Foot & Ankle Research Review™

Making Education Easy

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

I have put together a 'special' edition related to the 3rd International Foot & Ankle Biomechanics Congress (i-FAB) held recently at the University of Sydney, Australia. The conference was attended by over 300 clinicians, researchers and students from all over the world. The conference, held over 3 days, included speakers from 19 countries who were involved in four workshops, six keynote presentations and invited addresses, 55 platform presentations and 31 posters.

I have put together 10 reviews that will be of interest to all clinicians. However, for those interested in biomechanical modeling or scientific principles I suggest you read the full abstracts now available in the Journal of Foot & Ankle Research. Three presentations may be of particular interest to you. The first relates to a series of work conducted in Australia over the last 10 years on the impact of ageing on the foot (*Menz HB. Biomechanics of the ageing foot and ankle*). The second presentation conducted in the US relates to the impact of weight loss on foot structure (*Song J et al. Effects of weight loss on foot structure in obese adults: a pilot study)* and the third presentation from Australia relates to flip-flops in children (*Chard et al. Effect of thong style flip-flops on children's midfoot motion during gait).*

I hope you enjoy reading the latest edition of Foot and Ankle Research Review and welcome any feedback.

Kind regards,

Professor Keith Rome
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Biomechanics of the ageing foot and ankle

Author: Menz HB

Summary: In his presentation, the Australian keynote speaker explained that foot pain is associated with balance and gait problems, an increased risk of falls, difficulty undertaking activities of daily living and reduced health-related quality of life. In fact, such pain affects up to 24% of people aged over 65 years, with female sex, obesity and chronic medical conditions such as osteoarthritis and diabetes being risk factors for this condition. The contribution of lower limb biomechanical factors to the development of foot pain in older people is an increasingly popular area of research, and this presentation provided an overview of this topic.

Comment: The high epidemiological figures associated with foot problems and disability in older adults is worrying. Structural changes are common and the introduction of instrumentation such as plantar pressure analysis has a role to play not only in understanding the structural changes observed in older adults, but also in the conservative management that includes muscle strength programmes, balance exercises and foot orthoses. The use of foot orthoses in heel pain, a common condition often see in older adults, was explored. The evidence is poor, but future studies looking into the different types of foot orthoses was advocated. This was an excellent keynote and I recommend you read a recent publication by the author on a multifaceted podiatric intervention for the reduction of falls in the older adult (*Spink MJ et al. Effectiveness of a multifaceted podiatry intervention to prevent falls in community dwelling older people with disabling foot pain: randomised controlled trial.* BMJ. 2011;342:d3411: Available from: http://tinyurl.com/74ld5ua).

Reference: J Foot Ankle Res. 2012;5(Suppl 1):K3

http://www.jfootankleres.com/content/5/S1/K3

Effects of extrinsic rearfoot posting in custom foot orthoses on frontal plane kinematics and kinetics

Authors: Telfer S et al

Summary: These researchers investigated whether introducing incremental changes in an extrinsic rearfoot post used in foot orthoses (FOs) produces a linear trend in the user's frontal plane biomechanical responses, and whether these responses vary between pronated and normal feet. Five patients with a symptomatic pronated foot type and five healthy controls were recruited for the study. For each subject, a FO was manufactured from a 3D surface scan of their foot and nine additional FO designs with posting levels varying in 2° steps from 6° lateral to 10° medial were produced. Subjects wore the original orthotic for 1 week and then underwent kinematic and kinetic assessment while wearing that orthotic and while wearing each of the nine modified FOs. Analysis revealed significant ($p < 0.001$) differences in the effects of the devices on peak rearfoot eversion between the control and patient groups, giving evidence in support of the use of such devices to control rearfoot eversion.

Comment: This UK study will be of interest to clinicians who prescribe FOs. The results will be seen as a step in the right direction for the use of prescription personalised FOs. However, the results should be viewed with caution. Only five patients with symptomatic pronated foot types were analysed and results cannot be generalised to all patients with symptoms associated with foot pronation. In this study, only frontal plane motion was evaluated and measurements in the other two planes of motion need to be undertaken in this patient population. The final comment relates to the patient perception of the FOs. For example, the use of pain scales or comfort scales may have indicated a more clinical perspective.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):08

http://www.jfootankleres.com/content/5/S1/O8

The effect of different depths of medial heel skive on plantar pressures

Authors: Bonanno DR et al

Summary: The effect of different depths of medial heel skive on plantar pressures was evaluated in this study involving 30 adults (aged >18 years) with flat feet and no current foot pain or deformity. Plantar pressure data were collected for the forefoot, midfoot and heel while participants walked along an 8-metre walkway wearing a standardised shoe using the in-shoe Pedar-X® system. Four customised orthotic variables were investigated: no heel skive; 2 mm heel skive; 4 mm heel skive; 6 mm heel skive. While no significant change was observed with the 2 mm heel skive, statistically significant increases in peak pressure were observed at the medial heel with the 4 mm and 6 mm heel skives compared with no heel skive; 15% increase ($p = 0.001$) and 29% ($p < 0.001$), respectively. There were no significant differences between the orthoses with respect to plantar pressure at the midfoot and forefoot with any of the heel skives.

Comment: This Australian presentation demonstrated the differences in plantar pressure of a modified foot orthoses. Although the study demonstrated significant differences with various wedging, no clinical measures were obtained. This is disappointing, since clinicians would want to know if the purpose of prescribing foot orthoses reduces the pain, disability and impairment. Studies that evaluate asymptomatic people can be problematic, as the results do not necessarily translate into practice. Another problem with the study is that the biomechanical changes associated with this modification were not measured. Overall, a disappointing study that does not increase our knowledge of modified foot orthoses.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):09

http://www.jfootankleres.com/content/5/S1/O9

The validity of footprint-based measures of arch structure: revisiting the debate of fat versus flat feet in adults

Authors: Lau H-C et al

Summary: These researcher set out to evaluate the effect of BMI on radiographic and footprint-based measures of adult arch structure in 30 healthy adults (mean age 47.9 years; mean BMI 28.8 kg/m^2). Each subject had their arch index calculated from electronic footprints (EMED-SF, Novel GmbH, Germany) as the ratio of the area of the midfoot relative to the total foot contact area, ignoring the digits. The calcaneal-first metatarsal angle (CMT1) was derived from weight-bearing lateral radiographs. Multiple regression analysis revealed that both BMI ($p = 0.04$) and CMT1 angle ($P < 0.01$) were significant predictors of footprint-based measures of arch structure (arch index); the BMI and CMT1 angle accounted for 15% and 30% of the variation in arch index, respectively. When age and arch index were held constant, CMT1 angle was not significantly associated with BMI ($p = 0.89$). Furthermore, age was not found to be a predictor of either of the indices. The authors concluded that adult obesity selectively distorts footprint-based measures of arch structure, but does not influence the osseous alignment of the medial longitudinal arch.

Comment: At first glance the title suggests the differentiation between flat foot and a fat foot. However, this Australian study relating to obesity should be read with caution. The participants were recorded with an average BMI of 28.8, which could be interpreted as being overweight rather than obese. The results from the study reported that the osseous alignment of the medial longitudinal arch is not associated with obesity. The authors concluded by stating footprint-based measures should be interpreted with caution when comparing groups of adults with varying body composition.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):054

http://www.jfootankleres.com/content/5/S1/O54

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

For full bio CLICK HERE

Research Review publications are intended for New Zealand health professionals.

Effects of weight loss on foot structure in obese adults: a pilot study

Authors: Song J et al

Summary: This prospective randomised controlled pilot study involving 41 obese individuals (mean age 56.2 years) examined foot structure and function before and after significant weight loss. Subjects were randomised to one of two groups (treatment or controls). The treatment group underwent weekly education and received pre-packaged portion-controlled meals, while the control group received monthly education only. During the 3 months of the study, the mean BMI in the treatment group decreased significantly ($p < 0.001$) from 36.1 kg/m^2 to 34 kg/m^2. Analysis of malleolar valgus index, standing arch height and arch drop at baseline and at 3 months revealed no significant changes in this measurement for either group.

Comment: Obesity is on the increase and clinicians will treat and manage many patients defined as obese or overweight. This small study demonstrated that weight loss has no effect on foot structure measurements. It is no surprise that after 3 months no changes were observed in structural changes of the foot. It would be interesting to see other clinical measures evaluated such as a reduction in foot pain, an increase in walking velocity or a decrease in plantar pressure over the forefoot or rearfoot. Perhaps future studies may investigate these properties. However, this is a good novel pilot study, despite being limited due to the outcome measured.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):048

http://www.jfootankleres.com/content/5/S1/048

Mapping load transfer from the plantar surface of the foot to the walls of the total contact cast (TCC)

Authors: Begg L et al

Summary: This pilot case study involving two subjects, a 20-year-old healthy female and a 32-year-old female with a 17-year history of uncomplicated diabetes mellitus, aimed to systematically map pressure between the walls of the total contact cast (TCC) and the lower limb to identify those areas of greatest pressure, and to directly measure load transfer from the plantar surface of the foot to the cast walls. Each subject wore a bi-valved TCC with a capacitance sensor insole (pedar®, novel Gmbh, Germany) placed on to the plantar area and another into the participant's sports shoe. Pliance® sensors were placed along the lower leg (pliance®, novel Gmbh, Germany) and the highest pressures recorded by these were at the regions of the extensor retinaculum and posterior to the lateral malleolus. For the subject with diabetes, the average force per step for the resultant cast wall load was 159.2 N and for the subject without diabetes was 104.8 N. The load transfer from the plantar surface of the foot to the cast walls of the TCC was shown to be 34% for that worn by the subject with diabetes and 23% for the healthy subject.

Comment: This study from Australia will be of interest to clinicians dealing with diabetes. Although it is only a case study, the use of a TCC to transfer load from the plantar surface of the foot to the cast walls has clinical implications. If indeed, larger clinical trials are undertaken with similar findings, then the potential to reduce foot ulceration would advocate the use of this technique. From a patients perspective I would have liked to have seen a quality of life measure and a measure of comfort of the cast.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):012

http://www.jfootankleres.com/content/5/S1/012

Effect of thong style flip-flops on children's midfoot motion during gait

Authors: Chard A et al

Summary: The effects of thong style flip-flops on children's midfoot motion during walking and jogging was investigated in this study involving seven healthy children (mean age 10.47 years). Each child underwent five jogging and five walking trials while wearing flip-flops and while barefoot. Kinematic data was captured using a 14 camera, three-dimensional motion analysis system and markers were used to define three foot segments; hallux, forefoot and rearfoot. During walking, no significant effect of wearing flip-flops was seen, although a trend was evident towards a more dorsiflexed, everted and abducted midfoot. During jogging, flip-flops were seen to have a significant effect on the frontal plane, with the forefoot more inverted; -4.5 ± 6.3 SD with flip-flops compared with 3.8 ± 5.0 SD with bare feet at toe-off ($P = 0.016$). Sagittal and transverse plane measurements were not significantly different between the two groups while jogging.

Comment: This Australian study will be interest to clinicians who deal with children and parents on the impact of flip-flops (jandals) here in New Zealand. The results are somewhat surprising, as they found no difference between barefoot walking and flip-flops when walking. However, differences were noted in the forefoot during jogging. Caution about the use of flip-flops should be warranted to clinicians. Since the study only evaluated seven children aged approximately 10 years, younger children may illustrate a different set of results. However, based upon this small laboratory-based study, the media are stating that flip-fops are not necessarily bad for children's development. I would aid caution, as we do not know the long-term effects of this type of footwear.

Reference: J Foot Ankle Res. 2012;5(Suppl 1): 019

http://www.jfootankleres.com/content/5/S1/019

Altering gait by way of stimulation of the plantar surface of the foot: the immediate effect of wearing textured insoles in older fallers

Authors: Hatton A et al

Summary: The immediate effect of textured insoles on gait measurements in older fallers was assessed in this study involving 26 such adults (mean age 79 years; self-reported history of ≥2 falls in the previous year). Level-ground walking tests were conducted walking over 10m under two conditions; wearing smooth insoles (control) or textured insoles in the subject's usual footwear. Significant ($p < 0.043$) reductions in stride length and gait velocity were see with textured insoles; mean (95% CI) left stride length -2.92 (-5.49 to -0.34) cm, right stride length -2.87 (-5.64 to -0.09) cm, gait velocity -4.20 (-7.55 to -0.85) $cm.s^{-1}$. No significant differences were found for the other gait measures (cadence, step length, base of support, step time, cycle time, swing time, stance time, and single- and double-limb support times).

Comment: This UK study looked at textured insoles. Although the results demonstrated gait changes, no other parameters were reported. Previous work in this area using a different design demonstrated similar findings. This is a relatively new area using foot orthoses as a form of intervention for multiple sclerosis (MS). Common interventions for MS have been reported using ankle-foot orthoses. A limitation of the study was the lack of information about footwear. I believe that footwear alone may indeed have a therapeutic effect. Future work in neuromuscular conditions must take into account the impact of footwear from both a quantitative and qualitative perspective.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):021

http://www.jfootankleres.com/content/5/S1/O21

Foot loading of an African population

Authors: Stolwijk NM et al

Summary: These researchers compared foot shape and dynamic plantar pressure distribution of an African population (77 subjects from Malawi) and a Caucasian population (77 Dutch individuals) in an aim to understand how Africans can withstand heavier foot loading without developing foot complaints. None of the subjects investigated had reported foot complaints. Measurements were undertaken using a Foot Scan® pressure plate (Rsscan Int.). The Malawian group exhibited a significantly ($p < 0.007$) higher normalised mean pressure (MP), peak pressure (PP) and pressure-time integral (PPI) under the midfoot and a significantly ($p < 0.007$) lower MP, PP and PPI under the heel and metatarsal heads II and III, compared with the Dutch group. The Malawian group also exhibited a significantly higher arch index (mean 0.28 vs 0.21) and a significantly ($p < 0.05$) larger medial arch angle compared with the Dutch group. The trajectory of the centre of pressure was situated more posteriorly during the middle part of the stance phase and more anteriorly during the first and last part of the stance phase. These findings indicate that Africans have more contribution of the midfoot and toes during roll off than Caucasians, and this loading pattern generates a more equal distribution of pressure.

Comment: This Dutch study will be of interest to clinicians and researchers who are interested in morphological differences in foot shape and loading between different ethnic populations. The results are interesting since additional plantar pressures where found under the midfoot. The study looked at barefoot measurements and the introduction of footwear may give a different set of values. It is interesting to note similar findings have been reported in Maori and gout sufferers in New Zealand. I recommend you review the current abstract and also read the following articles: *Gurney JK et al. The Māori foot exhibits differences in plantar loading and midfoot morphology to the Caucasian foot.* Gait Posture 2012 Feb 22 [Epub ahead of print] (Available from: http://www.gaitposture.com/article/S0966-6362(12)00018-5/abstract); and *Rome K et al. Functional and biomechanical characteristics of foot disease in chronic gout: A case-control study.* Clin Biomech. 2011;26(1):90-94 (Available from: http://www.clinbiomech.com/article/S0268-0033(10)00254-8/fulltext).

Reference: J Foot Ankle Res. 2012;5(Suppl 1):025

http://www.jfootankleres.com/content/5/S1/O25

Scalpel debridement has minimal effects on painful plantar calluses in older people: a randomised trial

Authors: Landorf KB et al

Summary: This randomised, double-blind trial evaluated the effectiveness of scalpel debridement in reducing plantar pressure and pain associated with painful forefoot plantar calluses in 80 subjects with this condition, aged ≥65 years. Subjects either underwent normal scalpel debridement or sham scalpel debridement (controls) and were followed for 6 weeks. In both groups a large decrease in pain (up to a 41.9 mm decrease in pain on a 100 mm visual analogue scale) was seen following the intervention. A small, but non-significant, beneficial effect on pain was seen in favour of scalpel debridement in the period immediately post-debridement until 4 weeks (ANCOVA adjusted mean difference between groups; 6 to 7.2 mm). There were no significant differences in barefoot plantar pressures between the two groups at any time points.

Comment: The results from this Australian study illustrate an interesting debate. Scalpel debridement of painful plantar callus has minimal effect. While the study suggested an effect favouring scalpel debridement, the benefits were small and not statistically significant. There was no change in plantar pressure following scalpel debridement. The results conflict routine clinical practice. It is likely that scalpel debridement offers minimal pain relief, so other aspects of conservative care of painful calluses (e.g. padding) in addition to debridement may provide greater benefits that are clinically worthwhile to patients. However, sham procedures are not suitable within pragmatic trials, as they do not model usual practice. Furthermore, sham physical agents mimicking interventions such as scalpel debridement and foot orthotics may have physiological effects that are therapeutic. Indeed, one study on rheumatoid arthritis patients encountered this problem and the authors stated they do not favour this approach.

Reference: J Foot Ankle Res. 2012;5(Suppl 1):027

http://www.jfootankleres.com/content/5/S1/O27