Foot & Ankle RESEARCH REVIEW™

Making Education Easy

Issue 59 – 2024

In this issue:

Abbreviations used in this issue

AOFAS = American Orthopaedic Foot & Ankle Society
BMI = body mass index
CI = confidence interval
DPN = diabetes-related peripheral neuropathy
HbA1c = haemoglobin A1c
MTP = metatarsophalangeal
PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT = randomised controlled trial
ROM = range of motion

Welcome to Issue 59 of Foot and Ankle Research Review.

In this issue I highlight some recent publications investigating the role of biomechanical tests such as the supination resistance test, what neurological tests tell us and the possible link between childhood foot structure and adult foot complications. I also enjoyed the American review of a surgical procedure for the management of intractable plantar keratoses, which are notoriously tricky to remedy conservatively.

I hope you enjoy this issue.

Noho ora mai

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Supination resistance variations in foot and ankle musculoskeletal disorders: Implications for diagnosis and customised interventions with wedged insoles

Authors: Moisan G et al.

Summary: This study sought to quantify supination resistance (external force required to supinate the foot) in patients with plantar fasciopathy (PF; n = 14), posterior tibial tendon dysfunction (PTTD; n = 14) and chronic ankle instability (CAI; n = 14) versus 14 healthy controls. Supination resistance was lower in the foot with CAI ($p < 0.001$) and greater with PTTD ($p < 0.001$) than in the healthy foot. There was no difference between feet in PF or in healthy controls. In the injured CAI foot, supination resistance was lower than in healthy controls ($p < 0.001$), and in PF ($p = 0.012$) and PTTD ($p = 0.014$) feet. Regardless of group, supination resistance was higher on a surface with valgus inclination ($p < 0.001$) and lower on a surface with varus inclination ($p < 0.001$).

Comment: In the past, the supination resistance test has been employed to gauge the vertical lifting force required to supinate the weightbearing foot. The theory suggests that higher resistance to supination might signify increased demands on structures that manage pronation or generate supination moments across the subtalar joint. The study investigated supination resistance variations in individuals with different musculoskeletal disorders (CAI, PF, PTTD) compared to controls. It found that individuals with CAI exhibited lower supination resistance in the injured foot, making them prone to ankle sprains and long-term joint issues. Conversely, those with PTTD showed greater supination resistance in the injured foot due to morphological changes in the foot and ankle. However, individuals with PF did not display differences in supination resistance between injured and healthy feet. The study also observed that supination resistance increased during valgus inclination and decreased during varus inclination, with exceptions noted in CAI. Varus inclination decreased supination resistance in PTTD, bringing it closer to healthy foot levels.

Reference: J Foot Ankle Res. 2023;16(1):91

Abstract

Outcomes after proximal medial gastrocnemius recession and stretching vs stretching as treatment of chronic plantar fasciitis at 6-year follow-up

Authors: Riiser MO et al.

Summary: This 6-year comparative trial assessed long-term clinical outcomes of proximal medial gastrocnemius recession (PMGR) and stretching versus a protocol of stretching exercise among 40 patients with chronic plantar fasciitis and isolated gastrocnemius contracture. At 6 years, 33 patients were available for follow-up and seven patients had crossed over from non-operative to operative treatment. In a per-protocol analysis excluding crossovers, the operative group had better outcomes at 6 years based on American Orthopaedic Foot & Ankle Society (AOFAS) ankle-hindfoot score (88.9 vs 78.6; $p = 0.012$), for pain measured by Visual Analogue Scale (2.5 vs 5.5; $p < 0.001$), and for Manchester Oxford Foot Questionnaire total score (24.4 vs 45.9; $p = 0.05$). There were no between-group differences in ankle dorsiflexion or Achilles complex performance.

Comment: Despite no significant differences in ankle dorsiflexion or Achilles complex performance from baseline to 6 years' follow-up between groups, PMGR surgery was deemed safe and efficient. Further studies are needed to observe the long-term effects of PMGR surgery on ankle dorsiflexion and to understand additional factors contributing to chronic plantar fasciitis development. Limitations must be considered when interpreting the results, namely, the small sample size and challenges with the primary outcome measure, the AOFAS ankle-hindfoot score, which has limitations with respect to the test's responsiveness and reliability.

Reference: Foot Ankle Int. 2024;45(1):1-9
Abstract

Successful treatment of advanced Freiberg's disease with a modified Weil osteotomy, 5-year follow up: A Pilot case series with a review of the literature

Authors: Kooner S et al.

Summary: This small study assessed the 5-year clinical outcomes of a modified Weil osteotomy in 12 patients (mean age 30.7 years) with advanced Freiberg's disease. Over a mean follow-up of 5.2 years, all patients had postoperative radiological union and AOFAS score improved from 48.1 to 88.9 (mean improvement 40.8; $p < 0.001$). Overall, 92% of patients were satisfied with treatment at final follow-up, with excellent or good results. A superficial postoperative infection occurred in one patient and was treated with oral antibiotics.

Comment: Freiberg's disease is a common osteochondrosis that typically involves younger females with a predilection for the second metatarsal head. Freiberg's disease presents therapeutic challenges due to its rarity and varied treatment options. This study focused on assessing the long-term outcomes of modified Weil osteotomy in treating Freiberg's disease. Data showed excellent 5-year postoperative outcomes with minimal complications in 12 feet treated for advanced disease, supporting the study's hypothesis. Comparisons with previous studies on modified Weil osteotomy revealed similar efficacy and satisfaction rates. Complication rates ranged from 5% to 30%, mainly minor issues such as metatarsalgia and toe stiffness, treated conservatively. Despite the small patient cohort, this study stands as one of the largest case series on advanced Freiberg's disease treatment with modified Weil osteotomy, featuring a long follow-up period and a 100% follow-up rate. However, limitations include the lack of comparison with non-operative treatment and the need for larger, multicentre studies for better statistical power and comparison with alternative surgical approaches. Nonetheless, the study underscores the efficacy and safety of modified Weil osteotomy even in severe cases of Freiberg's disease.

Reference: Foot (Edinb). 2023;57:101952
Abstract

Surgical excision of intractable plantar keratoses (corns) of the foot: A scoping review

Authors: Reilly IN et al.

Summary: This scoping literature review assessed chart data on the surgical excision of plantar corns following the guidelines for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension using the framework outlined by Arksey and O'Malley for scoping reviews based on 15 studies. Iterative charting revealed overlapping codes and two main themes; closure by primary intention (with or without a skin flap) or by secondary intention, and whether excision was performed in combination with intractable plantar hyperkeratosis (IPK) excision with other (bony) surgery.

Comment: This scoping review explored surgical excision methods for IPKs of the foot, analysing 15 articles to identify key themes: closure techniques and combination with other surgeries. Variability in lesion characteristics highlights the need for individualised treatment approaches. Histopathologic examination after biopsy aids in accurate diagnosis, distinguishing IPKs from other conditions like verruca pedis. Lopez and Kilmartin suggest viral involvement in most IPKs, challenging traditional mechanical aetiology theories. Metatarsal surgery for IPKs faces high recurrence rates, possibly due to undiagnosed viral lesions. Sharp excision is recommended as the primary surgical option, with bony surgery reserved for confirmed cases without viral involvement. Full-thickness excision is the common approach, with closure techniques varying. While the review acknowledges limitations in data quantity, it emphasises the importance of histopathologic examination and questions the necessity of invasive bony surgeries in IPK treatment. Future research directions could explore skin-based strategies to avoid complications associated with bony surgeries. Additionally, investigations into alternative surgical methods such as curettage and electrosurgery may provide valuable insights into IPK management.

Reference: J Am Podiatr Med Assoc. 2023;113(6):22-044
Abstract

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Independent commentary by Professor Matthew Carroll

Matthew is a Professor of Podiatry within the School of Clinical Sciences at Auckland University of Technology (AUT). His research focus is on chronic long-term conditions that affect the lower limb and foot. His postgraduate qualifications include a PhD (AUT), a Master of Educational Leadership (AUT), a Master of Podiatry (Curtin) and a Postgraduate Diploma in Sports Medicine (Otago). In recognition of his contribution to learning and teaching in the podiatry profession he has been awarded two fellowships; a Senior Fellow of the Higher Education Authority and a Fellow of the Faculty of Podiatric Medicine of the Royal College of Physicians and Surgeons of Glasgow. Matthew also contributes to the research environment through regular publication of research, supervision of research students, and he is a current Associate Editor for the Journal of Foot & Ankle Research.

Lateral wedging of the foot: A scoping review

Authors: Jackson A et al.

Summary: In another PRISMA-based scoping review, investigators examined how lateral wedging in healthy adults altered foot function and how wedge design influences outcomes based on 21 studies. Full-length wedges were used in 13 studies, five studies did not report length, and one study used ≥1 wedge length. The most common material was ethylene vinyl acetate and hardness was inconsistently reported. A range of inclination angles, with limited explanation for values, were used. Most studies that analysed ankle/subtalar joint frontal plane moments showed an increase in external eversion moment.

Comment: This review examined the impact of lateral wedging on foot biomechanics, highlighting inconsistencies in reporting wedge properties and terminology. Most studies focused on full or sulcus length wedges, primarily investigating their effect on knee adduction moments (KAM). Longer wedges have been associated with greater reduction in KAM. Forefoot lateral wedging is shown to be most effective in reducing strain in the plantar aponeurosis. Material properties of wedges, such as hardness, were inconsistently reported, limiting understanding of their impact. Wedge inclination angles used ranged from 3° to 14°, with foot comfort influencing the choice of angle. However, the rationale for specific angles was unclear, and was possibly driven by availability of prefabricated materials rather than optimal biomechanical effects. Despite variability in wedge design, most studies reported lateral wedging to modify frontal plane moments at the ankle/subtalar joint and cause a lateral shift of the centre of pressure. Inconsistent terminology poses challenges, prompting the authors to propose a set of standard definitions for wedge length and placement to guide future research. Overall, there is a need for more standardised reporting and further investigation into optimal wedge design and material properties for desired biomechanical effects.

Reference: J Am Podiatr Med Assoc. 2023;113(5):21-180
Abstract

Do basic neurologic assessments tell us more than we realize?

Authors: Donnan L et al.

Summary: This study (n = 50) examined whether neurologic assessments using a monofilament and a tuning fork commonly used to screen for peripheral neuropathy and identification of foot ulceration and amputation risk, may provide a more holistic perspective of overall health status. Among participants self-reporting "excellent" health, a relationship with adequate vibration sensation was identified ($p < 0.01$). Correlations between a greater number of sites detected using a 10 g monofilament assessment were also identified with greater energy ($p = 0.03$), limited interference with social activities ($p = 0.03$), and greater confidence in a variety of functional tasks.

Comment: This study examined the relationships between podiatric neurologic assessments, functional capability, and self-perceptions of health. Data suggests that monofilament results may provide insights into functional capabilities and health perceptions, potentially promoting positive health behaviours among patients. Positive associations were found between good health perceptions and neurologic test results, highlighting the importance of a strengths-based approach in interpreting these assessments. For instance, better neurologic function correlates with fewer foot-related limitations and improved performance in physical tasks. Age and back pain were considered as potential confounding factors, but their correlations with neurologic assessments were limited. The study emphasises the need for clinicians to adopt proactive approaches in patient care, focusing on positive health messaging and language to influence behaviour positively while still addressing risks associated with certain lifestyle behaviours.

Reference: J Am Podiatr Med Assoc. 2023;113(5):20-263
Abstract

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Relationship between diabetes-related large-fiber neuropathy and dorsiflexion range of motion at the ankle and first metatarsophalangeal joints

Authors: McIlhatton AM et al.

Summary: This cross-sectional observational study examined the relationship between ankle joint and first metatarsophalangeal (MTP) joint dorsiflexion range of motion (ROM) and diabetes-related peripheral neuropathy (DPN) in 101 participants (mean age 65.0 years; 54% men; type 2 diabetes 97%; mean diabetes duration 8.7 years; DPN 23%). DPN was correlated with reduced ROM at the ankle (knee extended $r = -0.53$; $p < 0.001$; knee flexed $r = -0.50$; $p < 0.001$) and the first MTP ($r = -0.37$; $p < 0.001$) joint. DPN made unique contributions to regression models for ROM at the ankle (knee extended r^2 change = 0.121; $p < 0.001$ and knee flexed r^2 change = 0.109; $p < 0.001$) and first MTP (r^2 change = 0.037; $p = 0.048$) joint.

Comment: The study aimed to explore the relationship between DPN and ankle and first MTP joint dorsiflexion ROM in adults with diabetes. It revealed that DPN predicted reduced ankle and first MTP joint ROM after adjusting for various factors. Participants with DPN exhibited decreased ROM compared to those without. Additionally, higher BMI, longer diabetes duration, and elevated HbA1c levels correlated with decreased ankle and first MTP joint ROM. The study suggests that DPN independently contributes to joint stiffness, potentially exacerbating plantar pressure and diabetic foot ulcer risk. Clinicians are advised to assess joint ROM and neurologic function in diabetic patients to mitigate diabetic foot ulcer risk through prophylactic measures like foot orthoses and footwear modifications. However, the study acknowledges limitations, including its focus on type 2 diabetes, potential underestimation of DPN prevalence, and the need for further research to establish the relationship between joint mobility and plantar pressure.

Reference: J Am Podiatr Med Assoc. 2023;113(6): 21-097
Abstract

A biomechanical investigation of children with type 1 diabetes mellitus: Are children's feet a precursor to adulthood foot complications?

Authors: Agius R et al.

Summary: This nonexperimental, case-control study assessed whether 34 children (aged 10-16 years) living with type 1 diabetes mellitus (T1DM) have altered foot structure and gait parameters versus those without medical conditions. T1DM children had more dermatologic lesions and structural foot abnormalities, including claw (33.3%) and hammer (22.2%) toes, and hallux abducto valgus (HAV; 11.1%). The two groups exhibited differences in hindfoot-to-tibia angle at heel strike and toe-off, indicating limited ankle joint motion.

Comment: The study compared foot deformities, foot posture, and kinematics between children aged 10 to 16 years with T1DM and healthy counterparts of the same age range. Children with T1DM exhibited a higher prevalence of toe deformities, including hammer and claw toes, and HAV, along with a higher incidence of pronated foot posture and restricted ankle sagittal plane movement compared to the control group. Pronated feet were linked to increased medial longitudinal arch length, which elevated tensile forces on MTP joints, potentially leading to toe deformities and HAV. The study suggested that foot pronation might contribute to various musculoskeletal conditions affecting the foot. Additionally, soft-tissue thickening in T1DM youth, possibly due to nonenzymatic glycation, could limit joint mobility at the subtalar joint, impacting foot structure. Limited ankle dorsiflexion might exacerbate plantar fascia tension and affect forefoot function. The study highlighted the scarcity of research on foot structure in juvenile diabetic feet, emphasising the need for early screening and management to prevent lifelong complications. Though limited by a small sample size, the study provided significant findings warranting further research, including larger samples and younger age groups, to address paediatric diabetic foot concerns comprehensively.

Reference: J Am Podiatr Med Assoc. 2023;113(6): 21-134
Abstract

Ankle osteoarthritis: An online survey of current treatment practices of UK-based podiatrists and physiotherapists

Authors: Callaghan MJ et al.

Summary: This study used a self-administered online questionnaire to survey current clinical practices among 100 UK-based physiotherapists (n = 63) and podiatrists (n = 35) for the treatment of painful ankle osteoarthritis (OA). In both professions, the most common treatment aims were to reduce pain (89%) and improve quality of life (84%). In total, 51% of respondents offered 3-4 treatment sessions and 54% saw patients for 30-40 min at the first session. The most common modalities used by physiotherapists were patient education (100%), teaching self-management (92%), lifestyle modification (86%), ankle strengthening (87%), and proprioception exercises (86%). Among podiatrists, the most common modalities were patient education (100%), ankle strengthening (89%), activity pacing (80%), lifestyle modification (77%), and gait training (77%).

Comment: The study surveyed physiotherapists and podiatrists in the UK to assess and compare their current practices in managing OA, a condition for which there is limited guidance. Both professions commonly utilised patient education, lifestyle modification, and ankle strengthening exercises, with physiotherapists also employing self-management and proprioception exercises, while podiatrists additionally used activity pacing and gait training. Treatment choices aligned with reducing pain, improving quality of life, and teaching self-management, consistent with general OA guidelines. Some physiotherapists extrapolated evidence from other joint sites, such as recommending hip strengthening, which contrasts with specific recommendations for ankle OA. Certain treatment options like hydrotherapy and electrotherapy were used less frequently, possibly due to access limitations or conflicting guidelines. Orthotics were significantly more utilised by podiatrists, reflecting their specialised role in foot care. The study highlighted variations in practice and suggested the need for further research to assess the efficacy of current management approaches. However, limitations included the small sample size and lack of differentiation between various types of orthoses.

Reference: J Foot Ankle Res. 2023;16:89
Abstract

Effects of foot and ankle mobilisations combined with home stretches in people with diabetic peripheral neuropathy: A proof-of-concept RCT

Authors: Lepesis V et al.

Summary: This study assessed in people with DPN whether ankle and first MTP joint mobilisations (n =31) and home-based stretches improve joint ROM and reduce forefoot peak plantar pressures (PPPs) compared with standard care only (n = 30). At 6 weeks and 18 weeks there were no differences in ankle dorsiflexion in stance phase, plantar pressure or balance. However, the intervention had an increase in static ankle dorsiflexion range (left 1.52 cm and 2.9 cm, right 1.62 cm and 2.7 cm; $p < 0.01$). Between group differences also occurred in left hallux dorsiflexion (2.75°; $p < 0.05$) at 6 weeks and in right hallux dorsiflexion ROM (4.9°; $p < 0.01$) at 6 months. Functional reach was also increased with the intervention (6 weeks 3.13 cm; $p < 0.05$; 6 months 3.9 cm; $p < 0.01$). Adherence to the intervention was 80%.

Comment: The study aimed to assess the impact of a 6-week intervention involving foot and ankle mobilisations with home-based stretches on ankle and big toe dorsiflexion ROM (DF ROM), PPPs, and balance in individuals with DPN and limited joint mobility syndrome, compared to usual care. Results showed significant improvements in static ankle DF ROM following the intervention, supporting findings from studies on chronic ankle instability. However, dynamic ankle DF ROM, PPPs, and postural sway did not exhibit significant changes, contrary to expectations. The study also observed improvements in functional reach test, indicating enhanced balance, consistent with qualitative reports on improved balance confidence. While stretches alone may not suffice to increase ankle ROM in people with diabetes, the combined intervention showed promise in enhancing static ankle DF ROM. However, the study had limitations including the inability to differentiate the individual effectiveness of mobilisations and stretches, the method used to define ankle stiffness, and the short follow-up period. Nonetheless, the study recruited a full sample without major adverse effects, highlighting the feasibility of the intervention.

Reference: J Foot Ankle Res. 2023;16(1):88
Abstract