



Foot & Ankle Research Review™

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Issue 8 – 2011

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Welcome to the eighth edition of Foot & Ankle Research Review.

When undertaking these reviews I try to consider which articles would be of importance to clinicians. Four papers will be of interest to those who prescribe foot orthoses (shoe inserts). Shoe inserts is a particular topic area that covers a considerable amount of attention and those readers who are keen to know the impact of shoe inserts in the general population should read the Stolwijk article (*Plantar pressure with and without custom insoles in patients with common foot complaints. Foot & Ankle Int 2011;32[1]:57-65*). Foot orthoses are frequently prescribed for patients with knee pain and the reader will be interested to find out the results of a study on 52 patients with patellofemoral pain syndrome (*Barton et al: The immediate effects of foot orthoses on functional performance in individuals with patellofemoral pain syndrome. Br J Sports Med 2011;45[3]:193-7*). A large randomised clinical trial of the impact of foot orthoses in the military will be of interest to those who deal with military personnel (*Franklyn-Miller et al: Foot orthoses in the prevention of injury in initial military training: a randomized controlled trial. Am J Sports Med 2011;39[1]:30-7*). The final article in this series relating to foot orthoses looks at the impact of a total cast for plantar foot ulceration (*Burns and Begg: Optimizing the offloading properties of the total contact cast for plantar foot ulceration. Diabetes Medicine 2011;28[2]:179-85*).

I hope you enjoy reading the latest edition and any feedback is most welcome.

Kind regards,

Professor Keith Rome

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Are the feet of obese children fat or flat? Revisiting the debate

Authors: Riddiford-Harland DL et al

Summary: This Australian case-control study compared the feet of 75 obese children (mean age 8.3 years; mean BMI 25.2 ± 3.6 kgm⁻²) with those of 75 age- and sex-matched non-obese children (BMI 15.9 ± 31.4 kgm⁻²) in order to determine if the flatter foot structure characteristic of many obese primary school-aged children was due to lowering of the longitudinal arch (flat feet) or due to increased medial midfoot plantar fat pad thickness (fat feet). Ultrasonography was used to quantify plantar fat pad thickness and internal arch height. Analysis revealed a significantly ($p < 0.001$) greater medial midfoot fat pad thickness in obese children compared with non-obese children during both weight bearing and non-weight bearing (4.7 vs 4.3 mm and 5.4 vs 4.6 mm, respectively). Obese children also had significantly ($p = 0.006$) lowered medial longitudinal arch height compared to non-obese children (23.5 vs 24.5 mm). The findings indicate that obese children have both fatter and flatter feet than non-obese children.

Comment: This study will be of interest to those clinicians who deal with children and parents with flat-foot problems. The foot characteristics of the obese children showed significant differences in midfoot fat pad thickness and a lowering of the arch. Although differences occurred, the long-term consequences of obesity on the biomechanical structures of the foot still remains unknown. A limitation of the study is that the age group was only 8 year olds and therefore, changes in other age populations, for example under 6 years old or older still remains unknown. However, the article is well structured and there is a good discussion section that clinicians would find interesting.

Reference: *Int J Obes. 2011; 35:115-20.*

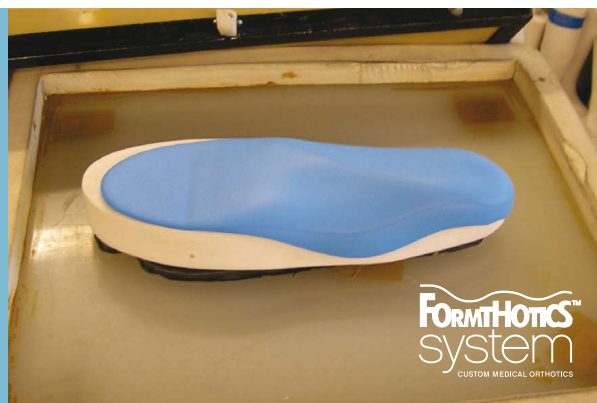
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Relationships between the Foot Posture Index and foot kinematics during gait in individuals with and without patellofemoral pain syndrome

Authors: Barton CJ et al

Summary: The purpose of this Australian study was to evaluate the extent to which the Foot Posture Index (FPI), a static foot posture measurement tool, can give insight into kinematic variables associated with foot pronation during level walking by comparing subjects with patellofemoral pain syndrome (PFPS; n = 26) and asymptomatic controls (n = 20). A 3-dimensional motion analysis system was used for kinematic analysis of the rearfoot and forefoot during walking, and each subject underwent clinical evaluation of the FPI. In the PFPS group, a more pronated foot type (measured by FPI) was associated with earlier peak rearfoot eversion ($r = -0.440$; $p = 0.031$) and greater peak forefoot abduction ($r = 0.502$; $p = 0.013$) relative to the floor. In controls, a more pronated foot type was associated with greater rearfoot eversion range of motion relative to the floor ($r = 0.614$; $p = 0.009$). The findings indicate a fair to moderate association between the FPI and some parameters of dynamic foot function in both subjects with PFPS and those without. The researchers conclude that inconsistent findings between the control and PFPS groups suggest that pathology may play a role in the relationship between static foot posture and dynamic function.

Comment: Foot posture is frequently evaluated in individuals with PFPS, particularly when considering prescription of foot orthoses. Evaluation of foot posture is often performed under the assumption that measuring static structures will provide insight into dynamic function, although this is largely unproven. This study illustrates a moderate relationship between foot type and PFPS. However, a cautionary note, the study is a case-control trial and does not demonstrate 'cause and effect'. Similar to many clinical studies the authors report that future prospective studies should be undertaken. The study may be of interest to clinicians, but still leaves the reader unclear on the impact of any intervention relating to PFPS.

Reference: *J Foot Ankle Res.* 2011;4:10.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3064639/?tool=pubmed>

Plantar pressure with and without custom insoles in patients with common foot complaints

Authors: Stolwijk NM et al

Summary: The effect of customised insole design on plantar pressure distribution was investigated in this study. Subjects had mean, peak and pressure-time integral measured during walking with and without the insoles. A variety of insoles were analysed and the insole height along the longitudinal and transverse cross section calculated. Subjects were assigned to subgroups based on medial arch height and complaint (forefoot or heel pain, flat, normal or high medial arch). Insoles caused a significant decrease in mean pressure under the metatarsal heads II-V and the calcaneus, and significantly ($p < 0.0045$) increased the mean pressure under the metatarsal bones and the lateral foot. A similar redistribution of pressure was found for the different subgroups. There was a slight difference in insole design between the groups, but this difference was small. The authors suggest that it might be sufficient to use basic insoles for certain patient groups.

Comment: This Dutch study evaluated 204 subjects complaining of foot problems who had been issued with foot orthoses. The aim was to determine the effect of orthotic design and the impact on plantar pressures. The article requires careful reading as a number of common lower limb and foot conditions were excluded (rheumatoid arthritis and diabetes). The introduction is confusing as it describes older adults and the impact of foot orthoses on the rheumatoid foot. Although the study demonstrated significant differences between those with and without foot orthoses in plantar pressure measurements it is difficult to ascertain the clinical interpretation of the results. Many clinicians have their own personal preference and it is unclear from this lengthy study if a pre-fabricated foot orthoses is any better or worse than a customised foot orthoses.

Reference: *Foot Ankle Int.* 2011;32(1):57-65.

<http://tinyurl.com/3fpyzpr>

Optimizing the offloading properties of the total contact cast for plantar foot ulceration

Authors: Burns J and Begg L

Summary: The offloading properties of the conventional total contact cast for plantar foot ulceration were compared with those of a cushion-modified total contact cast, which incorporates an inlay of 6 mm slow-rebound cellular urethane and 6 mm soft-cellular urethane. A comparison was made with the canvas cast shoe (the control condition). The Novel Pedar-X system was used to measure in-cast walking pressures in 20 participants. Compared with the control condition, the conventional total contact cast significantly ($p < 0.001$) reduced mean pressure at the ulcer site by 47%, peak pressure by 44% and the pressure-time integral by 37%. The cushioned-modified total contact cast significantly ($p < 0.001$) reduced mean pressure at the ulcer site by 60%, peak pressure by 70% and the pressure-time integral by 69%. The conventional total contact cast significantly reduced ($p < 0.05$) plantar pressure across the entire foot and each region of the foot compared with the cast shoe, and the cushion-modified total contact cast was found to further reduce these pressures. The findings show that offloading properties of the total contact cast can be enhanced with a 12 mm cellular-urethane-cushion modification.

Comment: This study will be of interest to clinicians who deal with plantar foot ulceration. The authors have set out to investigate in-cast pressure offloading in total contact casts. The article is well written and illustrates that the use of different materials can significantly alter key plantar pressure parameters such as mean pressure and pressure-time integrals. Although the sample size was small, with only 20 participants, the study will inform clinicians of the changes that occur between a cast shoe, total contact cast and cushion-modified contact cast. The use of additional material, in this instance a 6 mm slow-rebound cellular urethane can make a considerable difference. It would be of interest to note if the participants found that the modified devices were more comfortable and/or enhanced their quality of life. Perhaps future work could look into these important features.

Reference: *Diabet Med.* 2011;28(2):179-85.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1464-5491.2010.03135.x/abstract>

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Assessment of the natural history of forefoot bursae using ultrasonography in patients with rheumatoid arthritis: a twelve-month investigation

Authors: Bowen CJ et al

Summary: Musculoskeletal ultrasonography was used in this study to determine the natural history and clinical significance of forefoot bursae over a 12-month period in 120 patients (mean age 60.7 years) with rheumatoid arthritis (mean disease duration 12.99 years). Clinical markers of disease activity and foot symptoms on the Leeds Foot Impact Scale (LFIS) Questionnaire were recorded at baseline and at 12 months. Forefoot bursae were identified in 93.3% of subjects at baseline (individual mean 3.7). Bursae presence was found to be significantly ($p \leq 0.01$) associated with activity limitation/participation restriction at baseline and at 12 months (LFIS_{AP}: $r = 0.254$ and $r = 0.235$), and significantly ($p \leq 0.013$) associated with patient-reported foot impact for impairment/footwear (LFIS_F: $r = 0.226$ and $r = 0.236$). At 12 months, 42.5% of subjects had an increase in the number of forefoot bursae detectable on ultrasound and 45% of participants had a decrease. There was a significant ($p \leq 0.036$) correlation between the change in the number of bursae and changes in LFIS_F ($r = 0.216$) and LFIS_{AP} ($r = 0.193$). There was no significant association between changes in bursae number and changes in global well-being visual analog scale, CRP, ESR or Disease Activity Score in 28 joints.

Comment: This study will be of interest to clinicians who treat patients with rheumatoid arthritis. The results from 120 patients are surprising since forefoot bursae either demonstrated a regression or hypertrophied over time. The authors reported that these changes to the bursae correlated with self-reported foot impairment. The reader should be aware that the correlations reported in the article although significant were weak and that other factors may contribute to the observations found in the current study. However, the article is well-constructed and illustrates important findings over time, a factor that previous studies have not reported.

Reference: *Arthritis Care Res.* 2010;62(12):1756-62.

<http://onlinelibrary.wiley.com/doi/10.1002/acr.20326/abstract>

Foot orthoses in the prevention of injury in initial military training: a randomized controlled trial

Authors: Franklyn-Miller A et al

Summary: This randomised controlled trial (RCT) assessed whether orthoses produced by proprietary software interpretation of plantar pressures are able to reduce the rates of lower limb injuries in 'at risk' military personnel. A total of 624 military officer trainees were assessed for inclusion and 400 were enrolled in the study. Contact foot pressures during walking were measured by pressure plate recording and cadets were risk assessed and randomised to receive, or not receive (control group), customised foot orthoses. Both groups were followed-up at 7 weeks during their basic training period. The control group sustained a total of 61 injuries (1 injury per 1600 hours of training), significantly ($p < 0.001$) more than the orthotic intervention group who sustained only 21 injuries (1 injury per 4666 hours of training). This equated to an absolute risk reduction of 0.49 from the use of orthoses ($p < 0.001$).

Comment: This is a large UK study involving 624 naval cadets. The study uses plantar pressures to evaluate the impact of customised foot orthoses on injury prevention. Plantar pressure analysis is a tool that has been shown to be reliable and valid. It is nice to see the tool being used in a large RCT as previous studies evaluating the use of foot orthoses in prevention of injuries have not been previously presented. Nonetheless, this study demonstrates that plantar pressure analysis may be a reasonable tool to base orthotic protocols, although we cannot say that the result would have been any different to using a standard over-the-counter device. The study clearly shows fewer injuries particularly Medial Tibial Stress Syndrome and Iliotibial Tract Syndrome in the group that used orthoses.

Reference: *Am J Sports Med.* 2011;39(1):30-7.

<http://ajs.sagepub.com/content/39/1/30.abstract>

Functional and biomechanical characteristics of foot disease in chronic gout: a case-control study

Authors: Rome K et al

Summary: The effects of chronic gout on function and selected biomechanical parameters associated with gait were assessed in this study involving 25 patients with the disease and 25 age- and sex-matched controls. Subjects underwent gait assessment, including an evaluation of temporal-spatial gait parameters and plantar pressure measurements. Foot-specific-disease activity and foot function were assessed using the LFIS and general function was assessed using the Health Assessment Questionnaire, Foot Function Index (pain domain). Subjects with chronic gout had significantly ($p \leq 0.001$) higher levels of general and foot-specific disability, pain and impairment compared with controls. Furthermore, patients with chronic gout had significantly lower peak plantar pressures at the hallux, and while significantly higher pressure-time integrals were evident at the midfoot, lower values were observed at the hallux ($p \leq 0.05$). Compared with controls, patients with chronic gout walked slower and exhibited longer step and stride lengths.

Comment: This New Zealand study evaluates significant foot characteristics of chronic gout patients and compares them to age- and sex-matched controls. The study found changes in plantar pressure, gait parameters and pain, impairment and disability scales. Gout is a major problem in New Zealand and is on the increase with similar numbers being diagnosed with gout as are diagnosed with diabetes. The authors report that future directions are looking at the impact of foot orthoses and footwear on gout sufferers. It will be interesting to watch the developments of this study, as a podiatric intervention may indeed have a considerable benefit on the lives of gout patients.

Reference: *Clin Biomech.* 2011;26(1):90-4.

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The validity and reliability of diagnosing foot ulcers and pre-ulcerative lesions in diabetes using advanced digital photography

Authors: Hazenberg CE et al

Summary: This study evaluated the validity and reliability of using high-quality digital photographs to assess the presence of plantar foot ulceration and pre-ulcerative lesions in 32 patients with diabetes, who had an existing foot ulcer or who were at high risk of ulceration. Feet were assessed live, from photographs at weeks 2, and again at 4 weeks, by four independently operating foot care specialists, for the presence of an ulcer, abundant callus, or the absence of signs. Agreement scores were calculated using κ values (range, 0–1). Specificity and sensitivity scores were also calculated. During live assessment, plantar foot ulceration was cumulatively scored 59 times, callus 78 times, and absence of signs 149 times. Agreement with photographic assessment was good for callus ($\kappa = 0.61$), and very good for ulcer ($\kappa = 0.87$) and absence of signs ($\kappa = 0.83$). Sensitivity and specificity were high for ulcer (88% and 98%), callus (69% and 89%), and absence of signs (90% for both). Inter-observer agreement for photographic assessments was good for absence of signs ($\kappa = 0.59$ – 0.75) and ulcer ($\kappa = 0.72$ – 0.88), and moderate to good for callus ($\kappa = 0.48$ – 0.73); inter-observer agreement scores for live assessment were only slightly higher. Intra-observer agreement between repeated photographic assessments was good to excellent for all outcomes and observers ($\kappa = 0.70$ – 1.00).

Comment: Foot ulceration represents a significant problem in patients with diabetes mellitus in New Zealand. The authors report that the most efficient way to monitor the feet of these patients on a frequent basis seems to be through the use of a telemedical approach in the home environment. The results from this Dutch study are promising, demonstrating that foot ulcers and pre-ulcerative lesions can be assessed by trained professionals in a valid and reliable manner from digital photographs produced by a photographic foot imaging device. Clinicians should be aware that telemedicine is relatively new and the use of it in clinical practice needs to be further evaluated.

Reference: *Diabetes Technol Ther.* 2010;12(12):1011-7

<http://www.liebertonline.com/doi/abs/10.1089/dia.2010.0088>

The immediate effects of foot orthoses on functional performance in individuals with patellofemoral pain syndrome

Authors: Barton CJ et al

Summary: This Australian study evaluated the immediate effects of foot orthoses on functional performance and the association of foot posture and footwear with improvements in function in 52 patients (aged 18–35 years) with PFPS who were prescribed prefabricated foot orthoses (Vasyli Pro; Vasyli International, Labrador, Australia). The following functional outcome measures were evaluated: change in pain; change in ease of a single-leg squat on a five-point Likert scale; change in the number of pain-free step downs change in single-leg rises from sitting. Prefabricated foot orthoses significantly ($p < 0.05$) improved all functional measures. Poorer footwear motion control properties and a more pronated foot type were found to be associated with improvements in the number of pain-free single-leg rises from sitting and reduced pain during the single-leg squat when wearing the foot orthoses. A more pronated foot type was also found to be associated with improved ease of undertaking a single-leg squat when wearing foot orthoses.

Comment: A common treatment for PFPS is the prescription of foot orthoses. The results indicated that a prefabricated foot orthoses produced significant improvements for a number of functional measures related to the knee. The results are very promising and clinicians can provide evidence that foot orthoses do have an immediate effect on reducing pain and enhancing functional activities. Unfortunately, there is always a 'sting' in the tail. The results relate to a young adult population and it is difficult to make comparisons across all age groups. I strongly recommend that clinicians and students should read this paper as it would give an insight into key clinical aspects of this common musculoskeletal knee condition.

Reference: *Br J Sports Med.* 2011;45(3):193-7.

<http://bjsm.bmj.com/content/45/3/193.abstract>

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