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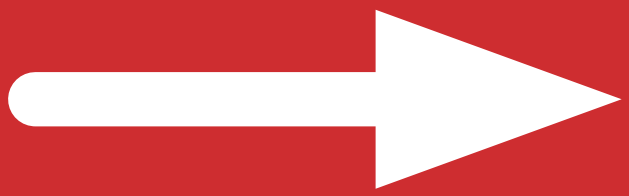

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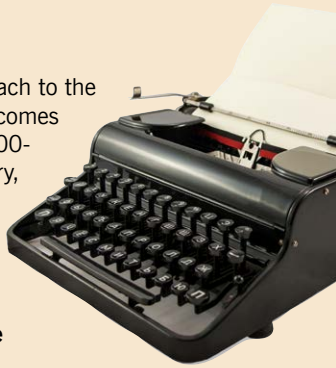

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The Annual Meeting of the CMSC is the largest North American meeting for healthcare professionals and researchers engaged in MS care.

GLATIRAMER ACETATE DEPOT FOR PRIMARY PROGRESSIVE MS

While glatiramer acetate (GA; Copaxone®, Teva Neuroscience) has long been FDA-approved for relapsing forms of multiple sclerosis (MS), a new safety and efficacy snapshot study from Israel looked at its use in primary progressive MS (PPMS). Two GA depot doses (40 mg or 25 mg) were studied in a 12-week trial that included 30 patients age 18-65 years with documented PPMS and disease worsening in the year before screening at a rate of ≥1 point increase per year on Expanded Disability Status Scale (EDSS) score and baseline EDSS score of 2 to 6.5. At baseline, mean age was 50.3 years and there was an even distribution of men and women; mean EDSS score was 5.1

EDSS scores remained stable, with only one 12-week confirmed disability progression (CDP). Notably, 72.4% of patients (68.4% in the 40-mg dose group and 80% in the 25-mg dose group) showed no evidence of progression (NEP), defined by the absence of 12-week CDP (96.6%), 12-week Timed 25-Foot Walk (T25FW) progression (79.3%), and 12-week Nine-Hole Peg Test (9HPT) progression (93.1%). MRI analysis indicated low MRI activity. Injection site reactions were the most common adverse events (AEs) and no unexpected AEs were reported. Rate for AEs was lower in the 25 mg group compared to the 40 mg group.

The authors concluded that these interim findings suggest GA depot as a safe and effective treatment for patients with PPMS, with a remarkable 72.4% NEP, stable EDSS score, and high proportion of stable T25FW and 9HPT scores once treated. ler

Source: *Fletcher S, Miller AE, Popper L, et al. (DMT21) Glatiramer Acetate Depot (Extended Release) Phase 2a Study in Patients With Primary Progressive Multiple Sclerosis: Safety and Efficacy Snapshot. Int J MS Care. 2024;26(S1):33.*

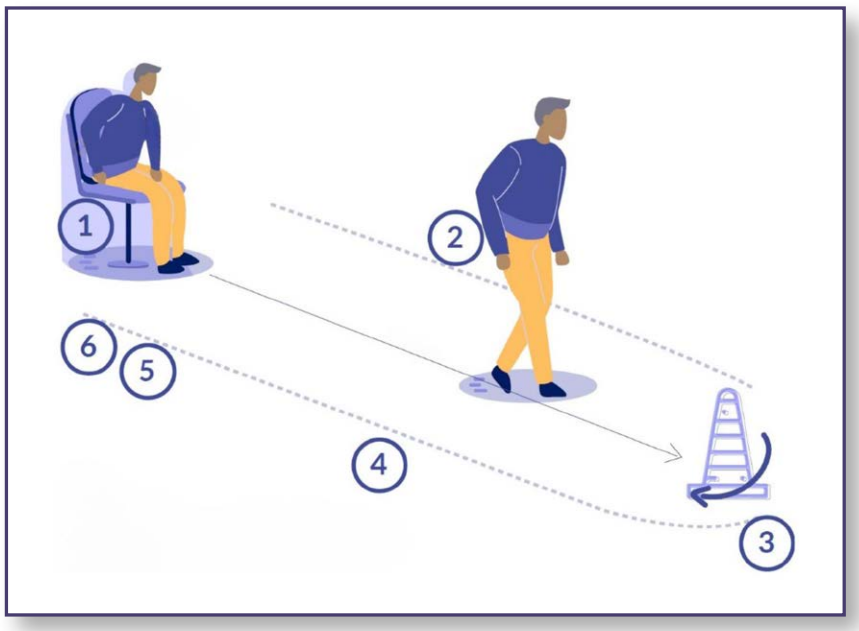
MS DISEASE PROGRESSION DESPITE EARLY HIGH-EFFICACY THERAPY

Today's disease-modifying immunotherapies (DMTs) have altered the course of multiple sclerosis (MS) and led to the introduction of high-efficacy early treatment (HEET). However, HEET does not prevent a portion of patients from experiencing relapse activity and disease progression. This single-center retrospective analysis looked at patients with relapsing-onset MS who were started on HEET within 5 years of diagnosis and then followed for at least 5 years. Therapies included anti-CD20, natalizumab, fingolimod, cladribine, and stem cell transplant. Progression at 5 years was defined as: (1) MS clinician documentation of progressive MS, (2) 1-point worsening on Expanded Disability Status Scale (EDSS) in patients with EDSS score ≤ 5.5 or 0.5-point worsening on EDSS in patients with EDSS score ≥ 6 in the absence of relapse, and (3) 20% increase in Timed 25-Foot Walk (T25FW) score.

Of the 315 patients analyzed, 35.6% experienced progression by T25FW, 20.5% by EDSS, and 3.7% by clinician disease category alone. In univariable analyses, progression by T25FW showed associations only at the $P < .10$ threshold with male sex, Hispanic ethnicity, higher baseline EDSS score, and comorbidity. In exploratory analysis, progression by T25FW at 5 years was also associated with retinal nerve fiber layer on optical coherence tomography.

In conclusion, the author wrote that T25FW is a more sensitive measure of MS disease progression and noted that Hispanic ethnicity places individuals at higher risk of disease progression. ler

Source: *Paredes D. (EPI03) Disease Progression Despite Early High-Efficacy Therapy in Patients With Multiple Sclerosis: Demographics and Clinical Predictors. Int J MS Care. 2024;26(S1):50*



Timed Up and Go test with the different sub-phases after the most complete segmentation. (1) Standing. (2) Go Walking. (3) Three-meter turning. (4) Return Walking. (5) Pre-sitting turning. (6) Sitting. Image reprinted from Ortega-Bastidas P, Gómez B, Aqueveque P, Luarte-Martínez S, Cano-de-la-Cuerda R. Instrumented Timed Up and Go Test (iTUG)—More Than Assessing Time to Predict Falls: A Systematic Review. Sensors. 2023; 23(7):3426. https://doi.org/10.3390/s23073426. Use is per Creative Commons Attribution (CC BY) license.

BACKWARD WALKING TRAINING IN MS...

...MAY EFFECTIVELY IMPROVE WALKING, BALANCE, OVERALL MOBILITY

Backward Walking (BW), as compared with Forward Walking (FW), is known to better differentiate fallers from nonfallers in people with multiple sclerosis (MS). However, the effectiveness of BW training in improving walking and balance in the MS population is now well studied. Researchers from Wayne State University used interim data from an ongoing study to examine the issue.

24 people with MS participated in an 8-week study that randomly assigned them to either a FW training or BW training session; each session consisted of 1 time a week during in-person visits with a physical therapists and 2 times a week with at-home exercises. Sessions included FW and BW at comfortable and fast speeds as well as standing balance assessments.

The research team reported that small effects were identified for group differences in fast FW forward velocity (MD = 0.94, t = 0.96, df = 22, P = .35, d = 0.39) and BW comfortable velocity (MD = 2.87, t = 0.74, df = 22, P = .47, d = 0.3), with the BW group depicting larger improvements.

These findings, the authors concluded, highlight the promise of BW training in people with MS and they went on to suggest that BW training may provide an effective means of improving walking as well as balance and overall functional mobility in this population. (ler)

Source: *Monaghan PG, VanNostrand M, Abbawi M, Fritz NE. (REH17) Backward Is the Way Forward: Preliminary Effectiveness of a Backward Walking Intervention in People With Multiple Sclerosis. Int J MS Care. 2024;26(S1):86.*

...CAN IMPROVE MOTOR FUNCTION

Previous research has shown that backward walking (BW) velocity in addition to MRI measures may improve fall prediction for people with MS. Researchers from Wayne State University used a case series to examine the impact of an 8-week training program to improve BW. Outcome measures included several structural brain measures as well as associated changes in gait, postural control, and falls. Tasks included functional tests (backward- and forward-walking velocity; sway during an eyes-closed, feet-together [ECFT] balance task; postural latency of stepping in reactive balance) and 3T MRI before and after the 8-week intervention, which included treadmill and overground BW once per week and home exercises twice per week. Falls were monitored for 6 months after the intervention.

The pilot study included 8 participants with relapsing-remitting MS (2 men, 6 women; age range, 51-65 years; Patient Determined Disease Steps score range, 1-5). Participants were divided into quartiles by BW speed.

At the end of the 8-week intervention:

- 7 participants had documented changes in brain structure which was associated with forward walking (4/8) and BW velocity (6/8).
- All participants improved sway metrics in the ECFT task.
- 7 participants improved reactive stepping responses.
    - 2 could not generate reactive steps backwards before training but were able to after.
- 4 participants improved their walking enough to move quartiles and reduce their fall risk. (ler)

Source: *Abbawi M, Stanley JA, Yu B, Myers E, Fritz NE. (CS14) Backward-Walking Training Can Improve Motor Function and Brain Structure in Patients With MS: A Case Series. Int J MS Care. 2024;26(S1):24.*

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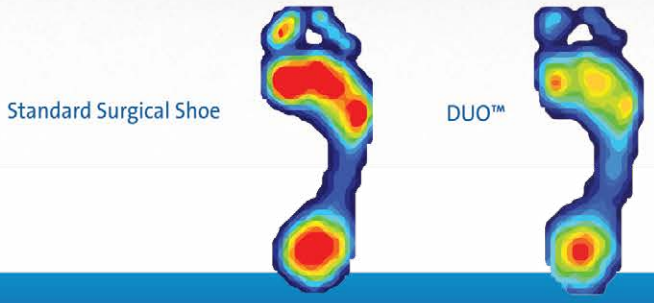

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The Annual Meeting of the CMSC

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...MAY IMPROVE PROPRIOCEPTION FOR BETTER BALANCE

The slowed somatosensory conduction associated with MS increases postural instability and reduces proprioception, yet prior research has shown people with MS have greater reliance on proprioception for balance. This paradox contributes to increased fall risk for this population. While prior research has focused on stationary balance and forward walking (FW), backward walking (BW) is more sensitive to predicting fall risk, most likely due to greater reliance on proprioception and lack of visual cues. These authors present an interim report on their study to examine the role proprioception plays in BW compared to FW.

To date, 35 participants (30 with relapsing-remitting disease, 3 with primary progressive disease, 2 with secondary progressive disease) had completed BW and FW trials at 2 speeds (comfortable and fast) on the GaitRite® walkway using vibration as a proxy measure for proprioception. Vibration thresholds were quantified at the great toe bilaterally using a 2-alternative forced-choice procedure.

Their findings show a significant correlation for vibration sensation and FW comfortable, FW fast, BW comfortable, and BW fast (all $P < .01$). They note that vibration sensation significantly predicted performance during all walking tasks with larger larger β coefficients seen during the BW tasks (comfortable $\beta = 0.75$; fast $\beta = 0.74$) as compared with FW (comfortable $\beta = 0.67$; fast $\beta = 0.70$).

They conclude that there is significant clinical relevance for conducting fall risk assessments and interventions that evaluate and enhance proprioception and advocate for BW as a more effective approach for assessing fall risk and as a more efficacious exercise intervention modality. ler

Source: *VanNostrand M, Monaghan PG, Fritz NE. (REH13) Examination of Proprioceptive Reliance During Backward Walking in Individuals With Multiple Sclerosis. Int J MS Care. 2024;26(S1):85.*

...MAY HELP WITH CONCERNS ABOUT FALLING AND FALL RISK

More research from Wayne State university advocates for incorporating measures of concerns about falling (CAF) in fall risk assessments and prevention efforts as it has greater predictive value than prior fall history. In this single session study, 34 participants with relapsing-remitting MS did a comprehensive battery of motor and cognitive testing and then reported the number of weekly falls for the next 3 months. Prospective falls were highly correlated with Patient Determined Disease Steps (PDDS), CAF, and retrospective fall history, and moderately correlated with balance, forward and backward walking speed, retrospective fall history, and executive functioning. (all $P \leq .01$).

Source: *Takla TN, Monaghan PM, Abbawi M, VanNostrand M, Fritz NE. (REH21) Predictors of Falls and Concern About Falling in People With Relapsing-Remitting Multiple Sclerosis. Int J MS Care. 2024;26(S1):85.*

...MAY BE EFFECTIVE IN IMPROVING REACTIVE BALANCE STRATEGIES

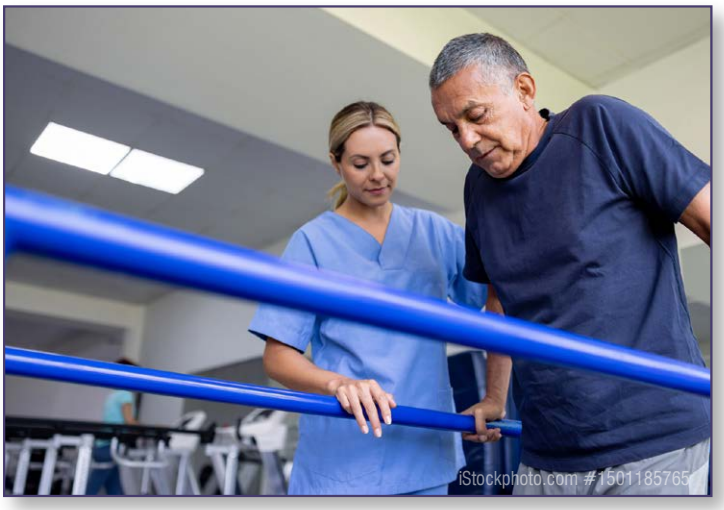
The neurological impairments of multiple sclerosis (MS) can include decreased walking speed, reactive balance, and functional mobility, which all contribute to falls. In looking for ways to improve reactive balance strategies, researchers from Nazareth University in Rochester, New York, wanted to examine perturbation-based balance training (PBBT), which has been reported to be more effective than typical balance training in reducing slip-falls while improving reactive balance. Their current study included 7 participants (6 with relapsing-remitting MS, 1 with secondary progressive disease) with an Expanded Disability Status Scale score < 6. Tests included Timed Up and Go (TUG), Timed Up and Go Dual Task (TUGDT), 3-Meter Backward Walking (BW), and Mini Balance Evaluation Systems (MiniBEST) reactive portion. Scores were assessed 1 week before the intervention (pretest), 1 week after the intervention (posttest1), and at a 5-month follow-up (posttest2). The intervention was 1 session of PBBT using a slip trainer platform with a dynamic overhead harness for 4 2-minute trials.

The researchers found that 1 session of PBBT improved BW in people with MS, potentially decreasing fall risk. Further, they found that the clinical effect on TUGDT indicated a maintained improvement at the 5-month follow-up, which suggests PBBT may be influential in preventing a decline in predictive fall risk outcome scores despite the progressive nature of the disease.

They concluded that a single session of PBBT may be effective in improving fall risk outcome measures in MS in a clinic setting where time and resources are limited. ler

Source: *Vore ME, Bonino S. (REH12) Effect of a Single Session of Perturbation Training on Individuals with Multiple Sclerosis. Int J MS Care. 2024;26(S1):85.*

REHAB THERAPY IMPROVES LOWER LIMB MUSCLE STRENGTH VS DRUG-ONLY THERAPY IN MULTIPLE SCLEROSIS



The treatment for multiple sclerosis (MS) does not cure the disease, but it is intended to reduce the intensity, duration, and frequency of symptoms. Rehabilitation therapy (RT), including an individualized physical therapy program (PTP) and adapted occupational therapy (OT), has benefits in terms of aerobic capacity, muscle strength, coordination, and ability to perform activities of daily living (ADL). The primary objective of this study was to examine the efficacy of RT comprising PTP, OT, and drug treatment (DT) versus DT alone in patients with MS. Another objective was to highlight the importance of continuing the PT and OT at home, in the long term, practically for their entire life.

Between 2020 and 2022, a follow-up observational study was conducted that included 77 patients diagnosed with MS, independent in terms of ability to perform ADL, divided into two groups: group A (39 patients who complied with the RT) and group B (38 patients who did not comply). At the beginning and end of the study, the following parameters were assessed: timed walk for 25 feet (Timed 25-Foot Walk test [T25FW test]), dexterity of the upper limbs (9-Hole Peg Test [9HPT]), and cognitive function (Paced Auditory Serial Addition Test [PASAT]).

Significant improvement in the experimental group was observed regarding the mobility and the performance of leg function (T25FW, $P < 0.05$) and finger dexterity (9HPT, $P < 0.05$) for the dominant hand. (Table)

In conclusion, the current study proves the importance of combining DT with RT in MS therapy with clear benefits in regaining muscle strength in the lower limbs, thus improving coordination and balance while walking and improving dexterity in the dominant hand. ler

Source: *Marcu FM, Ciobanu D, Boca IC, Sirbu E, Deme PA, Hreniuc NC, Ianc D. Rehabilitation therapy versus drug-only therapy in patients with multiple sclerosis. Turk J Med Sci. 2023;17;54(1):157-164. doi: 10.55730/1300-0144.5776.*

Table. The evolution of values for studied parameters within groups and comparison of these variables between the groups (95% CI).

	Group A (n = 39)		Group B (n = 38)		Interaction	Effect size	Group A changes		Group B changes	
	Baseline (mean ± SD)	Post (mean ± SD)	Baseline (mean ± SD)	Post (mean ± SD)	p	p	95% CI Lower/Upper	p	95% CI Lower/Upper	p
T25FW test	7.605 ± 0.774	6.864 ± 0.761	7.600 ± 0.761	7.463 ± 0.863	**0.002***	0.122	0.648/ 0.834	**0.000***	0.029/0.245	0.014
9HPT – dominant hand	19.803 ± 1.571	17.474 ± 1.714	19.774 ± 1.553	19.639 ± 1.728	**0.000***	0.289	1.985/ 2.672	**0.000***	–0.085/0.353	0.222
9HPT – nondominant hand	20.074 ± 1.639	20.133 ± 0.290	20.013 ± 1.655	20.150 ± 0.295	0.868	0.000	–0.129/0.011	0.098	–0.201/–0.073	**0.000***
PASAT	44.72 ± 5.605	47.103 ± 1.144	44.18 ± 5.291	44.579 ± 0.866	0.084	0.039	–3.735/–0.034	**0.001***	–1.237/0.448	0.349

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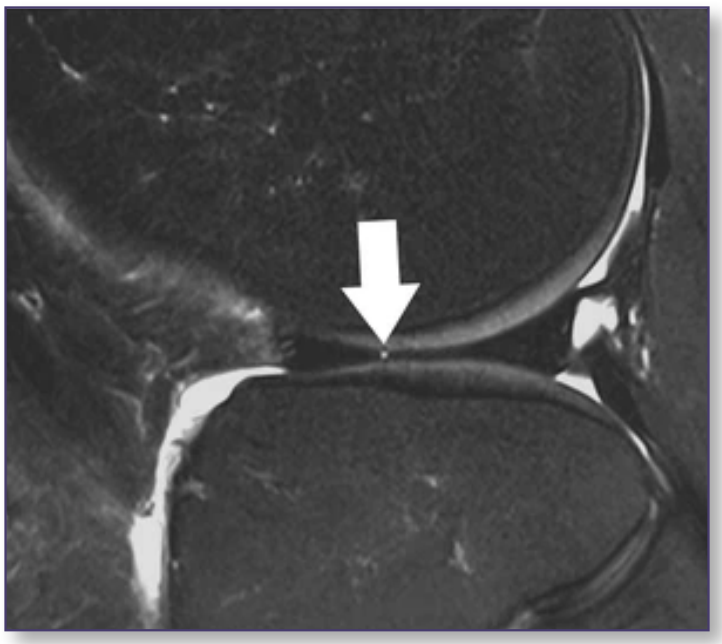
AAOS UPDATES CLINICAL PRACTICE GUIDELINE FOR MANAGEMENT OF ACUTE ISOLATED MENISCAL PATHOLOGY



Sagittal T2-weighted, fat-suppressed fast spin echo image of the right knee in a 39-year-old male patient acquired at 3 Tesla (Siemens Healthcare, Erlangen, Germany) using a dedicated 28 channel transmit-receive knee coil shows a small radial tear of the lateral meniscus (arrow). Reprinted from Bolog NV, Andreisek G. Reporting knee meniscal tears: technical aspects, typical pitfalls and how to avoid them. Insights Imaging 2016;7:385–398. https://doi.org/10.1007/s13244-016-0472-y. Use is per Creative Commons Attribution 4.0 International License.

In releasing its new clinical practice guideline (CPG) focused on acute isolated meniscal pathology, the American Academy of Orthopaedic Surgeons (AAOS) sought to help the medical community treat patients suspected of or diagnosed with an acute isolated meniscal tear.

Acute isolated meniscal tears often occur from a traumatic injury with rotation and flexion of the knee or direct impact. While it can happen to anyone, many acute isolated meniscal tears occur in a young active population, specifically high school and college athletes. Meniscal injuries can have a significant physical and emotional impact as patients need to take time off from work or school. For athletes, return to sport may take up to 4-7 months post-surgery.

"Treating acute meniscal tears is still an evolving area and compared to other guidelines that detail recommendations for the treatment of various musculoskeletal issues, the body of evidence surrounding this injury is relatively lacking," said Robert Brophy, MD, FAAOS, co-chair of the guideline development group. "While acute meniscal tears are common, there is more heterogeneity in terms of the injury, the pattern associated with the injury, and treatments, making it a more difficult area to study. This new [guideline] is a first step toward establishing guidelines and laying the foundation for developing a higher level of evidence to inform future recommendations."

New Diagnosis and Treatment Recommendations

The new guideline resulted in one strong and two moderate recommendations pertaining to the diagnosis and management of patients with acute meniscal injury. The guidance is not intended for patients with concurrent ligament issues like anterior cruciate ligament tears, nor is it appropriate for those suspected of chronic or degenerative meniscal tears. The CPG includes:

- A strong recommendation stating that magnetic resonance imaging (MRI) is the preferred imaging modality to diagnose acute meniscal tears because of its high accuracy, while computerized tomography (CT) arthrography or ultrasound can be used, particularly when MRI is not available or is contraindicated.
- A moderate recommendation that a physical examination, including joint line tenderness, the McMurray test and the Thessaly test, can effectively diagnose acute meniscal tears and may yield more accurate results when combined.
- A moderate recommendation that when indicated in the treatment of acute meniscal tear, surgery should preserve as much functional meniscal tissue as possible to mitigate patient risk for osteoarthritis, underscoring the importance of trying to preserve the meniscus to delay or prevent advancement of joint degeneration.

The guideline workgroup formulated 6 options for physicians and patients to consider. Options are used when there is little, conflicting, or no evidence. Highlights of the options include:

- A limited strength option states that patients with an acute meniscal tear who have failed conservative nonoperative treatment such as physical therapy may have better outcomes from surgical intervention within 6 months of injury.
- It is the consensus of the workgroup that patients with a displaced or displacing acute meniscal tear, particularly those restricting knee range of motion, can benefit from acute surgical intervention. The workgroup also advises that patients with a symptomatic acute meniscal tear who could benefit from a repair should be considered for early surgical intervention as it could optimize the likelihood for success.
- A limited strength option states that meniscus repair can improve patient outcomes compared to partial meniscectomy in acute isolated meniscal tears with healing potential.
- Biological enhancements, specifically bone marrow venting or platelet-rich plasma, received a limited strength option as a consideration to improve outcomes in patients undergoing surgical repair of acute isolated meniscal tears.
- Based on the workgroup's clinical opinion, physical therapy/rehabilitation may be beneficial to patients who present with an acute non-displaced isolated meniscal tear not amenable to repair

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when implemented as a non-operative treatment option as well as for those recovering from meniscal surgery.

"There's no doubt physical therapy is an integral part of the treatment algorithm for people with acute meniscal tears," said Brophy. "Whether you're trying to avoid surgery, planning on not doing surgery, or decide to do surgery, there will likely be a role for physical therapy as part of the treatment or recovery process."

While the study of acute meniscal tears is complex, physicians and patients now have a starting point to weigh the pros and cons to make informed decisions.

"It is important to understand that this [clinical practice guideline] is a guide, not a prescription," said Brophy. "However, this can help patients make an informed decision with their surgeon regarding optimal treatment for their injury."

Development of this guideline was a collaborative effort between representatives from the American Academy of the Physical Medicine and Rehabilitation; the National Athletic Trainers' Association; the American Orthopaedic Society for Sports Medicine, the American Physical Therapy Association; the Pediatric Orthopaedic Society of North America; and the American Medical Society for Sports Medicine.

To read the complete guideline, visit https://www.aaos.org/globalassets/quality-and-practice-resources/acute-meniscal-pathology/amp-cpg.pdf.

Source: *American Academy of Orthopaedic Surgeons Management of Acute Meniscal Pathology Evidence-Based Clinical Practice Guideline. aaos.org/ampcpg. Published June 10, 2024.*

MAJOR ADVERSE FOOT EVENTS PREVALENT IN DPN AND NEPHROPATHY

Peripheral neuropathy affects millions of individuals worldwide. The lifetime prevalence of peripheral neuropathy is estimated to be 50% among individuals with diabetes mellitus and this prevalence tends to increase with the duration of diabetes. Diabetic peripheral neuropathy (DPN) typically affects the distal extremities (feet and hands) and is, therefore, recognized as one of the incipient contributors to major adverse foot events (MAFEs) including foot fracture, ulcerations, Charcot neuropathic arthropathy (CN), osteomyelitis, and minor foot amputations or foot bone resections. MAFEs can singularly and collectively lead to major lower extremity amputation, which in turn can severely compromise an individual's functional mobility and quality of life.

Diabetic nephropathy, a form of chronic kidney disease (CKD), is another major complication of diabetes mellitus, with a reported occurrence in 20%-50% of those with diabetes. Like DPN, diabetic kidney disease progresses in severity with diabetes duration.

DPN combined with diabetic kidney disease progression may be the root causes of both MAFEs and early functional mobility deficits in individuals with diabetes mellitus, though this has not heretofore been demonstrated. The purpose of this study is to describe the frequency and relative risk for major adverse foot events and functional mobility deficits in those with DPN across the stages of CKD.

These authors studied 284 participants with diabetes mellitus, peripheral neuropathy, and CKD. MAFEs including foot fracture, ulcerations, Charcot neuropathic arthropathy (CN), osteomyelitis, and minor foot amputations were collected from foot x-ray reports in the medical records of 152 participants; functional mobility deficits were assessed in 132 participants using the modified physical performance test (mPPT). Moderate mobility deficit was categorized as mPPT scores 22-29 and severe mobility deficit as < 22. Unadjusted and adjusted (age, body weight, race, HbA1c) risk ratios (RR) were calculated across each stage of CKD, with stage 1 CKD used as the reference group.

As noted in the table, the RR for neuropathic foot fracture, CN, and diabetic foot ulceration remained consistent across CKD stages. The RR of minor amputation is greater in CKD stages 4 and 5. The RR of moderate or severe mobility deficit is greater in CKD stages 3 and 5 and in CKD stages 3, 4, and 5, respectively. An inverse association was observed between MAFE prevalence and mPPT scores across CKD stages.

The authors concluded that major adverse foot events and functional mobility deficits are prevalent in individuals with DPN and diabetic kidney disease. The risks for minor foot amputation and functional mobility deficits increase as early as stage 3 CKD and increase further in stages 4 and 5.

Source: *Sinacore DR, Jones MA, Kline PW. Major adverse foot events and functional mobility deficits associated with diabetic neuropathy and nephropathy. Metab Target Organ Damage. 2024;4:15. https://dx.doi.org/10.20517/mtod.2024.02. Use is per Creative Commons Attribution 4.0 International License.*

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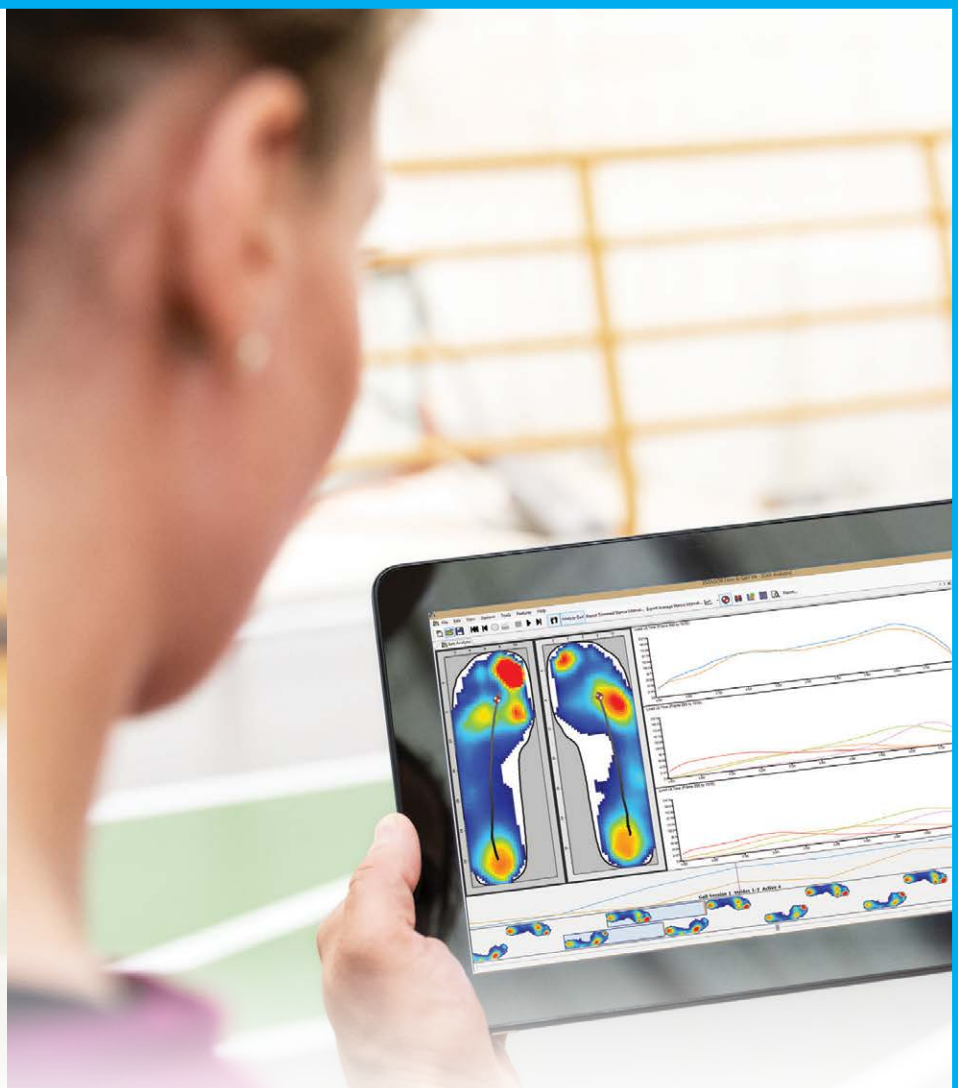

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Table. Age-, body weight-, Hbalc-, and race-adjusted risk ratio of major adverse foot events and physical function by stage of chronic kidney

	CKD stage 1	CKD stage 2	CKD stage 3	CKD stage 4	CKD stage 5
Major adverse foot event	*n* = 34	*n* = 42	*n* = 26	*n* = 25	*n* = 25
Fracture					
Frequency (%)	8 (24%)	8 (19%)	8 (31%)	5 (20%)	7 (28%)
Relative risk	Reference	0.47	0.74	0.48	0.81
95% confidence interval	-	(0.12, 1.83)	(0.16, 3.47)	(0.10, 2.24)	(0.21, 3.21)
Charcot deformity					
Frequency (%)	1 (3%)	3 (7%)	2 (8%)	1 (4%)	3 (12%)
Relative risk	Reference	1.92	2.45	1.25	4.29
95% confidence interval	-	(0.17, 21.3)	(0.17, 36.2)	(0.06, 26.2)	(0.38, 47.8)
Ulceration					
Frequency (%)	2 (6%)	4 (10%)	4 (15%)	5 (20%)	6 (24%)
Relative risk	Reference	2.33	4.34	3.66	5.04
95% confidence interval	-	(0.33, 16.57)	(0.53, 35.8)	(0.48, 28.1)	(0.80, 31.64)
Osteomyelitis					
Frequency (%)	0 (0%)	1 (2%)	0 (0%)	4 (16%)	6 (24%)
Relative risk	Reference	NA	NA	NA	NA
95% confidence interval	-	-	-	-	-
Minor amputation					
Frequency (%)	1 (3%)	2 (5%)	2 (8%)	5 (20%)	12 (48%)
Relative risk	Reference	1.48	1.33	6.18	25.04
95% confidence interval	-	(0.12, 18.8)	(0.07, 26.95)	(0.52, 73.6)	(2.72, 320.1)
Functional mobility	*n* = 32	*n* = 39	*n* = 23	*n* = 6	*n* = 5
Moderate deficits (mPPT 22-29)					
Frequency (%)	10 (31%)	16 (41%)	14 (61%)	4 (67%)	4 (80%)
Relative risk	Reference	2.61	7.03	6.79	11.7
95% confidence interval	-	(0.76, 8.95)	(1.75, 28.25)	(0.76, 61.1)	(0.96, 142.07)
	n = 26	*n* = 29	*n* = 17	*n* = 7	*n* = 3
Severe Deficits (mPPT < 22)					
Frequency (%)	4 (15%)	6 (21%)	8 (47%)	5 (71%)	2 (67%)
Relative risk	Reference	1.21	5.77	10.73	30.17
95% confidence interval	-	(0.20, 7.31)	(0.99, 33.76)	(0.90, 128.6)	(1.09, 833.5)

CKD: Chronic Kidney Disease; mPPT: Modified Physical Performance Test; NA: Not Applicable due to low Counts.

ROM & DYNAMIC STABILITY IN ATHLETES WITH LATERAL ANKLE SPRAIN

Ankle sprains are the most common lower-leg musculoskeletal injuries, frequently occurring among athletes and other physical active individuals. These authors from Saudi Arabia sought to compare the ankle range of motion (ROM) and dynamic stability of healthy and injured athletes for their dominant and nondominant legs.

A cross-sectional study design was selected to investigate this study with 32 male soccer players with average age: 22.6 ± 3.3 years, weight: 69.6 ± 5.7 kg, height: 176.8 ± 5.32 cm, with a history of a lateral ankle sprain on the dominant leg for the past 2 years. Ankle ROM was determined using dorsiflexion and plantar flexion by a goniometer. Dynamic stability was determined using the SWAY medical system. An independent t-test was used to study the differences between healthy and injured groups and between dominant and nondominant legs for dynamic stability, dorsiflexion, and plantar flexion range.

There were higher significant differences for dynamic stability in healthy participants than in injured participants for their dominant (P =

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	Mean ± SD	Significance
Healthy		
Dominant leg	86.69 ± 5.99	0.03*
Nondominant leg	84.44 ± 6.89	
Injured		
Dominant leg	57.43 ± 17.33	0.00*
Nondominant leg	74.60 ± 15.07	

*Significant at ≤ 0.05 level. SD: Standard deviation

Table. Healthy and injured groups comparison between the dominant leg and nondominant leg for dynamic stability (perimeter)

0.001) and nondominant (P = 0.001) legs. There were significant differences in dynamic stability in the dominant and nondominant leg (healthy [P = 0.033] and injured [P = 0.000] participants). The dominant leg shows higher dynamic stability in the healthy group, whereas nondominant leg shows higher dynamic stability in the injured group.

This study found significant differences between the injured and sound legs. The injured dominant and nondominant leg revealed a striking disparity in the ankle range of motion. Therefore, the study demonstrated that ankle sprain causes due to less stability of the ankle joint, which limits ankle movements. ler

Source: *Alomar AI, Nuhmani S, Ahsan M, Muaidi QI. A comparison of the range of motion and dynamic stability of the ankle joint of athletes with an ankle sprain as compared to healthy controls: A cross-sectional study. Int J Crit Illn Inj Sci. 2023;13:138-44. Use is per Creative Commons Attribution 4.0 International License.*

META-ANALYSIS SHOWS ESWT IS SAFE & EFFICACIOUS FOR PLANTAR FASCIITIS

Based on findings from a systematic review and meta-analysis, researchers from the University of Jaén in Spain reported that, when compared to corticosteroid injections:

- At 3 months, extracorporeal shock wave therapy (ESWT) was better than corticosteroids injections in
  - reducing pain (SMD −0.6; 95%CI −1.1 to −0.11) and
  - thickness of the plantar fascia (SMD −0.4; 95%CI −0.8 to −0.01) and
  - increasing foot function (SMD 0.27; 95%CI 0.12–0.44).
- At 6 months, ESWT was more effective in
  - reducing pain (SMD −0.81; 95%CI −1.6 to −0.06) and
  - increasing foot function (SMD 0.67; 95%CI 0.45–0.89).

Local pain and slight erythema were the most frequent adverse events. ler

Source: *Cortés-Pérez I, Moreno-Montilla L, Ibáñez-Vera AJ, Díaz-Fernández Á, Obrero-Gaitán E, Lomas-Vega R. Efficacy of extracorporeal shock-wave therapy, compared to corticosteroid injections, on pain, plantar fascia thickness and foot function in patients with plantar fasciitis: A systematic review and meta-analysis. Clinical Rehabilitation. 2024;0(0). doi:10.1177/02692155241253779*

CAN SHORT-TERM WEIGHT LOSS PROGRAMS WORK?

Long-term lifestyle change programs can be effective at achieving weight loss for adults with overweight or obesity and can lower their risks for developing chronic diseases, such as type 2 diabetes. However, enrollment and retention are challenging in long-term interventions.

A new systematic review and meta-analysis has found that even programs less than 13 weeks can indeed be helpful, as can programs that run 13–26 weeks. The findings demonstrated that multicomponent nutrition and physical activity interventions of 6 months or less can achieve weight loss by the end of the intervention period.

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The pooled mean difference for weight change was less than −2.59 kg (95% CI, −3.47 to −1.72; 14 RCTs; 2,407 participants; I2 = 69%) (Figure 1). The negative difference in mean weight change indicates that people in the intervention groups lost more weight than those in the comparison groups. For the studies with interventions lasting less than 13 weeks, the pooled mean difference for weight change was −2.70 kg (95% CI, −3.69 to −1.71; 7 RCTs, 1,051 participants, I2 = 73%). For the studies with interventions lasting 13 to 26 weeks, the pooled mean difference for weight change was −2.40 kg (95% CI, −4.44 to −0.37; 7 RCTs, 1,356 participants, I2 = 69%) (Figure 2).

The authors concluded that short-term multicomponent interventions involving physical activity and nutrition can achieve weight loss for adults with overweight or obesity. Offering short-term interventions as alternatives to long-term ones may reach people who otherwise would be unwilling or unable to enroll in or complete longer programs.

Source: *Rotunda W, Rains C, Jacobs SR, et al. Weight Loss in Short-Term Interventions for Physical Activity and Nutrition Among Adults With Overweight or Obesity: A Systematic Review and Meta-Analysis. Prev Chronic Dis. 2024;21:E21. doi: 10.5888/pcd21.230347.*

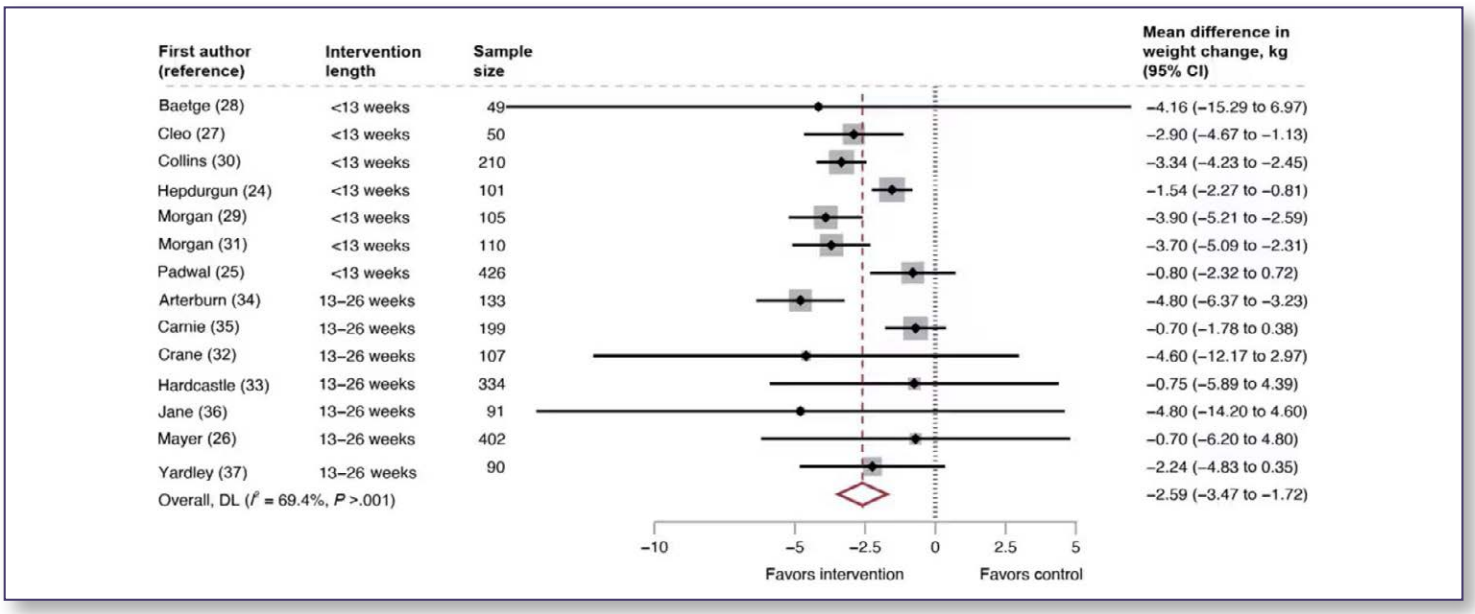


Figure 1: Mean difference in weight change across all included studies, intervention versus control, systematic review of weight loss in short-term interventions (N = 14) for physical activity and nutrition among adults with overweight or obesity. Meta-analysis was of the effects of intervention versus control on mean difference in weight change (kg) among the 14 included studies. Values less than 0 indicate an intervention effect (ie, favors intervention), and values greater than 0 indicate no intervention effect (ie, favors control). Abbreviation: DL, DerSimonian and Laird's Q test.

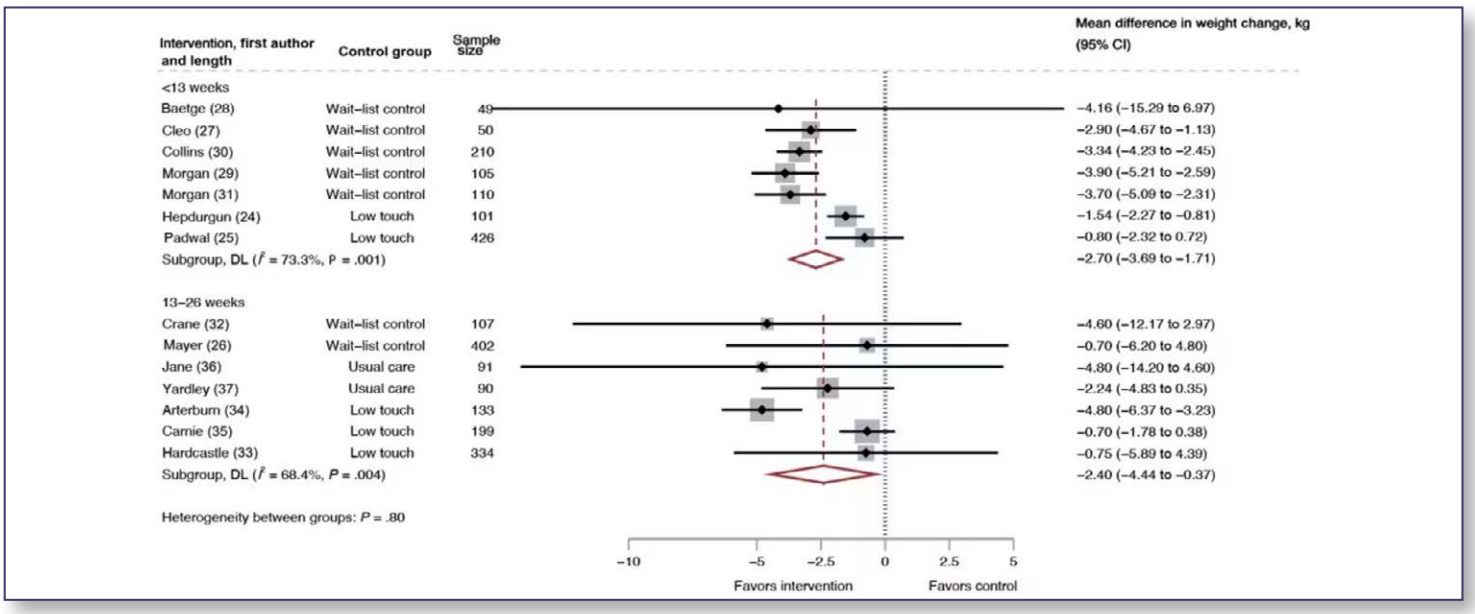
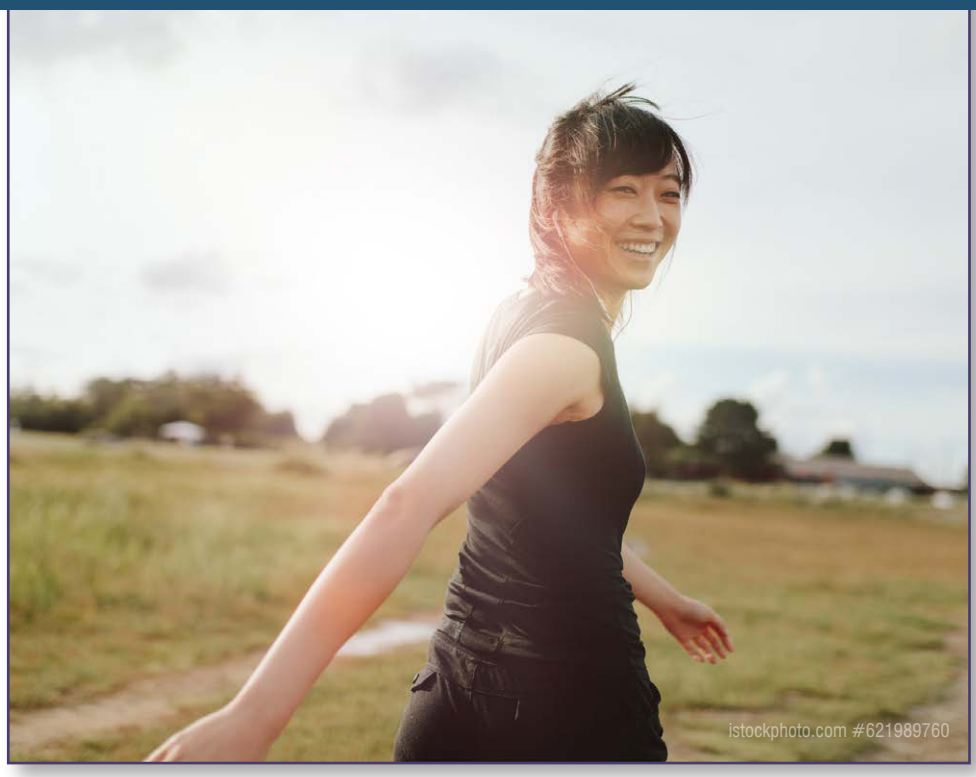


Figure 2: Mean difference in weight change by intervention duration, intervention versus control, systematic review of weight loss in short-term interventions (N = 14) for physical activity and nutrition among adults with overweight or obesity. Meta-analysis was of the effects of the intervention versus control on mean difference in weight change (kg), stratified by intervention duration. Intervention duration is defined as less than 13 weeks or 13 to 26 weeks. Values less than 0 indicate an intervention effect (ie, favors intervention), and values greater than 0 indicate no intervention effect (ie, favors control). Abbreviation: DL, DerSimonian and Laird's Q test. Overall, DL (I2= 69.4%, P > .001).

Retro Walking Shown to Decrease Inflammatory and Obesity Markers

By Ajith Soman, Sunil Chandy, Khalid Alkhathami, Baranitharan Ramamoorthy, and Bijad Alqahtani

Backward walking offers many benefits relative to forward walking, not least of which is a decrease in C-reactive protein, body mass index, and blood pressure levels.



It is a widely accepted fact that obesity is not much amenable to medical treatment. Diet and exercise, systematically undertaken, is the only way to treat obesity, manifested as a high body mass index (BMI). Of the different modes of exercise, walking at a brisk pace is beneficial to the cardiovascular health and helps in maintaining a healthy body weight. Retro walking, or backward walking, performed on a treadmill has been proven to expend energy and improve exercise capacity at a greater extent than forward walking, while also making a higher metabolic demand on the body. The discrepancy in metabolic cost among the 2 types of walking is postulated due to increased stride frequency and decreased stride length, and also owing to the concentric contraction of the quadriceps muscle as opposed to eccentric contraction, resulting in increased energy expenditure after retro walking.

C-reactive protein (CRP), an important inflammatory marker in serum, has been reported to be elevated in persons who are obese, and correlates with insulin resistance and endothelial dysfunction. The increased energy expenditure after retro walking may indirectly have an effect on CRP level and BMI, since inflammatory and obesity markers are linked to exercise capacity and energy expenditure. Thus, the aim of this study was to compare the effect of retro walking with that of forward walking on CRP levels, BMI, and blood pressure (BP), and to understand the influence of independent factors, namely systolic blood pressure (SBP), diastolic blood pressure (DBP), and BMI on CRP in untrained overweight and obese young adults.

Methods

This randomized controlled trial included 106 male subjects age 20–25 years, whose BMI was equal to or above 25 kg/m2, and who were not participating in habitual exercise training. The participants allotted to the retro walking group (n = 53) participated in a backward treadmill training program under supervision for 4 days a week for 12 weeks. Each session included an exercise period, which started with duration of 15 minutes, and progressed to 30 minutes over the 12-week training period. During the exercise period, the participants were made to walk backward at a speed of 4 km/h (or 67 meters/min) with a 10% gradient. The participants in the forward walking training group (n = 53) underwent a supervised treadmill training program with duration, intensity, and frequency similar to that of the retro walking treadmill training program.

CRP, BMI, and BP levels were measured

This article has been excerpted from "Retro walking treadmill training reduces C—reactive protein levels in overweight and obese young adults: A randomized comparative study," by the same authors. Health Sci Rep. 2023 Apr; 6(4): e1169.Published online 2023 Mar 30. doi: 10.1002/hsr2.1169. Editing has occurred, including the renumbering or removal of tables and figures, and references have been removed for brevity. Use is per CC Attribution 4.0 License.

	Pretreatment		Posttreatment		*p*	
Outcome	Forward walking	Retro walking	Forward walking	Retro walking	Time	Time × group
BMI	32.70 ± 4.88	32.12 ± 4.37	29.76 ± 4.70	27.23 ± 3.52	<0.0001	<0.0001
DBP	84.19 ± 3.26	83.11 ± 2.48	82.45 ± 3.12	78.98 ± 1.55	<0.0001	<0.0001
SBP	129.37 ± 13.92	130.90 ± 4.82	128.71 ± 5.32	123.40 ± 3.90	<0.0001	<0.0001
CRP	4.29 ± 3.33	3.47 ± 2.48	3.67 ± 2.96	1.47 ± 1.02	<0.0001	<0.0001

Table 1: Between-group analysis of outcomes in forward and retro walking.

Abbreviations: BMI, body mass index; CRP, C reactive protein; DBP, diastolic blood pressure; SBP, systolic blood pressure.

before and after the training sessions. Blood samples were obtained after an overnight 12-hour fast and immediately before commencement of the treadmill exercise. The post-exercise blood samples were taken 24–72 hours following the last exercise session. Body height, body weight, BMI, hip circumference, waist circumference, waist–height ratio, and waist–hip ratio were measured using standardized methods. Four BP readings were taken with the participant seated, the arm supported on a cushion at chest level, resting a minute between each measurement. The mean of the last 3 readings was considered the final level of BP. Comparison of the measured values before and after intervention and between the groups was done and the influence of BMI and BP on CRP levels was determined.

Results

Both groups recorded a significant decrease ($P < 0.001$) in CRP, BMI, and BP levels postintervention. The participants who underwent retro walking training showed a significantly ($P < 0.001$) higher decrease in all the outcomes as compared with the forward walking group (Table 1). CRP levels were seen to be influenced by BMI and DBP.

Multiple regression analysis revealed that BMI (β: 0.432, $P < 0.0001$, 95% CI: 0.156–0.337) and DBP (β: 0.317, $P < 0.0001$, 95% CI: 0.078–0.441) were the significant predictors of CRP.

The results of mediation effect of DBP on BMI and CRP have been descripted in Figure 1. The total effect of BMI on CRP was (0.366, $P < 0.0001$, 95% CI: 0.281– 0.451) with a direct effect of 0.259, $P < 0.0001$, 95% CI: 0.173–0.346 and an indirect effect of 0.107, $P < 0.0001$, 95% CI; 0.060–0.162.

Discussion

The primary aim of this study was to compare the effects of retro walking and forward walking training on blood CRP level and BMI of untrained young men. CRP, an important inflammatory marker in serum, has been reported to be elevated in persons who are obese, and correlates with insulin resistance and endothelial dysfunction. Obesity or an increase of fatty tissue causes chronic inflammation in the body, which in turn causes an increase in cytokine synthesis. Furthermore, CRP is most consistently associated with atherogenesis when compared with other inflammatory markers, and hence poses a greater cardiovascular risk. Many studies have demonstrated the interrelationship of CRP, BMI, and BP, though this relationship has not been conclusively proven.

The results showed that CRP levels and BMI decreased significantly in both groups following treatment. In addition, both SBP and DBP were also seen to be reduced after normal walking and retro walking. The effect of retro walking in reducing the level of CRP, BMI, DBP, and SBP over the period of intervention was greater than that of forward walking. The variables SBP, DBP, and BMI were seen to influence CRP levels.

At a similar level of intensity, backward walking places higher demands on metabolic sensorimotor, cardiovascular, and perceptual

The effect of retro walking in reducing the level of CRP, BMI, DBP, and SBP over the period of intervention was greater than that of forward walking.

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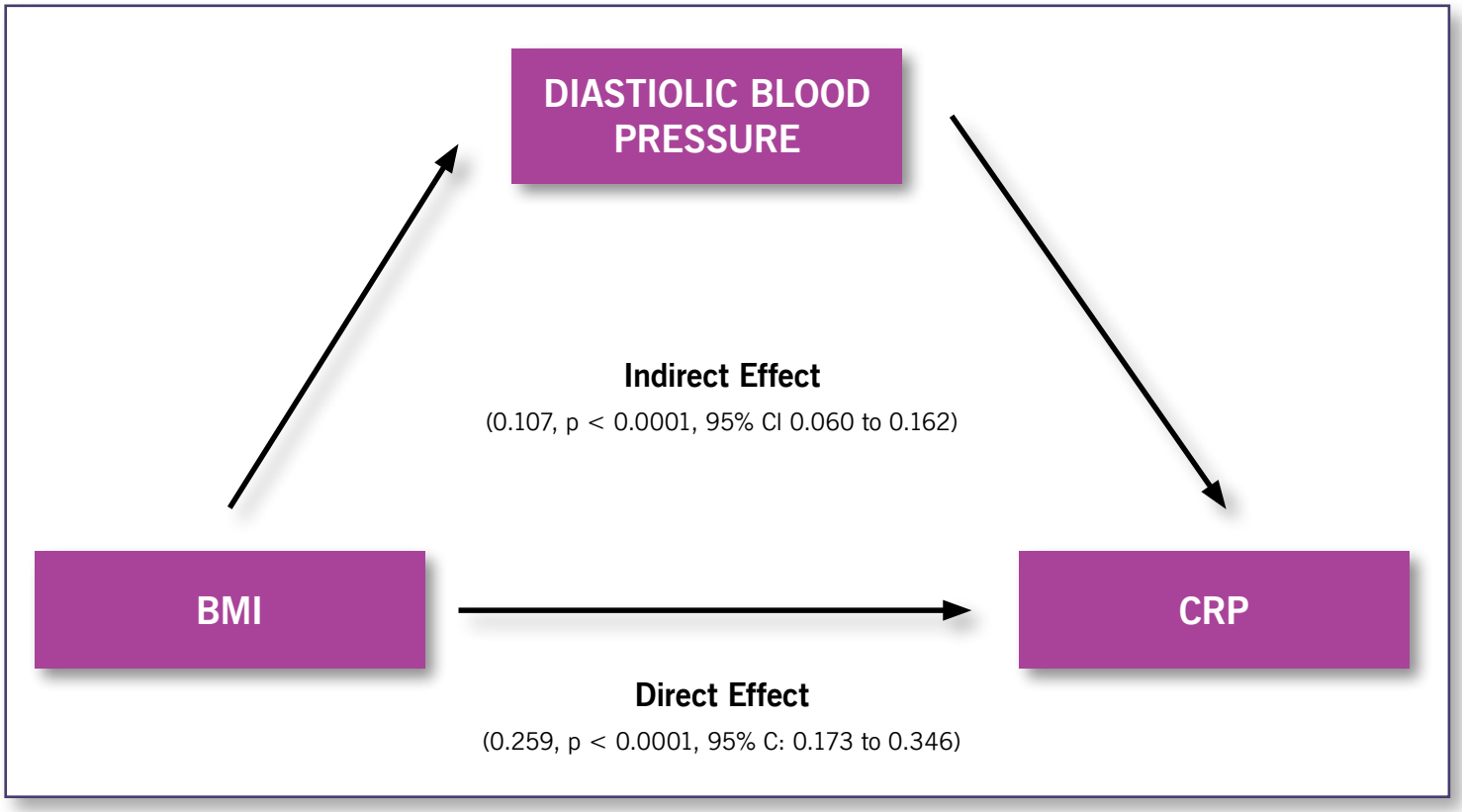

Figure 1: Mediation effect. Mediating role of diastolic blood pressure in the relationship between body mass index and C reactive protein.

responses than forward walking. Also, backward walking poses a considerable challenge to standing dynamic balance, thus recruiting more neurons in the process. Hyun-Gyu and co-workers found that backward walking stimulated the lower limb muscles and resulted in higher energy consumption in the lower limbs. They also stated that backward walking stimulates the quadriceps muscles and other muscles, which subsequently move the knee joint in a considerably more balanced manner as compared with forward walking. Owing to the increased challenge to the different systems of the body, retro walking increases energy expenditure relative to forward walking. This increased energy expenditure causes a decrease in the level of adiposity in the body, thus leading to decreased body weight and consequently decreased BMI, as proven in the results of the present study. Similarly, several researchers have found that retro walking produces more energy expenditure than forward walking at similar speeds.

Exercise and physical activity have been known to reduce levels of CRP by increasing levels of adiponectin—a relatively novel anti-inflammatory adipocytokine known to improve insulin sensitivity. Leptin is yet another polypeptide, which is closely associated with CRP levels and is decreased with physical activity and exercise. Exercise, in general, can decrease levels of adipose tissue and leptin levels and increase adiponectin levels, ultimately leading to decreased CRP levels.

Physical exercise has been seen to have an influence on the immune system in that it reduces the number of mononuclear cells in blood, which in turn produce proinflammatory cytokines like IL-1 (Interleukin-1), IL-6 (Interleukin-6), IL-8 (Interleukin-8), and CRP. Moderate exercise done regularly can decrease CRP and IL-6 levels in obese persons. Exercise has an anti-inflammatory effect, which can reduce systemic inflammation and CRP levels. In agreement to this, the present study also saw a decrease in CRP levels following both modes of walking.

As an exercise mode that places more demand on the cardiovascular and metabolic system than regular walking, it could be expected that retro walking would have a similar effect, but of more magnitude, on CRP levels. The present study is the first, to the knowledge of the study authors, to evaluate the effect of a backward walking program on an inflammatory marker and cardiovascular risk factor such as CRP in young obese and pre-obese individuals. Terblanche et al. found that a backward walking program can increase levels of cardiovascular fitness and produce changes in body composition. Similarly, a meta-analysis demonstrated that physical training can be correlated to reduced CRP levels regardless of age or gender, and that greater improvements in CRP levels could be seen additionally when the BMI is reduced. In contrast, Mouridsen et al. noted that there was a spike in high-sensitivity CRP as an immediate response to exercise, however, the increase was moderate and not independently associated with coronary artery disease.

The multiple linear regression analysis revealed that BMI and DBP were the significant predictors of CRP. Studies have demonstrated

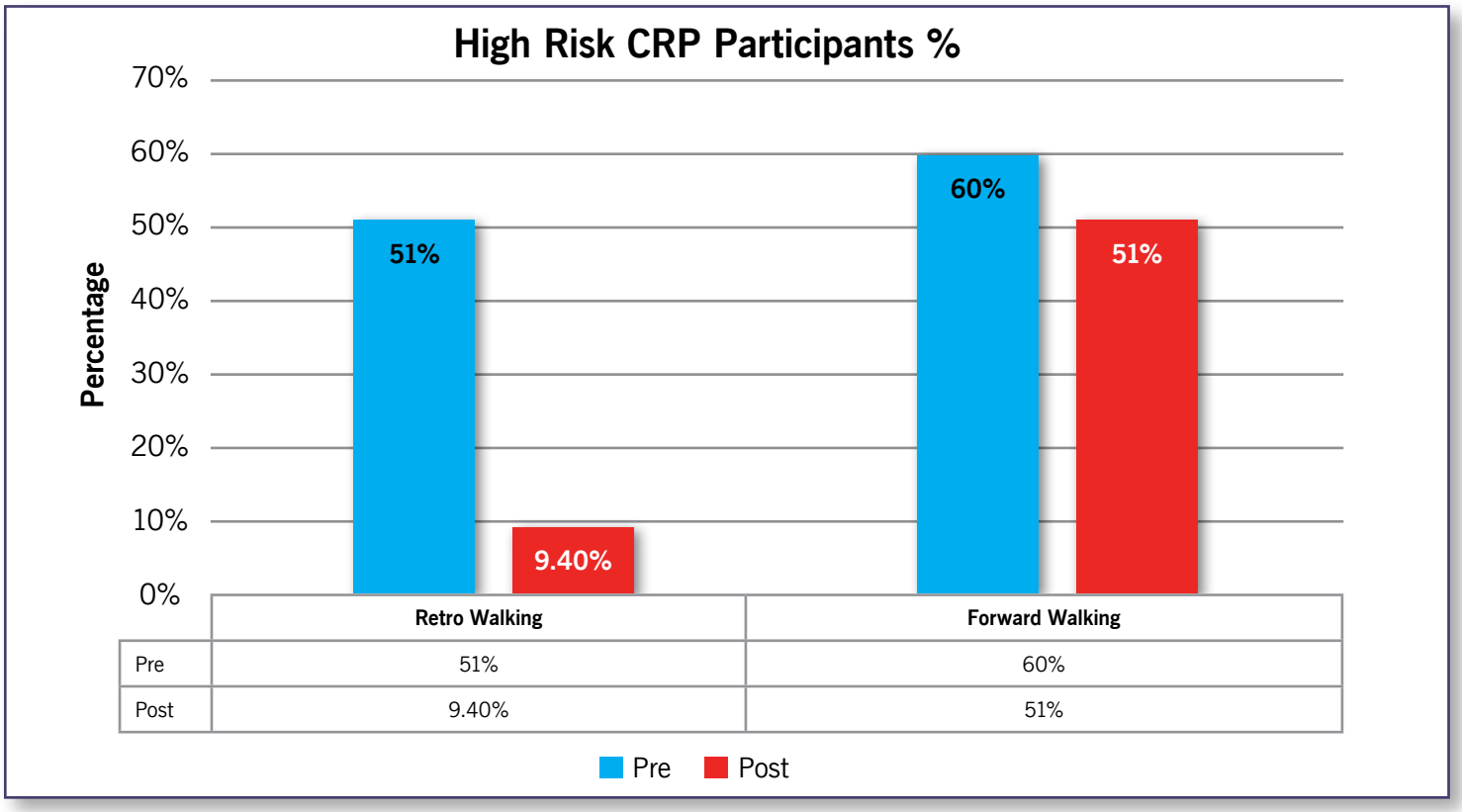

Figure 2: Pre- and post-exercise high risk (CRP > 3 mg/L) CRP values. BMI, body mass index; CRP, C reactive protein.

CRP to be associated with obesity, increased waist circumference, and SBP; these parameters can be used for identification and intervention in children and adolescents with high risk of atherosclerosis. An expanding body of evidence indicates that inflammation has a major role to play in the development of high BP; elevated levels of CRP have been shown to be associated with the incidence of hypertension in middle-aged adults. In the present study, most of those who had stage 1 hypertension were in the high-risk CRP category (CRP > 3 mg/L), and conversely, none of those with high-risk CRP were with normal BP (Figure 2). This would demonstrate the importance of CRP as a predictor of cardiovascular risk factors, including hypertension and ischemic heart disease. The study of factors that can modify CRP levels in the body would play an important role in prevention and management of cardiovascular risk factors.

In the between-groups comparison, there was a significant difference in the outcomes between the forward-walking and retro-walking groups. The present study adds to the existing body of literature to provide evidence about the benefits of retro walking by documenting a reduction in CRP, which is not only an important inflammatory marker, but also a cardiovascular risk factor. Retro walking also places less stress on the weight bearing joints of the lower limb and thus reduces the probability of injury during exercise in people who are overweight or obese, and more energy can be expended in a shorter period of time, which makes the exercise more time efficient. It can be surmised that retro walking is a viable replacement to forward walking in reducing cardiovascular risk factors.

Retro walking increases energy expenditure relative to forward walking.

Conclusions

The present study demonstrates that both retro walking and forward walking can help alleviate CRP level and obesity. However, the retro walking program has added benefits over a forward walking program of similar intensity in modifying these outcomes. BMI and DBP have the potential to influence CRP levels in the blood. These factors can be considered while designing an exercise program to modify cardiovascular risk factors in young individuals. Considering the advantages and practicability of use, retro walking can be a valuable addition to any exercise program which aims at addressing obesity and cardiovascular risk factors.

Authors Ajith Soman, Khalid Alkhathami, Baranitharan Ramamoorthy, and Bijad Alqahtani practice in the Department of Health Rehabilitation; Sunil Chandy practices in the Department of Clinical Lab Science. All are in the College of Applied Medical Sciences at Shaqra University in Saudi Arabia.

Current Ankle Osteoarthritis Treatment Practices of UK Podiatrists & Physiotherapists

By Michael J. Callaghan, Jinal Pravin Gala, and Edward Roddy

There is a need for guidance to help allied healthcare professionals manage an evidence-based treatment plan of usual care for ankle osteoarthritis.

International clinical guidelines recommend non-pharmacological interventions such as exercises and weight loss as first-line management for osteoarthritis (OA), regardless of joint site. Whereas several evidenced-based non-surgical management options for clinicians and patients are available for other joints, specific evidence for ankle OA interventions is sparse and patients report mixed experiences of non-surgical management. Extrapolating recommendations from other joints may not be appropriate and there is a lack of guidance for clinicians on treatment best practices. Therefore, the study authors undertook a survey of United Kingdom (UK)–based physiotherapists and podiatrists to understand better how painful ankle OA is managed in current clinical practice.

Methods

UK-based physiotherapists and podiatrists who treat patients with ankle OA completed a self-administered online questionnaire about their professional and clinical service characteristics, diagnostic criteria, treatment aims, preferred treatment options, and treatment outcome measures. Participants were required to care for people with symptomatic ankle OA in their clinical practice but there were no exclusions for age, length of experience, or clinical setting. Participants were advised that for the purpose of this survey ankle OA was defined as talocrural (tibiotalar) joint OA and did not include the subtalar joint. Data were collected anonymously and stored on JISC online survey (www.onlinesurvey.ac.uk). 'Usual care' was defined as a combination of 'Always' and 'Frequently', and 'Not usual care' was defined as 'Sometimes,' 'Rarely,' 'Never', and 'not applicable' combined. Statistically significant differences in responses between the physiotherapists and podiatrists were analyzed using X2 tests for each treatment modality. Statistical significance was set at $P < 0.05$.

Results

Between June 1 and August 31, 2021, 98 valid responses to the survey were received from 63 physiotherapists and 35 podiatrists. The most common treatment aims in both professions were to reduce pain (n = 87, 89%) and improve quality of life (n = 82, 84%). Several outcome measures were used, most commonly patient satisfaction (n = 62, 63%) or a visual analogue scale (n = 51, 52%) or a numerical rating scale (n = 42, 43%) to measure pain. Physiotherapists and podiatrists relied upon various features to diagnose ankle OA, with the 3 most common being reduced ankle range of motion (n = 90, 92%), the site of pain (n = 81, 83%), and imaging (n = 85, 87%). Fifty respondents (51%) offered 3 or 4 treatment sessions and 53 respondents (54%) saw patients for 30–40 minutes at the first treatment session.

This article has been excerpted from "Ankle osteoarthritis: an online survey of current treatment practices of UK-based physiotherapists and podiatrists." Journal of Foot and Ankle Research. 2023;16:8. https://doi.org/10.1186/s13047-023-00683-3. Editing has occurred, including the renumbering or removal of tables and figures, and references have been removed for brevity. Use is per CC Attribution 4.0 International License.

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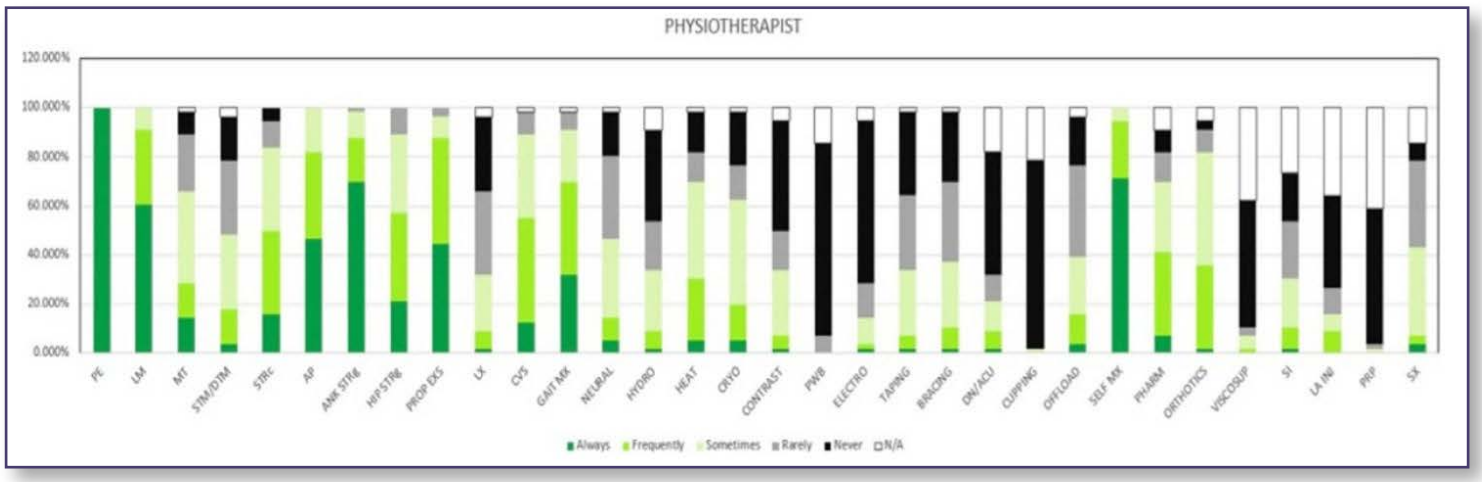

Figure 1: Treatment used for ankle OA by Physiotherapists. Figures are presented as a % of valid responses (n = 98). PE, patient education; LM, lifestyle modification; MT, manual therapy of peripheral joints; STM/DTM, soft tissue mobilisation/ deep tissue mobilisation; STRc, stretching; AP, activity pacing; ANK STRg, ankle strengthening; HIP STRg, hip strengthening; PROP EXS, proprioception exercises; LX, lumbar spine management; GAIT Mx, gait management; NEURAL, neural mobilisation; HYDRO, hydrotherapy; HEAT, heating/ heat therapy; CRYO, cryotherapy; CONTRAST, contrast bath; PWB, paraffin wax bath; ELECTRO, electrotherapy; DN/ACU, dry needling/ acupuncture; OFFLOAD, offloading; SELF MX, self-management; PHARM, pharmacotherapy; VISCOSUP, visco-supplementation; SI, steroid injection; LA INJ, local anaesthesia injection; PRP, platelet-rich plasma injection; SX, refer for surgery

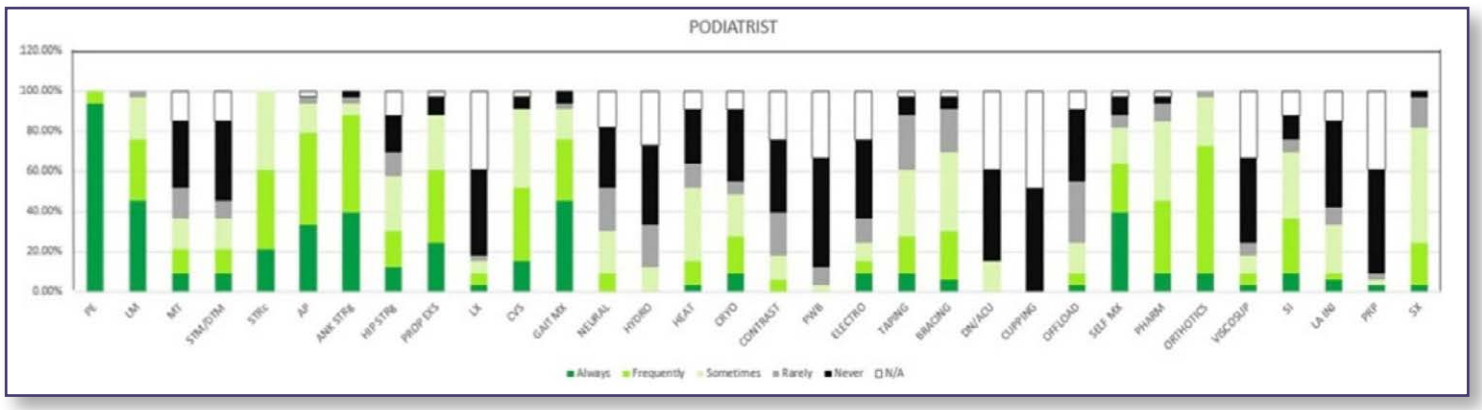

Figure 2: Treatment used for ankle OA by Podiatrists. Figures are presented as a % of valid responses (n = 98). PE, patient education; LM, lifestyle modification; MT, manual therapy of peripheral joints; STM/DTM, soft tissue mobilisation/ deep tissue mobilisation; STRc, stretching; AP, activity pacing; ANK STRg, ankle strengthening; HIP STRg, hip strengthening; PROP EXS, proprioception exercises; LX, lumbar spine management; GAIT Mx, gait management; NEURAL, neural mobilisation; HYDRO, hydrotherapy; HEAT, heating/heat therapy; CRYO, cryotherapy; CONTRAST, contrast bath; PWB, paraffin wax bath; ELECTRO, electrotherapy; DN/ACU, dry needling/ acupuncture; OFFLOAD, offloading; SELF MX, self-management; PHARM, pharmacotherapy; VISCOSUP, visco-supplementation; SI, steroid injection; LA INJ, local anaesthesia injection; PRP, platelet-rich plasma injection; SX, refer for surgery

The 5 most common modalities used by physiotherapists were patient education (n = 63, 100%), teaching self-management (n = 58, 92%), lifestyle modification (n = 54, 86%), ankle strengthening (n = 55, 87%), and proprioception exercises (n = 54, 86%) (Figure 1). For podiatrists, these were patient education (n = 35, 100%), ankle strengthening (n = 31, 89%), activity pacing (n = 28, 80%), lifestyle modification (n = 27, 77%), and gait training (n = 27, 77%). Less than 30% of respondents in either profession opted for ankle bracing or taping as usual care. Physiotherapists used the treatment options of proprioception (P = 0.003), hip strengthening (P = 0.007), hydrotherapy (P = 0.031), and self-management (P = 0.001) significantly more often than podiatrists (Figure 2). Taping (P = 0.025), bracing (P = 0.04), orthotics (P = 0.002), referral for surgery (P = 0.029), and corticosteroid injections (P = 0.004) were used significantly more often by podiatrists than physiotherapists (Figures 1, 2).

Discussion

This is the first survey to assess and compare current practice in managing ankle OA amongst physiotherapists and podiatrists in the UK. There is little guidance currently available to help allied healthcare professionals plan an evidence-based management plan of usual care for managing this condition; most guidance is for knee OA and hip OA.

Both professions always or usually used patient education, lifestyle modification, and ankle strengthening exercises, with physiotherapists additionally using self-management and proprioception exercises, whereas podiatrists additionally used activity pacing and gait training. Outside of these 5, other commonly used ways to manage ankle OA by physiotherapists

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were hip strengthening (58%) and by podiatrists were orthotics (73%) and self-management (64%). These treatment choices align with the top 3 treatment aims in both professions: to reduce pain, improve quality of life, and teach self-management. This consensus concurs with many general OA guidelines (not ankle OA specific), such as National Institute for Health and Care Excellence (NICE) and Osteoarthritis Research Society International (OARSI), which includes patient education, exercise, and self-management as core treatment options. Additionally, the results of this survey align with the treatment research agenda from an international foot and ankle OA consortium, which recommended understanding usual care of foot and ankle OA to inform the design of control interventions in clinical trials. It is also in line with the modern rehabilitation model for chronic pain, which suggests using education to improve the effectiveness of other treatment options and adding active/self-management techniques as a part of usual care.

Some of the treatment options reported by physiotherapists suggest they extrapolated evidence from other joint sites and applied to ankle OA. Hip strengthening was commonly used by physiotherapists (58%) but not podiatrists (27%), which does not align with a systematic review recommending hip strengthening for the conservative management of knee OA but not ankle OA. There were several treatment options that were used sometimes, rarely, or never by physiotherapists or podiatrists including hydrotherapy, electrotherapy, dry needling/acupuncture, taping, and intra-articular injections of visco-supplementation or platelet-rich plasma (PRP). Possible reasons include lack of access to hydrotherapy, contradictory OA guidelines by NICE and OARSI about acupuncture for OA, a lack of injection skills, and either the limited availability of visco-supplementation products or PRP in the National Health Service or a lack of supporting evidence. The observation that few physiotherapists (4%) and podiatrists (15%) used electrotherapy to treat ankle OA contrasts with NICE and OARSI guidelines recommending transcutaneous electrical nerve stimulation (TENS) to alleviate pain.

> This is the first survey to assess and compare current practice in managing ankle OA amongst physiotherapists and podiatrists in the UK.

Less than a third of respondents in either profession opted for ankle bracing or taping as usual care. This is surprising, particularly with physiotherapists, since taping is commonly used to reduce ankle range of motion and improve joint stability. The aim of ankle braces is similar, but the low uptake of bracing might be due to the survey not specifying the stage of ankle OA clinicians should consider when responding to these questions. It might be that some clinicians only consider ankle bracing in end-stage ankle OA.

Orthotics were used significantly more by podiatrists (73%) than physiotherapists (37%), consistent with the finding of a survey of physiotherapists' and podiatrists' treatment of plantar fasciitis that foot orthotics were considered the specialist role of podiatrists. It is possible that physiotherapists refer to other services for orthotics but this survey did not distinguish those fitting orthotics themselves and those referring to podiatric or orthotic services. The use of footwear, as opposed to orthotics, was not available as a treatment option in the survey and it is possible that respondents may have opted for this if it had been available. Interestingly, despite podiatrists being asked to contribute at the survey's development stage, a 'footwear' option was not suggested and so was not included in the final version. Although this survey provides data from physiotherapists and podiatrists as to what is current practice for 'usual care' in ankle OA, this has not yet been robustly assessed for its efficacy and should be the target for future funding applications.

A survey on the management of foot and ankle OA by general practitioners in Australia found that pharmacological management was favored over active and self-management techniques. The survey reported on herein found medications were used by nearly half of both physiotherapists and podiatrists. There are about 1,400 physiotherapists and 450 podiatrists registered as independent or supplementary prescribers in the UK, but the survey did not ask whether medications were prescribed directly by the physiotherapist or podiatrist, or whether the patient was required to see another healthcare professional to obtain a prescription.

Conclusions

This first-ever survey revealed UK-based current practices of physiotherapists and podiatrists to treat painful ankle OA. This study provides a better understanding of how ankle OA is treated in UK current clinical practice and can inform future clinical trials to assess usual care and compare this with new treatment modalities. ler

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Foot Rehabilitation Exercises for Flatfoot: A Case Study

By Pradhyum D. Kolhe , H V Sharath , Siddhi G. Rathi , Deepali S. Patil

Pes planus is also known as flatfoot. It comes from Latin words that mean *pes* as foot and *planus* as flat or ground level. Here, the medial longitudinal arch of the foot descends, resulting in a lack of spring action and increased stress on the entire foot with each step. It serves as an adaptive support base for the entire body, functions to dissipate the forces of weight bearing and acts to store energy during the gait cycle. The dysfunction of the arch complex typically does not present with symptoms; however, it can impact the biomechanics of the lower limbs and lumbar spine, leading to a higher likelihood of pain and injury. Occurrence of pes planus among children exceeds 70% during the initial 4 to 6 years of life, yet it has been documented to decline to approximately 9% post the age of 6.

Flatfoot is defined by the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes. Flat feet are commonly seen in orthopedic clinics and are usually functional and painless. The etiology of flatfoot remains elusive at present. Numerous studies propose a correlation between the debilitation of the intrinsic muscles of the foot and the diverse abnormalities that impact the foot arch, including both pes planus and pes cavus.

Case Presentation

A 20-year-old female arrived at the musculoskeletal department of physiotherapy with concerns about her walking difficulties. These difficulties were attributed to her developmental flatfeet and an underdeveloped heel on one foot, which she has had since birth. Despite these structural issues, her general examination showed no abnormalities, and she was able to maintain normal activity levels. Upon clinical examination, it was confirmed that she had bilateral flatfeet with decreased arches and an underdeveloped heel on 1 foot.

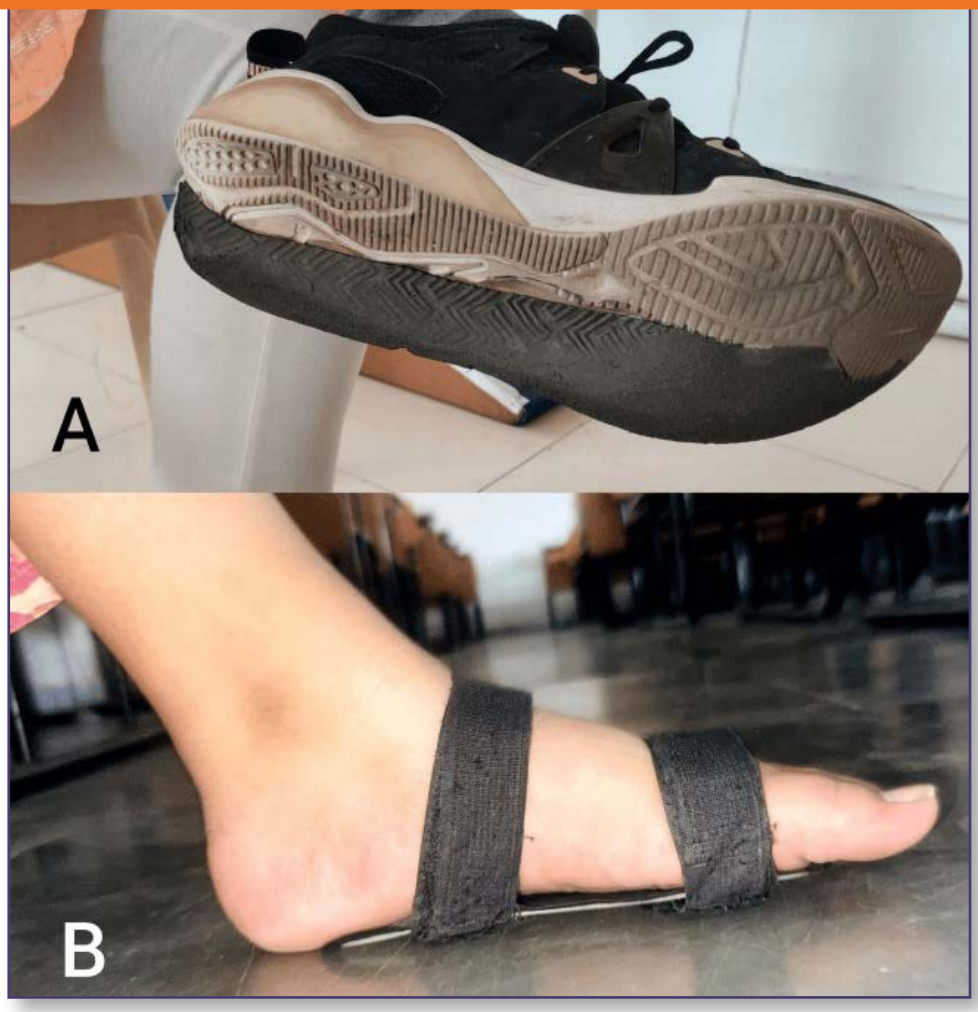

Figure 1: A- Implanted plates in shoes; B- Arch support splints

She was utilizing orthotic interventions such as arch support splints for both feet (Figure 1A) and implanted plates in her shoes (Figure 1B) to assist with balance while walking. Flatfoot was confirmed through the Fiess line test, as illustrated in Figure 2. On examination, manual muscle testing (MMT) (Table 1) was conducted on the patient with flatfoot before rehabilitation was given. It was observed that there was reduced strength in dorsiflexion and inversion movements compared to plantarflexion and eversion, indicative of possible muscle imbalances associated with the condition. The patient also complained of pain during strenuous activity. X-sens gait analysis was employed to examine and analyze gait patterns. However, apart from these foot deformities, no other

This article has been excerpted from "Effect of Foot Rehabilitation Exercises for Painful Flat Foot in a 20-Year-Old Female: A Case Study Analysis," by the same authors, which was originally published in Cureus 2024;16(4): e59377. DOI 10.7759/cureus.59377. Editing has occurred, including the removal of references for brevity. Use is per CC Attribution 4.0 International License.

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significant abnormalities are noted. Neurologically, she displays normal muscle tone and strength in both lower extremities. Gait analysis indicated compensatory movements to adjust to the altered foot structure. With ongoing orthotic management and monitoring, her prognosis for maintaining functional independence remains positive.

Physiotherapy Management Intervention

Physiotherapy plays a pivotal role in the comprehensive management of patients with flatfoot, a condition characterized by the collapse or flattening of the arches of the feet. Through a tailored regimen of exercises and interventions, physiotherapists aim to alleviate symptoms, enhance foot strength, and improve overall biomechanics. The treatment protocol is typically designed for 2 months of duration with 5 days per week. It involves a combination of targeted exercises such as towel gathering, heel cord stretching, toe spreading, and posterior tibialis exercises. These exercises not only help in strengthening the intrinsic foot muscles but also promote flexibility and alignment of the foot structures. Additionally, incorporating barefoot walking or engaging in activities without supportive footwear allows for natural movement patterns, facilitating proprioceptive feedback and muscle activation. Table 2 displays a well-designed exercise protocol for foot rehabilitation. Under the guidance of a physiotherapist, patients embark on a journey of rehabilitation, gradually restoring function and stability to their feet. Through consistent dedication to the prescribed program, individuals with flatfoot can experience significant improvements in pain management, mobility, and overall quality of life, thereby highlighting the invaluable role of physiotherapy in the holistic management of this condition.

Figure 2: Fiess-line test

Outcome measures for this intervention included a visual analog scale to assess pain levels during strenuous activities of the patient, along with foot assessment scales such as Foot Function Index (FFI), Foot and Ankle Ability Measures (FAAM), and Foot Posture Index (FPI), as mentioned in Table 3.

Post-intervention, orthotic management and ongoing monitoring have been initiated to facilitate functional independence.

Discussion

Pes planus is a prevalent condition marked by the collapse of the medial arch, abduction of the forefoot, internal rotation, plantar flexion of the talus, and eversion of the calcaneus. Subotnick reported that pes planus is observed in 20% of the overall population. Khamis and Yizhar et al concluded that changes in foot structure can have an impact on adjacent body segments due to the interconnected nature of the body's structures, which can be likened to a chain reaction manner. Indeed, according to Precilla et al, the kinematic chain exercise has demonstrated a significant impact in reducing pain from flatfeet, resulting in noticeable improvements in foot function and balance as well.

The present case has difficulty in walking due to flatfeet and an underdeveloped heel highlights the importance of physiotherapy in treating such conditions. Physiotherapists play a vital role in dealing with the issues caused by flatfeet by using specific exercises and treatments to reduce symptoms and enhance

S.No.	Targeting Muscles	Pre-rehabilitation	Post-rehabilitation
1	Intrinsic muscles	1	4+
2	Abductor hallucis muscle (Toe abduction)	1	4+
3	Dorsiflexors	1	4+

Table 1: Pre- and Post-rehabilitation Manual Muscle Testing (MMT)

MMT- 0: No evidence of muscle contraction; 1: Trace contraction, but no movement; 2: Movement with gravity eliminated (passive range of motion); 3: Movement against gravity, but without resistance; 4: Movement against gravity and some resistance; 5: Normal strength, movement against full resistance

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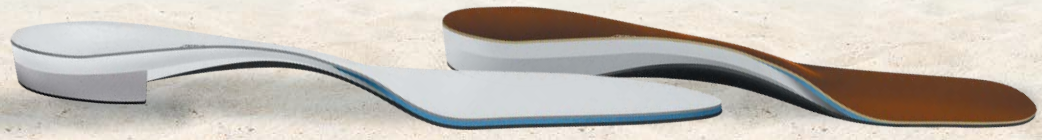

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S.No.	Exercise program	Description of Exercise	Intensity
1	Scrunching exercise	Scrunching exercise that involves compressing a towel that is lying on the floor between the toes.	15 minutes/session
2	Achilles tendon stretching	One leg should be forward and slightly bent at the knee while facing a wall. inform the participants to place their other leg behind them and to keep both their heels flat on the ground. Asked to gently press your hips against the wall	Hold for 30 seconds, followed by a 30-second relaxation period, and then repeat once 3 sets of 10 repetitions
3	Toe abduction exercise	Placing both feet flat on the floor. Tell to abduct toes as widely as possible.	Hold out for 5 seconds and then relax for 2 seconds. 3 sets of 10 repetitions
4	Strengthening of Posterior Tibialis	For these the participant has to cross seat and tie Band of resistance around foot. On other end of band underneath to the other foot. Ankle has to be relaxed and tell to move foot upwards towards roof. Return to start position slowly	3 sets of 10 repetitions 5 days once a week for 60 days
5	Golf ball rolling	Determine which foot is afflicted. While sitting comfortably on a chair with both feet flat on the floor. Place the golf ball beneath the arch of the foot, then roll it back and forth under the arch with light pressure	Continue this rolling motion for approximately 2 minutes.
6	Bare foot walking	Participants were asked to go barefoot or told to wear either sock, slippers without any supports and standing activities like watching TV, playing, key is that they have stand on their feet	Bare foot walking for at-least 45 minutes with barefoot activity per day, 5 times a week

Table 2: Optimized exercise protocol for flatfoot rehabilitation

S.No.	Assessing scales	Pre-rehabilitation (/n)	Post-rehabilitation (/n)
1	Foot Function Index (FFI)	Pain and stiffness: 5/6	Pain and stiffness: 2/6
		Difficulty: 4/6	Difficulty: 1/6
		Activity Limitation: 5/6	Activity Limitation: 1/6
2	Visual analogue scale (VAS)	07/10	02/10
3	Foot and Ankle Ability Measures (FAAM)	ADL subscale - 50%	ADL subscale- 97%
		Sports subscale- 50%	Sports subscale- 100%
4	Foot Posture Index (FPI-6)	06/12	-2/12

Table 3: Pre- and Post-rehabilitation Assessments for flatfoot

FFI: Pain: 1: No pain; 2: Mild pain; 3: Moderate pain; 4: Severe pain; 5: Very severe pain; 6: Worst pain imaginable; Difficulty: 1: No difficulty; 2: Mild difficulty; 3: Moderate difficulty; 4: Severe difficulty; 5: Very severe difficulty; 6: So difficult unable; Activity limitation 1: None of the time; 2: A little of the time; 3: Some of the time; 4: Much of the time; 5: Most of the time; 6: All of the time

VAS: 0: No pain; 10: Worst pain

FAAM: Higher (100%) the score lesser the disability

FFPI-6: Normal: 0 to +5; Pronated: +6 to +9, Highly Pronated +10: Supinated: -1 to -4, Highly supinated -5 to -12

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foot mechanics. The recommended 2-month treatment plan, which includes exercises such as towel scrunches, heel stretches, toe spreads, and posterior tibialis exercises done 5 times a week, shows potential in strengthening the muscles in the feet and improving their flexibility and alignment. Encouraging activities without shoes also helps promote natural movements, which aids in providing feedback to the muscles and activating them.

The exercise plan provided in Table 2 offers a comprehensive approach to foot rehabilitation, highlighting the diverse aspects of physiotherapy in addressing concerns related to flatfeet. Towel-gathering exercises, for instance, help strengthen the intrinsic foot muscles. Meanwhile, heel cord stretching promotes flexibility in the Achilles tendon and calf muscles, essential for achieving proper foot alignment during gait. Furthermore, incorporating exercises that target toe spreading and activate the posterior tibialis muscle aids in stabilizing and providing support to the arches of the foot. Strengthening the posterior tibialis muscle, in particular, is pivotal in preventing excessive pronation and supporting the medial longitudinal arch.

FFI is a self-administered survey utilized for evaluating how foot problems or injuries affect a person's capacity to carry out everyday tasks. Visual analogue scale is used to check pre- and post-rehabilitation pain level. FAAM is a questionnaire that individuals complete to assess their functional limitations and disabilities associated with foot and ankle conditions. FPI is a clinical tool used to assess the static alignment of the foot and ankle complex.

A cross-sectional investigation was carried out to assess and contrast the reliability and diagnostic precision of the FPI-6 and Clarke's angle (CA) in identifying flexible flatfoot in adolescents age 12 to 18 years, taking into account radiographic examination as the benchmark measure. In their systematic review, Hara et al analyzed the impacts of short-foot exercise (SFE) in contrast to foot orthosis or alternative forms of interventions. Physiotherapy interventions focus on these particular muscle groups to address biomechanical abnormalities linked to flatfoot, ultimately relieving symptoms and enhancing functional outcomes.

Figure 3: A- Achilles tendon stretching and B- Strengthening of Posterior Tibialis

Figure 4: Golf ball rolling exercise

Conclusions

In this case study, the efficacy of foot rehabilitation exercises in managing painful flatfoot in a 20-year-old female was investigated. The patient's presentation with foot pain and discomfort due to flatfeet significantly impacted her daily functioning and quality of life. Through a structured rehabilitation program comprising targeted exercises, stretching, and orthotic intervention, notable improvements were observed in pain reduction, functional mobility, and foot posture. The implementation of a personalized exercise regimen focusing on intrinsic foot muscle strengthening, arch support enhancement, and proprioception improvement played a pivotal role in addressing the underlying biomechanical issues contributing to painful flatfoot. Moreover, incorporating stretching exercises helped alleviate muscle tightness and enhance flexibility, augmenting the effectiveness of the rehabilitation program. This case study underscores the importance of tailored rehabilitation protocols to meet individual needs in patients with painful flatfoot. By targeting biomechanical abnormalities, strengthening intrinsic foot muscles, and optimizing foot posture, clinicians can effectively alleviate symptoms, enhance functional outcomes, and improve overall quality of life for individuals with this condition. Further research and larger-scale studies are warranted to validate these findings and elucidate the long-term efficacy of foot rehabilitation interventions for painful flatfoot. Ultimately, continuous studies on foot rehabilitation not only improve clinical procedures but also play a fundamental role in fostering overall wellness and reinstating functional autonomy for individuals. ler

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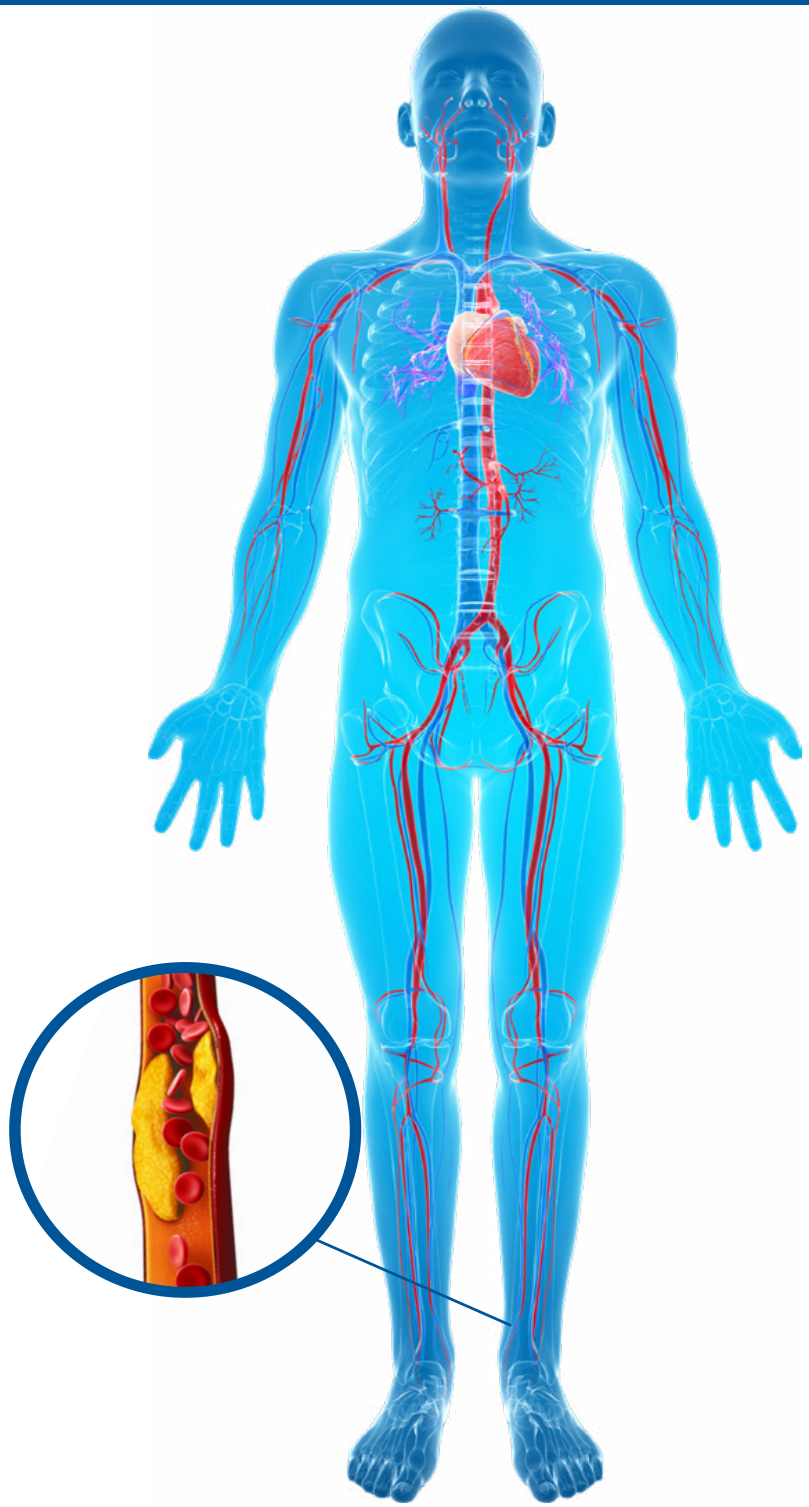

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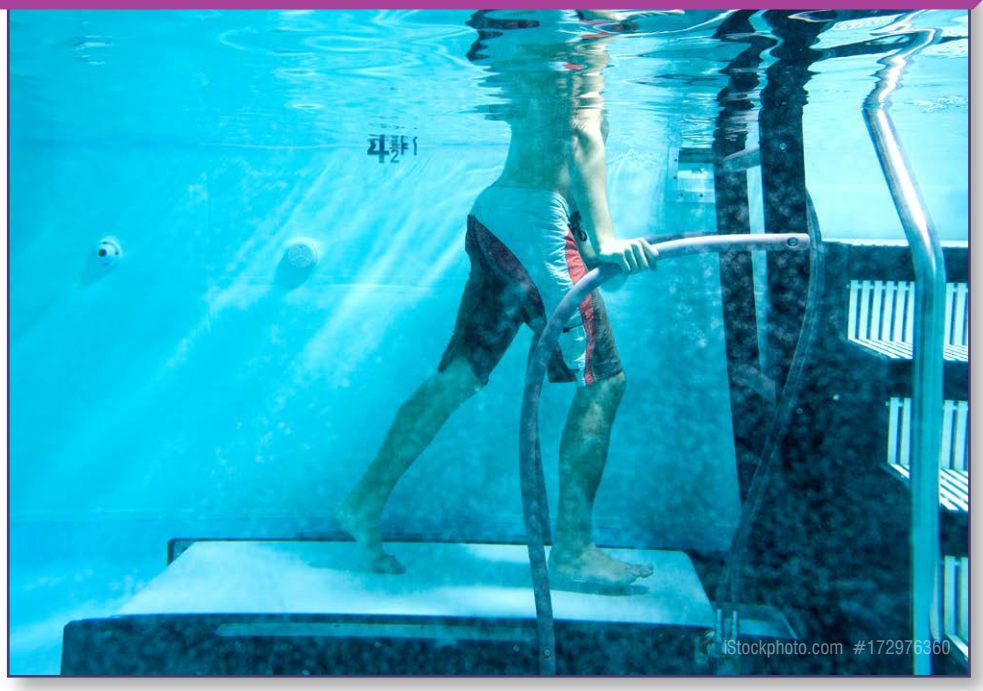
Aquatic vs Conventional PT for Severe Ankle Sprains in Elite Athletes

By Maryam M. Sadaak, Salwa Fadl Abdelmageed, and Mona Mohamed Ibrahim



This study came as highly needed because it highlighted the benefit of aquatic training in the rehabilitation of Grade 3 acute ankle sprain by showing very promising results.

Ankle sprains are the second most common sports injury after knee injuries, with about 85% of them affecting the lateral ankle ligaments, and ankle injuries account for 14% of orthopedic emergency visits related to sports. These injuries are particularly prevalent in sports like basketball and volleyball due to jumping and landing mechanisms as well as rapid direction changes.

Physiotherapy, incorporating functional therapy along with a pain-free active range of motion, manual therapy, anteroposterior manipulation, therapeutic exercise, taping, muscle strength training, stability training, and sport-specific exercises, has shown promising results compared to immobilization and the PRICE (Protection, Rest, Ice, Compression and Elevation) protocol only during the inflammatory phase. The use of a semi-rigid cast in the early phase of ankle sprain was associated with faster recovery and higher satisfaction compared to elastic bandages. In cases where conservative treatment fails to improve stability, pain, or function after 3–6 months, surgical intervention with the modified Broström technique as the primary approach was recommended, followed by the anatomical reconstruction approach when there is a lack of adequate tissues for repair.

With this in mind, the study authors sought to investigate the effect of aquatic therapy as an early rehabilitation protocol for elite athletes with acute Grade 3 lateral ankle sprain Grade 3 on back-to-sport time, dynamic balance, pain, athletic performance, and muscle power compared to land-based exercise training.

Methods

The cohort included 38 athletes, age 18–30 years, with Grade 3 ankle sprain with sprain onset from 1 to 7 days. All participants are professional athletes, mainly participating in above-head sports such as volleyball and basketball. The patients were randomly allocated into 2 treatment groups: Group I (control group): 15 patients received a conventional physical therapy (PT) program of structured therapeutic exercise program, manual therapy, and land-based exercises, in addition to external support; and Group II (aquatic therapy group): 15 patients received aquatic training (refer to blue box on page 48). Visual Analog Scale (VAS) was used to measure the pain intensity, while the dynamic balance was measured by the Star Excursion Balance Test (SEBT). Athletic performance was measured by HOP Tests (single, triple, 6-m, and crossover hops) aided by the Agility T-Test (ATT) and Illinois Agility Test (IAT). Muscle power was tested by a single leg press. Finally, back to sports time was recorded for each participant in both groups.

Results

There was a significant interaction effect of aquatic therapy and time for VAS ($P < 0.001$), single hop ($P < 0.001$), triple hop ($P < 0.001$),

This article has been excerpted from "Effect of aquatic versus conventional physical therapy program on ankle sprain Grade 3 in elite athletes: randomized controlled trial." J Orthop Surg Res 19, 400 (2024). https://doi.org/10.1186/s13018-024-04855-0. Editing has occurred, including the renumbering or removal of tables and figures, and references have been removed for brevity.

Continued on page 47

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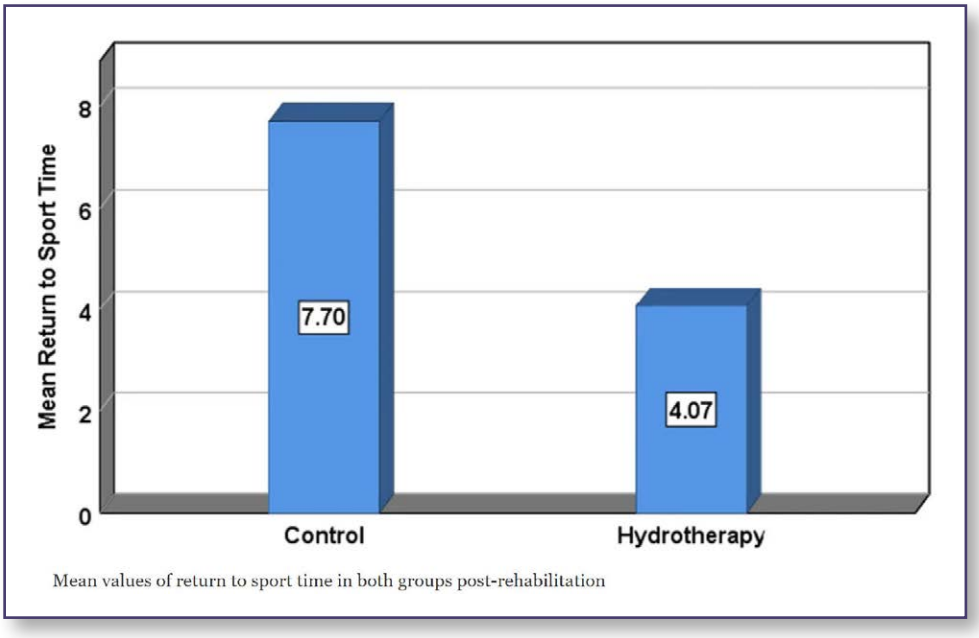
Continued from page 44

crossover hop ($P < 0.001$), IAT ($P = 0.019$), and ATT ($P < 0.001$) of both affected and nonaffected. There was no significant interaction effect of aquatic therapy and time for 6-MHT of affected ($P = 0.923$) and nonaffected ($P = 0.140$). There was a significant main effect of time for all dependent variables ($P < 0.001$) except for 6-MHT of affected ($P = 0.939$), nonaffected ($P = 0.109$) subjects, and IAT ($P = 0.099$). The SEBT and single leg press revealed a significant difference between groups on affected and non-affected sides ($P < 0.001$*). Lastly and most importantly, the back-to-sport time revealed a significant difference in the return-to-sport time in favor of the aquatic therapy group, who returned faster than the control group ($P < 0.001$*) (Figure).



Mean values of return to sport time in both groups post-rehabilitation

Discussion

The findings of the present study demonstrate the superiority of an accelerated early intervention protocol utilizing a 4-week aquatic therapy training program for Grade 3 acute ankle sprain in elite professional athletes. A comparison with the traditional physiotherapy rehabilitation program revealed significant differences favoring the aquatic therapy group in terms of ankle pain, overall functionality, dynamic balance, and various athletic performance and power measures. Notably, athletes following the suggested aquatic therapy protocol achieved a faster return to sport, approximately 4.7 weeks after injury, compared to 7.7 weeks for land-based exercises used in the control group. These results challenge the common practice of immobilization and casting and recently rigid tapping as the initial treatment, favoring functional treatment and therapeutic exercises in enhancing athletic performance and reducing the risk of reinjury.

Related research regarding this study showed no significant difference between aquatic therapy and land-based therapy regarding chronic ankle instability treatment. Therefore, this study came as highly needed because it highlighted the benefit of aquatic training in the rehabilitation of Grade 3 acute ankle sprain by showing very promising results.

Aquatic therapy presented strong historical beneficial usage and overall reduction of pain together with both cardiovascular and musculoskeletal health beneficial effects through water buoyancy. However, it showed no significant difference from other types of therapy for some orthopedic conditions such as osteoarthritis. Therefore, these studies formed a strong base for the current study to support the superior results that were shown by this study.

Considering individual preferences and factors like cost, accessibility, and resource availability is crucial when selecting the most appropriate treatment for acute ankle sprains. Aquatic therapy may be particularly suitable for individuals who prefer water-based exercises or have limitations in weight-bearing activities, while traditional PT may offer greater accessibility and cost-effectiveness for certain individuals.

The current study focused on the ultimate way to decrease the return-to-sport time while maintaining the optimal performance level, the least amount of pain, and ideal balance and muscle power, which in return increased the general satisfaction and psychological welfare of both the athletes and their contractors. However, it was limited to the professional athletic population of mainly overhead athletes and high-contact sports age 18–30 years and had injuries within 7 days.

The findings of the current study agreed with that of a previous study regarding edema and pain in specific musculoskeletal conditions of assuming the upright position during running in water. This upright posture resembles walking and non-weight-bearing exercise in warm water in the aquatic therapy group. Moreover, certain studies have indicated that aquatic therapy could potentially alleviate pain in individuals with musculoskeletal injuries when compared to receiving no therapy. However, these studies did not find significant pain reduction benefits of aquatic therapy when compared to ground exercises.

Previous research has consistently indicated that aquatic therapy holds promise in enhancing performance outcomes among athletes with musculoskeletal injuries and has found supporting evidence for its efficacy in regard to muscle power and performance parameters. Aquatic therapy can help athletes with deficits secondary to ankle sprain by facilitating early rehabilitation through water buoyancy, reducing pressure over the joints, decreasing pain and swelling, and increasing strength, flexibility, and range of motion. It also provides a low-impact environment for athletes, reducing stress on the joints and allowing them to safely perform exercises that may not be possible on land. Underwater exercises can improve balance and stability in athletes with ankle sprains by enhancing proprioception, leading to improved joint stability and better performance on land-based activities. Further, investigations assessing the impact of aquatic therapy on various athletic performance measures, such as speed, jumping ability, and power, have reported significant improvements following the intervention.

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In line with these findings, this study demonstrated that elite professional athletes participating in a 4-week aquatic therapy training program exhibited significant improvements in muscle power level, agility, and balance compared to those undergoing traditional PT rehabilitation. These results reinforce the notion that aquatic therapy offers a valuable approach to optimizing athletic performance during the recovery process.

While this study demonstrated significant positive outcomes of aquatic therapy for Grade 3 ankle sprains, several questions remain unanswered, presenting avenues for future research. Firstly, the long-term effects of aquatic therapy on functional outcomes, such as return to sports and prevention of recurrent sprains, need to be explored. Lastly, exploring the potential benefits of combining aquatic therapy with other complementary interventions, such as manual therapy or neuromuscular training, may further enhance the rehabilitation outcomes for individuals with Grade 3 ankle sprains. Future research endeavors addressing these unanswered questions will contribute to a deeper understanding of the therapeutic potential of aquatic therapy and further optimize its application in clinical practice.

Conclusion

Aquatic therapy is more effective than traditional protocols regarding early rehabilitation of Grade 3 acute ankle sprain in elite professional athletes for reducing pain intensity, improving dynamic balance and athletic performance and power, and accelerating their return to sports time. Because aquatic therapy produces better outcomes, it is advised to be included in the rehabilitation programs of athletic patients with Grade 3 acute ankle sprains.

Authors

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Treatment Protocols

All groups were treated by the same physical therapist. Group I received a rehabilitation protocol approved by the Clinical Practice Guidelines Linked to the International Classification of Functioning, Disability and Health from the Academy of Orthopedic Physical Therapy of the American Physical Therapy Association, while group II received the aquatic therapy program.

- Visual Analog Scale (VAS) was used to measure the pain intensity.
- Assessment of dynamic balance was measured by the Star Excursion Balance Test.
- Functional performance was assessed by the HOP tests which are used to assess an athlete's performance and ability to return to sports after injury according to the level of his functional performance tests. These tests include the Single hop test (SHT), Triple hop test (THT), Cross-over hop test (CHT), and 6-m hop test.
- The Illinois Agility Test (IAT) and the Agility T-test were used to measure the athlete's ability to change direction, accelerate, decelerate, and move laterally. It involves forward, lateral, and backward movements which are used for proprioception and athletic performance level assessment.
- Lastly, the muscles of the lower limb strength levels were assessed by the single-leg press test.To return to sports, athletes need to be able to do 10 reps of the single leg press with 1.5 times their body weight.

The control group received a conventional physical therapy rehabilitation program which consisted of: through the first-week means of immobilization were made by bracing and external support , Low-LASER therapy was used for managing the pain, occupational training, lymphatic drainage, therapeutic exercises in the form of active range of motion (ROM) (ankle pumps), active assisted eversion/inversion, stretching exercises, and neuromuscular training through towel curls.

In the second week, resistive ankle ROM was maintained through resisted dorsiflexion/planter-flexion, resisted inversion/eversion, postural re-education by doing toe raises and heel walking, balance training by lunging on stable/un-stable surfaces, step-ups/downs, lateral step-ups/downs, and lastly manual therapy techniques: joint mobilization, talar mobilization and 1st metatarsophalangeal joint mobilization grade I.

All techniques were done in relevance to the pain and the ability of the participants to perform them. In the third and fourth weeks, the exercise progressed to mini squat on an unstable surface, single-leg stance while playing catch, single-leg stance while playing with the coach, single-leg stance with lower-limb movement, and single-leg stance with lower-limb movement on an unstable surface regarding the balance training. The manual therapy included deep friction massage, joint mobilization, talar mobilization, and 1st metatarsophalangeal joint mobilization grade II/III was included in the program.

The aquatic therapy exercise group received underwater training from the first week as follows: warm-up by doing forward/backward walking, lateral walking, lateral cross-over stepping, straight-leg walking and deep-water bicycle, and stretching exercises that included the posterior calf and tibialis anterior muscles.

The exercise protocol was progressed through the second and third weeks by doing mobility training that consisted of planter/dorsiflexion using modified resistance fin, strengthening exercise that included hip extension, double-leg squat, single-leg squat, forward lunge, hip abduction from standing and lateral step-ups using elastic bands and underwater weights.

In the fourth week proprioception training was applied by doing forward lunges on a step while using dumbbells, single leg stance while tossing the ball, and squats on a modified underwater balance board; functional training was introduced by doing vertical jumping and stationary running using a resistance cord.

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MAGNETIC MAT HELPS MUSCLES TO WORK TOGETHER

Engineers at the Massachusetts Institute of Technology (MIT) have designed a sort of workout mat for cells that can help scientists zero in, at the microscopic level, on exercise's purely mechanical effects. The new design is not so different from a yoga mat: Both are rubbery, with a bit of stretch. In the case of the MIT mat, it's made from hydrogel—a soft, gel-like material that is about the size of a quarter and is embedded with magnetic microparticles.

To activate the gel's mechanical function, the researchers used an external magnet underneath the mat to move the embedded particles back and forth, wobbling the gel in turn like a vibrating mat. They controlled the frequency of the wobbling to mimic the forces that muscles would experience during actual exercise. They next grew a carpet of muscle cells on the gel's surface and activated the magnet's motion. Then, they studied how the cells responded to being "exercised" as they were magnetically vibrated.

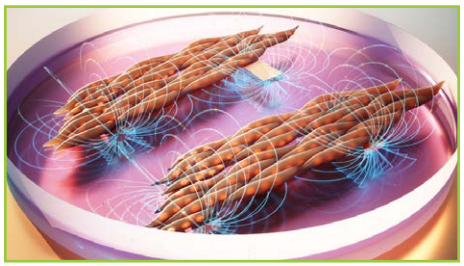

Image courtesy of Ella Marushchenko.

So far, the results suggest that regular mechanical exercise can help muscle fibers grow in the same direction. These aligned, "exercised" fibers can also work, or contract, in sync. The findings demonstrate that scientists can use the new workout gel to shape how muscle fibers grow. With their new device, the team plans to pattern sheets of strong, functional muscles, potentially for use in soft robots and for repairing diseased tissues.

"We hope to use this new platform to see whether mechanical stimulation could help guide muscle regrowth after injury or lessen the effects of aging," said Ritu Raman, PhD, the Brit and Alex d'Arbeloff Career Development Professor in Engineering Design at MIT. "Mechanical forces play a really important role in our bodies and lived environment. And now we have a tool to study that."

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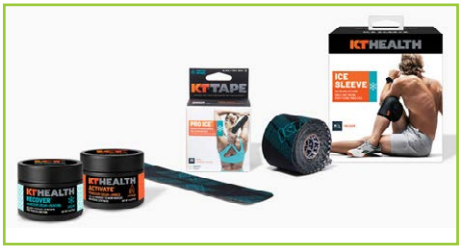

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SAMSUNG ELECTRONICS DEVELOPED HIP-ASSIST ROBOT TO ADVANCE FITNESS IN THE ELDERLY

Samsung Electronics has developed EX1, an exercise assistance robot, with the goal to

Image courtesy of Sahmyook University.

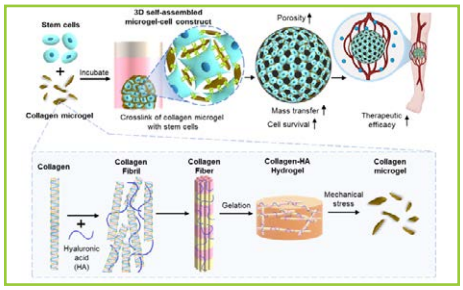
amplify physical function and strength in senior individuals. This advanced robotic aid offers tailored workouts with both assistive and resistive modes, aiming to prevent falls and bolster overall health in this demographic.

Led by Professor Wan-hee Lee from Sahmyook University College of Health Science, Korea, a collaborative team of researchers, Noble County, and Samsung Electronics, assessed the effectiveness of EX1 in executing a 4-week combined exercise program for older adults. Twenty-one adults age 65 years or above performed a supervised exercise program consisting of walking, and strength and balance exercises, wearing EX1 for 50 minutes per session, 3 times a week for 4 weeks. To compare pre- and post-exercise attributes, the spatiotemporal parameters and pelvic movement were analyzed by G-Walk. Additionally, functional outcomes were evaluated by the Timed Up and Go (TUG) test, muscle power by rehabilitative ultrasound imaging, and waist-hip ratio. Following the exercise regimen, significant improvements were noted in various spatiotemporal factors: stride length increased by 12.42%, whereas propulsion increased by 21.29%, suggesting improved walking ability. The TUG test revealed a 6.63% decrease in completion time, indicating improved dynamic balance and expanded movement range among participants. Additionally, there was a 1.71% reduction in the waist-hip ratio.

While the statistical significance of the increased walking speed wasn't confirmed, a noticeable enhancement, especially during mid-walking, was attributed to the assistive mode of EX1. This mode notably improved stride length, affecting forward movement in straight walking. Moreover, pelvic movement in 3 planes significantly improved, aligning within normal ranges, fostering efficient walking by reducing energy consumption and bolstering stability through extended feet and a lower body center. The exercise program also positively impacted 1-leg standing endurance, potentially due to strengthened hip-centered muscles crucial for fall prevention among older adults. Analysis of muscle activity revealed heightened activation of core muscles during walking, likely influenced by EX1's waist support, contributing to trunk stability maintenance.

These findings suggest that although the 4-week exercise period was relatively short for older adults and did not notably enhance muscle strength, EX1 still displayed positive effects on improving gait function and balance ability in this population.

STEM CELL THERAPY AIMS TO PREVENT AMPUTATIONS FROM CLI



This image depicts the concept of self-assembling stem cell therapy. Image courtesy of KIST

A research team led by Dr. Sangheon Kim of the Center for Biomaterials Research at the Korea Institute of Science and Technology (KIST) announced that they have developed a 3D stem cell therapy to treat critical limb ischemia (CLI) through a self-assembling platform technology using a new material microgel. By using collagen microgels, a new biocompatible material, the researchers were able to easily transplant stem cells into the body and increase cell survival rate compared to 3D stem cell therapies made of cells alone.

The team processed collagen hydrogels to micro-scale to create porous, 3D scaffolds that are easy to inject in the body and have a uniform cell distribution. The microgel-cell constructs developed by the researchers expressed more pro-angiogenic factors and exhibited higher angiogenic potential than cell-only constructs. When microgel-cell constructs were injected into the muscle tissue of mice with CLI, blood perfusion rate increased by about 40% and limb salvage ratio increased by 60% compared to the cell-only constructs, confirming their effectiveness in increasing blood flow and preventing necrosis in the ischemic limb.

Due to its excellent angiogenic effect, the new stem cell therapy is expected to provide an alternative for patients with CLI who have limited treatment options other than amputation. Furthermore, since angiogenesis is an essential component of various tissue regeneration processes, it can be extended to other diseases with similar mechanisms to peripheral arterial disease.

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NOVEL WEARABLE SENSORS AND AI TRANSFORM BALANCE ASSESSMENT

Using wearable sensors and advanced machine learning algorithms, researchers have developed a novel method that could revolutionize balance assessment practices. Image courtesy of Alex Dolce, FAU.

Using wearable sensors and advanced machine learning algorithms, researchers from Florida Atlantic University's College of Engineering and Computer Science have developed a novel approach that addresses a crucial gap in balance assessment and sets a new benchmark in the application of wearable technology and machine learning in healthcare. The approach is a significant advance in objective balance assessment, especially for remote monitoring in home-based or nursing care settings, potentially transforming balance disorder management.

For the study, researchers used the Modified Clinical Test of Sensory Interaction on Balance (m-CTSIB. Wearable sensors were placed on study participants' ankle, lumbar, sternum, wrist, and arm. Researchers collected comprehensive motion data from the participants under 4 different sensory conditions of m-CTSIB: balance performance with eyes open and closed on a stable surface; and eyes open and closed on a foam surface. Each test condition lasted about 11 seconds without breaks to simulate continuous balance challenges and streamline the assessment process. Researchers used inertial measurement unit (IMU) sensors coupled with a specialized system to evaluate ground truth m-CTSIB balance scores for their analysis.

The data was then preprocessed and an extensive array of features was extracted for analysis. To estimate the m-CTSIB scores, researchers applied Multiple Linear Regression, Support Vector Regression and XGBOOST algorithms. The wearable sensor data served as the input for their machine-learning models, and the corresponding m-CTSIB scores from Falltrak II, 1 of the leading tools in fall prevention, acted as the ground truth labels for model training and validation. Multiple machine-learning models were then developed to estimate m-CTSIB scores from the wearable sensor data. Researchers also explored the most effective sensor placements to optimize balance analysis.

Results of the study underscore this approach's high accuracy and strong correlation with ground truth balance scores, suggesting the method is effective and reliable in estimating balance. Data from lumbar and dominant ankle sensors demonstrated the highest performance in balance score estimation, highlighting the importance of strategic sensor placement for capturing relevant balance adjustments and movements.

"Positioned on areas like the lower back and lower limbs, these sensors provide insights into 3D movement dynamics, essential for applications such as fall risk assessment in diverse populations, "said Behnaz Ghoraani, PhD, associate professor, FAU Department of Electrical Engineering and Computer Science, co-director of the FAU Center for SMART Health, and a fellow, FAU Institute for Sensing and Embedded Network Systems Engineering. "Coupled with the evolution of machine learning, these sensor-derived datasets transform into objective, quantifiable balance metrics, using an array of machine learning techniques."

Results provide important insights into the significance of specific movements, feature selection, and sensor placement in estimating balance. Notably, the XGBOOST model, utilizing the lumbar sensor data, achieved outstanding results in both cross-validation methods and demonstrated a high correlation and a low mean absolute error, indicating consistent performance.

The objectives of this study emerged from recognizing the need for advanced tools to capture the nuanced effects of different sensory inputs on balance.

NEW JOURNAL WILL FOCUS ON REHABILITATION AND ASSISTIVE TECHNOLOGIES

JMIR Rehabilitation and Assistive Technologies, a member publication of the University of Toronto is a new venue for publishing interdisciplinary research on the development, implementation, and evaluation of health innovations and emerging technologies in the field of rehabilitation, with a focus on pragmatic yet rigorous and impactful science. These innovations may also relate to a program such as a self-management intervention, clinical pathway, or device. Further, the publisher is interested in submissions that describe the need for rehabilitation interventions and innovations (eg, gaps in the transition from acute care to rehabilitation). Also welcomed are original research articles, review articles, viewpoints, or research letters related to methodological advances in the study of rehabilitation and its assistive technologies. In particular, the publisher is interested in papers that engage relevant knowledge users (eg, patients, families, etc.) in developing, implementing, and evaluating these health innovations and interventions and emerging technologies. Mixed methods studies are highly relevant for studying the complexities of rehabilitation and thus are also welcomed submissions. JMIR Publications, an open-access publisher, aims to reach wide audiences.

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RESEARCH TEAM DEVELOPS NEW TECHNOLOGY FOR ROBOTIC PROSTHETIC LEG CONTROL

A subject demonstrates robotic control of a prosthetic foot using a Raspberry Pi4 system. Robotic control was also demonstrated with Bluetooth and with the subject wired to the prosthetic foot. Image courtesy of Daegu Gyeongbuk Institute of Science and Technology.

A research team led by Professor Sang-hoon Lee at the Department of Robotics and Mechatronics Engineering, Daegu Gyeongbuk Institute of Science and Technology. South Korea, has successfully developed an imperceptive surface electromyography (sEMG) sensor. The sensor is crucial in allowing people with lower limb amputations to control robotic prosthetic legs as they want and is expected to contribute greatly to rehabilitation and a better quality of life.

This imperceptive sEMG sensor mimics a serpentine structure to provide flexibility and elasticity while achieving breathability and adhesion. Hence, the sensor can be applied to various amputated parts of the body and can be used repeatedly over an extended period of time. Furthermore, combined with a wireless module, the sensor obtains real-time signals generated when it is used to walk with robotic prosthetic limbs, sockets, and silicone liners.

To verify the sensor's function, the research team attached the imperceptive sEMG sensor to the residual limb of a study subject and evaluated the sensor's function by recording the subject's muscle signals. The results demonstrated that the sensor successfully acquired high-quality, real-time muscle signals of the subject walking in various environments (on flat ground, up and down slopes, and on stairs) and transmitted the signals wirelessly to assist the individual in walking, as verified from the motion analysis sensor embedded in the robotic prosthetic leg.

Furthermore, by analyzing muscle signals generated from plantarflexion and dorsiflexion in people with lower limb amputations, the research team confirmed that the selective signal acquisition performance of the imperceptive sEMG sensor is better than that of other commercial sensors. In this regard, the research team expects the sensor to be applied across various wearable technologies, in addition to precise control of robotic prosthetic legs and hands based on bio-signals.

OTC BIOELECTRIC BANDAGE

Vomaris recently announced the launch of its US Food & Drug Administration–cleared PowerHeal™ bioelectric bandage for over-the-counter (OTC) use. PowerHeal bioelectric bandages are powered by patented microcell battery technology. Foundationally inspired by the body, the technology mimics the electrical energy (known as transepithelial potential) that skin naturally creates and uses to heal itself. This approach not only creates an optimal healing environment by maintaining moisture, it provides crucial antibacterial protection and introduces a new dimension of care, by generating electricity through moisture-activated microcell batteries that are embedded within the bandages. PowerHeal does more than just cover a wound like traditional bandages, it helps heal it. Multiple published scientific and clinical studies have demonstrated its ability to accelerate the movement of healing cells across the wound surface and to effectively kill up to 99.99% of bacteria without the use of antibiotics, to help heal wounds by 2–3 times faster.

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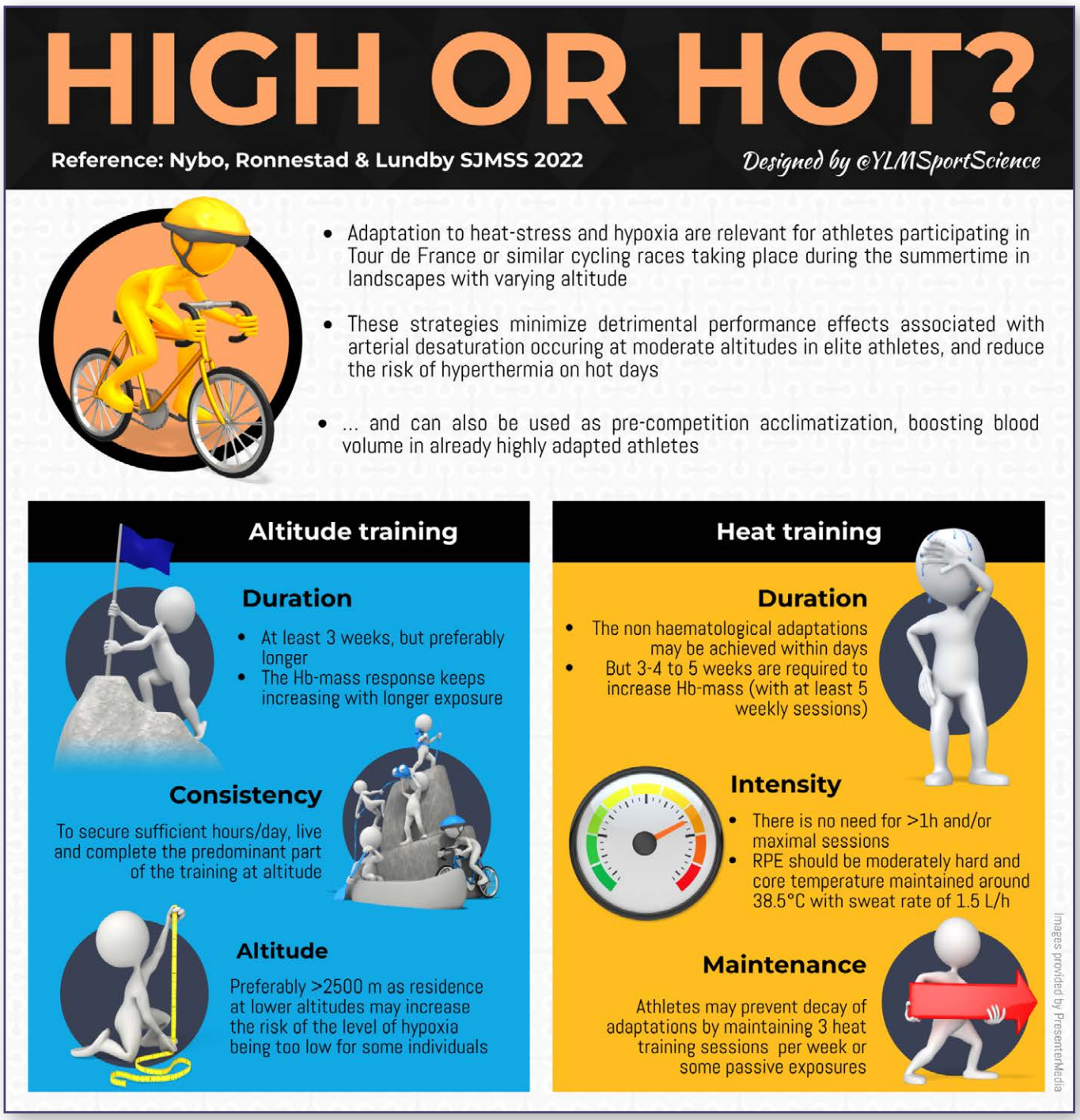
iTENS
itens.com



Source: Nybo L, Rønnestad B, Lundby C. High or hot—Perspectives on altitude camps and heat-acclimation training as preparation for prolonged stage races. Scand J Med Sci Sports. 2024; 34:e14268. doi: 10.1111/sms.14268

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