

# Foot & Ankle Research Review™

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Issue 26 – 2015

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### Abbreviations used in this issue

**BMI** = body mass index  
**DMARDs** = disease-modifying anti-rheumatic drugs  
**FAAM** = Foot and Ankle Ability Measure  
**FHSQ** = Foot Health Status Questionnaire  
**FPI** = Foot Posture Index  
**MTP** = metatarsophalangeal  
**OR** = odds ratio  
**RA** = rheumatoid arthritis  
**RCT** = randomised controlled trial  
**VAS** = Visual Analogue Scale

## Welcome to the latest issue of Foot and Ankle Research Review.

First up we look at two interesting articles focusing on foot ulceration. The first article investigates the microbiology of infected foot ulcers in RA, an area of investigation currently lacking in the literature. The second investigates predictors of plantar pressure in diabetes and will be of specific interest to clinicians who deal with diabetic foot ulcers. Other topics covered in this issue include response to conservative treatment of nonchronic plantar fasciitis, mobilisation/stretching vs steroid injection for plantar fasciitis, BMI and paediatric foot posture, plantar heel pain and footwear difficulties, pincer nails and foot loading, reliability of hand-held Doppler use by podiatrists, biophysical properties of normal and hyperkeratotic foot skin and characteristics of the first metatarsophalangeal joint in gout and asymptomatic hyperuricaemia.

I hope you enjoy reading the latest issue of Foot and Ankle Research Review and look forward to your feedback.

Kind Regards,

**Professor Keith Rome**

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## Prevalence and microbiological characteristics of clinically infected foot-ulcers in patients with rheumatoid arthritis: a retrospective exploratory study

**Authors:** Fitzgerald P et al.

**Summary:** This retrospective UK study collected data on patients attending a RA foot ulcer clinic between 1<sup>st</sup> May 2012 and 1<sup>st</sup> May 2013 to estimate the prevalence of clinical infection in foot ulcers of such patients and to describe the microbiological characteristics and associated risk factors. A total of 28 patients with RA and foot-ulcers were identified; eight (29 %) of these patients had clinical infection and wound swabs were taken. The median age of patients with clinical infection was 74 years, 50% were women and the mean duration of RA was 22 years. Six patients had cardiovascular disease/peripheral-vascular disease and two had diabetes. Six patients were receiving DMARDs; three were on biologic medications and two on steroids. Five of the eight wound swabs cultured skin flora, one grew *Staphylococcus aureus*, one exhibited no growth and one was rejected due to a labelling error. The study authors pointed out that while almost a third of people with RA and foot ulcers attending clinic over one year had clinical infection, microbiological analysis failed to isolate pathogens in the majority of wound swabs. The study provided insufficient data to determine risk factors of clinical infection.

**Comment:** Foot ulceration in people with RA is not a common occurrence and hence the study from the UK only reported on 28 participants. Although clinicians observe over 90% of people with RA have foot and ankle problems, only small percentages develop foot ulcers. The study is novel as there is limited evidence on the clinical characteristics of people with RA and foot ulcers. Reviewing the results, people with foot ulceration had a well-established disease with a number of participants with co-morbidities such as cardiovascular and peripheral vascular disease. Both co-morbidities prohibit wound healing. From the current evidence we know that high plantar pressures are found in the forefoot of people with established RA. The limitations of the study are the retrospective research design and the small number of participants. This does limit the value to translate to clinical practice. However, the article does raise a number of issues to consider relating to clinical practice and wound swabs as part of ulcer management. Furthermore, the description on the microbiological characteristics of infections is novel and the article is recommended to clinicians with an interest in long-term chronic foot conditions.

**Reference:** *J Foot Ankle Res.* 2015;8:38

[Abstract](#)

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## Predictors of barefoot plantar pressure during walking in patients with diabetes, peripheral neuropathy and a history of ulceration

**Authors:** Barn R et al.

**Summary:** Factors predicting plantar pressures in a population of diabetic patients at high risk of foot ulceration were investigated in this cross-sectional study involving 167 such patients with peripheral neuropathy and a history of ulceration; the mean age was 63 years and 329 feet were analysed. Barefoot peak pressures during walking were calculated for the heel, forefoot, midfoot, lesser toes and hallux regions, and demographic data, foot structure and function, and disease-related factors were recorded. Regression analysis was able to predict between 6% (heel) and 41% (midfoot) of the variation in peak plantar pressures, with the largest contributing factor in the heel model being glycosylated haemoglobin concentration, in the forefoot prominent metatarsal heads, in the midfoot Charcot deformity, in the lesser toes hammer toe deformity, and in the hallux previous ulceration. Global features such as body mass, gender, age or diabetes duration were not as strong predictors of plantar pressure as variables with local effects, such as foot deformity. Such local deformities should be adequately managed to reduce plantar pressure and ulcer risk.

**Comment:** Foot ulcers may be an indicator of worsening diabetic neuropathy. However, the behaviour of plantar pressure patterns over time and during the progression of neuropathy, especially in patients who have a clinical history of foot ulcers, is still unclear. This Dutch study suggests that high peak pressures significantly increase the risk of foot ulceration in diabetes mellitus. This is not novel but what is added to the current evidence on foot ulceration in people with diabetes is the number of predictive foot-related factors. The strength of the article was that the study focused on a high-risk population. However, in many observational studies a limitation is that data is only collected at one time point. Future studies are required over time to see if the same predictors are observed. I strongly recommend you read this article in full.

**Reference:** *PLoS One*; 2015;10(2):e0117443

[Abstract](#)

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## Physical examination variables predict response to conservative treatment of nonchronic plantar fasciitis: Secondary analysis of a randomized, placebo-controlled footwear study

**Authors:** Wrobel JS et al.

**Summary:** In order to determine whether initial clinical findings could help predict the response of patients with nonchronic plantar fasciitis to conservative treatment primarily consisting of supportive footwear and stretching, these US investigators recruited 77 patients from two outpatient podiatric clinics in the Chicago, Illinois metropolitan area. Multivariable analysis revealed that among 69 patients completing the 3-month follow-up assessment after receiving the footwear intervention, inability to dorsiflex the ankle past  $-5^\circ$  (OR 3.9,  $p = 0.024$ ), non-severe ( $\leq 7$  on ordinal scale) first-step pain (OR 3.8,  $p = 0.021$ ), and heel valgus in relaxed stance (OR 4.0,  $p = 0.014$ ) each predicted treatment failure (defined as a  $<50\%$  reduction in heel pain at 3-month follow). Furthermore, limited ankle dorsiflexion also correlated with higher heel pain severity at initial presentation ( $r = -0.312$ ,  $p = 0.006$ ) and those with severe ankle equinus were almost four-fold more likely to experience a favorable response to treatment focused on supportive therapy and Achilles tendon stretching.

**Comment:** These researchers found that individuals presenting with less severe equinus and less severe pain did worse with conservative care and suggest that it may be more appropriate to use more advanced therapies earlier in such patients. In this study, ankle equinus was only measured during the screening session, and it would be of interest to investigate potential flexibility improvements in all participants after the initiation of the included stretching protocol.

**Reference:** *PM R* 2015;Sept 25 [Epub ahead of print]

[Abstract](#)

## Joint mobilization and stretching exercise vs steroid injection in the treatment of plantar fasciitis: A randomized controlled study

**Authors:** Celik D et al.

**Summary:** The effectiveness of joint mobilisation combined with stretching exercises ( $n = 22$ ) vs steroid injection ( $n = 21$ ) was investigated in this US RCT involving patients with plantar fasciitis (mean age 45.5 years; 23 females). Joint mobilisation combined with stretching exercises was applied three times per week for three weeks (9 visits), while those receiving steroid injections received one injection at baseline. At 3-, 6-, and 12-week follow-up, neither age, sex, BMI nor dorsiflexion range of motion significantly impacted pain relief or functional outcomes (measured using the VAS and FAAM) compared to baseline. While planned pairwise comparisons showed significant ( $p < 0.05$ ) improvements in pain relief and functional outcomes in both groups at the 3-, 6- and 12-week follow-ups compared to baseline, at the 12-week and 1-year follow-ups, pain and functional outcomes were significantly ( $p = 0.02$ ) improved in only the joint mobilisation/stretching exercise group. The overall group-by-time interaction was statistically significant ( $p = 0.001$ ) for both FAAM ( $F = 7.0$ ) and VAS ( $F = 8.3$ ) scores. Between-group differences favored the steroid injection group at the 3-, 6- and 12-week follow-ups for both pain relief and functional outcomes. However, no significant differences were detected in the measured outcomes at the 1-year follow-up.

**Comment:** While both groups showed significant improvements at the 3, 6 and 12-week follow-ups, those receiving steroid injections exhibited better outcomes at all three time points. Improvements, however, continued only in the joint mobilisation combined with stretching exercises group for a period of time ranging from 12 weeks to 1 year. Limitations of the study include the fact that it did not examine dorsiflexion range of motion at follow-up; the stretching exercises may have aided in increasing dorsiflexion range of motion, which may explain the improvements in pain and function between 12 weeks and 1 year. While joint mobilisation produced effective results at 1 year, this intervention requires a skilled therapist and is a time-consuming procedure. Patients with plantar fasciitis exhibit short-term relief with steroid injection followed by an increase in symptoms that equal the final results produced by manual therapy.

**Reference:** *Foot Ankle Int.* 2015;Sept 23 [Epub ahead of print]

[Abstract](#)



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## The relationship between paediatric foot posture and body mass index: do heavier children really have flatter feet?

**Authors:** Evan AM and Karimi L

**Summary:** The relationship between children's foot posture and BMI was explored in this study utilising the Foot Posture Index (FPI-6) in a large study population involving a total of 728 children aged from three to 15 years. Three FPI-6 score levels defined the range of flatfeet detected (FPI-6  $\geq$  +6, FPI-6  $\geq$  +8 and FPI-6  $\geq$  +10). Among the study population, 290 (40%) children had flatfeet (FPI-6  $\geq$  +6), while the remainder (60%) had non-flatfeet; 142 (20 %) had an FPI score  $\geq$  +8 and 41 (5 %) had a FPI score  $\geq$  +10. A total of 272 (37 %) children were overweight, however, only 74 (10.1 %) of such children had flatfeet (FPI  $\geq$  +6), which diminished to 36 (4.9 %) at FPI  $\geq$  +8, and 9 (1.2 %) at FPI  $\geq$  +10. A significant but very weak correlation was found between BMI and FPI ( $r = -0.077$ ,  $p < 0.05$ ). There was no association identified between increased BMI and flatfeet in children.

**Comment:** Childhood obesity is terribly concerning from a wider health perspective. This Australian study is a retrospective study of previous studies conducted by one of the main authors. The findings are interesting but like many topic areas relating to paediatrics it is controversial. For example, in the current study the FPI was used. The FPI was originally developed for paediatrics. However, in childhood obesity, applying the FPI to this population may cause issues with validity. Previous studies have reported the use of imaging modalities that would include x-ray, magnetic resonance imaging or computed tomography. The issues of cost and ethical considerations need to be considered. It is an interesting article to read but has a number of implications relating to measurement and clinical implications of the current findings.

**Reference:** *J Foot Ankle Res. 2015;8:46*

[Abstract](#)

## Determinants of footwear difficulties in people with plantar heel pain

**Authors:** Sullivan J et al.

**Summary:** This study investigated whether individuals with plantar heel pain experience footwear-related difficulties compared to asymptomatic individuals, and identified factors associated with footwear comfort, fit and choice. 192 individuals with plantar heel pain and 69 asymptomatic controls were recruited and assessed using the footwear domain of the Foot Health Status Questionnaire (FHSQ). Foot posture, foot strength and flexibility, pedobarography and pain level were also assessed in the plantar heel pain group. Compared with asymptomatic participants, individuals with plantar heel pain reported lower FHSQ footwear domain scores (mean difference -24.4;  $p < 0.001$ ; 95 % CI -32.0 to -17.0). Individuals with plantar heel pain experience difficulty with footwear comfort, fit and choice and reduced heel loading during barefoot walking, toe flexor weakness and female gender were all found to be independently associated with such difficulties.

**Comment:** In agreement with previous studies, this Australian study found that people with plantar heel pain have significantly greater difficulty with footwear comfort, fit and choice compared to unaffected individuals. Included in the limitations of the study, are the cross-sectional design, meaning that conclusions cannot be made regarding cause-and-effect when considering associations between FHSQ footwear domain scores and individuals variables. Furthermore, plantar pressure measures were not collected in-shoe and are, therefore, not reflective of foot loading whilst shod.

**Reference:** *J Foot Ankle Res. 2015;8:40*

[Abstract](#)

## Foot loading is different in people with and without pincer nails: a case control study

**Authors:** Sano H et al.

**Summary:** While studies suggest that pincer nails are caused by lack of upward mechanical forces on the toe pad, clinically significant pincer nails are also often observed among healthy walkers. This prospective Japanese case-control study tested the hypothesis that in these cases, the affected toes do not receive adequate physical stimulation from walking and loading. Twelve bilateral pincer nail cases (24 affected feet) and 12 age- and sex-matched healthy control subjects (24 feet) were enrolled. The S-Plate platform (Medicapeurs Co. France) was employed to measure plantar pressure during free ambulation in both the barefoot and shod state. The pincer nail group had significantly lower pressure on the first toe than the control group in both the barefoot and shod state; the peak pressure area was mostly the metatarsal head area in the pincer nail group, whereas it was mostly the first toe area in the control group. Peak pressure area was a significant risk factor for pincer nail development according to binomial logistic regression analysis, indicating that walking behavior appears to contribute to pincer nail development.

**Comment:** This study found that the first toes of the pincer nail group experienced significantly less pressure during free ambulation than the first toes of the control group, both in the barefoot and shod conditions. Furthermore, compared to the barefoot condition, the pressure on the first toes of the pincer nail group was significantly reduced by wearing shoes. Poorly fitting shoes are considered to be a major cause of pincer nails. Either patient's with pincer nails tend to wear bigger shoes to avoid pain, or pincer nails develop because the first toenail does not receive sufficient pressure from the ill-fitting shoes. The study authors suggest that pincer nails of walkers could be treated by correcting the walking behaviour so that more pressure is placed on the toe pad.

**Reference:** *J Foot Ankle Res. 2015;8:43*

[Abstract](#)



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to read about Xerosis Management in Diabetics reviewed by Hon. Associate Professor Marius Rademaker and Dr Patricia Lowe

This overview of dry skin (xerosis) in patients with diabetes mellitus and its management covers key aspects of the underlying pathology, diagnosis and assessment, and treatment.



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## Use of hand-held Doppler ultrasound examination by podiatrists: a reliability study

**Authors:** Tehan PE and Chuter VH

**Summary:** This multi-centre inter- and intra-rater reliability study examined the reliability of the interpretation of hand-held Doppler findings by podiatrists for non-invasive vascular assessment of the lower limb. Four podiatrists (the raters; two public and two private practitioners) participated in the study, examining three aspects of Doppler use; (i) use of Doppler (i.e., technique and interpretation), (ii) interpretation of Doppler audio sounds, and (iii) interpretation of visual Doppler waveforms (i.e., tracings). Two testing sessions, 1 week apart were attended by the participants meeting current guidelines for vascular screening at either the private practice (n = 32), or the public practice (n = 31). Use of Doppler demonstrated the lowest reliability for both pairs of clinicians; inter-rater reliability Cohen's kappa ( $\kappa$ ) 0.20 to 0.24 and intra-rater reliability  $\kappa$  0.27 to 0.42. Compared with private podiatrists, the public podiatrists showed higher reliability in audio interpretation; inter-tester reliability  $\kappa$  0.31, intra-tester reliability  $\kappa$  0.53 vs inter-tester reliability  $\kappa$  0.61, intra-tester reliability  $\kappa$  1.00. Highest reliability of evaluation of Doppler waveform tracings was seen with inter-rater reliability ranging from  $\kappa$  0.77 to 0.90 and intra-rater reliability from  $\kappa$  0.81 to 1.00.

**Comment:** This Australian study found the reliability of the clinical use of hand-held Doppler by the participating podiatrists to be low, suggesting a need for ongoing education for podiatrists using Doppler in clinical practice. The study suggests that podiatrists had a higher skill level in interpretation of visual waveforms and audio of Doppler waveforms in isolation than when the assessment had to be performed and the visual and audio results interpreted concurrently in a clinical setting. The authors point out that despite their best efforts to include podiatrists with a range of experience and undergraduate training from the two main areas of clinical practice (public and private), the clinicians participating in this study may not have been representative of the podiatry profession as a whole and further studies are warranted.

**Reference:** *J Foot Ankle Res.* 2015;8:36

[Abstract](#)

## Characterising the biophysical properties of normal and hyperkeratotic foot skin

**Authors:** Hashmi F et al.

**Summary:** This study, involving 93 subjects, used non-invasive methods to characterise the biophysical properties of foot skin in healthy and pathological states including xerosis, heel fissures, calluses and corns. Significantly ( $p < 0.01$ ) lower levels of hydration and elasticity, and greater surface texture were found in calluses, corns, xerotic heel skin and heel fissures than unaffected skin sites. There was evidence for a positive correlation between hydration and elasticity data ( $r \leq 0.65$ ) at hyperkeratotic sites.

**Comment:** This UK study showed that measurable differences exist between hyperkeratotic and normal foot skin and that measures of hydration and elasticity were different between different classifications of callus and fissures. The authors pointed out that their study had a number of limitations, particularly with regard to measuring skin surface hydration and elasticity.

**Reference:** *J Foot Ankle Res.* 2015;8:35

[Abstract](#)

### Independent commentary by Professor Keith Rome.

Keith was awarded a Diploma in Chiropody and Membership to the Society of Chiropodists and Podiatrists in 1979 and worked in the health service and private practice. He has worked in full-time academia within podiatry and physiotherapy since 1988. He was awarded a Bachelor of Science in Podiatry from the University of Westminster in 1989 and in 1990 a postgraduate diploma in Biomechanics from the University of Strathclyde.



In 1994, he was awarded a Master of Science Degree in Research Methodology for Physical Therapists from Kings College London and in 2000 was awarded a PhD from the University of Teesside, UK. He was promoted to a Reader in Musculoskeletal Rehabilitation in 2002, and in 2005 was appointed as Professor of Podiatric Rehabilitation at University of Teesside. In 2007 he was appointed a Professor in Podiatry to AUT University, New Zealand.

Keith is currently leading podiatric research at AUT University and his current research interests relate to chronic gout, rheumatoid arthritis and the effects of foot orthoses/footwear on postural stability in long-term chronic conditions.

## Characteristics of the first metatarsophalangeal joint in gout and asymptomatic hyperuricaemia: a cross-sectional observational study

**Authors:** Stewart S et al.

**Summary:** In a cross-sectional observational study in 24 gout patients, NZ researchers assessed first metatarsophalangeal joint (1MTPJ) patient-reported outcomes and clinician-assessed characteristics and compared them to 29 people with asymptomatic hyperuricaemia and 34 age- and sex-matched controls. Gout patients experienced greater 1MTPJ pain ( $p = 0.014$ ), foot pain and disability ( $p < 0.001$ ), activity limitation ( $p = 0.002$ ), and odds of disabling foot pain (OR 13.4,  $p < 0.001$ ) than controls. They also reported lower ratings of overall wellbeing ( $p = 0.034$ ), and reductions in lower limb function for daily living ( $p = 0.002$ ), and recreational activities ( $p < 0.001$ ). Physician reported characteristics included increased 1MTPJ plantar ( $p = 0.004$ ), dorsal ( $p = 0.003$ ) and medial ( $p = 0.004$ ) temperature, decreased range of motion ( $p < 0.001$ ) and plantarflexion force ( $p = 0.012$ ), and increased odds of having more severe hallux valgus (OR 0.3,  $p = 0.041$ ). People with asymptomatic hyperuricaemia also had increased odds for disabling foot pain (OR 4.2,  $p = 0.013$ ), increased activity limitation ( $p = 0.033$ ), and decreases in lower limb function for daily living ( $p = 0.026$ ) and recreational ( $p = 0.010$ ) activities compared to controls. Measures of 1MTPJ plantarflexion force were also increased ( $p = 0.004$ ) and they had a more pronated foot type ( $p = 0.036$ ).

**Comment:** In middle-aged men, gout is the most common form of inflammatory arthritis, and hyperuricaemia is the most important risk factor. In the absence of symptoms of acute arthritis in patients with gout and an absence of symptoms in the asymptomatic hyperuricaemic group, both reported high levels of foot- and lower limb-related pain and disability. Gout patients also experienced 1MTPJ-specific changes in pain, joint motion, muscle strength, hallux valgus severity and temperature. There were also a number of structural and functional changes at the 1MTPJ with gout. The study included only males so the results may not apply to both genders. In addition, patients with comorbid conditions including diabetes, cardiovascular disease and hypertension were not excluded. The cross-sectional design prevents determination of cause and effect relationships between 1MTPJ characteristics and different disease states.

**Reference:** *J Foot Ankle Res.* 2015;8:41

[Abstract](#)

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