool was used to analyze her walking patterns in detail. The objective reports generated by the application

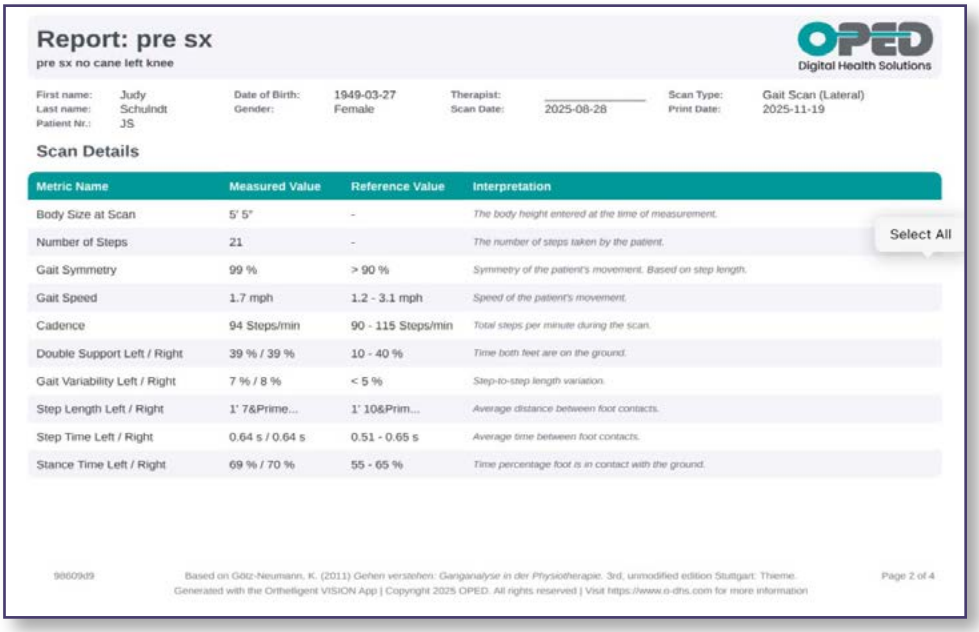
provided comprehensive temporal-spatial data, such as walking speed and time spent in various phases of the gait cycle, as well as joint angle data for a precise understanding of her movement deviations. These quantitative insights complemented the visual and subjective assessments, offering a thorough overview of JS's gait characteristics and informing subsequent intervention strategies.

A subjective assessment of JS's left leg was conducted before any interventions were implemented. During terminal stance, observed from the sagittal view, there was noticeable hip flexion, knee flexion, and ankle dorsiflexion. When examining the coronal view, genu varum was present, accompanied by ankle dorsiflexion and an outward rotation "toe out" of the foot. Although a complete video was available for review, a representative screenshot was utilized to capture the left leg at terminal stance, corresponding to approximately 50% of the gait cycle.

The objective data obtained from the VISION Gait Analysis application, specifically from the lateral (sagittal) view, revealed several key abnormalities in JS's walking pattern. The analysis demonstrated a noticeably slow walking speed, which was accompanied by an increased duration of double limb support—meaning JS spent more time with both feet on the ground during walking. Additionally, there was a bilateral increase in stance time, indicating prolonged periods where each foot remained in contact with the ground.

Joint angle graphs generated by the application revealed a noticeable shoulder line asymmetry between the left and right sides, suggesting compensatory postural adjustments during walking. The data also confirmed the presence of left genu varum and external alignment of the left foot, both of which contribute to JS's overall instability and altered gait mechanics.

JS demonstrates abnormalities across the sagittal, coronal, and transverse planes, all of which contribute to her impaired knee stability, diminished function, and reduced endurance during ambulation. Specifically, persistent knee flexion and ankle dorsiflexion are observed throughout the stance phase of gait. This combination creates a knee flexion moment that requires JS to generate stability either through concentric contraction of the quadriceps to extend her knee, or via eccentric contraction of the soleus muscle to slow the forward movement of the tibia.



Report: pre sx

pre sx no cane left knee

OPED Digital Health Solutions

First name:	Judy	Date of Birth:	1949-03-27	Therapist:		Scan Type:	Gait Scan (Lateral)
Last name:	Schulndt	Gender:	Female	Scan Date:	2025-08-28	Print Date:	2025-11-19
Patient Nr.:	JS						

Scan Details

Metric Name	Measured Value	Reference Value	Interpretation
Body Size at Scan	5' 5"	-	The body height entered at the time of measurement.
Number of Steps	21	-	The number of steps taken by the patient.
Gait Symmetry	99 %	> 90 %	Symmetry of the patient's movement. Based on step length.
Gait Speed	1.7 mph	1.2 - 3.1 mph	Speed of the patient's movement.
Cadence	94 Steps/min	90 - 115 Steps/min	Total steps per minute during the scan.
Double Support Left / Right	39 % / 39 %	10 - 40 %	Time both feet are on the ground.
Gait Variability Left / Right	7 % / 8 %	< 5 %	Step-to-step length variation.
Step Length Left / Right	1' 7&Prime...	1' 10&Prim...	Average distance between foot contacts.
Step Time Left / Right	0.64 s / 0.64 s	0.51 - 0.65 s	Average time between foot contacts.
Stance Time Left / Right	69 % / 70 %	55 - 65 %	Time percentage foot is in contact with the ground.

Select All

98609d9

Based on Götz-Neumann, K. (2011) Gehen verstehen: Ganganalyse in der Physiotherapie. 3rd, unmodified edition Stuttgart: Thieme.

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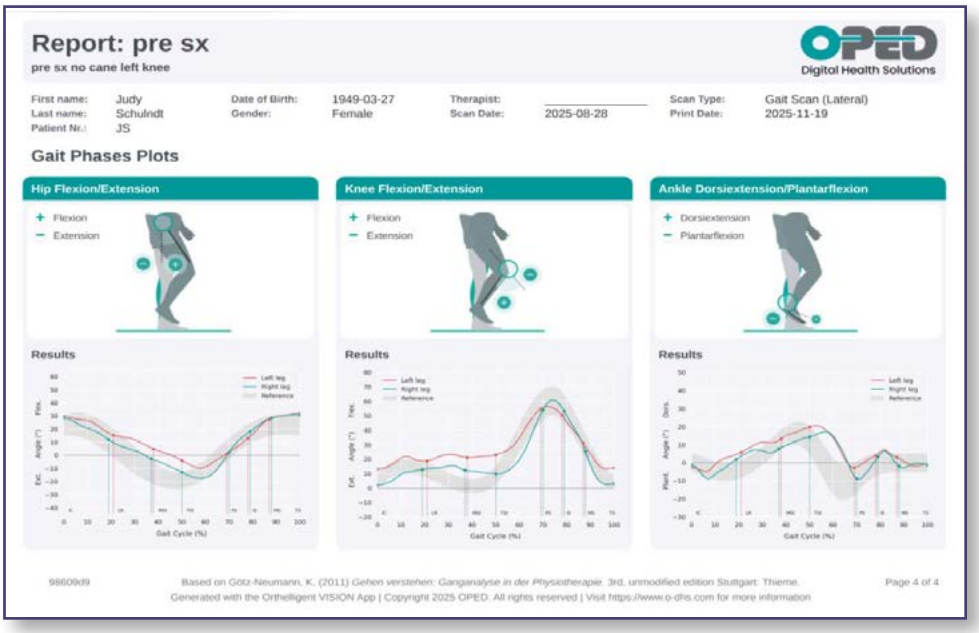
While the joint angle graphs provided by the application showed pronounced deviations during terminal stance. These included increased hip flexion, increased knee flexion, and increased ankle dorsiflexion angle and prolonged dorsiflexion. Such findings suggest that JS's gait is characterized by compensatory movements, likely resulting from her underlying knee instability and related osteoarthritis. These objective measurements offer valuable insights into the specific biomechanical challenges she faces and help guide targeted interventions for her rehabilitation.



Report: pre sx

pre sx no cane left knee

OPED Digital Health Solutions

First name:	Judy	Date of Birth:	1949-03-27	Therapist:		Scan Type:	Gait Scan (Lateral)
Last name:	Schulndt	Gender:	Female	Scan Date:	2025-08-28	Print Date:	2025-11-19
Patient Nr.:	JS						

Gait Phases Plots

Hip Flexion/Extension

+ Flexion
− Extension

Knee Flexion/Extension

+ Flexion
− Extension

Ankle Dorsiextension/Plantarflexion

+ Dorsiextension
− Plantarflexion

Results

98609d9

Based on Götz-Neumann, K. (2011) Gehen verstehen: Ganganalyse in der Physiotherapie. 3rd, unmodified edition Stuttgart: Thieme.

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The VISION Gait Analysis application's objective data from the coronal view highlighted several asymmetries and deviations in JS's gait pattern. Specifically, the analysis reported differences in stance time between the left and right sides, indicating that JS spends less time on her left leg during ambulation. Additionally, discrepancies in leg axis and foot alignment were observed, reflecting further biomechanical challenges.

However, both the knee and ankle are positioned in a biomechanical disadvantage, meaning they are unable to generate sufficient force to effectively control further knee flexion

Continued on page 28

Continued from page 27

or ankle dorsiflexion during the stance phase. As a result, JS adopts compensatory strategies to manage these challenges. The primary compensatory mechanism involves reducing the duration of single limb support on the affected limb. This is typically achieved by either shortening her step length or increasing the amount of time spent in double limb support, where both feet are in contact with the ground.

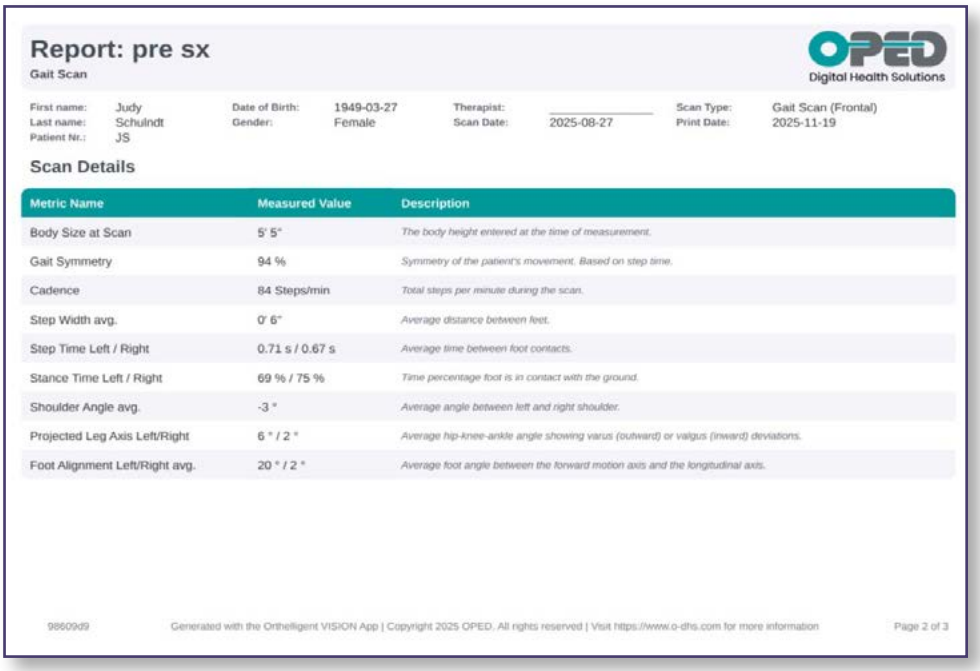
The implications of these abnormalities are reduced mobility, continued joint deterioration at the left knee or in other joints as well as, reduced range of motion.

What are possible interventions?

- Through PT Improving range of motion, strength and posture.
- Utilize a cane or walker.
- Support the knee with an Unloader Brace.
- Surgical intervention.
- Is there more?

In the next installment we will explore the initial effect of using a cane. And check in with JS regarding her journey. (ler)

As a Certified Prosthetist and Orthotist, Pamela K Hale is a nationally recognized speaker and works with clinicians to assess movement patterns and recommend solutions. Her expertise helps improve patient mobility and supports the rehabilitation of those with movement challenges.



Report: pre sx
Gait Scan
OPED Digital Health Solutions

First name: Judy
Last name: Schulndt
Patient Nr.: JS
Date of Birth: 1949-03-27
Gender: Female
Therapist:
Scan Date: 2025-08-27
Scan Type: Gait Scan (Frontal)
Print Date: 2025-11-19

Scan Details

Metric Name	Measured Value	Description
Body Size at Scan	5' 5"	The body height entered at the time of measurement.
Gait Symmetry	94 %	Symmetry of the patient's movement. Based on step time.
Cadence	84 Steps/min	Total steps per minute during the scan.
Step Width avg.	0' 6"	Average distance between feet.
Step Time Left / Right	0.71 s / 0.67 s	Average time between foot contacts.
Stance Time Left / Right	69 % / 75 %	Time percentage foot is in contact with the ground.
Shoulder Angle avg.	-3 °	Average angle between left and right shoulder.
Projected Leg Axis Left/Right	6 ° / 2 °	Average hip-knee-ankle angle showing varus (outward) or valgus (inward) deviations.
Foot Alignment Left/Right avg.	20 ° / 2 °	Average foot angle between the forward motion axis and the longitudinal axis.

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Report: pre sx
Gait Scan
OPED Digital Health Solutions

First name: Judy
Last name: Schulndt
Patient Nr.: JS
Date of Birth: 1949-03-27
Gender: Female
Therapist:
Scan Date: 2025-08-27
Scan Type: Gait Scan (Frontal)
Print Date: 2025-11-19

Gait Plots

Shoulder line
Projected leg axis
Foot alignment
Left
Right
Left
Right

	Down ⊖	⊕ Up
Avg.	-2.5 °	
Min.	-5.9 °	
Max.		1.4 °

	Valgus ⊖	⊕ Varus		Valgus ⊖	⊕ Varus
		6.4 °	Avg.		2.2 °
		1.5 °	Min.	-1.9 °	
		10.0 °	Max.		4.4 °

	Internal ⊖	⊕ External		Internal ⊖	⊕ External
		19.6 °	Avg.		1.7 °
	-0.5 °		Min.	-1.9 °	
		43.7 °	Max.		7.9 °

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References

1. Fitzgerald GK, Piva SR, Irrgang JJ. Reports of joint instability in knee osteoarthritis: its prevalence and relationship to physical function. *Arthritis Rheum*. 2004 Dec 15;51(6):941-6. doi: 10.1002/art.20825.
2. Orthelligent® VISION: die KI-basierte Ganganalyse - O-DHS English. O-DHS English. Published September 22, 2025. https://en.o-dhs.com/produkt/orthelligent-vision/. Accessed December 5, 2025.

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A Foot Forward for Optimum Health

"A Foot Forward for Optimum Health" is a column designed to enlighten the old guard in a new way about lower extremity impairment as it pertains to foot drop. The intent is to challenge evidence-based research and practice so that it addresses real world issues shaped by social determinants of health. For every common issue is an uncommon response that will provide insight to improve health outcomes by putting one foot forward at a time–efficiently and effectively.

Ankle neutral or 0˚ midswing (R)

Ankle 5˚ dorsiflexion midstance (R) heel

Ankle 10˚ dorsiflexion terminal stance (heel off the ground)

Ankle 15˚ plantarflexion preswing (R) (60 degrees metatarsal head hyperextension)

Ankle ROM Half Kneeling (L)

Is Neutral Enough for Ankle Dorsiflexion?

By Dr. Jennifaye V. Brown

McCormick et al[1] have described surgical interventions to restore ankle range of motion (ROM) due to foot drop and physicians conducted a thorough review of and outcomes of these different approaches. Throughout the article, the focus was on restoring to neutral or zero degrees of ankle dorsiflexion in hopes of not having to use ankle foot orthosis (AFO). The purpose of the AFO is to position the foot so that it is parallel to the floor during swing phase which is the only time it is normally held isometrically at 0 degrees of talocrural joint dorsiflexion.[2-4] Otherwise, the AFO should provide ankle stability in stance phase during which the ankle ROM varies between 5 degrees of plantarflexion (loading response), 5 degrees of dorsiflexion (midstance), 10 degrees of dorsiflexion (terminal stance) and 15 degrees of plantarflexion (preswing) via eccentric or concentric muscle activity, the latter needed for push off at preswing.[2-4] Additionally, individuals with foot drop need more than neutral talocrural joint dorsiflexion for other functional activities such as sit↔stand, getting up from the floor, squatting, and stair negotiation, particularly step over step.[5] Furthermore, AFOs should be person-centered in that they reflect the personalities and function for activities engaged in during daily living.[6-8]

I have a suggestion for physical therapy practitioners who analyze daily activities and provide therapeutic interventions to achieve energy efficient and effective movement strategies for daily living skills. Simply, loosen the restrictive traditional AFO VELCRO® strap at the proximal tibia and or ankle joint or replace it with the appropriate tension of VELSTRETCH® that accommodates the muscle strength present. More elasticity for stronger muscles with isolated movement and less elasticity for muscles that cannot generate enough force to move segments of the lower extremity. Then proceed to practice gait on a variety of surfaces, sit↔stand, squatting, stair negotiation step over step, and getting up and down from the floor as these functional activities require tibial movement forward and backward and the elastic tension strap allows for that movement. Create therapeutic exercises and or break down activities into component parts in which tibial movement occurs via concentric, eccentric and or isometric muscle activity as it pertains to specific segments of gait during stance and swing phase and those other functional activities. The exercise program should entail a flexibility component open and closed chain and the exercises should vary in type (weight bearing and non-weight bearing) and order (isometric, concentric and eccentric muscle contractions) as well as reflect the individual's social determinants of health.[9-10] Also, include neuromuscular retraining and an aerobic component of different intensities.[9-10] For example, the exercises and physical activities for a mother with a newborn who wants to safely push the stroller without falling should be distinctly different from the retired elderly male who wants to return to golf with his caddy and walk 6 holes of the 12-hole course. ler

Jennifaye V. Brown, PT, MSPT, PhD, NCS, CAPS is an American Physical Therapy Association 4-time 10-year board certified neurologic physical therapist in Charleston, South Carolina, specializing in stroke rehabilitation, specifically gait analysis and treatment, AFO design, and the redesign of lived spaces allowing individuals with disabilities to age in place. She is the author of the book, Brace Yourself: Everything You Need to Know About AFOs After Stroke.

References

1. McCormick KL, Patel D, Chien BY, Greisberg JK, Vulcano E. Surgical management of foot drop. *Orthop Rev (Pavia)*.

AFO with elastic strap allows for tibia forward motion during functional activities and during gait

AFO with elastic strap: sit prior to stand

Sit↔Stand

Terminal Stance (R)

Squatting

Half-kneeling (R)

2024;16:120047. Published 2024 Oct 3. doi:10.52965/001c.120047

2. Johnston TE, Keller S, Denzer-Weiler C, Brown L. A Clinical Practice Guideline for the Use of Ankle-Foot Orthoses and Functional Electrical Stimulation Post-Stroke. *J Neurol Phys Ther.* 2021;45(2):112-196. doi:10.1097/NPT.0000000000000347
3. Choo YJ, Chang MC. Effectiveness of an ankle–foot orthosis on walking in patients with stroke: a systematic review and meta-analysis. *Sci Rep*. 2021;11:15879. doi.org/10.1038/s41598-021-95449-x
4. Adams JM, Cerny K. Observational gait analysis a visual guide. Thorofare, NJ: SLACK Incorporated; 2018.
5. Hyodo K, Masuda T, Aizawa J, Jinno T, Morita S. Hip, knee, and ankle kinematics during activities of daily living: a cross-sectional study. *Braz J Phys Ther.* 2017;21(3):159-166. doi:10.1016/j.bjpt.2017.03.012
6. Vinci P, Gargiulo P. Poor compliance with ankle-foot-orthoses in Charcot-Marie-Tooth disease. Eur. J Phys Rehabil Med. 2008;44 (1): 27–31.
7. Brown JV, Best S, Suhr J. Ankle Foot Orthoses: The Impact of Appearance, Function, and Fit in Individuals with Stroke. Lower Extremity Review. 2021;13(11):39-50. Available at: https://lermagazine.com/cover_story/ankle-foot-orthoses-the-impact-of-appearance-function-and-fit-in-individuals-with-stroke
8. Brown JV, Cotton J, Best S, Suhr JA. Communicating key features of an ankle foot orthosis from a patient's perspective: a case study. *NSAH Journal.* 2020; 17(1):6-20.
9. Adhikari SP, Tretriluxana J, Dev R, Eglitis E, Shrestha N, et al. FITT-CORRECT: Updated dynamic and evidence-based principle of exercise prescription. *J Nov Physiother Rehabil.* 2021; 5: 005-009.
10. Winstein C, Stein J, Arena R. Guidelines for adult stroke rehabilitation and recovery. Stroke. 2016; 47(6):e98-e169. doi:10.1161/STR.0000000000000098

Innovative Sock Technology for the Prevention and Management of Decubitus Ulcers

Background

Decubitus ulcers can be a persistent and serious challenge, particularly in patients with diabetes, peripheral arterial disease, neuropathy, stroke, and other conditions that impair circulation and sensation. These ulcers can result in prolonged healing times, infection, reduced quality of life and amputation. Effective prevention and management strategies require interventions that reduce friction, shear forces, and pressure while promoting wound healing.

Challenge

Standard socks often exacerbate problems by causing friction and moisture buildup, which can further damage fragile skin. The ideal garment needs to prevent irritation, minimize shear forces in the skin, maintain comfort and fit, offer breathability, and control moisture. A therapeutic sock should also avoid causing additional trauma to the skin during use and removal.

Solution

Tamarack Protection Socks with GlideWear™ Technology, recipient of the APMA Seal of Approval. The socks incorporate a dual-layer, low-friction fabric that significantly reduces friction against the skin and shear forces that lead to damage. The GlideWear Technology allows the sock's inner and outer layers to move independently, reducing the shear forces that commonly lead to skin breakdown by 50% to 80%, protecting target areas from soft tissue damage. The socks are available in multiple styles, sizes, cuff lengths and are available in black or white.

Example 1: A 46-year-old male patient with a stage III decubitus ulcer.

50-year-old female with spinocerebellar ataxia and a stage II decubitus ulcer

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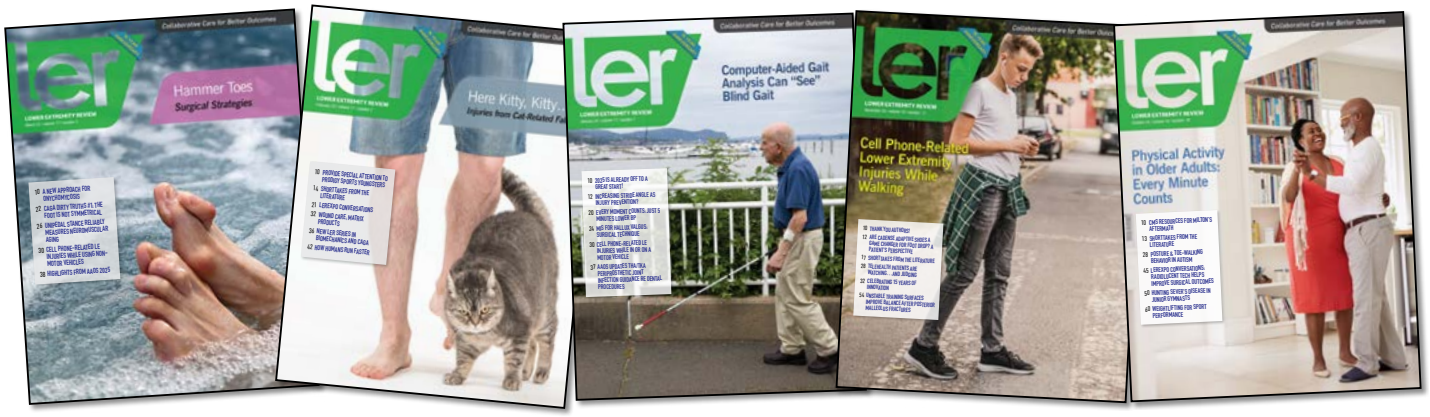

LOWER EXTREMITY REVIEW
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New & Noteworthy

Noteworthy products, association news, and market updates

DME MACS EXPAND COVERAGE FOR OA KNEE BRACES

The Centers for Medicare & Medicaid Services and the Durable Medical Equipment Medicare Administrative Contractors (DME MACs) recently released a final revision to the Knee Orthoses Local Coverage Determination (LCD) and corresponding Policy Article, which take effect January 25, 2026.

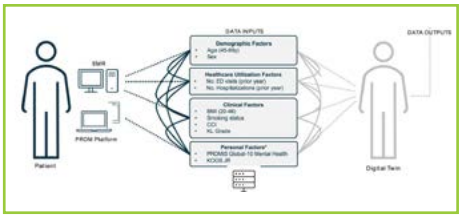
The LCD proposes modifications to the coverage criteria for knee orthoses with single or double upright, adjustable flexion and extension joint, medial-lateral and rotation control, with varus/valgus adjustment for the management or treatment of ambulatory Medicare beneficiaries with pain or reduction in mobility and/or function due to medial or lateral tibiofemoral osteoarthritis (OA). According to the LCD, Medicare will cover knee orthoses for this patient population without requiring joint instability if the following criteria are met and documented: (1) the patient is ambulatory, (2) the patient is experiencing pain or functional impairment due to OA, (3) the knee orthosis provides varus or valgus adjustment, and (4) the patient expresses a willingness to use the orthosis.

To read the LCD, visit www.cms.gov/medicare-coverage-database/view/lcd.aspx?LCDId=33318. To read the Policy Article, visit www.cms.gov/medicare-coverage-database/view/article.aspx?articleId=52465&ver=70 .

AI "DIGITAL TWINS" HELP PATIENTS MAKE SMARTER DECISIONS ABOUT KNEE SURGERY

An artificial intelligence (AI)–powered tool helped patients make more confident, personalized decisions about knee replacement surgery–and led to better outcomes months later–according to a new study from researchers at Dell Medical School at The University of Texas at Austin.

The study found that patients who used the tool reported higher decision quality, less regret, and better knee function compared to those who received educational materials alone. The tool uses AI to create a "digital twin"–a virtual simulation that predicts surgical risks and benefits for each patient based on their own health data–and helps clarify treatment preferences through a guided, personalized process.



Schematic of the AI-enabled Decision Aid.

The randomized clinical trial enrolled more than 200 people with advanced knee osteoarthritis. Patients who used the AI tool had better treatment alignment with their personal goals and were more likely to reach meaningful improvements in knee health within 6 to 9 months after their consultation. Patients who used the AI tool were also more likely to choose a treatment that aligned with their personal goals–whether surgical or non-surgical–and experienced greater improvement in knee-specific health over time. The results suggest that integrating AI-powered tools into routine care could help patients and clinicians make more informed, personalized decisions, especially for conditions like osteoarthritis where outcomes can vary widely.

TARGETED PROTECTION FROM FRICTION

ShearBan is a patented, low-friction, self-adhesive material that neutralizes friction and shear forces that contribute to the formation of diabetic foot ulcers, blisters, hot spots, and calluses. Conventional treatments commonly involve applying temporary solutions to the skin itself. Instead, ShearBan provides months of lasting

protection by adhering directly to the problem areas of the footwear, custom orthoses, insoles, braces, or gear where pain, discomfort, and damage are occurring. By eliminating wound-causing shear forces in these zones, ShearBan provides immediate, therapeutic relief, allowing the skin to move naturally and comfortably while preventing further damage. The product is available in pre-cut sizes and in bulk sheets for customized solutions as the injury requires. It is extremely durable and is thin enough to preserve the original fit of the footwear and equipment patients depend on.

Tamarack Habilitation Technologies
866/795-0057
tamarackhti.com

RESEARCHERS EXPLORE AFOS FOR TREATING ACHILLES TENDINOPATHY

In Elisa Arch's Orthotics and Prosthetics for Enhanced Mobility Lab, at the University of Delaware (UD), Newark, students are exploring how a specially designed ankle-foot orthosis (AFO) from medical device start-up Biomotum, Portland, Oregon, can help people with Achilles tendinopathy (AT) regain mobility. The device, used alongside sensors, is tested on a split-belt treadmill, allowing students to collect precise data on tendon load while experimenting with stiffness adjustments that could enhance rehabilitation outcomes. Her

work has received seed funding from UD's Big Ideas Challenge.

According to Arch, associate professor of kinesiology and applied physiology in UD's College of Health Sciences, "AFOs have never been tested in people with Achilles tendinopathy."

"AFOs are like a spring, and the tendon is like a giant rubber band," explained Arch. "As the ankle tries to bend, the rubber band controls how much it bends. The AFO provides resistance to bending, which is what your calf muscles and Achilles tendon also do."

A close-up of the AFO developed by Biomotum. The AFO will be tested in 29 study participants, marking the first time an AFO has been tested to help people with AT.

The Biomotum device allows separate adjustment of dorsiflexion and plantarflexion stiffness, which is key for AT rehabilitation and may help avoid adverse side effects. Arch hypothesizes that higher stiffness provides greater tendon offloading and that gradually reducing stiffness as the tendon heals could support recovery. Using stiffness to assist an injured joint is a relatively new concept. Arch notes in the clinic that an AFO's stiffness is not traditionally quantified.

"If we can prove feasibility in concept, which the [National Institute of Health] wants to see, we could get larger awards," said Arch, who believes her research may be of interest to the US Department of Defense. "AT is a common overuse injury in active service members. If we can put an AFO on them and have them up and active earlier in rehab, they can return to duty sooner."

CLEVELAND RESEARCHERS LAUNCH FIRST MAJOR STUDY TO ADDRESS ONYCHOMYCOSIS

Athletes are 2.5 times more likely than the general public to develop nail fungus, according to a study in the *Journal of the American Academy of Dermatology*. The condition can disrupt training, change performance, and end careers. However, until now, no thorough study has examined how nail fungus affects various sports. Toward this end, Case Western Reserve University and University Hospitals (UH), both in Cleveland, Ohio, recently announced the launch of the first large-scale collaborative study focused on onychomycosis, a chronic fungal infection of the nails, among athletes.

The 6-month study also includes UH Drusinsky Sports Medicine Institute–the healthcare partner of the Cleveland Ballet, Cleveland Browns, and Cleveland Monsters–and Ortho Dermatologics, Bridgewater, New Jersey. These partners will help identify and recruit 100 to 200 collegiate and professional athletes, allowing researchers to gather data across multiple sports. They will also raise awareness, facilitate survey distribution, and assist with athlete screening and optional nail sampling for follow-up studies.

The study began in December, with initial results expected by June. Athletes will be surveyed through an electronic questionnaire that asks about nail appearance, discomfort during training or competition, impact on performance, and previous treatments. The anonymous survey captures how toenail fungal infections affect daily activities, confidence and athletic function.

Future study phases will focus on advanced diagnostic tools and enhanced treatment protocols with applications extending beyond professional athletics. The research could particularly benefit military personnel and other groups facing similar risks from repetitive foot trauma, shared equipment and challenging physical environments.

INTERIM ORTHOSIS FOLLOWING PARTIAL FOOT AMPUTATION

DARCO's Body Armor® PFA Walker is designed for healing following partial foot amputation. Specifically engineered for post-surgical healing after partial foot amputation, this interim orthosis offers reliable protection, stability, and comfort throughout the recovery process. This lightweight, durable walker features an integrated air pump for even pressure distribution and a soft, breathable lining within a rigid outer shell for secure stabilization. A wide opening accommodates swelling and allows for easy on-and-off application. Built with DARCO's innovative PowerPod® EVA outsole, the PFA Walker is 25% lighter than previous models while providing superior traction, shock absorption, and slip resistance. Its ventilated honeycomb design encourages airflow, while the sole promotes natural posture and ergonomic movement.

DARCO Direct
304/781.5255
darcodirect.com

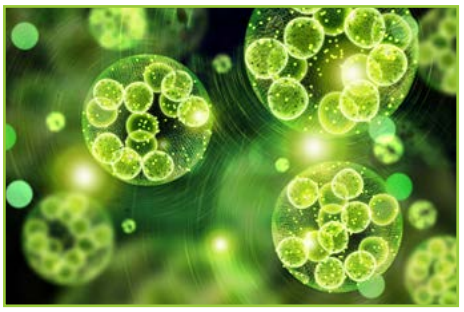
MAGNESIUM CREAM WITH LAVENDER FOR SORE MUSCLES

KT Health Soothe Magnesium Cream harnesses the power of lavender and magnesium to provide holistic wellness and multipurpose pain management for active individuals and athletes. It delivers soothing pain relief for sore muscles with the added benefit of Arnica Montana for anti-inflammatory support. Key ingredients include magnesium, lavender essential oils, arnica, aloe, shea butter, vitamin e, and jojoba oil for a hydrating blend for healthy skin. Activate™ Cream warms and loosens tight muscles; it is formulated for pre-workout use to reduce stiffness. Recover™ Cream lightly cools and relieves muscle and joint pain; it is formulated for post-workout use to reduce soreness. Soothe™ Cream calms both mind and body; it is designed for soothing aroma therapy use.

KT
385/376-1811
kttape.com

PLANT COMPOUND FOUND TO TREAT DIABETIC WOUNDS, FOOT ULCERS

Researchers at the Nagaland University in India have identified a naturally occurring plant compound called Sinapic acid, a naturally occurring antioxidant found in various edible plants, as a powerful therapeutic agent that can significantly enable wound healing in patients



with diabetes. Their study demonstrated that oral administration of Sinapic acid can accelerate diabetic wound healing, improve metabolic health, and mitigate oxidative stress in diabetic models. According to the research, the compound works by activating the SIRT1 pathway, which plays a crucial role in tissue repair, angiogenesis, and inflammation control. The discovery marks a major advancement that could result in safe, natural, and effective treatments for diabetic wound management.

LEG SLEEVE FOR SUPPORTING MOBILITY

The Neural Sleeve 2, an advanced non-invasive technology for supporting mobility, facilitates muscle re-education to help rewire walking for people living with neurological conditions such as multiple sclerosis, cerebral palsy, spinal cord injury, stroke, and other diagnoses such as muscle spasms/spasticity. Powered by Cionic's artificial intelligence–driven MultiStim technology, it is the first and only US Food and Drug Administration–cleared device to simultaneously activate muscle movement and relax muscle spasms. The device integrates advanced technology in a sleek, bionic clothing–inspired form factor for all-day wear. The new design enhances flexibility and sizing to fit more users, inspire confidence, and simplify donning and doffing. Together with the Cionic app and dedicated support from expert mobility specialists, the Neural Sleeve 2 offers a comprehensive solution for mobility, improving walking in the moment, adapting to daily life, and promoting greater independence over time.

Cionic
888/481-3724
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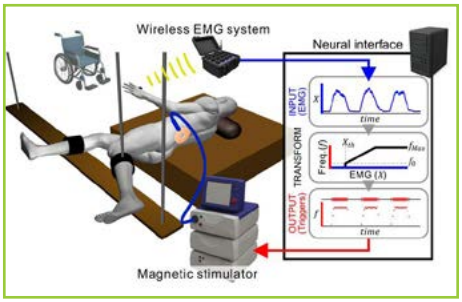
NONINVASIVE SPINAL STIMULATION ENABLES PATIENTS WITH PARAPLEGIA TO REGAIN STEPPING CONTROL



Schematic illustration of the noninvasive closed-loop spinal interface. Hand muscle activity is recorded by surface electrodes and converted into trigger pulses for magnetic stimulation applied over the lumbar spinal cord. This allows individuals with paraplegia to control stepping movements of their legs. Image courtesy of TMIMS.

Spinal cord injury (SCI) rostral to the lumbar locomotor center disrupts communication between the brain and the spinal circuits that control leg movements, leading to paraplegia. A research team led by Dr. Yukio Nishimura of the Tokyo Metropolitan Institute of Medical Science (TMIMS), Japan, in collaboration with Dr. Toshiki Tazoe and colleagues, has now

demonstrated a novel noninvasive closed-loop spinal stimulation paradigm that restores stepping control in humans with paraplegia.

The system records electrical activity from hand muscles and converts these signals into trigger pulses for magnetic stimulation delivered to the lumbar spinal cord. By performing rhythmic hand grips, participants with SCIs were able to initiate and terminate bilateral leg stepping and also control step length and cadence.

Ten individuals with chronic SCIs participated in the study. Repeated application of the closed-loop stimulation led to progressive improvements: Stimulus-induced stepping became stronger over time, particularly in participants with thoracic SCIs. Volitional stepping without stimulation improved in participants with incomplete SCIs, suggesting strengthening of residual descending pathways. This noninvasive approach bypasses the lesion site and strengthens preserved spinal and descending circuits, thereby enabling recovery of bilateral stepping control. Because the technique does not require surgery, it represents a safe and promising alternative for patients with contraindications to invasive procedures.

REDESIGNED TECHNICAL RUNNING SOCKS

The redesigned Balega UltraGlide with LYCRA® Dry sock is constructed with a combination of the brand's signature moisture-wicking Drynamix yarn and LYCRA Dry fibers to deliver a technically advanced sock for runners. Drynamix is a high-performance fiber with moisture-wicking and cooling properties built into the structure of the yarn, so the performance benefits are permanent. LYCRA Dry fibers reduce friction and movement to prevent irritation, blisters, and hotspots. The redesigned sock also includes several technical features, such as added metatarsal padding to help distribute pressure evenly, support the metatarsal bones, and absorbs shock; an extra-deep heel pocket that secures the sock in place to reduce slippage during movement; left and right anatomical fit to the natural contours of each foot; and padded front and rear ankle tabs to provide extra comfort and protection to help prevent blisters and irritation. Now available in a No-Show silhouette.

Balega
balega.com

NUTRITION BOOK HELPS PATIENTS RECOVER FASTER FROM SURGERY, INJURY

HEAL: Your Recovery Blueprint with 100+ Healing Recipes for Injury & Surgery is a nutritional guide written by oculoplastic surgeon Kami Parsa, MD, that provides patients with a clear, science-based plan for faster, stronger recovery. Dr. Parsa's experience after recovering from major heart surgery, combined with extensive clinical research, inspired him to create *HEAL*. In the book, he explains how specific nutrients and foods directly influence healing physiology–from inflammation and tissue repair to collagen formation and immune resilience. The book outlines how nutrition can reduce inflammation, support wound and tissue healing, enhance collagen repair, strengthen immune function, and restore energy and vitality after surgery or injury. The guide, which offers a holistic framework that blends nutrition, lifestyle, regenerative medicine, and practical recovery strategies, includes 100+ healing recipes, daily and weekly meal plans, grocery lists, recovery timelines, and pre- and post-surgery checklists.

HEAL: Your Recovery Blueprint
Author: Dr. Kami Parsa
Available at Amazon, and major online retailers.

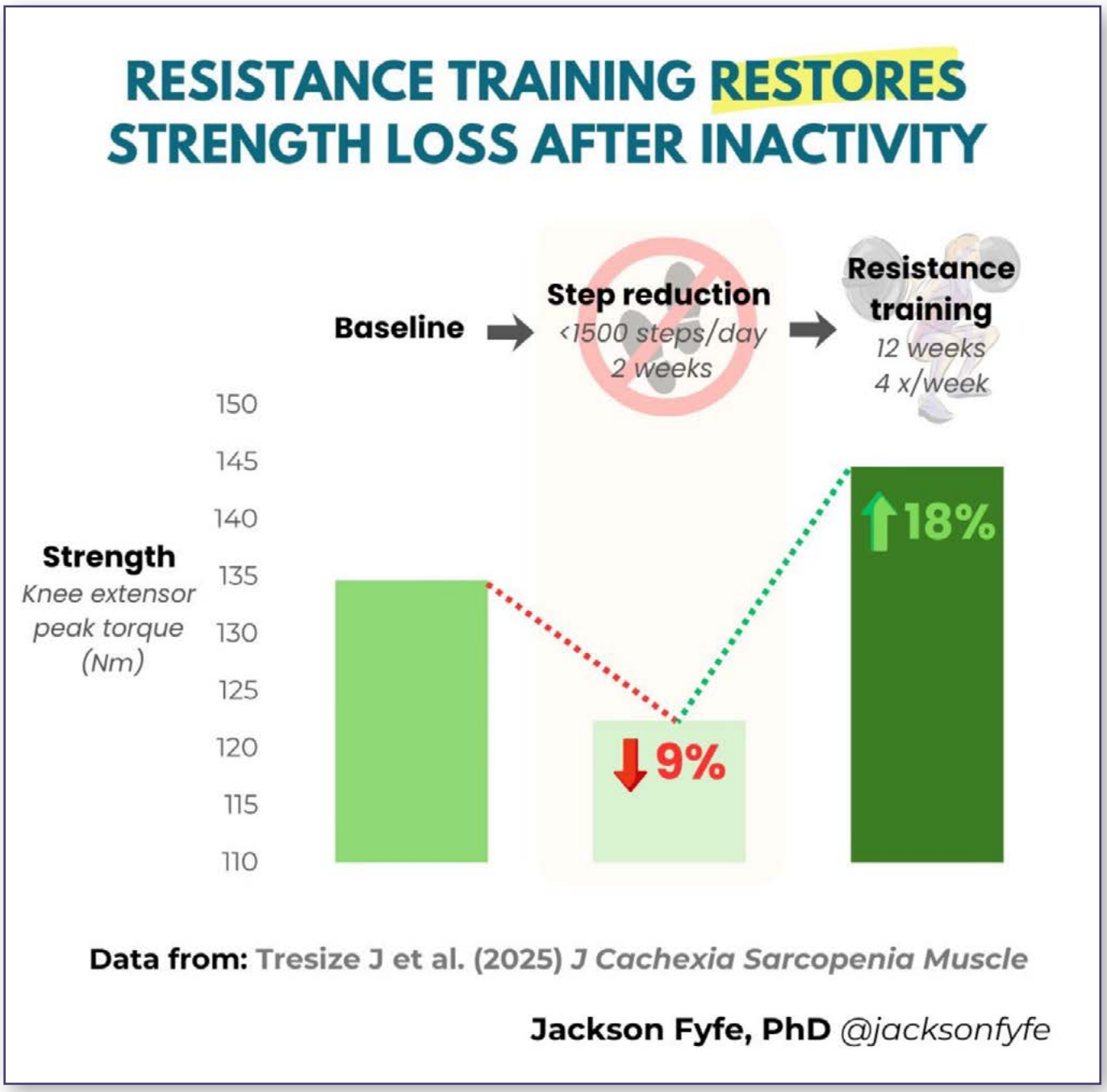
TRULIFE RECEIVES 2025 HANGER PARTNER AWARD FOR OPERATIONAL PERFORMANCE

Trulife has been awarded the 2025 Hanger Partner Award for Operational Performance at Hanger Live 2026, recognizing excellence in electronic data interchange transaction accuracy and consistently high on-time delivery performance. The recognition carries particular significance given Hanger's position in orthotic and prosthetic patient care, known for its clinical network and commitment to operational and clinical standards, focusing on empowering patient mobility. Being recognized and awarded by such a trusted industry leader underscores Trulife's focus on reliability, process excellence, and long-term partnership sustainability.

Resistance Training Restores Strength Loss After Inactivity

A new study in pre- and post-menopausal women (aged 40-60 years) found 2 weeks of inactivity (<1,500 steps per day) was enough to drop strength by about 9% (and muscle mass by 2%). But here comes the good news:

Not only did 12 weeks of resistance training restore these deficits, it further improved strength and muscle mass ABOVE starting levels.



Source: Trezise J, Lima RM, Poppitt SD, Fanning AC, Devine A, Blazevich AJ. Postinactivity exercise training improves sarcopenia traits in 40-60-year-old women regardless of fortified milk supplementation. J Cachexia Sarcopenia Muscle. 2025 Dec;16(6):e70080. doi: 10.1002/jcsm.70080.

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