

Foot & Ankle Research Review

Making Education Easy

Issue 5 – 2010

In this issue:

- *Unstable shoes: effect on balance*
- *Plantar fasciitis: extracorporeal shockwaves vs corticosteroid injection*
- *Dynamic splinting for plantar fasciopathy*
- *A new paradigm of podiatry care in RA*
- *Dry skin and diabetic foot ulceration*
- *Hyperbaric oxygen therapy for foot ulcers*
- *Ankle sprains: accelerated rehabilitation beneficial*
- *VTE with immobilisation for Achilles tendon injury*
- *Kinematics of normal- and low-arched paediatric feet*
- *Custom orthoses for paediatric flat feet*

Welcome to the latest edition of Foot and Ankle Research Review.

In this edition I have included two articles that may be of interest to those who treat children's foot conditions. A common concern of many parents and guardians is related to their child's feet, especially those with flat feet. The lack of classification and functional understanding of paediatric flat feet indicates the necessity to evaluate the differences between this condition and a normal foot dynamically. Flat feet have been linked with lower limb and postural dysfunction in childhood and later life. The first article relates to a protocol established for looking at three-dimensional gait analysis of children with low-arched and normal-arched feet (Twomey et al. *Gait & Posture* 2010;32:1-5). The second article relates to a systematic review of the non-surgical intervention of flat feet (Rome et al. [Cochrane Database Syst Rev. 2010;7:CD006311](#)). I hope you find the selection for Foot & Ankle Research Review stimulating reading and welcome your feedback.

Kind regards,

Professor Keith Rome

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Effects of an unstable shoe construction on balance in women aged over 50 years

Authors: Ramstrand N et al

Summary: This Swedish study involving 31 non-active women aged >50 years, who did not exercise more than once per week, evaluated the relative effects of using an unstable shoe (Masai Barefoot Technology [MBT]) on standing balance, reactive balance and functional stability. Twenty women (mean age 60 years) were assigned to wear the MBT shoe while 11 acted as controls (mean age 58 years). None of the women had balance disorders. Baseline assessments were performed and subjects in the intervention group were instructed to wear their MBT shoes as often as possible during the 8 weeks of the study; balance tests were undertaken on three different occasions with a minimum of 4 weeks between tests. Analysis of balance data from 17 subjects in the intervention group who completed the study and all 11 controls was undertaken; 2 subjects withdrew from the study due to hip or lower back pain while wearing the shoes. The intervention group showed significant improvements from baseline ($p < 0.05$) in stabilising their centre of pressure following a rapid, downward rotating perturbation, when balancing on an unstable surface with eyes closed, and in directional control when performing a limits of stability test. However, when comparisons were made between the intervention and the control group for each testing occasion, no significant differences were observed for any of the variables which the intervention group significantly improved upon across testing occasions.

Comment: There has been exponential growth in the use of footwear and shoe inserts for enhancing postural stability or balance. Upright posture is controlled by the central nervous system, which integrates visual, vestibular and somatosensory information about body position to initiate appropriate motor and muscle responses at the trunk and lower limbs. The somatosensory system is a diverse sensory system comprising the receptors and processing centres to produce the sensory modalities such as touch, temperature, body position and pain. The effects of unstable shoes on postural stability in the current study centres around postulations that improved balance performance when wearing such interventions may be attributed to alterations in sensory information at the plantar surface of the foot. Although the current study demonstrated improvements with the use of the MBT shoe, the results did not differ significantly from the control group. A limitation of the study is that the shoes, by design, create an unstable base for standing and walking and it is possible that there is an increased risk of falls associated with their use. While this risk is likely negligible in healthy older adults, it may not be appropriate to prescribe the footwear in cases where a subject's balance is compromised. This study suggests that further work is necessary to find the optimum design for use in older adults, with and without a history of falls, before any definitive conclusions can be made.

Reference: *Clin Biomech.* 2010;25(5):455-60

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Comparison of high-dose extracorporeal shockwave therapy and intralesional corticosteroid injection in the treatment of plantar fasciitis

Authors: Yucel I et al

Summary: The efficacy of high-dose extracorporeal shockwave therapy applied with an ankle block was compared with that of corticosteroid injection in the treatment of plantar fasciitis in this Turkish study involving 60 patients whose symptoms of fasciitis had persisted for more than 6 months. Patients were assessed at baseline and at 3 months using a patient-assessed 100mm visual analogue scale (VAS) pain score and a physician-assessed heel tenderness index; a decrease of at least 50% from baseline to 3 months in either of these scores was considered to be a successful result. A significant improvement from baseline was seen at 3 months in 27/33 (82%) extracorporeal shockwave recipients and in 23/27 (85%) corticosteroid injection recipients. There was no significant difference between the two groups in VAS score change at 3 months.

Comment: Plantar fasciitis is a very common musculoskeletal foot problem frequently seen by clinicians. However, there are numerous interventions available to clinicians ranging from stretching to shoe inserts, extracorporeal shockwave therapy and corticosteroid injections. In the current study, high-dose extracorporeal shockwave therapy and corticosteroid injection were used. The study concluded that both modalities were successful, but the authors suggested corticosteroid was more cost-effective. However, a previous study using a randomized, controlled design demonstrated that intralesional corticosteroid injection was both more efficacious and more cost-effective than low-energy extracorporeal shockwave therapy in the treatment of plantar fasciitis that has persisted for more than 6 weeks (Porter MD and Shadbolt B *Clin J Sport Med.* 2005;15(3):119-24). Unfortunately, there is no consensus for differentiating between low-energy and high-energy shock waves, as multiple physical variables are involved. Hence, the debate continues on the use of low- or high-intensity extracorporeal shockwave therapy, and clinicians should be aware of these issues before considering such treatment.

Reference: *J Am Podiatr Med Assoc.* 2010;100(2):105-10

<http://www.japmaonline.org/cgi/content/abstract/100/2/105>

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Plantar fasciopathy treated with dynamic splinting: a randomized controlled trial

Authors: Sheridan L et al

Summary: Therapeutic protocols for plantar fasciitis have included stretching exercises, physical therapy, foot orthoses and corticosteroid injections, but a single modality has not been found to be universally effective. This randomized controlled 12-week study involving 60 patients (76 feet), from four different clinics across the US, investigated the efficacy of stretching with dynamic splinting in the treatment of plantar fasciitis. A total of 30 patients were assigned to the intervention group and received dynamic splinting for nightly wear to obtain a low-load, prolonged-duration stretch with dynamic tension. The other 30 patients were assigned to the control group and all 60 patients received non-steroidal anti-inflammatory drugs, orthoses and corticosteroid injections, as required. Patients in the intervention group exhibited a significantly ($p < 0.0001$) greater mean change from baseline in plantar fasciopathy pain/disability scale score compared with controls (-33 vs -2 points).

Comment: This study reported that dynamic splinting was successful in reducing pain in patients with plantar fasciitis and suggested it should be incorporated in the standard care for this condition. The study design reported that all of the patients were given the current standard of care, which included non-steroidal anti-inflammatory medications, orthotic devices and corticosteroid injections as required. The intervention group were also given the dynamic splint. The number of patients in the intervention group completing the study is unclear, as is any indication that they found the splinting device acceptable. The publication also falls substantially short of the CONSolidated Standards of Reporting Trials (CONSORT) standards for the information that should be included in a report of a randomized clinical trial. Similar to other studies, prospective longitudinal studies are required to evaluate the clinical efficacy and cost-effectiveness of an intervention.

Reference: *J Am Podiatr Med Assoc.* 2010;100(3):161-5

<http://www.japmaonline.org/cgi/content/abstract/100/3/161>

Looking through the 'window of opportunity': is there a new paradigm of podiatry care on the horizon in early rheumatoid arthritis?

Authors: Woodburn J et al

Summary: These UK-based researchers reviewed recent paradigm shifts in the management of early rheumatoid arthritis (RA) and explored new opportunities for the management of this disease. They point out that during the past decade there have been significant advances in the clinical understanding and care of patients with RA and that the advent of tumour necrosis factor inhibitors and other biologic therapies have further revolutionised care. They describe a new paradigm of podiatry care in early RA which they say is driven by current evidence indicating that, even in low disease activity states, destruction of foot joints may be progressive and associated with accumulating disability. The paradigm emphasises the role of the podiatrist in the multidisciplinary team approach to ongoing care for patients with this disease. Key aspects of the paradigm include the following; early disease detection, targeted therapy, tight control of foot arthritis and disease monitoring. Under the new paradigm, the researchers propose to increase the knowledge and understanding of RA, to create specialist podiatry roles in which podiatrists engage in Early Arthritis Clinics as part of the multidisciplinary team, and to have podiatrists tightly controlling foot arthritis using personalised treatment plans.

Comment: This UK review summarises evidence from clinical trials in the last 10-15 years and synthesises the approach adopted by this group, and others, to early rheumatoid arthritis. In the sense that this approach has now been 'formalised' this represents new and useful information. The authors emphasise that, wherever possible, they are employing appropriate clinical research but acknowledge that there are areas where the necessary data are not yet available. This is particularly so in the paragraph relating to 'targeted foot care' where they argue the care 'should be delivered by specialist podiatrists working in a multidisciplinary clinic in both primary and secondary care'. The paper highlights not only the role podiatrists can play in the multidisciplinary team, but also highlights a 'research agenda' for those interested in the health care community.

Reference: *J Foot Ankle Res.* 2010;3:8

www.jfootankleres.com/content/3/1/8/abstract

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Moisture status of the skin of the feet assessed by the visual test Neuropad correlates with foot ulceration in diabetes

Authors: Tentolouris N et al

Summary: The association between the moisture status of the skin of the feet and the development of foot ulceration in diabetic patients was investigated in this study involving 379 individuals with diabetes who were aged ≤ 75 years. Foot ulceration was present in 121 of the subjects. Peripheral neuropathy was assessed using the neuropathy disability score, neuropathy symptom score, vibration perception threshold and the 10-g monofilament perception test. The Neuropad was used to determine the moisture status of the skin of the feet, and was applied for 10 minutes under the first metatarsal head, bilaterally. An abnormal Neuropad result, indicating dryness of the skin, was found more often in patients with foot ulceration than without (95% vs 52.3%). Patients with foot ulceration were found to have more severe peripheral neuropathy. Multivariate logistic regression analysis showed that the odds of foot ulceration increased with an abnormal Neuropad response (OR 16.28; 95% CI 6.27-38.24). If this finding is confirmed prospectively, the Neuropad may prove useful as a screening test for the prediction of foot ulceration.

Comment: The current study will be of interest to clinicians who frequently deal with diabetic foot problems. Diabetic foot syndrome frequently results in foot ulcers which are both distressing for the patient and difficult to treat, as well as being a significant financial burden to the health sector. Neuropad assesses the status of the sweat gland (sudomotor) response by measuring the moisture status of the foot. An abnormal sweat gland response is closely correlated with the onset of peripheral autonomic neuropathy in the feet. Current screening tools for the early detection of the diabetic foot syndrome in primary care require a subjective patient response and rely on the skill of healthcare professionals. However, autonomic neuropathy affects small fibres much earlier in the disease process (in most cases) and Neuropad, unlike the currently available tests in primary care, will detect this damage when patients are asymptomatic of large fibre damage. In summary, Neuropad is a new, sensitive and appropriate for everyday clinical use test for detecting sudomotor diabetic neuropathy and identification of patients at higher risk for chronic diabetes complications.

Reference: *Diabetes Care* 2010;33(5):1112-4

<http://care.diabetesjournals.org/content/33/5/1112.abstract>

Hyperbaric oxygen therapy facilitates healing of chronic foot ulcers in patients with diabetes

Authors: Londahl M et al

Summary: This randomized, single-centre, double-blind, placebo-controlled clinical trial undertaken by researchers from Sweden, investigated the effect of hyperbaric oxygen therapy (HBOT) on the management of chronic diabetic foot ulcers. A total of 94 patients with Wagner grade 2, 3 or 4 ulcers were randomized to receive treatment with HBOT (n = 49) or hyperbaric air (placebo group, n = 45); all patients had had at least one full-thickness below the ankle wound for >3 months. All subjects were assigned to treatment in the hyperbaric chamber for 5 days per week for 8 weeks (40 treatment sessions). More than 35 treatment sessions were completed in 38 HBOT recipients and 37 placebo recipients. In the intention-to-treat analysis, at 1-year follow-up, complete healing of the index ulcer (ulcer with the largest area at the time of inclusion and duration of > 3 months) was achieved in significantly (p = 0.03) more HBOT recipients than placebo recipients (52% vs 29%). In a sub-analysis of those patients completing >35 treatment sessions, healing of the index ulcer occurred in 23/38 (61%) HBOT recipients compared with 10/37 (27%) placebo recipients (p = 0.009).

Comment: HBOT has been promoted as an effective treatment for diabetic foot wounds and the first controlled trial for this indication was reported over 20 years ago. Advocates have suggested that the experimentally demonstrated effects of HBOT on improving wound tissue hypoxia, enhancing perfusion, reducing oedema, down regulating inflammatory cytokines, promoting fibroblast proliferation, collagen production and angiogenesis, make it a useful adjunct in clinical practice for 'problem wounds', such as diabetic foot ulcers. The study findings illustrate the beneficial effects of this procedure and suggest that it might reduce the risk of lower-extremity amputation in diabetic patients with foot wounds, although the technique does require expensive technology. It should be kept in mind that because both patients and clinicians are strongly motivated to avoid the devastating outcome of amputation, there is a high potential for bias in poorly designed trials. Thus, large-scale multi-centred randomized studies are needed to fully examine the systemic effects of HBOT.

Reference: *Diabetes Care* 2010;33(5):998-1003

<http://care.diabetesjournals.org/content/33/5/998.abstract>

Effect of accelerated rehabilitation on function after ankle sprain: randomised controlled trial

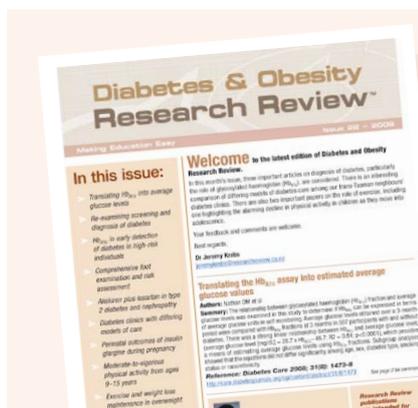
Authors: Bleakley CM et al

Summary: This randomized controlled trial compared the efficacy of an accelerated protocol for functional rehabilitation following acute ankle sprains with that of standard treatment (rest, ice, compression and elevation). The study involved 100 patients with acute grade 1 or 2 ankle sprains, who had presented at an accident and emergency clinic or University sports injury clinic. Half of the patients received standard care (two 10 minute applications of ice and compression with 10 minutes of rest in between, undertaken three times daily for 1 week), while the other half received standard care plus exercises (adapted from a standard protocol and undertaken for 20 minutes three times per day) during the first week following their injury. From weeks 1-4, both groups underwent standardised treatment involving ankle rehabilitation exercises, undertaken for 30 minutes each week. Subjective ankle function (the primary outcome measure) was, on average, significantly better in the exercise group compared with the standard care group at each time point (weeks 1-4) and the overall treatment effect was in favour of the exercise group (p < 0.01). One week after injury, the exercise group exhibited significantly (p < 0.05) higher activity levels than the standard care group. However, the groups did not differ at any other time point for pain on activity, pain at rest, or swelling. Both groups had similar Karlsson scores at 16-week follow-up, and the overall rate of re-injury at that time point was 4% (two patients in each group).

Comment: This work conducted in the UK would be of interest to clinicians who have immediate access to trained clinicians such as physiotherapists. Ankle sprains are often regarded as minor injuries but they cause short-term immobility and loss of function, with a risk of long-term problems and re-injury. Early return to normal lower limb function is a key objective of functional treatment. The findings from the current study provide evidence that rehabilitation exercises are an effective adjunct to functional treatment of ankle sprains. Readers may be interested in additional information supplied by the authors about the use of DVD and/or instruction sheets showing the exercises utilised. The authors state that patients who self-diagnose, and opt to initiate rehabilitation themselves, may risk damage; as always, initial contact with a trained clinician is essential for gaining an accurate diagnosis. Until further evidence is available, the early exercises are contraindicated in grade 3 sprains or ankle syndesmosis injury.

Reference: *BMJ* 2010;340:c1964

http://www.bmj.com/cgi/content/abstract/340/may10_1/c1964



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Venous thromboembolism following prolonged cast immobilisation for injury to the tendo Achillis

Authors: Healey B et al

Summary: A recent New Zealand study investigated the incidence of venous thromboembolism (VTE) following prolonged cast immobilisation for Achilles tendon injury. The study involved an audit of 208 patients (mean age 39 years) attending the Orthopaedic Assessment Unit at the Wellington Hospital between January 2006 and December 2007 who required immobilisation in a cast for injury of their Achilles tendon. Three patients (1%) were found to have a documented VTE risk factor and one patient received aspirin prophylaxis; none received low molecular weight heparin. Symptomatic VTE developed during immobilisation in 13 patients (6.3%); 6 patients developed a distal deep-vein thrombosis (DVT), four developed a proximal DVT and three developed a confirmed pulmonary embolus. The authors point out that the incidence of VTE identified in their study is similar to that reported following elective hip replacement and that the same level of protection should be provided for both types of patients.

Comment: The incidence of tendo Achilles injury requiring prolonged immobilisation is increasing, probably because of the increasing popularity of recreational sports. The development of thromboprophylactic measures has reduced the frequency of VTE and the use of thromboprophylaxis has become routine after major orthopaedic surgery. However, the question of whether prophylaxis after minor surgery and lower limb injury is necessary still remains an issue for debate. In the absence of guidelines regarding prophylactic treatment in patients with Achilles tendon rupture no standard procedure for thromboprophylaxis has been demonstrated. A reliable screening procedure could potentially increase the safety of patients, since the detection of asymptomatic clots could limit the risk of the further propagation and development of pulmonary embolism, but no positive cost benefit of such a routine has been demonstrated.

Reference: *J Bone Joint Surg Br.* 2010;92(5):646-50

<http://www.jbjs.org.uk/cgi/content/abstract/92-B/5/646>



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

Kinematic differences between normal and low arched feet in children using the Heidelberg foot measurement method

Authors: Twomey D et al

Summary: This study investigated the kinematics of the foot in normal- and low-arched feet in children aged 9-12 years old, and determined the differences in multi-segment foot motion between these two foot types. Analysis, using the Heidelberg foot measurement method was undertaken in 25 normal-arched feet and 27 low-arched feet. The study found that the kinematic differences in the foot between the two groups during walking were relatively small, except for the forefoot supination and medial arch angles. Throughout the gait cycle, the magnitude of the medial arch angle was approximately 10° greater in the low-arched group compared with the normal-arched group. The initial, minimum and maximum forefoot supination angles were significantly ($p < 0.03$) different between the low-arched and normal-arched feet, with the normal-arched group having higher forefoot supination angles relative to the midfoot throughout the gait cycle. This finding indicates that the forefoot of the low-arched foot remains less pronated during the gait cycle. No significant difference was seen in the motion of the rearfoot between the two foot types. The results of this study provide normative values for children's feet and highlight the mechanical differences in flexible flat feet in this age group.

Comment: The foot has an important affect on the more proximal segments of the lower extremity, influencing possible causes of injury and/or dysfunction. Three-dimensional lower body kinematics is recognised as a validated method for quantifying gait and is frequently used in clinical decision making. Although the foot is a complex structure it is frequently modelled as a single rigid body in conventional 3D models. This approach is inappropriate in evaluating the effect of variations in foot function, as well as foot pathologies and interventions. A limitation of previous studies has been the absence of an appropriate description of the weight bearing foot posture of the children included in the study (i.e. whether the foot is normal, flat or high-arched). The current study allows researchers and clinicians to identify variations in the 3D function of a normal versus flat foot and may assist in the design of appropriate interventions for the management of this condition.

Reference: *Gait & Posture* 2010;32(1):1-5

[http://www.gaitposture.com/article/S0966-6362\(10\)00036-6/abstract](http://www.gaitposture.com/article/S0966-6362(10)00036-6/abstract)

Non-surgical interventions for paediatric pes planus

Authors: Rome K et al

Summary: This study was undertaken to determine the effectiveness non-surgical interventions for paediatric pes planus (flat feet) and used the Cochrane Central Register of Controlled Trials to search for all randomized and quasi-randomized trials reporting such interventions up to June 2009. Three trials involving a total of 305 children were included in this review. However, because of clinical heterogeneity, data from the studies was not pooled. In the first trial, involving 40 children with juvenile arthritis and foot pain, the use of custom-made orthoses resulted in significantly greater reductions in pain intensity and disability compared with controls. The second trial, involving 1-5 year olds with bilateral flat feet ($n = 129$), reported the subjective impression of pain reduction after wearing shoes. However, the third trial, involving 7-11 year olds with bilateral flat feet ($n = 178$) reported no significant difference in the number of individuals with foot pain when those who used custom-made or pre-fabricated orthoses were compared to those who did not.

Comment: This summary of a Cochrane review presents what we know from research about the effect of non-surgical treatments for pes planus in children. The review shows that in children with flat feet and juvenile idiopathic arthritis, custom foot orthoses may improve pain and function slightly. This review found information mainly on custom foot orthoses or shoe inserts. A custom foot orthosis is a medical device that is made from a custom mould of the child's foot, prescribed by a qualified health-care professional, and designed by that professional to allow more normal foot and leg function, and to decrease the pressure on parts of the foot that might be causing pain. However, the evidence from randomized controlled trials is currently too limited to draw definitive conclusions about the use of non-surgical interventions for paediatric pes planus. Future high-quality trials are warranted in this field. Only limited interventions commonly used in practice have been studied and there is much debate over the treatment of symptomatic and asymptomatic pes planus.

Reference: *Cochrane Database Syst Rev.* 2010;7:CD006311

www2.cochrane.org/reviews/en/ab006311.html

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