Foot & Ankle RESEARCH REVIEW™

Making Education Easy

Issue 47 – 2021

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Welcome to Issue 47 of Foot and Ankle Research Review.

I have highlighted some recent diabetes publications that investigate prevalence rates, health care utilisation and adherence to guidelines, and the follow-up effect of interventional therapy for vascular disease. There is also research investigating running retraining and hallux valgus related to footwear fit in adolescent populations. I was also intrigued by Dueñas et al., who investigated the concept of pressure discomfort threshold.

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

Noho ora mai

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Independent commentary by Associate Professor Matthew Carroll

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MORE INFO

Diabetes-related foot disease in Australia: A systematic review of the prevalence and incidence of risk factors, disease and amputation in Australian populations

Authors: Zhang Y et al.

Summary: These authors systematically reviewed the literature published to December 31, 2019 reporting the prevalence and incidence of diabetes-related foot disease (DFD; ulcers and infection), the prevalence of risk factors for DFD (e.g. neuropathy, peripheral artery disease), and of diabetes-related amputation (total, minor and major amputation) in Australian populations. Among 20 eligible publications, the prevalence of risk factors for DFD ranged from 10.0-58.8%, the prevalence of DFD from 1.2-1.5%, the incidence of DFD-related hospitalisation from 5.2-36.6 per 1000 person-years within diabetes populations, and the incidence of diabetes-related amputation from 5.2-7.2 per 1000 person-years. Among in-patients, the prevalence of risk factors ranged from 35.3-43.3%, DFD from 7.0-15.1% and amputation during hospitalisation from 1.4-5.8%. The authors concluded that the findings may suggest that a low proportion of people with risk factors develop DFD, but that it is also possible that there is an underestimation of DFD prevalence in Australia.

Comment: Approximately 4.6 to 4.8% of the global population with diabetes have foot disease. Population studies reporting the incidence of foot disease are limited. In Australian populations, data points towards a low prevalence of diabetes-related foot disease but high incidence rates of amputation. This is suggestive that current health strategies may be effective in preventing diabetes-related foot disease but not amputation in those with foot disease. Data from this review suggests that a relatively high proportion of people with diabetes in Australia have risk factors for developing foot disease, and a high incidence of amputation (5.2–7.2 total amputation incidence range per 1000 person-years), this rate being markedly higher than recently published global data. I was particularly interested that the review showed no marked differences between Indigenous and non-Indigenous people for these risk factors – this may be related to the tight inclusion criteria of the review. More population-based data is required as I feel the prevalence rates of diabetic foot disease is underestimated.

Reference: J Foot Ankle Res. 2021;14(1):8
Abstract

Association between processes of diabetes care and health care utilization in patients with diabetes: Evidence from a nationally representative US sample

Authors: Delevry D et al.

Summary: The association between quality of processes of diabetes care in terms of adherence (determined using the Diabetes Care Survey) to American Diabetes Association (ADA)-recommended guidelines for processes of diabetes care and health care utilisation was investigated in this study involving adults with diabetes identified from the pool of five panels of the Medical Expenditure Panel Survey, a nationally representative US sample, between 2012 and 2017. Adherence to the ADA-recommended guidelines was defined as undergoing the following annually: glycosylated haemoglobin check, foot examination, dilated eye examination, lipid panel, influenza immunisation, blood pressure check, and dental examination. Among an estimated 26.3 million adults with diabetes, 7.8% met the ADA-recommended guidelines for processes of diabetes care, and adherence rates of individual recommendations were generally <50%. Those who adhered to the ADA-recommendations were older adults, non-Hispanic white patients, and married non-smokers with higher income and private insurance. Socioeconomic disadvantage and minority status were associated with nonadherence to the ADA-recommended guidelines. ADA guideline-adherent patients had a significantly lower mean number of inpatient hospital stays (0.98 vs 1.62; $p < 0.001$) and outpatient visits (17.9 vs 12.8; $p < 0.001$) than nonadherent patients.

Comment: Data continues to demonstrate that because of diabetes-related complications, utilisation of health care services is higher among people with diabetes compared to those without diabetes. This study demonstrated that adherence rates to the America Diabetes Association recommended guidelines which includes biannual HbA1c assessment, foot examination, eye examination, dental examination, lipid panel, blood pressure measurement, and influenza immunisation was below 50% in the population investigated. Worryingly, but in agreement with other previous data, socioeconomic disadvantage and minority status were linked to non-adherence, with adherence to guidelines associated with reductions in hospitalisations. These findings are important for all who manage diabetic patients. Are you ensuring that the patients you manage are undergoing full annual diabetes screening?

Reference: J Diabetes. 2021;13(1):78-88
Abstract

Five-year follow-up observation of interventional therapy for lower extremity vascular disease in type 2 diabetes and analysis of risk factors for restenosis

Authors: Ding H-X et al.

Summary: This retrospective study investigated the clinical characteristics of lower extremity vascular diseases in type 2 diabetes and evaluated the long-term efficacy of vascular intervention in 362 patients who underwent vascular intervention at a single hospital in China. At 5-year follow-up post intervention, blood pressure, fasting blood glucose, glycated haemoglobin (HbA1c), total cholesterol (TC), triglyceride Ester (TG), and low density lipoprotein-cholesterol (LDL-C) values were significantly ($p < 0.01$) lower compared with baseline values. Compared with patients with vascular patency, those with vascular restenosis exhibited significantly ($p < 0.001$) higher levels of fibrinogen, blood glucose, HbA1c, TC, TG, LDL-C, and small dense low-density lipoprotein (sdLDL), however, the level of HDL-C in the vascular restenosis group was significantly lower compared with the vascular patency group.

Comment: Complications related to lower extremity vascular disease in type 2 diabetes are serious. It is not only the main cause of diabetic foot and amputation but also an important predictor of cardiovascular events and cardiovascular death. This study demonstrated that vascular intervention was associated with improvement of numerous key disease markers at 5 years post intervention. In the analysis of the surviving patients (245) in the cohort who received vascular intervention, cases were predominantly due to inferior knee artery disease with a 40% incidence rate of vascular restenosis. Perhaps not surprisingly those patients with vascular restenosis had a significantly longer duration of diabetes, hypertension, and cigarette smoking ($p < 0.001$). Interestingly this group also had significantly higher levels of fibrinogen, blood glucose and HbA1c. Demonstrating these indictors may be associated with a prognosis of restenosis. These results highlight the importance of early screening and intervention for lower extremity pathology in people with diabetes.

Reference: J Diabetes. 2021;13(2):134-142
Abstract

Fatigue in children with pronated feet after aerobic exercises

Authors: Gómez-Benítez MLÁ et al.

Summary: This study involving 105 children aged 10-12 years examined whether children with pronated feet become more fatigued following participation in sports tests than those with normal feet. The children participated in aerobic-type resistance exercises with six stations at which they remained for 30 sec. The Foot Posture Index (FPI) was used to measure the posture of the foot and the plantar footprint was evaluated via the Arch Index and Clarke's angle before and after aerobic-type resistance exercises. The Pictorial Children´s Effort Rating Table (PCERT) questionnaire was used to evaluate perceived tiredness and pain during or after physical activity was recorded. Children with pronated feet exhibited a greater change in the variables used to measure the foot posture and the plantar arch, indicating that the feet undergo pronation more after physical exercise. Higher levels of fatigue were evident in children with pronated feet than those without; average PCERT 7.60 versus 5.46, respectively.

Comment: The association between a pronated foot type and injury is controversial and the centre of numerous debates. Nonetheless, orthotic therapy is commonly prescribed in children who present with leg or foot fatigue related to exercise participation. This study examined if children with pronated feet (categorised by the foot posture index (FPI) experienced more perceived tiredness following exercise than children with neutral feet. The authors report that FPI increased (became more pronated following exercise). Data indicated no significant difference in results of tests between the two groups and those with a more pronated foot had higher perceived fatigue following the prescribed exercise. The results must be interpreted on the basis of limitations. The FPI system used to categorise feet is a static measure and does not infer how the foot will function during a dynamic activity. It is too simplistic to infer that a neutral foot as assessed by the FPI will not exhibit high levels of pronation during weightbearing activities. The scale used to assess fatigue also has limitations which may be associated with the general fitness levels of the participants within the groups prior to study entry. Although the activity in hours per week was described by the authors, there was no quantification of aerobic fitness levels in the study participants. Overall, this study will not answer this question but only further add to the debate.

Reference: J Am Podiatr Med Assoc. 2020:19-058
Abstract

Comparison of 3D scanning versus traditional methods of capturing foot and ankle morphology for the fabrication of orthoses: A systematic review

Authors: Farhan M et al.

Summary: This systematic review aimed to compare the speed, accuracy and reliability of 3D scanning with traditional methods of capturing foot and ankle morphology for fabricating orthoses. Included studies compared 3D scanning to a traditional form of capturing morphology of the foot and/or ankle (plaster cast, foam impression box, ink footprint, digital footprint and clinical assessment) and were of any study design involving healthy or clinical populations of any age and gender. Among six studies meeting inclusion criteria, compared to traditional methods, 3D scanning appeared to be faster than casting (2-11 min vs 11-16 min). High variability was seen in inter-rater reliability (Intraclass correlation coefficient [ICC] 0.18-0.99) and intra-rater reliability (ICCs 0.25-0.99) for both 3D scanning and traditional techniques, with higher agreement generally dependent on the foot parameter measured.

Comment: Clinicians who manufacture and prescribe foot orthoses and ankle foot orthoses will fall into two camps, those who have embraced 3D scanning technologies and those who use traditional plaster-based techniques to obtain an accurate representation of the foot. Whist there is no right or wrong, this systematic review presents an overview of research that has compared the various methods of obtaining an accurate foot cast. Unsurprisingly, the review concludes that studies comparing the various methodologies are limited due to the quality of the studies. The pragmatist in me cannot see how traditional plaster methods will remain in long-term use, particularly with the advent of ever increasing accurate and efficient app- and mobile-based technologies, and the development of virtual consultations.

Reference: J Foot Ankle Res. 2021;14(1):2
Abstract

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Effects of a 10-week running-retraining programme on the foot strike pattern of adolescents: A longitudinal intervention study

Authors: Consuegra González PJ et al.

Summary: This study compared the effects of 10 weeks of different running-retraining programmes (running technique n = 39; 15% increased step frequency n = 37; barefoot training n = 30) versus control (no retraining n = 43) on rearfoot strike (RFS) prevalence in 180 adolescents (aged 13-16 years, 45.3% girls). After 10 weeks, there were no differences in RFS in the left foot, but there were differences for the right foot ($\chi 2 = 9.239$; $p = 0.025$). However, a re-test found no differences for either the left foot or the right foot. No group displayed changes in RFS prevalence from the pre-test to the re-test.

Comment: Running retraining programmes have conventionally targeted runners with problems that may be associated with technique. The results of this Spanish study demonstrated no significant changes in rear foot strike (RFS) pattern following either of the three running intervention techniques. The results to me were not surprising considering the short nature of the trial and the methodological limitations. One overarching question I have is why you would need to alter the RFS pattern globally in this cohort of this age? I am very sceptical of the very limited evidence that associates an RFS patterns in the adolescents with an increased injury risk, and the supposition that changing to a more midfoot or forefoot strike pattern is necessary to prevent injury. Definitely a controversial area of research that will cause further debate.

Reference: Gait Posture. 2021;83:147-151
Abstract

Evaluating shoe fit in older adults using a 3D scanner: A cross-sectional observational study

Authors: Jalali A et al.

Summary: This Iranian cross-sectional, observational study examined the mismatch of shoe and foot among 50 female and 30 male senior citizens (65 to 87 years old). Overall, 57 (71.3%) wore shoes with improper lengths and 23.7% with shorter than ideal lengths. In more than 90% of participants, the shoe's width and metatarsophalangeal region perimeter were shorter than the feet. There was a relationship between hallux valgus and narrower metatarsophalangeal width ($r = 0.33$; $p = 0.003$) and heel width ($r = 0.29$; $p = 0.009$).

Comment: Some very interesting data from this study indicating that 70% of the study participants were wearing footwear of inappropriate length (defined as less than a 1 cm space between the toe and the end of the shoe). Approximately a quarter of the participants also wore footwear shorter than their measured foot length. These findings of poor footwear fitting may not be surprising to clinicians who routinely assess feet; however, this again highlights the need to regularly check footwear fit particularly in patients who have chronic diseases that affect the foot (diabetes and inflammatory arthritic conditions most notably). Data also showed week associations between poor footwear fit and hallux valgus (bunions). The proposition that poor fitting footwear causes bunions has not been equivocally established and I feel will remain an area of speculation for many years.

Reference: Footwear Science 2020;12(3):161-171
Abstract

Hallux valgus in pre-school-aged children: The effects of too-short shoes on the hallux angle and the effects of going barefoot on podiatric health

Authors: Kinz W et al.

Summary: This study of pre-school-aged children in Japan examined the feet and the fit of shoes and compared hallux angles with those of children who went only barefoot at pre-school. Of 1238 feet examined, 12.3% had a straight position of the great toe and 19.1% had a valgus angle of >10°. Among 620 children, 75.5% were wearing outdoor shoes of insufficient length, while among 381 children 84.6% had indoor shoes that were too short. The fit of the shoes and the hallux angle were correlated, the shorter the shoe the greater the hallux angle. Relative risk of lateral hallux deviation was up to 30% greater if outdoor shoes were two sizes too short. Hallux angle was smaller in children who went barefoot versus those who habitually wore indoor shoes.

Comment: This Japanese based study contends that poor footwear fit is associated with hallux valgus development (bunions) and secondly, that going barefoot can help counteract an increased valgus angle. Based on the significant limitation of this study, namely the method that was used to measure hallux valgus angle, I would caution about integrating the evidence from this study into your practice recommendations. The method of hallux valgus measurement was based on the outline of the foot, a technique that is greatly affected by foot posture. The conclusion that spending more time barefoot will counteract the effects of hallux valgus and potentially straighten the position of the hallux were a step too far from my perspective. This statement is unsupported by the study data and speculative.

Reference: Footwear Science 2020;Dec 2 [Epub ahead of print]
Abstract

Effects of using insoles of different thicknesses in older adults: Which thickness has the best impact on postural stability and risk of falling?

Authors: Büyükturan Ö et al.

Summary: This study examined the effects of insoles of various thicknesses on postural stability and risk of falling in 56 older adults. Insoles of different thicknesses affected static postural stability ($p = 0.003$) and static risk of falling ($p < 0.001$), and also affected dynamic risk of falling ($p = 0.003$) and dynamic postural stability ($p = 0.034$). The highest postural stability scores and the lowest risk of falling were recorded using 10 mm insoles ($p < 0.05$).

Comment: The premise of this study was that variation in the thickness of insoles placed inside shoes may have the ability to reduce the risk of falls and improve postural stability. Postural stability was measured on a balance platform with anteroposterior and medial/lateral movement quantified. Although the authors conclude that the 10 mm insole placed inside the shoe was the best option to improve postural stability, there was no significant difference obtained between the 5 and 10 mm insole regarding static or dynamic stability measurements. However, there were significant differences between the use of insoles when compared to the barefoot stability measurements. My take-home message from this study is that a lightweight insole may help with stability of the foot. What is unknown is what is the most suitable footwear style to place the insole in?

Reference: J Am Podiatr Med Assoc. 2018;Apr 18 [Epub ahead of print]
Abstract

Influence of age, gender and obesity on pressure discomfort threshold of the foot: A cross-sectional study

Authors: Dueñas L et al.

Summary: This cross-sectional study ($n = 36$) aimed to describe a pattern of pressure discomfort threshold (PDT; measured with an adapted manual dynamometer) of the foot plantar surface as a tool for assessment of painful foot conditions to describe how it alters with age, gender and obesity. The pattern of PDT showed a higher threshold on the heel and external foot ($p < 0.001$) and was influenced by age ($p < 0.001$), especially in participants aged >65; by gender, with women having higher values ($p < 0.001$) and by obesity ($p < 0.001$).

Comment: The authors investigated the concept of the pattern of pressure discomfort threshold (PDT) interpreted as the minimum pressure that produces discomfort. With the assumption that discomfort is a precursor of pain. Data indicated there is a PDT for the foot, with heel and external midfoot areas showing more tolerance to higher pressures. The authors propose that there is a turning point around 65 years old when PDT is increased significantly on the heel, midfoot and forefoot. This change could be explained by age related changes to the mechanical properties of the plantar foot, reductions in response by the nervous system to painful stimuli, and age-related soft tissue adaptation (increased tissue stiffness). Data also pointed to a gender difference with women showing higher PDT than men and higher PDT patterns in obese compared to non-obese people. Whilst it is not surprising that areas of high contact show higher threshold levels, it is interesting how the levels of threshold change over time. This study was conducted in a healthy population – the effect of chronic disease on discomfort threshold perceptions would be very interesting.

Reference: Clin Biomech (Bristol, Avon). 2020;82:105252
Abstract