Foot & Ankle Research Review™

Making Education Easy

Issue 17 – 2013

In this issue:

Abbreviations used in this issue
BMI = body mass index
JIA = juvenile idiopathic arthritis
RA = rheumatoid arthritis

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

I have chosen a range of articles that reflect current clinical practice. There are two specific articles that are related to diabetes, footwear and walking. The clinical relevance of the articles will be of interest to clinicians. One article looks at barefoot waking in diabetics (Najafi et al: The impact of footwear and walking distance on gait stability in diabetic patients with peripheral neuropathy. J Am Podiatr Med Assoc 2013;103(3):165-73), and the other article looks at adherence with footwear (Waaijman et al: Adherence to wearing prescription custom-made footwear in patients with diabetes at high risk for plantar foot ulceration. Diabetes Care. 2013; 36(6):1613-8).

I hope you enjoy reading the reviews and I look forward to any feedback.

Kind Regards,

Professor Keith Rome
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Assessment of foot and ankle muscle strength using hand held dynamometry in patients with established rheumatoid arthritis

Authors: Carroll M et al

Summary: This study used hand-held dynamometry to evaluate significant differences in foot and ankle muscle strength between individuals with and without RA. Fourteen patients with established RA (mean disease duration 22 years) and 20 aged- and sex-matched controls underwent assessment of their maximal muscle strength of ankle plantarflexion, dorsiflexion, eversion and inversion. The two groups exhibited significant ($p \leq 0.04$) differences in muscle strength in plantarflexion, eversion and inversion, but not in dorsiflexion, with RA patients exhibiting a significant decrease in ankle dorsiflexion, eversion and inversion and a significantly ($p = 0.03$) lower plantarflexion-dorsiflexion ratio than controls.

Comment: This study reviews an area with minimal available literature in this patient group and will be of interest and relevance to clinicians. The study uses a clinical instrument that is easy to use and quantifies muscle strength in a quick and effective manner. A limitation of the study is that RA is a disease that changes depending upon the activity level and future work needs to be undertaken evaluating the instrument over time. Furthermore, further work is required to assess the reliability of the instrument in this cohort.

Reference: J Foot Ankle Res. 2013;6(1):10
http://www.jfootankleres.com/content/6/1/10

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The effects of prolonged running on foot posture: a repeated measures study of half marathon runners using the foot posture index and navicular height

Authors: Cowley E and Marsden J

Summary: This study involving 30 runners aimed to identify changes in foot posture (measured using the Foot Posture Index [FPI-6] and navicular height) after running a half marathon. A significant ($p < 0.05$) 5 mm drop in navicular height in both feet was seen after running a half marathon. While FPI-6 measurements did not reveal a change in the right foot (+0.4, Rasch +0.76), they did reveal a side x time interaction with an increase in score indicating a more 'pronated' position in the left foot of +2 (Rasch value +1.7).

Comment: The research question is valid and it adds to the body of literature investigating potential mechanisms linking foot posture and lower limb injury. The authors reported that the changes in foot posture towards a more pronated position may have implications for foot function. This will be of interest to clinicians and the authors do report that a limitation of the study was not controlling for footwear. Different shoe manufacturers describe their brand as enhancing cushioning and controlling motion. However, the results indicate that foot posture does change and the clinician should be aware of the findings from the study when advising footwear for people running long distances.

Reference: J Foot Ankle Res. 2013;6(1):20

http://www.jfootankleres.com/content/6/1/20

Foot orthoses for the management of low back pain: a qualitative approach capturing the patient's perspective

Authors: Williams AE et al

Summary: The impact and patient's experiences of providing foot orthoses for non-specific low back pain with associated altered lower limb biomechanics was investigated in this study. A total of 25 patients were provided with customised foot orthoses and after 16 weeks underwent conversational style interviews. Data collection and analysis followed an interpretivistic phenomenological approach and showed that foot orthoses appeared to be effective. The main influence on this outcome was a patient-focussed consultation process and approach. The consultation was identified as an opportunity for fostering mutual understanding, with verbal and visual explanation reassuring the patient. This approach influenced the patient's beliefs, their experience of low back pain (psychological) and engagement with the foot orthoses (physical).

Comment: This UK paper makes a useful contribution to the understanding of the use and value of foot orthoses in practice. While a number of practitioners would no doubt state that some of the findings of the paper are well known to them, these beliefs and experiences have not been demonstrated through research. The findings indicate foot orthoses can play an important role in the management of people with chronic lower back pain. Similar to many clinical studies involving foot orthoses we do not know which type of foot orthoses is best for this clinical group. However, the qualitative aspect does give the reader a patient's perspective of being prescribed foot orthoses and I strongly recommend your read the article.

Reference: J Foot Ankle Res. 2013;6(1):17

http://www.jfootankleres.com/content/6/1/17

Factors affecting center of pressure in older adults: the Framingham Foot Study

Authors: Hagedorn TJ

Summary: These US researchers investigated demographic differences in foot function in 2111 subjects taking part in the Framingham Foot Study, a population-based study of community-dwelling adults. Significant differences in foot function (characterised using the center of pressure excursion index [CPEI] were noted by sex ($p < 0.0001$), by age in women ($p = 0.04$), and by past high heel use in women ($p = 0.04$). Foot function during gait, collected for both feet using a Tekscan Matscan® pressure mat, revealed no influence of BMI or physical activity, but did show that this parameter was affected by sex, as well as by age and shoe-wear in women.

Comment: Demographic differences in foot function are an interesting area of research. This large population-based study provides an excellent opportunity to evaluate demographic influences on plantar pressure loading. For those clinicians using plantar pressure systems the authors describe a novel measure called the CPEI, a measure of foot function. The issue with a number of different measurement variables is the question: "which is the best one to use?" The author's report that they have used CPEI in previous studies. However, for busy clinicians who use plantar pressure systems, there is a need for further work on why this particular measure is better than traditional measures such as peak plantar pressure or pressure time integrals.

Reference: J Foot Ankle Res. 2013;6(1):18

http://www.jfootankleres.com/content/6/1/18

The effect of customised and sham foot orthoses on plantar pressures

Authors: McCormick CJ et al

Summary: This study involving 30 adults aged between 18 and 51 years sought to compare the effects on plantar pressures of three sham foot orthoses to a customised foot orthosis and to establish the perceived credibility and the expected benefit of each orthotic condition. Five randomly assigned conditions were employed: (i) shoe alone, (ii) customised foot orthosis, (iii) contoured polyethylene sham foot orthosis, (iv) contoured ethylene vinyl acetate (EVA) sham foot orthosis, and (v) flat EVA sham foot orthosis. Plantar pressures were collected for the heel, midfoot and forefoot using the Pedar®-X in-shoe system at 0 and 4 weeks under each of the five conditions. Subjects also answered a Credibility/ Expectancy Questionnaire in order to determine the credibility and expected benefit of each orthotic condition. The contoured polyethylene sham orthosis was the only condition to not significantly affect peak pressure at any region of the foot when compared to the shoe alone at week 0. The other four orthoses significantly reduced peak pressure at the heel, but not at the lateral midfoot and forefoot. All of the sham orthoses provided the same effect as the shoe alone at the medial midfoot and this corresponded to effects that were significantly different to the customised orthosis. No real differences were observed between any of the measurements under any of the conditions at week 0 and week 4. The contoured polyethylene sham orthosis, which was perceived as being less credible and less likely to provide benefits than the other orthoses, which were considered to be similar in this regard.

Comment: This Australian article is one that clinicians and researchers should read and should be considered as a key article for anyone involved with foot orthoses. The sham devices were made of materials that would collapse under minimal force, thus providing minimal effect on plantar pressures. The sham orthoses evaluated in this study do provide some mechanical effects, but they do not provide the same general effects as a customised orthoses (i.e. they do function as a sham intervention). Of importance, though, is that some of the sham orthoses behaved similarly to the customised orthoses. For researchers, this is important as different material characteristics demonstrate different mechanical effects. A comment reported by the authors stated that it remains unclear how these plantar pressure changes may influence clinical outcomes. I strongly recommend that this article be read in full to give a reflective view of sham devices and their potential impact on biomechanical parameters.

Reference: J Foot Ankle Res. 2013;6(1):19

http://www.jfootankleres.com/content/6/1/19

Foot function is well preserved in children and adolescents with juvenile idiopathic arthritis who are optimally managed

Authors: Hendry GJ et al

Summary: Disease activity, impairments, foot function, disability and gait characteristics were compared between a well-described cohort of 14 JIA patients (mean age 12.4 years) and 10 normal healthy controls (mean age 12.5 years). Subjects undewent three-dimensional gait and plantar pressure analysis to measure biomechanical foot function. The juvenile arthritis foot disability index, forefoot and rearfoot deformity scores, and clinical and musculoskeletal ultrasound examinations were used to measure localised disease impact and foot-specific disease activity. The JIA group exhibited low levels of disease activity, mild-to-moderate foot impairments and disability, and reduced lateral forefoot abduction within a 3-5° range. Healthy subjects showed minor trends towards increased midfoot dorsiflexion. Both groups exhibited similar timing and magnitude of remaining kinetic, kinematic and plantar pressure distribution variables during the stance phase.

Comment: The results from this UK-based study of children with JIA indicate that suppression and tight control of active foot disease prevents or reduces the frequency and severity of joint destruction and the associated structural and functional impairments. The study uses a complex foot model to determine foot motion and was developed and tested for adults with inflammatory joint disease. Using foot models in children is difficult and time-consuming. However, the results demonstrate no differences between those with JIA and age-matched controls. For clinicians, the results suggest that the articular function in the foot can be well preserved when disease activity is suppressed using optimised medical care that includes joint injections, customised foot orthoses, use of a multidisciplinary team and disease modifying therapies. It is interesting to note that customised foot orthoses were prescribed and the long-term benefits have yet to be determined in adults and children.

Reference: Gait Posture2013;38(1):30-6

http://www.gaitposture.com/article/S0966-6362(12)00382-7/abstract

The role of foot morphology on foot function in diabetic subjects with or without neuropathy

Authors: Guiotto A et al

Summary: This Italian study used a foot model to examine foot morphology in people with and without diabetes, with and without peripheral neuropathy. Three dimensional multisegment foot kinematics and plantar pressures were assessed in 120 feet: 80 feet in diabetics (25 cavus, 13 with hallux valgus and 13 with valgus heel), 40 feet (24 cavus, 11 with hallux valgus and 20 with valgus heel) in the control group, and the neuropathic groups (28 cavus, 18 with hallux valgus and 24 with valgus heel). Comparing neuropathic subjects with cavus foot, valgus heel with controls with the same foot morphology, important differences were identified and included significantly ($p < 0.03$) decreased contact surface on the hindfoot and significantly ($p < 0.05$) increased dorsiflexion and peak plantar pressure on the forefoot. Interestingly, diabetic subjects with valgus hallux or with normal foot arch were no more likely to display significant differences in biomechanics parameters than the control group.

Comment: The results illustrate the complexity of using foot models. There is no one foot model used and several studies have used different models. Therefore, the results from this study are indeed different from other studies. This is an issue both for researchers and clinicians. The current study found that all the diabetic subjects with normal foot arch or with valgus hallux were no more likely to display significant differences in biomechanics parameters than controls. The problem for clinicians is that prescribing foot orthoses based upon the foot biomechanics has yet to be determined. The authors postulate a number of reasons for the changes between those with and without neuropathy, but no real insight to the differences, apart from a comment about adopting different motor strategies. In conclusion, a disappointing manuscript that does not really give an additional insight into foot mechanics in diabetes.

Reference: Gait Posture 2013;37(4):603-10

http://www.gaitposture.com/article/S0966-6362(12)00370-0/abstract

Foot and Ankle Research Review

Independent commentary by Professor Keith Rome,
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For full bio CLICK HERE

Research Review publications are intended for New Zealand health professionals.

The impact of footwear and walking distance on gait stability in diabetic patients with peripheral neuropathy

Authors: Najafi B et al

Summary: This US study investigated gait differences in patients with diabetes and peripheral neuropathy over short and long walking distances, and investigated the potential benefit of footwear for improving gait in patients with this condition. A total of 12 such patients and eight controls walked under two conditions (barefoot and regular shoes) at their habitual speed over short (7 m) and long (20 m) distances, while validated body-worn sensors were used to extract spatiotemporal gait parameters. Vibratory perception threshold was measured at the great toe in order to quantify neuropathy severity. Subjects with diabetes and peripheral neuropathy exhibited gait deterioration during all of the walking trials. Differences between the two groups only achieved statistical significance during long walking distance trials; when barefoot walking, gait unsteadiness (defined as coefficient of variation of gait velocity) was significantly higher in the diabetes with peripheral neuropathy group (83%, $p = 0.008$), and shod and barefoot double support times were longer (>20%, $p = 0.03$). A higher correlation between neuropathy severity and gait unsteadiness was evident, with this being more aparent during the barefoot walking/long walking distance condition ($r = 0.77$, $p < 0.001$), and significantly ($p = 0.02$) improved by 46% by the wearing of footwear.

Comment: This study reports that gait alteration in patients with diabetes and peripheral neuropathy is most pronounced while walking barefoot over longer distances and that footwear may improve gait steadiness in this patient group. A clinical question needs to be asked: "why evaluate diabetic patients barefeet over long distances?" Gait changes will occur because of adaptation to the surface. There are a number of limitations to the study. The study was conducted in a laboratory setting and the results may not relate to other surfaces such as pavements, sand or gravel. Only a small number of participants were recruited into the study and there was limited information about the footwear worn. Therefore, to replicate the study would be difficult. From a biomechanical perspective the authors describe 'unsteadiness' as a measure based on statistical inter-cycle fluctuation of gait velocity. This may not be the same as postural instability which has been researched in diabetes and other long-term chronic foot conditions.

Reference: J Am Podiatr Med Assoc. 2013;103(3):165-73

http://www.japmaonline.org/content/103/3/165.abstract

Adherence to wearing prescription custom-made footwear in patients with diabetes at high risk for plantar foot ulceration

Authors: Waaijman R et al

Summary: Adherence to prescription custom-made footwear in diabetic patients at high risk of ulcer recurrence and factors determining adherence to such devices were investigated in this objective study involving 107 patients with diabetes, neuropathy and a recently healed plantar foot ulcer. A shoe-worn, temperature-based monitor was used to measure footwear use during seven consecutive days, while daily step count was measured simultaneously using an ankle-worn activity monitor. The mean ± SD adherence was found to be 71 ± 25%, with adherence at home being 61 ± 32%, over 3959 ± 2594 steps, and away from home 87 ± 26%, over 2604 ± 2507 steps; among 35 patients with low adherence (<60%), adherence at home was 28 ± 24%. Multivariate linear regression analysis revealed the following factors to be associated with higher adherence to the custom-made footwear; lower BMI, more severe foot deformity and more appealing footwear.

Comment: This Dutch study is interesting as typically adherence is measured using subjective methods such as questionnaires, face-to-face interviews or diaries. The use of an accelerometer-based sensor is relatively new. The results demonstrated that adherence was much lower at home than away from home. Patients were significantly more active at home than away from home. This further amplifies the problem of footwear use at home, increasing the cumulative stress on an inadequately protected foot. Therefore, interventions aimed to increase adherence should primarily target the home situation (e.g., through the prescription of special off-loading footwear for indoors). I recommend you read this article. Clinicians would be interested as low adherence may lead to re-ulceration or ulcers that do not heal. As the authors reported, improvement in adherence could be enhanced with protective footwear specifically for indoors and should be promoted. The only comment I would make is that we do not know any information on the amount of barefoot walking, which is the most hazardous walking condition.

Reference: Diabetes Care 2013;36(6):1613-8

http://care.diabetesjournals.org/content/36/6/1613.abstract

Effect of custom-made foot orthoses in female hallux valgus after one-year follow up

Authors: Reina M et al

Summary: This prospective study was undertaken to determine if the use of custom-made foot orthotics for 12 months would prevent the advancement of mild-to-moderate hallux valgus in women with the condition. A total of 54 women were divided into two groups and received either custom-made foot orthoses or no such treatment (controls). Measurements of hallux abductus and first intermetatarsal angles were undertaken at baseline and at 12-months' follow-up; both baseline angles were similar for the control and orthotic groups (hallux abductus angle 19.92 vs 20.55 degrees, first intermetatarsal angle 10.56 vs 10.86 degrees). At 12 months, no significant differences were seen in these angles and there were no significant intra-group differences in the comparisons of the baseline and follow-up angles.

Comment: The results of this Spanish study are disappointing, but not surprising. It is interesting to note that both mild and moderate hallux valgus participants were chosen. There is no mention about adherence to the customised foot orthoses or any information about the drop-outs over 12 months. Adherence to foot orthoses will be of major concern and it is difficult to ascertain the impact on patients quality of life. It is always disappointing to review articles that just look at imaging and do not consider if pain or disability have been reduced. The underpinning philosophy of the intervention is based upon the assumption that hallux valgus is due to excessive foot pronation. However, the author's report that the progress of hallux valgus is multifactorial and those remaining factors were not controlled in the study. Clinical trials are prone with difficulties but clinicians are fully aware that foot orthoses may work in some individuals, but not in others. I recommend you read the article, but consider some of the limitations.

Reference: Prosthet Orthot Int. 2013;37(2):113-9

http://poi.sagepub.com/content/37/2/113.abstract