Foot & Ankle Research Review™

Making Education Easy

Issue 40 – 2019

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Abbreviations used in this issue:
ITW = idiopathic toe walking
PCR = polymerase chain reaction
RA = rheumatoid arthritis
RCT = randomised controlled trial

Podiatrists Board of New Zealand

Welcome to Issue 40 of Foot and Ankle Research Review.

In this issue I have highlighted two footwear studies that explored experiences and attitudes towards both retail and therapeutic footwear. These studies provide some great insight from the patient's perspective. There is a very interesting study form the USA surrounding onychomycosis that will have you thinking. It is also great to see some research surrounding describing the benefits of combined orthotic and footwear therapy for idiopathic toe walkers.

I hope you enjoy this issue and please keep the feedback coming in.

Kind regards,

Associate Professor Matthew Carroll
matthewcarroll@researchreview.co.nz

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"Come and live with my feet and you'll understand" – a qualitative study exploring the experiences of retail footwear in women with rheumatoid arthritis

Authors: Tehan PE et al.

Summary: This qualitative study used reflexive thematic analysis of conversational style interviews to determine factors influencing the choice of retail footwear by 20 women with rheumatoid arthritis (RA). The women sought lightweight footwear that was easy to put on and off, had adequate cushioning and width, had flexible soles, and used breathable materials. This was driven by the need for comfort, cost and usability; aesthetics were less of a priority. The women did not feel empowered to make good choices about retail footwear for symptomatic relief and did not receive support from podiatrists and shoe shop staff.

Comment: I would highly recommend that all clinicians who provide footwear advice and education read this manuscript. The study provides insight into the key issues concerning the use of retail footwear in women with RA. There are some very polarising participant statements highlighting the lack of education that is provided to patients and indeed if clinicians are listening to the needs of the patient. One such example is how a loss of choice in footwear contributed to a visual change in identity from whom they were prior to their RA. For the participants in this study there was a constant compromise between achieving comfort and their feelings about their appearance and how they feel others perceive them.

Reference: J Foot Ankle Res. 2019;12:15
Abstract

Gender differences in attitudes and attributes of people using therapeutic shoes for diabetic foot complications

Authors: Jarl G et al.

Summary: This questionnaire-based survey compared attitudes and attributes among women and men (n = 1230) using therapeutic shoes for diabetic foot complications. Responses were received from 443 (36.0%) respondents (294 men, 149 women, mean age 69.2 years), among whom more men than women were in paid employment (20.4% vs 9.4%; $p<0.05$), had someone to remind them to wear therapeutic shoes (27.6% vs 10.0%; $p<0.05$), and a had history of foot ulcers (62.9% vs 46.3%; $p<0.05$) or minor amputation (17.7% vs 6.7%; $p<0.05$). More women received a disability pension (18.8% vs 10.2%; $p<0.05$). Overall, women reported worse general health, and a more negative attitude to the price and appearance of therapeutic shoes and how they felt about wearing them in public. Women also exhibited less understanding of their control/responsibility for ulcer prevention (lower internal locus of control).

Comment: This Swedish-based survey compared attitudes and attributes of women and men using therapeutic shoes for diabetic foot complications. The study found that whilst participants preferred therapeutic shoes due to their functional aspects (fit and comfort), they preferred the appearance and weight of conventional shoes. The survey found a higher dissatisfaction among women with the appearance of therapeutic shoes and their disinclination to wear them in public. The authors postulating that this may be related to the fact that fashionable shoes for women are often less functional than fashionable shoes for men, emphasising that gender differences in shoe styles are large. The survey again highlights the issue of appearance of footwear and the relationship to treatment adherence.

Reference: J Foot Ankle Res. 2019;12:21
Abstract

Effects of heel lifts on lower limb biomechanics and muscle function: A systematic review

Authors: Rabusin CL et al.

Summary: This systematic review of 23 studies (n = 377; study Modified Quality Index 5-13/15) sought to establish the effects of heel lifts on lower limb biomechanics and muscle function during walking and running. In asymptomatic subjects, 10 mm heel lifts decreased swing phase duration (standardised mean difference [SMD] -1.3) while ≥5 cm heel lifts decreased velocity (SMD -0.93) during walking; during running in asymptomatic subjects 15 mm heel lifts decreased maximum ankle dorsiflexion angle (SMD -1.5) and 12 and 18 mm heel lifts decreased gastrocnemius muscle tendon unit length (SMD -0.96). In those with restricted ankle joint dorsiflexion, during walking 6 and 9 mm heel lifts increased medial gastrocnemius electromyography amplitude (SMD 0.68-0.98). In haemophiliacs, during walking 9 mm heel lifts increased ankle joint maximum range of motion (SMD 1.6).

Comment: Heel lifts are commonly prescribed for an array of injuries related to the foot and ankle. Despite the frequent use of heel lifts as a clinical treatment the mechanism of action is unclear. Although heel lifts are used to aid in rehabilitation of these conditions the review highlighted specific effects heel lifts have on gait parameters. The alterations to gait are clinically relevant, the review showing there may be changes to swing phase, decreased walking velocity and changes to ankle range of motion. These are clinically important points uncovered by this review. It is often to easy to focus on the pathology that the heel lift is prescribed for without consideration of how the intervention will affect global foot and ankle function and gait patterns.

Reference: Gait Posture 2019;69:224-34
Abstract

Can runners maintain a newly learned gait pattern outside a laboratory environment following gait retraining?

Authors: Zhang JH et al.

Summary: This study examined whether changes in gait pattern developed during treadmill-based gait retraining to reduce peak-tibial shock were retained during unconstrained running, including overground, uphill and downhill running. Overall, 80% of participants responded to gait retraining and reduced peak tibial shock. The training effect of reduced peak tibial shock was maintained during treadmill running on the level (Cohen's $d=1.65$; $p<0.05$) and during uphill (Cohen's $d=0.91$; $p=0.001$) and downhill (Cohen's $d=1.29$; $p<0.05$) running, and during overground level (Cohen's $d=0.85$; $p=0.014$) running, but not during overground uphill (Cohen's $d=0.62$; $p=0.054$) or downhill (Cohen's $d=0.48$; $p=0.12$) running.

Comment: The article raises an important question for those who use gait retraining routinely. Specifically, this study used data related to peak tibial shock obtained from wireless accelerometers to examine the effect of gait retraining. While there are numerous running retraining programmes, this study used the technique described by Crowell and Davis 2011. This involved a two-week progressive training on a treadmill whereby participants were encouraged to run with softer footfalls using visual cues (tibial shock data) as a guide. The data demonstrated in a small population that not all gait changes are transferable to the normal running environment. This emphasises the need for studies to examine the effects of these programmes over a longer time period.

Reference: Gait Posture 2019;69:8-12
Abstract

Full length foot orthoses have an immediate treatment effect and modify gait of children with idiopathic toe walking

Authors: Michalitsis J et al.

Summary: This within-subject RCT in 10 patients with idiopathic toe walking (ITW), combined the use of high-top boots and orthoses to increase the number of heel contacts during gait and change spatio-temporal gait parameters. The combination treatment increased heel contact ($p = 0.021$) compared to barefoot walking, and gait changes included increased stride time ($p = 0.006$), a decrease in swing phase ($p < 0.010$), an increase in stance phase ($p < 0.010$) and an increase in double support time ($p < 0.001$).

Comment: The research indicates that a combined treatment focusing on harder and thicker high-top footwear with foot orthoses manufactured from a rigid material improves foot stability when managing ITW conservatively. The foot orthoses used in this study were a carbon fibre full-length orthoses and the footwear were Nike Air Force 1 high-top boots. As in previous ITW gait and footwear studies, children with ITW demonstrated different stride length and velocity parameters in barefoot walking compared to shod walking. The addition of shoes led to stride length and velocity parameters reaching age appropriate values. Importantly, this study demonstrated that the occurrence of toe walking can be reduced with footwear and rigid foot orthoses. An exciting area of research where the effect of different types of footwear was investigated. The next step for research is to ascertain if foot orthoses can indeed be considered a long-term treatment option for this condition.

Reference: Gait Posture 2019;68:227-31
Abstract

The effectiveness of non-surgical interventions for common plantar digital compressive neuropathy (Morton's neuroma): a systematic review and meta-analysis

Authors: Matthews BG et al.

Summary: This meta-analysis and systematic review examined non-surgical interventions for Morton's neuroma (MN) and the clinical evidence base for the management of MN based on 25 studies (7 RCTs, 18 case series). In total, 8 interventions were identified, the most common being corticosteroid or sclerosing injections (7 studies each). Meta-analysis of 2 RCTs indicated that corticosteroid injection decreased pain more than control based on a 100-point visual analog scale (weighted mean difference -5.3; 95% CI -7.5 to -3.2). Other effective treatments identified in the RCTs included manipulation/mobilisation and extracorporeal shockwave therapy.

Comment: A well-constructed review that investigated this common clinical presentation. The review found that while there is evidence to support the use of corticosteroid injection or manipulation/mobilisation in the management of the neuroma, there is still no clear consensus as what should be considered a frontline or secondary treatment. The review provides a good summary of evidence surrounding invasive interventions (injection therapies). Regarding corticosteroid injections, the data demonstrated the inconsistency surrounding injection therapy with regard to frequency of injections and follow-up periods. Although footwear and padding are commonly used clinical therapies, it is concerning to note how little high-quality evidence there is to support use. This is an area where more high-quality research is required. This is well worth a read to bring you up to speed with the current evidence base.

Reference: J Foot Ankle Res. 2019;12:12
Abstract

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Independent commentary by Associate Professor Matthew Carroll

Matthew is Associate Professor of Podiatry and Head of Postgraduate Programmes within the School of Clinical Sciences at the Auckland University of Technology. He graduated in podiatry at the CIT in Wellington. He undertook his postgraduate work at Otago University, Dunedin, New Zealand, Curtin University, Western Australia and Auckland University of Technology, Auckland, New Zealand. His research areas include investigating musculoskeletal function in the lower limb in inflammatory arthritis. He is active in the supervision of higher degree students. He is Associate Editor for BMC Musculoskeletal Disorders and is an Editorial Board Member for the Journal of Foot & Ankle Research.

Progressive changes in walking kinematics throughout pregnancy – A follow up study

Authors: Forczek W et al.

Summary: This study examined how gait kinematics change during pregnancy and the effects of physical activity level and energy balance in 30 women in the first, second and third trimesters of pregnancy. No differences were observed in spatiotemporal variables of walking kinematics during pregnancy. However, gait analysis indicated increments in base of support and single support measures. Generally, sagittal plane mobility of the lower limb joints did not change, however, in late pregnancy, pelvic tilt increased. Throughout gestation, hip and pelvis angles differed significantly over the gait cycle. Energy balance ('positive', 'balanced' or 'negative' dietary energy intake and energy expenditure over 7 days) was "balanced' in the first trimester, but the relative number of participants with negative balance increased during pregnancy. Gait parameters were independent of energy balance; however, correlations were found between gait parameters (base of support, velocity, stride length, and total physical activity) in advanced pregnancy.

Comment: This study examined gait changes through the three trimesters of pregnancy. In line with previous research the study found that functional adaptations related to postural stability increased through the trimesters. This study notes that there were changes in the base of gait and foot position as pregnancy progresses. These changes being related to changes at the hip (increased width and anterior tilt). The authors also advocate for physical activity (muscle strengthening) during pregnancy and this may help negate issues with gait instability. Interestingly the authors found no significant alterations to gait speed or cadence through progression of pregnancy.

Reference: Gait Posture 2019;68:518-24
Abstract

Fungal diversity and onychomycosis: An analysis of 8,816 toenail samples using quantitative PCR and next generation sequencing

Authors: Joyce A et al.

Summary: In this analysis of 8816 clinically suspicious toenail samples collected by US podiatrists from patients aged 0 to 103 years were investigated using next-generation sequencing and quantitative PCR to determine diagnosis effectiveness and to quantify the microbial flora. About 50% of suspicious toenails had both fungi and bacteria, with the dermatophyte *Trichophyton rubrum* having the highest relative abundance being present in 40% of samples. Of the remaining 50% of samples, 34% had bacteria and 16% had neither. Fungi were present in <1% of samples. Nondermatophyte molds were found in 11.0% of fungus-positive samples.

Comment: This article only reinforces my doubts over the usefulness of current culture techniques used in the standard diagnosis of onychomycosis. The study suggests that the cause of onychomycosis may be more diverse than presently estimated. Of the 8816 samples, approximately 50% (n = 4328) were positive for fungal organisms (as well as bacteria). Data demonstrated that whilst *T. rubrum* was a main contributor (present in 40% of the fungal positive samples) to onychomycosis, many additional organisms must be considered and may have more involvement than previously suspected. The authors also challenge the use of empirical oral terbinafine without the benefit of confirmatory diagnosis. First, this may lead to actively selecting for alternative organisms by targeting the wrong genus and species while encouraging the development of resistance. Second, other similar nail disorders cannot be excluded without nail sampling, such as trauma, psoriasis, lichen planus, or other nail diseases. This article will get you thinking about your patients who have not responded to antifungal therapy.

Reference: J Am Pod Med Assoc. 2019;109(1): 57-63
Abstract

The use of urea for the treatment of onychomycosis: a systematic review

Authors: Dars S et al.

Summary: This review conducted a systematic literature analysis to examine the use of urea as monotherapy and an adjunct therapy versus other treatment regimens for onychomycosis. Of 560 studies identified, only 6 were included all of which had methodological concerns. Most had small sample sizes and heterogeneity in outcome measures and follow-up, but nevertheless a trend suggested that urea plus topical or oral antifungal treatment regimens improved treatment efficacy.

Comment: The review found little evidence to support the use of urea as a standalone treatment for onychomycosis. The authors do, however, suggest that urea, as an adjunct to standard treatment regimens, may improve the efficacy of treatment. The most significant limitation identified by the review was that although all studies investigated mycosis in adults, the pathogen, type of infection and percentage of nail involvement varied or was not reported. If we take into consideration the findings of the onychomycosis study by Joyce et al, 2019 (see left) it is difficult to prove that a treatment for fungal nails is effective if it is unknown, if it is indeed a fungal infection causing the nail pathology. The authors also report a role for urea as an alternative method of nail removal, where mechanical debridement or surgical intervention is contraindicated prior to commencement of topical treatment.

Reference: J Foot Ankle Res. 2019;12:22
Abstract

An investigation into the effects of, and interaction between, heel height and shoe upper stiffness on plantar pressure and comfort

Authors: Melvin JMA et al.

Summary: This study examined heel height and material stiffness to understand the interaction effect on plantar pressure and comfort in 16 female participants with experience of high heels. Increased heel height over five heel heights (35-75 mm) increased plantar pressure under the metatarsal heads and reduced pressure in both the hallux and heel. Higher heels also increased discomfort, particularly toe discomfort, which increased 154.3% in 35-75 mm heels. Stiffness of shoe uppers did not affect plantar pressure, but did increase discomfort, especially on the top of the foot (108.6%) and back of the heel (87.7%), as well as overall width (99%) and overall comfort (100.7%). Interactions between heel height and upper material stiffness were observed in comfort questionnaire data.

Comment: The study demonstrated that increasing heel height increased pressures to the plantar metatarsal region but not to the heel or hallux in the higher heel heights. Although not a new finding surrounding the forefoot pressure, the reduction in pressure to the hallux was interesting. This reinforces to me how the hallux may become less functional at higher heel heights. The study also demonstrated that stiffer upper material had no effect on plantar pressures; however, at higher heel heights the stiffer material was perceived as less comfortable. From a design perspective this may indicate that shoes with heel heights of 65-75 mm may be more comfortable when manufactured from a softer upper material. This may be a good feature to advise patients to look for who wear heels between 65-75 mm.

Reference: Footware Sci 2019;11(1):25-34
Abstract