Foot & Ankle Research Review™

Making Education Easy

Issue 15 – 2013

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Abbreviations used in this issue
CT = computed tomography
EMG = electromyography
MRI = magnetic resonance imaging
RA = rheumatoid arthritis

Welcome to the first edition of Foot and Ankle Research Review for 2013.

Within this edition I have included a range of articles that reflect the diversity of foot and ankle research. I recommend three articles that you may want to read in more detail. The first article relates to the use of insoles in reducing diabetic foot ulceration (Paton JS et al: A comparison of customised and prefabricated insoles to reduce risk factors for neuropathic diabetic foot ulceration: a participant-blinded randomised controlled trial). The second article relates to the use of foot orthoses in reducing foot pronation (Liu A et al: Effect of an antipronation foot orthosis on ankle and subtalar kinematics). The final article is about measuring intrinsic muscle strength (Soysa A et al: Importance and challenges of measuring intrinsic foot muscle strength).

Finally, I would like to say thank you for the positive feedback I have received relating to the special edition on rheumatic diseases published last year. We are looking at producing another topic-focussed special edition later this year.

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

Kind Regards,

Professor Keith Rome
keithrome@researchreview.co.nz

A comparison of customised and prefabricated insoles to reduce risk factors for neuropathic diabetic foot ulceration: a participant-blinded randomised controlled trial

Authors: Paton JS et al

Summary: This UK participant-blinded controlled trial, randomised 119 patients with neuropathic diabetic feet to receive either custom-made or pre-fabricated foot orthoses. The F-scan in-shoe pressure measurement system was utilised to record data at time of issue and at 6 months; primary outcomes measures were total contact area, forefoot rate of load, duration of load as a percentage of stance, peak pressure and forefoot pressure-time integral. 40% of recipients were fully compliable with wear (minimum wear 7 hours per day, 7 days per week). Intention-to-treat analysis revealed no differences between insoles in peak pressure or three of the other four kinetic measures. Mean forefoot pressure-time integral was slightly reduced at time of issue in custom-made functional insole recipients compared with those receiving prefabricated insoles (27% vs. 22%), and custom-made insoles remained more effective at 6-months' follow-up (30% vs 24%; p = 0.001).

Comment: The choice of footwear used to accommodate insoles can affect function. Therefore, care must be taken not to generalise the findings of this trial beyond the type of therapeutic footwear provided within the study. The implication that forefoot pressure-time integral and other selected variables are symbolic of ulceration risk is too simplistic and should be approached with caution; the aetiology of diabetic neuropathic ulceration is multi-factorial and complex, therefore, whilst clearly relevant to ulceration risk, kinetic parameters are merely surrogate measures of internal tissue stress. Further studies are required using a randomised controlled trial design to assess insoles used for the prevention of diabetic neuropathic foot ulceration and particular attention should be given to the comparison of insole type using incidence of ulceration as a primary measure of outcome.

Reference: J Foot Ankle Res. 2012;5(1):31

http://www.jfootankleres.com/content/5/1/31/abstract

Older adults adopted more cautious gait patterns when walking in socks than barefoot

Authors: Tsai YJ and Lin SI

Summary: Stride characteristics and motion of the body's centre of mass was assessed in 21 young and 20 older adults while walking on a smooth floor while barefoot or while wearing socks. The results found that while young adults did not exhibit significant differences under the two conditions, older adults showed decreased walking speed and stride length and reduced the centre of mass minimal velocity during the single limb support phase while walking in socks.

Comment: This study from Taiwan will be of interest to clinicians and researchers interested in falls and related injuries in older adults. The findings support the hypothesis that older people adopted more cautious gait patterns while walking in socks. One potential explanation for the difference between the young and older adults is plantar sensitivity. Plantar cutaneous sensation is well accepted to provide critical sensory feedback for the control of standing and walking. Inadequate plantar sensory feedback has been reported to lead to imbalance and cautious gait. Compared to barefoot, wearing socks could potentially interfere with the detection of plantar surface stimulations. A cautionary note is that the study was conducted on a smooth floor surface and it is not clear if similar effects would be observed for carpeted floor where older adults often prefer to walk with socks. Similarly, only one type of socks was used in this study, thus the results may not be applicable to socks with different material properties, in particular non-slip socks.

Reference: Gait Posture 2013;37(1):88-92

http://www.gaitposture.com/article/S0966-6362%2812%2900252-4/abstract

Weightbearing and non-weightbearing ankle dorsiflexion range of motion: are we measuring the same thing?

Authors: Rabin A and Kozol Z

Summary: The aim of this US study was to examine the relationship between ankle dorsiflexion range of motion as measured in weight-bearing and non-weight-bearing conditions. Two examiners measured ankle dorsiflexion under the two conditions in 43 healthy volunteers and found that weight-bearing and non-weight-bearing ankle dorsiflexion measurements produced significantly ($p < 0.001$) different results.

Comment: This is an interesting article, but nothing new has been advocated. Ankle dorsiflexion measurement is important for clinical and research use and previous studies have reported that instrumentation should not be interchanged. The study is disappointing as many clinicians are fully aware of differences between weight-bearing and non-weight-bearing measurements. There are a number of limitations that the reader should be aware. Testing in the current study involved a small student population as subjects. However, their methodological quality would have benefitted from the use of an actual patient population and comparison with a reference standard. When validating ankle dorsiflexion measurement techniques, actual patient populations should be used.

Reference: J Am Podiatr Med Assoc. 2012;102(5):406-11

http://www.japmaonline.org/content/102/5/406.abstract

Effect of an antipronation foot orthosis on ankle and subtalar kinematics

Authors: Liu A et al

Summary: The effect of an anti-pronation foot orthoses on motion of the heel relative to the leg and the individual contributions of the ankle and subtalar joints to this effect was investigated in this UK study involving five healthy male subjects who had intracortical pins placed in order to track the movement of the tibia, calcaneus and talus during walking. Small and unsystematic reductions in abduction and eversion of the heel relative to the leg at various times during stance were seen with the anti-pronation foot orthoses, and changes in calcaneus-tibia motion ranging between 1°-3° were seen (this range was comparable with that described in the literature). The observed orthotic effect was due to changes at the ankle and subtalar joints, the scale and nature of which showed high inter-subject variability, as too did peak angular position, range of motion and angular velocity in frontal and transverse planes.

Comment: The methodology used in this study was novel. The results are interesting and should be considered in light of limitations. The anti-pronation orthoses reduced the peak and range of rearfoot eversion and, to a lesser degree, abduction relative to the leg in all subjects. However, contrary to clinical paradigms (in particular Roots theory), these changes were inconsistent between subjects and occurred to varying degrees at different times of stance. It is not clear whether the small alterations in joint kinematics the authors reported can lead to changes in clinical symptoms. The data are from a small sample of asymptomatic individuals, so the orthosis has only been tested in a limited range of foot types. Also, it is inappropriate to draw conclusions about how foot orthoses result in clinical benefit from such small asymptomatic samples. However, I strongly recommend you read the article.

Reference: Med Sci Sports Exerc 2012;44(12):2384-91

http://tinyurl.com/b3da8y5

Treatment of ingrown toenail with proximolateral matrix partial excision and matrix phenolization

Authors: Karaca N and Dereli T

Summary: This Turkish study evaluated the long-term (24 months) efficacy of proximolateral matrix partial excision followed by chemical matricectomy with phenol in 225 patients (345 procedures) with stage 2 or 3 ingrown toenail. The success rate of the procedure was 99.7%, with only one recurrence of ingrown toenail during the 24-month follow-up period (the recurrence occurred at 8 months). Furthermore, cosmetic results were remarkably good and no severe complications occurred.

Comment: One of the major concerns is that this study did not include a control group and used a case series, which can be subject to a number of potential additional biases, threatening the external validity. For example, were all eligible patients included in the study and was complete follow-up obtained? New trials are also needed to determine if the addition of chemical ablation to a surgical procedure gives a reduction of the risk of recurrence compared to the surgical procedure alone. Furthermore, new trials should also examine relevant, uniform short-term outcomes, such as healing time as an objective measurement and participant satisfaction as a subjective measurement, in addition to the primary outcome of recurrence or regrowth. None of these outcome measures were evaluated in the current study.

Reference: Ann Fam Med 2012;10(6):556-59

http://www.annfammed.org/content/10/6/556.abstract

Importance and challenges of measuring intrinsic foot muscle strength

Authors: Soysa A et al

Summary: This review looked at the available literature up to June 2012 with the aims of determining the role of intrinsic foot muscles and related implications of intrinsic weakness, and to evaluate the different methods used to measure intrinsic foot-muscle strength. The review found that there is no widely accepted method of measuring intrinsic foot-muscle strength. Most methods measure only toe flexor strength and include the paper grip test, plantar pressure, toe dynamometry and the intrinsic positive test. Furthermore, it is unclear whether any method can actually isolate intrinsic muscle strength. CT, ultrasonography, MRI, EMG, and muscle biopsy have been used as indirect methods to investigate intrinsic muscle structure and performance, but lack the ability to measure muscle force.

Comment: This Australian-based systematic review will be of interest to clinicians and researchers that measure muscle strength within the foot. This review suggests that at present, there is no adequately validated method of measuring intrinsic muscle strength. The main challenges are that no direct method can isolate intrinsic muscle strength from extrinsic muscle strength, and indirect methods cannot quantify muscle force. Future research in this field would benefit from using a combination of indirect and direct methods to measure intrinsic muscle force, because both measures have their strengths and limitations. Similar to many measures used within foot and ankle research, an accurate and reliable measure of intrinsic muscle strength will enable prospective studies to address the causal relationship questions between intrinsic muscle weakness and foot/toe deformity in long-term chronic foot conditions. Furthermore, a validated method of measuring intrinsic muscle weakness can guide future research into clinical trials of intrinsic strength training in a variety of clinical populations. Overall, a better measurement of intrinsic muscle strength is necessary to improve the clinical management of long-term chronic foot conditions. I recommend you read the article.

Reference: J Foot Ankle Res. 2012;5(1):29

http://www.jfootankleres.com/content/5/1/29

The effect of three different toe props on plantar pressure and patient comfort

Authors: Johnson S et al

Summary: The effect of toe prop treatment on plantar digital pressure was evaluated in 22 subjects with lesser digital deformities and associated apical skin lesions. Pressure was recorded under three toe prop conditions (leather, gel and silicone mould) via pressure sensors placed on the apices of the lesser toes and the comfort of each condition was determined using a modified comfort index. Compared with no toe prop, a significance difference ($p<0.05$) in mean peak pressure was observed at the apex of the 2nd toe when using the silicone and gel toe props (both $p < 0.001$). A significant difference was also seen in mean pressure time integral at the apex of the 2nd toe when using silicone ($p<0.004$) and gel ($p<0.001$) toe props. While there was an indication that the silicone toe prop was more comfortable, there was no significant correlation between comfort and the recorded peak pressures.

Comment: The results from this UK study highlight a significant reduction in peak plantar digital pressure and plantar digital pressure-time integral on the apex of the second digit for the gel and silicone toe prop conditions. Although the authors reported that the use of silicone and gel toe props are the most suitable current treatments when the desired objective is to reduce peak plantar digital pressure as well as pressure time integral for lesions on the apex on the second digit, there are a number of limitations to the study. Only 25 subjects were recruited and there was no control group as a comparison. Subjects were excluded if they had no apical lesion, complex ulcerations, foot surgical intervention, inappropriate footwear and an inability to walk unaided. It is unclear if patients with long-term chronic conditions such as RA were excluded. A future prospective study into the use of toe props is strongly recommended. In summary, an interesting article to read, but be aware of the limitations.

Reference: J Foot Ankle Res. 2012;5(1):22

http://www.jfootankleres.com/content/5/1/22

Foot and Ankle Research Review

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

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The efficacy of nonsurgical interventions for pediatric flexible flat foot: a critical review

Authors: MacKenzie AJ et al

Summary: This systematic review searched the available literature from 1970 onwards for evidence for the efficacy of nonsurgical interventions for flexible pediatric flat feet and identified 13 articles for inclusion. Unfortunately, the low quality of the available studies negates definitive conclusions regarding such intervention.

Comment: This New Zealand based critical review demonstrated the limited evidence for the efficacy of nonsurgical interventions for children with flexible flat feet. The authors concluded that clinicians need to consider the lack of good-quality evidence in their decision-making for the management of paediatric flat foot. The article highlighted that many of the studies used varying forms of foot orthoses, with and without footwear modifications, as the intervention. The effect of footwear with foot orthoses on gait was investigated and found a significant decrease in foot abduction, but without control group comparisons it is uncertain if any of these changes provide a functional change for children with flat feet. A limitation of the review was the exclusion of non-English language publications. Similarly, consensus statements and expert reviews were also excluded. However, the review does illustrate the lack of good quality evidence in an area that is often a concern to clinicians and more importantly to parents/guardians.

Reference: J Pediatr Orthop. 2012;32(8):830-4

http://tinyurl.com/akw9d5q

'My feet - visible, but ignored . . .' A qualitative study of foot care for people with rheumatoid arthritis

Authors: Williams AE and Graham AS

Summary: In order to explore patients' experiences of foot problems associated with RA, sixteen women and six men who had received foot health interventions for such conditions were recruited and attended three focus groups conducted by an experienced researcher**.** The study design was qualitative with an interpretive phenomenological approach to the data collection and analysis. Findings were organised into five themes: knowledge of, and explanation about, foot symptoms; the significance of foot symptoms in relation to diagnosis of RA; accessing foot health interventions; improvements to foot health interventions; the effectiveness of foot health interventions. It was evident that foot problems were often ignored by practitioners despite them being of concern to the participants, and such lack of attention occurred from before diagnosis through to foot management.

Comment: This qualitative research design illustrates the disparity between what people with RA perceive their needs to be and what is provided in the UK. The picture in New Zealand is unclear, but a similar scenario is very likely to be observed. The study had a relatively small number of participants and may not be a fully representative cross-section of the wider population of people with RA-related foot problems. The results may also have cultural specificity, and generalisability may be limited to healthcare systems such as those in New Zealand. Bias could also have occurred in that the people volunteering to take part in the study may have done so because they have had negative experiences. Although there are limitations, it is clear that the participants of this study have revealed much about their experiences from which we can learn. That foot problems are ignored is of concern at multiple levels here in New Zealand, ranging from the implications of ignoring foot symptoms that may aid diagnosis, to ignoring the need for foot health interventions.

Reference: Clin Rehabil. 2012;26(10):952-9

http://cre.sagepub.com/content/26/10/952.abstract

Reduction of peak plantar pressure in people with diabetes-related peripheral neuropathy: An evaluation of the DH Pressure Relief Shoe™

Authors: Raspovic A et al

Summary: This study involving data from 14 subjects with diabetic peripheral neuropathy evaluated the capacity of the DH Pressure Relief Shoe™ to offload areas of high pressure under the diabetic neuropathic foot. A within-subjects, repeated measures design was employed and three footwear conditions were evaluated in a randomised order: the participants' own standard shoe, the DH Pressure Relief Shoe™ and a canvas shoe (the control). The primary outcome measure was peak plantar pressure, measured using the pedar-X® mobile in-shoe system. A significant difference in mean peak plantar pressure was evident between the DH Pressure Relief Shoe™ (155.4 kPa) and the control shoe (315.9 kPa; $p=0.002$), and the participants' standard shoe (273.0; $p=0.001$); a reduction of 51% compared with the control shoe and 43% compared with the participants' standard shoe.

Comment: This article will be of interest to clinicians who frequently encounter issues of footwear in the diabetic population. The Australian-based study has demonstrated the DH Pressure Relief Shoe™ reduced plantar pressures more than the other two shoe conditions. The authors concluded that the DH Pressure Relief Shoe™ may be a useful alternative to current offloading modalities used in clinical management of diabetic foot ulceration. However, clinical trials are needed to test their effectiveness for ulcer healing and to ensure they are useable and safe for patients in everyday activities. The findings from this study should be interpreted in light of limitations. Firstly, the study measured peak pressure, not healing, as a primary outcome measure and results cannot be directly extrapolated. Pertinent issues that affect healing, such as compliance, functional effectiveness of the device and health-related quality of life, may be useful and future studies may want to include these measures. A larger, high-quality randomised trial with a comparison group is recommended to evaluate the effectiveness of the DH Pressure Relief Shoe™ on ulcer healing. Finally, despite the pedar-X® system being valid and reliable, it only measures forces acting vertical to the pedar-X® insole and it is likely that the forces that shoes exert against the plantar surface of the foot are more complex in nature.

Reference: J Foot Ankle Res. 2012;5(1):25

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3483184/