

Foot & Ankle Research Review™

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Issue 22 – 2014

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Abbreviations used in this issue

BMI = body mass index

RCT = randomised controlled trial

Welcome to the latest issue of Foot & Ankle Research Review.

In this issue I have focused on the use of sandals. Slip-on sandals (i.e. one strap across the distal-dorsal foot) have become increasingly popular due to their light-weight, convenience and comfort and there have been a number of studies evaluating the function of such footwear. The first article reviews the impact of a cut-out foot orthosis with sandals (Becerro de Bengoa Vallejo R et al.: Clinical improvement in functional hallux limitus using a cut-out orthosis). The second article relates to seasonal changes in people with inflammatory arthritis (Brenton-Rule A et al.: An evaluation of seasonal variations in footwear worn by adults with inflammatory arthritis: a cross-sectional observational study using a web-based survey). The final sandal-related article evaluates the effects of sandals on the medial longitudinal arch (Escalona-Marfil C et al.: A radiographic and anthropometric study of the effect of a contoured sandal and foot orthosis on supporting the medial longitudinal arch).

I hope you enjoy reading Foot & Ankle Research Review and any feedback will be most welcome.

Kind Regards,

Professor Keith Rome

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Clinical improvement in functional hallux limitus using a cut-out orthosis

Authors: Becerro de Bengoa Vallejo R et al.

Summary: In a cross-sectional study in 46 female patients with functional hallux limitus, Spanish researchers aimed to determine whether cut-out orthosis treatment would increase first metatarsal plantarflexion by increasing the declination angle. Using the cut-out orthosis, the movement of the plantarflexion declination angle of the first metatarsal bone was increased by 29.84° versus 27.69° without orthosis ($p < 0.031$). Use of the cut-out orthosis also reduced adduction movement of the first metatarsal bone in the transverse plane.

Comment: Movement of the first metatarsophalangeal joint in the sagittal plane is an essential component of normal function of the human foot during gait. This Spanish study found that the cut-out orthosis modification, using the declination angle of the first metatarsal with the orthosis was significantly greater than without the orthosis. The study also detected a significant difference between "with" versus "without" orthosis for the plantarflexion of the first metatarsal bone. Limitations to the study include the fact that the results reported are specific to the orthosis device tested, and therefore, it is not known whether the results obtained would have been different for a device manufactured by a different method, and/or from different materials. Future research should extend the scope of the study by investigating a variety of manufacturing and prescription methods commonly employed. In addition, although enabling direct access of the sensors to skin overlying the bony segments of the hallux and metatarsal bones, the use of sandals may have minimised the magnitude of motion changes associated with both non-orthosis and orthosis use.

Reference: *Prosthet Orthot Int.* 2014;Sep 26 [Epub ahead of print]

[Abstract](#)

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An evaluation of seasonal variations in footwear worn by adults with inflammatory arthritis: a cross-sectional observational study using a web-based survey

Authors: Brenton-Rule A et al.

Summary: This cross-sectional, web-based study evaluated seasonal variation in footwear habits of 197 New Zealanders with inflammatory arthritic conditions (mostly North Island women of European descent, aged 46–65 years). Survey participants had rheumatoid arthritis (35%) and/or osteoarthritis (57%), and 68% reported established disease of >5 years duration. Therapeutic footwear had been supplied to 18% of participants. The most frequently reported types of footwear worn regardless of the time of year were walking and athletic shoes. In summer, 42% of participants reported wearing sandals most often. The footwear features of greatest importance were comfort, fit and support. Difficulties with footwear (63%), getting hot feet in the summer (63%) and the need for a sandal that could accommodate a supportive insole (73%) were commonly reported.

Comment: Inflammatory arthritis affects more than 500,000 New Zealanders. Foot problems are commonly associated with adult arthritic conditions, particularly with rheumatoid arthritis and other inflammatory arthritic conditions such as gout, systemic sclerosis, psoriatic arthropathy, systemic lupus erythematosus and osteoarthritis. This study from New Zealand found that therapeutic footwear was reported as being worn by a small number of participants regardless of the season. In evaluating footwear worn in winter and summer, the authors found that athletic and walking shoes were the most popular style reported regardless of season. Sandals were found to be worn frequently during the summer. Although this may not be surprising to many clinicians, there is limited understanding on how sandals function in people with inflammatory arthritis. Given the reported popularity of wearing athletic shoes, walking shoes and sandals in people with inflammatory arthritis, further research investigating the long-term effects of commercially available footwear on foot pain, impairment and disability may be warranted. An interesting comment made by patients was “someone should invent a sandal that will take the insole and support your foot...”. This may indicate a lack of awareness of the more supportive, higher quality sandals that are commercially available. This is an interesting article to read for those clinicians who treat people with arthritis.

Reference: *J Foot Ankle Res.* 2014;7:36

[Abstract](#)



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A radiographic and anthropometric study of the effect of a contoured sandal and foot orthosis on supporting the medial longitudinal arch

Authors: Escalona-Marfil C et al.

Summary: Australian and US researchers examined whether a sandal incorporating an arch-profile similar to an in-shoe foot orthosis raises the medial longitudinal arch. A contoured sandal increased dorsal arch height when compared to barefoot and flat sandals using both anthropometric (n = 10; mean age 26.3 years; BMI 23.5 kg/m²) and radiographic (n = 11; mean age 26.1 years; BMI 22.0 kg/m²) assessment. The standardised mean differences ranged from 0.95 (mean difference 5.1 mm; 95% CI 0.3-1.6) to 1.8 (mean difference 4.3 mm; 95% CI 1.9-6.6). Small differences were observed between the contoured sandal and in-shoe orthosis of 1.9 mm (95% CI 0.6-3.3) with radiographic assessment and 1.2 mm (95% CI -0.4 to 0.9) with anthropometric assessment. The contoured sandal approximated the subtalar neutral position (0.4 mm; 95% CI -0.5-0.7).

Comment: This study conducted in the US and Australia showed that the medial longitudinal arch height is elevated by contoured sandals and approximates subtalar joint neutral position of the foot and that achieved by an orthosis. Practitioners wanting to increase the medial longitudinal arch can do so with either an orthosis or a contoured sandal that includes the raised arch profile form of an orthosis. When interpreting the findings from this study it is important to understand that the study did not measure changes in pain and disability in a symptomatic group. The authors do not know if the amount of change in arch/navicular height engendered by the contoured sandals is clinically meaningful in changing pain and disability in symptomatic participants. In this preliminary study of the contoured sandals, asymptomatic healthy participants were purposely selected in order to remove any possible influence of pain on the x-ray or anthropometric measurement process. Follow up studies to establish if the contoured sandals influence pain, disability and foot posture are now required.

Reference: *J Foot Ankle Res.* 2014;7(1):38

[Abstract](#)

Musculoskeletal and activity-related factors associated with plantar heel pain

Authors: Sullivan J et al.

Summary: An Australian study in 202 people with plantar heel pain and 70 asymptomatic controls examined relationships between musculoskeletal and activity-related measures and plantar heel pain. Patients with plantar heel pain had a higher BMI, reduced range of motion in ankle dorsiflexion, reduced strength of the ankle evorator and toe flexor, and a different inversion/eversion strength ratio. There were no differences for other measures including foot alignment, invertor or dorsiflexor strength, ankle eversion or inversion range of motion, first metatarsophalangeal joint extension range of motion, generalised hypermobility, occupational standing time or exercise level.

Comment: Plantar heel pain is the most common foot disorder treated by healthcare practitioners and is estimated to affect approximately 10% of people at some stage of their life. This large Australian study of plantar heel pain was associated with higher BMI, reduced ankle dorsiflexion range of motion, and weakness of the ankle evertors and toe flexors compared with asymptomatic people. Although associations were reported, limitations of the study include the cross-sectional design, meaning that any of the differences in the measures between the groups cannot be distinguished as either causative factors or as result of the condition. The focus of this study was limited to investigating mechanical factors associated with plantar heel pain, but it is possible that non-mechanical factors may also play a role in this condition. It has been suggested that heel pain may have a higher incidence in women than in men, although evidence regarding this is inconclusive. In addition, recent evidence has linked metabolic disorders to soft tissue conditions – namely tendinopathy. However, I strongly recommend you read the article as it gives an insight into foot strength deficits, which could be addressed with appropriate exercise prescription as a part of a comprehensive management strategy.

Reference: *Foot Ankle Int.* 2014;Sep 18 [Epub ahead of print]

[Abstract](#)

Effects of shock-absorbing insoles during transition from natural grass to artificial turf in young soccer players. A randomized controlled trial

Authors: Kaalund S and Madeleine P

Summary: This RCT compared the use of shock-absorbing insoles on the pain and comfort experienced during the switch from training on natural grass to training on third-generation artificial turf in 75 young soccer players. Three weeks after switching from natural grass to artificial turf, pain intensity was increased and comfort decreased ($p < 0.05$). In those using shock-absorbing insoles, pain intensity scores were lower than in those using their usual insoles ($p < 0.05$).

Comment: This Danish study demonstrated that the switch from natural grass to artificial turf is associated with decreased comfort and increased pain intensity at rest and during physical activity, i.e. training. Pain intensity measured 3 weeks after the addition of shock-absorbing insoles was reduced, demonstrating the potential role of these insoles in pain perception. This study is the first prospective randomised controlled study conducted with blinded investigators evaluating the effects of shock-absorbing insoles on pain and comfort during continuous training. Stratified randomisation by age and team level ensured that the anthropometric values of the players and the volume of training did not affect the findings. The participants were young soccer players. Thus, the present findings may not be generalisable to adult players. The mean temperature decreased from 7.7° to 5° to 2.5°C during the assessments, and the mean precipitation levels were 14, 0, and 22 mm. Thus, it is unlikely that the climatic changes were solely responsible for the changes reported in comfort and pain perception. Future studies could investigate the effects of insoles on specific pain sites. RCTs with longer intervention times are needed to confirm these findings since only 3 weeks was measured and does not represent the clinical setting. However, for those healthcare professionals that deal with soccer players, the use of shock absorbing insoles to increase comfort and decrease the pain is potentially warranted.

Reference: *J Am Podiatr Med Assoc.* 2014;104(5):444-50

[Abstract](#)

Effects of foot orthoses on Achilles tendon load in recreational runners

Authors: Sinclair J et al.

Summary: A UK trial in 12 male runners assessed differences in Achilles tendon load when running at 4.0 m/s with and without orthoses. Significant reductions in Achilles tendon load were associated with running with versus without foot orthotics suggesting that foot orthoses may reduce the incidence of chronic Achilles tendon pathologies in runners.

Comment: Achilles tendon pathology is a frequently occurring musculoskeletal disorder in runners, accounting for approximately 8-15% of all injuries in recreational runners. A key intervention that has been advocated by clinicians for the prevention and treatment of Achilles tendinopathy is foot orthoses. This UK study observed that Achilles tendon load parameters were significantly reduced with the presence of orthotic intervention in comparison to running without orthotic inserts. Although the mean reduction in tendon kinetics was relatively small, the results indicate that 11 of the 12 participants exhibited reductions in Achilles tendon parameters as a function of orthotic intervention. This finding may be relevant clinically for the pathogenesis of Achilles tendinopathy and provide insight into the mechanism by which orthotics serve to attenuate the symptoms of Achilles tendinopathy. Although the authors state that orthotic intervention may be appropriate for runners who are predisposed to Achilles tendon pathology, only 12 participants were evaluated. Furthermore, it appears none of the participants had a history of Achilles tendon pathology. There are many studies that are conducted in a laboratory and then make inference to the clinical setting. Clinicians should be aware of laboratory-based articles that claim the benefits of foot orthotics in common musculoskeletal disorders.

Reference: *Clin Biomech.* 2014;Aug 8 [Epub ahead of print]

[Abstract](#)

Effects of weight loss on foot structure and function in obese adults: A pilot randomized controlled trial

Authors: Song J et al.

Summary: This 3-month RCT assessed the effect of weight reduction on foot structure, gait, and dynamic plantar loading in 41 obese adults (mean age 56.2 years and BMI 35.9 kg/m²) receiving a portion-controlled weight loss intervention or a delayed-treatment control. After 3 months a significantly greater weight loss was observed in the intervention than the control group (5.9 kg vs 1.9 kg; $p = 0.001$). No differences were observed between the groups in anatomical foot structure or gait. However, the treatment group had a significantly lower plantar peak pressure than the control group beneath the lateral arch and the fourth metatarsal ($p < 0.05$) at 3 months. The change in plantar peak pressure correlated with the change in weight at the second metatarsal ($r = 0.57$; $p = 0.0219$), third metatarsal ($r = 0.56$; $p = 0.0064$) and the medial arch ($r = 0.26$; $p < 0.0001$) at a subsequent assessment at 6 months.

Comment: Over two thirds of Americans are at least overweight and one third are obese. The majority of studies examining the relationship between obesity and plantar pressure have been cross sectional and associative. This US study is the first prospective RCT designed to explore the effects of weight loss on foot structure, gait and plantar pressure. This study was limited to asymptomatic obese adults with no significant musculoskeletal disabilities or pain. Small sample size, stringent subject criteria, modest weight loss, and short follow up period limit the clinical utility of this exploratory study. Participants' foot structure and function most closely resemble those subjects with flatfoot. While no change was noted on foot structure and gait parameters, the results showed that even a modest weight reduction could yield significant reduction in plantar loading. These dynamic plantar load alterations that accompanied moderate weight loss did not occur uniformly throughout the foot but rather specific to certain regions of the foot in this group of participants with planus foot type. Additional studies are needed to examine the prevalence of foot pain/disability in obese subjects, the role of a specific footwear and exercise program, and the significance of foot disability on adherence to healthy lifestyle. This is an interesting study and clinicians may want to read the full article.

Reference: *Gait Posture* 2014;Sep 6 [Epub ahead of print]

[Abstract](#)

Foot and Ankle Research Review

Independent commentary by Professor Keith Rome,
School of Podiatry, AUT University, Auckland.

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.



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Personalized orthoses as a good treatment option for Charcot neuro-osteoarthropathy of the foot

Authors: González Fernández ML et al.

Summary: The biomechanical characteristics of feet in Charcot neuro-osteoarthropathy patients and reulceration rates were assessed before and after personalised conservative orthotic treatment in 35 patients with Charcot's foot in a longitudinal prospective study. Over 1 year, 70 feet received orthotic treatment, with 41 being Charcot feet. Ulceration rates were 73.2% in Charcot feet versus 31.0% in those without Charcot's before the study began, and these rates fell to 9.8% in Charcot feet and 0% in the feet without Charcot's after 1 year of wearing customised orthoses.

Comment: Charcot neuro-osteoarthropathy is a non-infectious, chronic, degenerative disease of the foot and has been linked to diseases that involve peripheral neuropathy or repeated trauma to the foot. This Spanish study reported a higher prevalence of Charcot neuro-osteoarthropathy in men than in women, contrasting with other reports that have suggested no predilection for either sex. The authors suggest that 1 year of personalised orthotic treatment was able to reduce the ulceration rate to 9.8% in feet with Charcot neuro-osteoarthropathy. The limitations of this study include the lack of a control group of untreated patients. As control data, they used retrospective data for the study participants corresponding to the year before treatment. A further limitation was that the unit of analysis was the foot rather than the patient. The findings, similar to many studies involving long-term chronic foot conditions is that conservative management involving personalised orthotic treatment based on off-loading foot orthoses and therapeutic footwear according to the foot deformity is the best initial option in patients. I recommend you review the paper especially if you are interested in the non-surgical management of people with diabetes.

Reference: *J Am Podiatr Med Assoc.* 2014;104(4):375-82

[Abstract](#)



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Comparing the immediate effects of UCBL and modified foot orthoses on postural sway in people with flexible flatfoot

Authors: Payehdar S et al.

Summary: This study investigated the effect of a rigid University of California Berkeley Laboratory (UCBL) foot orthosis, a modified foot orthosis, and normal shoes on the postural sway of 20 young adults with flexible flatfoot. The study revealed no difference in medial-lateral and anterior-posterior stability indices between modified foot orthoses and normal shoes; however, overall stability index was significantly lower with the UCBL foot orthosis than with the modified foot orthosis.

Comment: Various therapeutic approaches, including exercise therapy, surgery and orthoses have been reported to be used for flexible flatfoot in adults. This study from Iran demonstrated that there was no significant difference between the mean sway in standing with shoe only and standing with a combination of shoe and orthoses. The results are not surprising as previous studies have demonstrated no differences in young or older adults. Recent studies have suggested people with neuromuscular conditions such as multiple sclerosis and Parkinson's showed greater improvement. Clinicians may be interested in this different approach to the use of foot orthoses. Foot plantar mechanoreceptors provide detailed information about contact pressure, which is used for feedback mechanisms of the postural control system and balance. Interventions such as a foot orthosis may optimise sensory information from the plantar surface of the foot and may improve balance. However, the study looked at very young adults and well-constructed sports shoes were used, therefore reducing the effect of the foot orthoses.

Reference: *Prosthet Orthot Int.* 2014;June 18 [Epub ahead of print]

[Abstract](#)

Characteristics of diabetic foot ulcers in Western Sydney, Australia

Authors: Haji Zaine N et al.

Summary: To examine characteristics of diabetic foot ulcers in Western Sydney, data from 195 outpatients with diabetes were retrospectively analysed. Patients were 66.2% male, had a median age of 67 years, median BMI of 28 kg/m², 75.4% had peripheral neuropathy and the median postcode score for socioeconomic status was 996. Diabetic foot ulcers in these patients had a median cross sectional area of 1.5 cm², a median volume of 0.4 cm³, 45.1% occurred on the plantar foot, 16.6% had a University of Texas (UT) Wound Grade of 0C to 3C (with ischaemia) and 11.8% had a UT Wound Grade of 0D to 3D (with infection and ischaemia), and 25.6% with osteomyelitis. One major and four minor amputations were required.

Comment: This Australian study provides useful information about the classification, characteristics and location of diabetic foot ulcers, and the patients' socioeconomic status. The authors report the ulcer types were heterogeneous ranging from superficial to deep involving tendon, bone and joint with infection and ischaemia. This will be of interest to clinicians as they often treat a range of chronic diabetic foot ulcers. This study is limited by the evaluation of patients with diabetes only. Other factors should be considered such as HbA1c, specifying cause of ulcers due to foot deformities (such as hallux valgus, clawed toes), foot pathologies (such as fissures and callosities) and biomechanical abnormalities (such as cavus and Charcot foot), medical history such as malignancies/chemotherapy and medications, which may impair wound healing. However, the authors report that there is a paucity of information on predictive values of risk factors for diabetic foot ulcerations. Therefore, in-depth information will be useful in developing a risk assessment-model for a larger prospective cohort study. This will enable clinicians to identify and estimate the risk factors associated with diabetic foot ulcers (such as patient comorbidities, history and physical examination). For comparison, future studies should also evaluate people without diabetes who present with foot ulcers.

Reference: *J Foot Ankle Res.* 2014;7(1):39

[Abstract](#)