

Foot & Ankle Research Review™

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Issue 33 – 2017

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Abbreviations used in this issue

BMI = body mass index
MPJ = metatarsophalangeal joint
PFJ = patellofemoral joint
ROM = range of motion



Podiatrists Board of New Zealand

Welcome to issue 33 of Foot and Ankle Research Review.

The manuscript by Menz et al., is a highlight for me and well worth a read for those who prescribe foot orthoses. It is pleasing to see research stemming from data of foot orthotic manufactures as this highlights what is occurring in the clinical environment. I also read with interest the research surrounding minimalist footwear and wonder how many clinicians still advocate this type of footwear.

I hope you enjoy this issue and please keep the feedback coming in.

Kind regards,

Dr Matthew Carroll

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Custom-made foot orthoses: an analysis of prescription characteristics from an Australian commercial orthotic laboratory

Authors: Menz HB et al.

Summary: Cluster and discriminant function analyses of prescription forms (from 178 clinical practices across Australia and Hong Kong) obtained from an Australian podiatric orthotic laboratory were conducted in order to describe the characteristics of custom-made foot orthosis prescriptions in terms of type, cast correction, arch-fill technique, cast modifications, shell material, shell modifications and cover material. Three broad clusters were defined related to increasing 'control' of rearfoot pronation. Five variables (rearfoot cast correction, cover shape, orthosis type, forefoot cast correction and plantar fascial accommodation) identified these clusters with 70% accuracy. Between clusters differences occurred in relation to patient age and sex and the clinician's geographic location.

Comment: This study described the patterns of custom-made foot orthoses prescription from one commercial orthotic lab in Australia. The study found that the prescription of foot orthoses can be broadly categorised into three clusters based upon the prescription features of orthosis type, cast correction, arch fill technique, cast modifications, shell material, shell modifications and cover material raises. I'm sure if you routinely prescribe foot orthoses you will see similarities to your prescribing habits by the descriptions contained within this study. Overall I am left with two main impressions. First, that there is still a large disparity between the thoughts that are espoused in research surrounding foot orthoses and the realities of what occurs in the commercial environment. This is evidenced by the large amount of literature questioning many aspects of the Root paradigm, yet many orthotic prescribing principles described by this research are largely underpinned by this paradigm. Second, although orthotics are described as custom made the study has demonstrated through the identification of prescribing clusters that many custom foot orthotic prescriptions are similar, therefore, are foot orthotic prescription habits comparable to other prescription devices, such as prescription glasses?

Reference: *J Foot Ankle Res.* 2017;10:23

[Abstract](#)

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Optimisation of rocker sole footwear for prevention of first plantar ulcer: comparison of group-optimised and individually-selected footwear designs

Authors: Preece SJ et al.

Summary: This study aimed to determine whether prefabricated, retail available, group-optimised footwear designs (n = 8; 4 apex positions × 2 rocker angles) could achieve adequate pressure reductions in 102 individuals with diabetes to reduce the risk of first ulceration, or whether bespoke footwear is required. Peak plantar pressure increased as apex position moved distally and rocker angle was reduced (p < 0.001). The group-optimised design had an apex at 52% of shoe length, an apex angle of 95°, and a 20° rocker angle. Using this design 71-81% of peak pressures were <200 kPa, both in the full diabetic cohort and in a cohort with peripheral neuropathy (n = 17). Only small increases in this proportion (<5%) occurred when participants wore individually selected footwear.

Comment: The study investigated how plantar foot pressures are affected through variations in the apex angle and rocker angle in footwear. The performance of the footwear was assessed using the pressure threshold of 200 kPa proposed by Owings et al., reducing forefoot pressures below this point being seen as optimal in the diabetic population. The research presents a great insight into the potential development of prefabricated footwear (mass produced footwear incorporating specific design features) as opposed to custom footwear. This is particularly pertinent as footwear choices made by those with diabetes without a history of ulceration often occur in a retail setting as opposed to advice provided by a health care professional. Data indicated that the optimal design of the rocker sole was to have the apex angle of 52° and a rocker angle of 20°. This study emphasises how important it is to collect and analyse plantar foot pressures in the diabetic population as part of a routine clinical assessment. The study also indicates how important it is to have trained health care professionals providing advice surrounding footwear selection for the diabetic population.

Reference: *J Foot Ankle Res.* 2017;10:27
[Abstract](#)



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High prevalence of Achilles tendon enthesopathic changes in patients with type 2 diabetes without peripheral neuropathy

Authors: Ursini F et al.

Summary: This study evaluated changes in the mechanical properties of tendons in 43 patients with type 2 diabetes mellitus and 40 controls by assessing the prevalence of asymptomatic Achilles tendon enthesopathic changes. Type 2 diabetics had a higher prevalence of hypo-echogenicity (26.7% vs 2.5%; p = 0.0001), enthesal thickening (24.4% vs 8.7%; p = 0.007) and enthesophytes (74.4% vs 57.5%; p = .02), but there were no differences in the number of patients with erosions, cortical irregularities, bursitis or tears. The mean sum of abnormalities was increased in type 2 diabetes patients (1.5 vs 0.7; p < 0.0001), along with the proportion of patients with bilateral involvement (72.1% vs 45.0%; p = 0.01).

Comment: The study demonstrates that the Achilles tendon in a subgroup of type 2 diabetics demonstrates characteristics similar to other chronic conditions. Data showed a significantly higher presence of Achilles tendon enthesal abnormalities (hypo-echogenicity, thickening calcification and enthesophyte formation) in a diabetic population without peripheral neuropathy. Important questions are raised by the research; is there specific type 2 diabetes associated Achilles tendinopathy and are there any potential relationships to neuropathy and or vascular changes in the lower limb? It is good to see research starting to investigate specific musculoskeletal injuries in this population.

Reference: *J Am Podiatr Med Assoc.* 2017(2):99-105
[Abstract](#)

Biomechanical factors associated with Achilles tendinopathy and medial tibial stress syndrome in runners

Authors: Becker J et al.

Summary: This lab-based study assessed rearfoot kinematics in runners with Achilles tendinopathy (n = 13) or medial tibial stress syndrome (n = 8) versus healthy controls (n = 21) to determine rearfoot eversion duration, excursion and velocity. In those with Achilles tendinopathy or medial tibial stress syndrome, standing tibia varus angles were higher (8.67° vs 6.76°; p = 0.002), static dorsiflexion range of motion was lower (6.14° vs 11.19°; p = 0.002), rearfoot eversion at heel-off was greater (-6.47° vs 1.07°; p < 0.001), and duration of eversion was longer (86.02% stance vs 59.12% stance; p < 0.001) than in controls. Excursion or velocity of eversion did not differ. Logistic regression ($\chi^2 = 20.84$; p < 0.001) suggested a 1% increase in eversion duration during the stance phase increased the odds of injury by 1.08 (95% CI 1.023-1.141; p = 0.006).

Comment: The relationship between rearfoot kinematic and kinetics to lower limb injury has long been a focus of biomechanical research. However, the duration of rearfoot eversion, especially in relation to running injuries, has received little attention in the biomechanics literature. Participants with injury demonstrated a significantly longer duration of rearfoot eversion compared to control participants. The author's postulate that based on their data, arch height and range of motion within foot joints may not play an important role in injury development. However, lower limb alignment (tibial position) and ankle joint range of motion were associated with Achilles tendon and medial tibial stress injuries. Clinically this could be interpreted that quantifying the degree of, and reducing the duration of rearfoot eversion is important. The results should be considered in light of some major limitations. First, participants were already injured when they entered the study, therefore attributing the injury solely to the lower-limb kinematics and kinetics is problematic. Second, the method of diagnosis was not standardised, consequently, injuries were also not classified as acute (new) or recurring (chronic). A challenge for the clinician is how to determine the length of rearfoot eversion in the clinical setting.

Reference: *Am J Sports Med.* 2017;Jun 1 [Epub ahead of print]
[Abstract](#)

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Independent commentary by Dr Matthew Carroll

Matthew graduated in podiatry at the CIT in Wellington. He undertook his postgraduate work at Otago University, Dunedin, New Zealand, Curtin University, Western Australia and Auckland University of Technology, Auckland, New Zealand. He is Head of Podiatry and Senior Lecturer at Auckland University of Technology, Director/Treasurer of the Australia New Zealand Podiatry Accreditation Council and a Board member of the Podiatrists Registration Board of New Zealand. He has a special interest in inflammatory arthritis and is active in research in rheumatoid arthritis, gout and lupus.



Clinical and functional characteristics of people with chronic and recent-onset plantar heel pain

Authors: Barnes A et al.

Summary: This cross-sectional study described clinical and functional characteristics of chronic (>12 months) plantar heel pain (n = 71) versus recent onset (<6 months) heel pain (n = 64). Chronic heel pain was associated with reduced ankle dorsiflexor and toe flexor strength, but better self-reported foot function. BMI, ankle and first metatarsophalangeal joint (1st MPJ) range of motion (ROM), inversion and eversion strength, calf endurance, self-reported foot pain, and physical activity did not differ between groups.

Comment: This study demonstrated that in people with heel pain of greater than 12-months duration, strength deficits were noted in the ankle and digital flexors. Clinically these deficits may result from secondary adaptations due to factors such as antalgic gait. The findings emphasise the importance of quantifying muscle strength, and providing muscle strength exercises as part of the rehabilitation program for those with chronic plantar heel pain. However, these recommendations must be considered in the context of a major limitation related to the study design and nature of heel pain. Due to the cross-sectional nature of the study it was not possible to differentiate whether the strength deficits present in the participants with chronic heel pain preceded chronicity or occur as a result of it.

Reference: *PM R. 2017;pii:S1934-1482(17)30540-3*
[Abstract](#)

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A cross-sectional study comparing foot and ankle characteristics in people with stroke and healthy controls

Authors: Kunkel D et al.

Summary: This small study examined foot and ankle characteristics in 23 stroke patients and 16 controls, and between stroke patients who experience falls and non-fallers. In stroke patients, reduced 1st MPJ sensation (p = 0.016) and 1st MPJ ROM (p = 0.025) occurred in the affected foot. Pooled data for both feet indicated reduced 1st MPJ sensation (p = 0.020), higher Foot Posture Index scores suggesting greater foot pronation (p = 0.008) and reduced foot function (p = 0.003) in stroke patients versus controls. Patients with stroke who experienced falls had greater foot pronation versus non-fallers (p = 0.027).

Comment: Defining the characteristics of the foot and ankle in the post stroke foot has received little attention in research. In the context of a small sample size this study showed altered sensation, altered foot posture, reduced foot function, reduced 1st MPJ ROM and deformities to the hallux were significantly more prevalent in participants who suffered a stroke. An ankle foot orthoses is traditionally used to increase ground clearance during gait, with minimal consideration given to management of foot deformity. The research highlights that foot and ankle problems in stroke require more targeted interventions that address the multitude of joint and positional deformities that occur post stroke.

Reference: *Disabil Rehabil. 2017;39(12):1149-54*
[Abstract](#)

Textured and stimulating insoles for balance and gait impairments in patients with multiple sclerosis and Parkinson's disease: A systematic review and meta-analysis

Author: Alfuth M

Summary: This meta-analysis examined whether textured or stimulating insoles altered gait characteristics and balance/postural control in multiple sclerosis and Parkinson's disease patients. In total, six studies were identified of which five had low methodological quality (<17/37 on the CONSORT- Statement checklist), and one had moderate methodological quality (27/37) on the checklist. There was no effect of textured/stimulating insoles versus control conditions for the primary outcomes for gait, cadence (Standardised mean difference [SMD] -0.09; 95% CI -0.35 to 0.16), gait velocity (SMD 0.18; 95% CI -0.17 to 0.53), or step length (SMD -0.13; 95% CI -0.31 to 0.05). Nor were there any differences in the primary outcomes for balance centre of pressure (CoP) displacement (SMD subtotal for multiple sclerosis 0.07; 95% CI -0.15 to 0.28) and CoP velocity (SMD -0.08; 95% CI -0.55 to 0.39).

Comment: Textured surfaces on insoles are increasingly used to enhance plantar sensory feedback and improve impaired balance and gait in those with neurological diseases such as multiple sclerosis and Parkinson's disease. This systematic review investigated the effect of textured insoles on the following outcomes: CoP displacement and CoP velocity/sway rate for balance/postural control, cadence, velocity and step length for gait. The authors concluded that using textured or other types of stimulating insoles for the treatment of balance and gait impairments in patients with multiple sclerosis and Parkinson's disease seem to have no effect. This finding must be taken in the context of some limitations, the most significant being sample size of the included studies. In the six studies analysed through which conclusions are drawn, there was only a total of 68 patients with Parkinson's disease and 85 patients with multiple sclerosis. I feel this area of research warrants further investigation before a claim of no benefit can be made.

Reference: *Gait Posture 2017;51:132-41*
[Abstract](#)

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The preferred movement path paradigm: Influence of running shoes on joint movement

Authors: Nigg BM et al.

Summary: 3-D ankle and knee joint kinematics were analysed to determine differences in lower extremity joint kinematics in 35 heel-toe runners running barefoot and wearing three different running shoes. Mean ankle and knee joint kinematics did not differ between running shoe conditions. Apart from knee flexion and ankle dorsiflexion most runners (80-100%) maintained their movement path between running shoes (<3°). However, many runners had ankle and knee joint kinematics (especially ankle dorsiflexion and knee flexion) that differed between conventional running shoes and barefoot running by >3°.

Comment: I found this article of interest as it provides some guidance on three proposed paradigms by which running shoes may influence foot position. These include (1) there exists a “comfort filter” that runners use when selecting a shoe which may be associated with protection against injuries; (2) runners try to stay in a “preferred movement path” a movement path that is assumed to be associated with minimal energy demand; and (3) “functional groups” of individuals exist who respond similarly to changes in footwear conditions. This research specifically investigated the preferred movement paradigm. The term “movement path” is used to describe the trajectory of joint angles or segment markers during a given movement such as heel-toe running. The authors hypothesised that when running in similar footwear conditions, the joint kinematics will change minimally. The study assessed ankle and knee joint kinetics during running in three running shoes (traditional, racing flat and minimalist shoe). Data indicated knee and ankle joint kinematics were similar irrespective of shoe type; however, there were substantial differences between the minimalist and conventional running shoe. Whilst the movement path paradigm is very speculative and relatively unproven, it raises some interesting questions. First, does changing footwear alter soft-tissue load, and if so how? Second, how does changing joint kinematics alter running economy?

Reference: *Med Sci Sports Exerc.* 2017;49(8):1641-48

[Abstract](#)

Footwear characteristics are related to running mechanics in runners with patellofemoral pain

Authors: Esculier JF et al.

Summary: This study examined the relationship between the minimalism of running shoes and habitual running kinematics and kinetics in 69 runners with patellofemoral pain. There was a moderate correlation between Higher Minimalist Index shoe scores and lower foot inclination ($r -0.410$; $p < 0.001$) and lower peak patellofemoral joint (PFJ) force ($r -0.412$; $p < 0.001$). There were also moderate Spearman's rank correlations between lower shoe mass and greater step rate ($\rho 0.531$; $p < 0.001$) and lower peak PFJ force ($\rho -0.481$; $p < 0.001$), and greater shoe flexibility was also associated with lower foot inclination ($\rho -0.447$; $p < 0.001$).

Comment: The results of this research indicate that a more minimalist running shoe may be beneficial for those with patellofemoral pain. The main findings were that in a more minimal shoe, foot inclination angle was lower at foot strike, step rate was higher and PFJ force was lower. The authors speculate that recommending more minimalist footwear may facilitate implementation and retention of gait retraining interventions in this population. Although this research advocates for the use of minimalist running shoes, there is a lot of evidence to the contrary for the effectiveness of minimalist footwear. There has also been a significant drop in the global sales figures of minimalist footwear since the peak in 2011, raising the question – Are minimalist shoes indeed effective or are they a fad?

Reference: *Gait Posture* 2017;54:144-47

[Abstract](#)

Prevention of friction blisters in outdoor pursuits: A systematic review

Authors: Worthing RM et al.

Summary: This systematic review examined whether sock, antiperspirant, or barrier strategies prevented friction blisters in wilderness and outdoor pursuits (running, hiking, marching, etc.). In total, 11 studies were identified (5 sock, 3 antiperspirant, 3 barrier strategies), but only two had moderate levels of confidence in the effect estimate based on the Scottish Intercollegiate Guidelines Network methodology checklist and meta-analysis was prevented by clinical and methodological diversity of the studies.

Comment: Having provided medical care for the OXFAM trail walk for many years and treating hundreds of blisters, a systematic review on blisters was too tempting not to comment on. Not surprisingly most research on blisters is of low quality, non-randomised and based in military populations affecting the quality of the research recommendations. Interventions detailed by the review include the use of varying sock types and constructions, antiperspirant sprays, taping and emollients. Despite the well-compiled review it is very difficult to provide any evidenced-based recommendations. Indeed the authors state that despite nearly 80 years of research, the existing body of literature does not yet provide sufficient evidence to support the formulation of robust, meaningful, clinical practice guidelines. I guess you will just have to rely on your clinical experience in the management of blisters.

Reference: *Wilderness Environ Med.* 2017;28(2):139-49

[Abstract](#)



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