

Foot & Ankle RESEARCH REVIEW™

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Issue 58 – 2023

In this issue:

- NZ podiatrist prevention strategies for DFD
- A progressive muscle strengthening programme for PHP
- Patterns & predictors of wearing orthopaedic footwear
- TyG index & severity of DFUs
- Foot health & quality of life with chemotherapy
- DFUs & lower limb oedema
- Dorsal vs. plantar approach to Morton's neuroma resection
- Age-associated changes in walking strategies
- Non-union & reoperation after hallux interphalangeal joint arthrodesis
- Fasciotomy for lower leg lat-CECS

Abbreviations used in this issue

DFD = diabetes-related foot disease
DFU = diabetic foot ulcer
IWGDF = International Working Group of the Diabetic Foot
(lat-)CECS = (lateral-) chronic exertional compartment syndrome
NZSSD = NZ Society for the Study of Diabetes
OR = odds ratio
PAD = peripheral arterial disease
PHP = plantar heel pain
TCC = total contact cast
TyG = triglyceride-glucose
VGRF = vertical ground reaction force

Welcome to Issue 58 of Foot and Ankle Research Review.

In this issue I highlight some recent publications surrounding the development of a foot strengthening programme, the use of orthopaedic footwear in people with diabetes, age-associated changes in walking strategies and foot health in people with breast cancer undergoing chemotherapy.

I hope you enjoy this issue.

Noho ora mai

Associate Professor Matthew Carroll

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Research Review thanks Foot Science International for their sponsorship of this publication and their support for ongoing education for healthcare professionals.

How does the clinical practice of Aotearoa New Zealand podiatrists align with international guidelines for the prevention of diabetes-related foot disease?

Authors: Jepson H et al.

Summary: These researchers sought to examine how well NZ podiatrists align their practice with international guideline recommendations for the prevention of diabetes-related foot disease (DFD). A total of 77 responses (16.3% of the NZ podiatry workforce) were received from a cross-sectional web-based survey; 52 of these were included in the analysis (73% from private-sector podiatrists). Podiatrists who worked in the public sector described significantly higher caseloads of patients who had foot ulcers ($p < 0.001$) and diabetes ($p = 0.03$). The two most commonly used guidance documents were the IWGDF guidelines and the NZSSD risk stratification pathway. When treating patients with a very low- to moderate-risk foot, >50% of podiatrists reported screening more frequently than the guidelines recommend, however guidelines were generally followed for the screening and management of patients with a high-risk foot. Only four podiatrists (5%) reported using a structured education programme. Private sector podiatrists reported significantly lower rates of multi-disciplinary team care ($p = 0.03$) and provision of custom-made footwear ($p = 0.04$).

Comment: This study conducted the first survey of NZ podiatrists to understand their practices related to the prevention of DFD. The results show that podiatrists in NZ use different practices for DFD prevention. The study suggests an inconsistency in screening frequency, suggesting possible over-screening of individuals at low or very low risk of DFD. This highlights the need for national guidelines on DFD prevention. Regarding diagnostic testing, podiatrists' practices are guided by international guidelines and NZ risk stratification systems, although some rely on subjective vascular assessments such as pulse palpation, rather than objective measurements. To identify peripheral neuropathy, all respondents used the 10g monofilament, which is consistent with reliable results in predicting foot ulcers. The study shows that podiatrists often educate their patients through face-to-face verbal communication, while structured education is used less. This is consistent with the broader movement toward patient-centred care, but highlights the challenge of integrating diabetes self-management education into routine clinical practice. Exercise recommendations are often made but seem to be based more on the clinician's experience. Integrated care teams exist in NZ, but other care modalities such as Māori health providers and telemedicine are underutilised.

Reference: *J Foot Ankle Res.* 2023;16(1):53

[Abstract](#)

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Development of a foot and ankle strengthening program for the treatment of plantar heel pain

Authors: Osborne JWA et al.

Summary: The aim of this Delphi study was to achieve consensus from a panel of experts on a progressive muscle strengthening programme for plantar heel pain (PHP). First, an open-ended questionnaire gathered data on key exercises for three common sub-groups of patients with PHP (younger athletic, overweight middle-aged, older). Following this, experts suggested changes to the proposed exercises. Finally, experts indicated their agreement to the amended exercises. Consensus (>70% agreement) was reached for three programmes: heel raises, digital plantarflexion and the short foot exercise, however experts differed in their view of how these should be carried out. Some experts did not recommend the heel raise exercise and the heel raise with digits dorsiflexed exercise variation, as they reported a perceived difficulty in carrying out the exercises or flaring of symptoms.

Comment: The article reports the results of a Delphi study that developed a strengthening exercise programme for PHP. The study reached consensus on three programmes that included heel raises, digital plantarflexion and the short foot exercise. The results showed that experts agreed on the exercises to include in each programme, but there were differences in the way they were applied, such as the number of repetitions, sets and weight. Of note, heel raises, commonly recommended to improve calf strength, are frequently recommended, although recent evidence calls into question their effectiveness in PHP treatment. The study emphasises the importance of progressive exercises to increase strength, as supported by the American College of Sports Medicine guidelines, which recommend increasing weight and functionality in each phase of exercise. While the study provides valuable insight into exercise recommendations, it also highlights the need for further research to evaluate programme effectiveness and consider patient preferences in exercise prescription.

Reference: *J Foot Ankle Res.* 2023;16(1):67

[Abstract](#)

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Independent commentary by Associate Professor Matthew Carroll

Matthew is an Associate Professor of Podiatry at Auckland University of Technology. His research focus is on chronic long-term conditions that affect the foot. He is a current Editorial Board member for the *Journal of Foot & Ankle Research*, Academic Editor for *PLOS ONE*, and past Associate Editor for *BMC Musculoskeletal Disorders*.



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Objectively assessed long-term wearing patterns and predictors of wearing orthopaedic footwear in people with diabetes at moderate-to-high risk of foot ulceration

Authors: Exterkate SH et al.

Summary: This 12-month observational study investigated the long-term wearing patterns and predictors of wearing orthopaedic footwear in 61 patients (mean age 68 years) with diabetes and loss of protective sensation or peripheral artery disease. Patients wore their orthopaedic footwear for a mean of 8.3hrs/day. The predetermined threshold for footwear adherence was wearing footwear for $\geq 60\%$ of the total assumed time out of bed per day (16hrs); 66% of patients were non-adherent with footwear use. Significantly longer wearing times were observed in patients with a consistent wearing pattern than an inconsistent pattern (12.7 vs. 3.6 hrs/day, respectively, $p < 0.001$), and in those who reported higher satisfaction with their wear of orthopaedic footwear ($p < 0.001$). Wear times were significantly longer on weekdays than on Saturdays and Sundays (8.7 vs. 8.0 and 6.9 hrs/day, $p < 0.010$).

Comment: The study examines the duration of wearing orthopaedic footwear in people with diabetes, particularly those at risk of developing diabetic foot ulcers. It compares its results with existing quantitative and qualitative studies. The research shows that most participants have poor adherence to wearing orthopaedic footwear, a crucial aspect in preventing diabetic foot ulcers. The study highlights that wear time is significantly longer on weekdays than on weekends and underlines the importance of consistent daily use. Notably, participants with a stable wearing pattern tended to have longer daily wearing times, indicating that habit formation has the potential to improve adherence. The study's multivariate model attributed 28% of the wear time variance to factors such as satisfaction with wearing shoes and low education level, although the latter was not statistically significant. The study suggests that objective measurements of adherence at the individual level are needed, and interventions may need to focus on improving communication styles between healthcare providers and patients to promote long-term adherence.

Reference: *J Foot Ankle Res.* 2023;16(1):60

[Abstract](#)

Association between triglyceride glucose index and severity of diabetic foot ulcers in type 2 diabetes mellitus

Authors: Chen W et al.

Summary: The association between triglyceride-glucose (TyG) index and the severity of diabetic foot ulcers (DFUs) was explored in this observational, retrospective study of 1059 patients with type 2 diabetes. Patients were stratified into three TyG tertile indexes. The highest TyG tertile was associated with a significantly increased risk of severe DFUs compared with the lowest tertile (OR 1.377, $p = 0.039$), and this persisted after adjustments for potential confounders (multivariable-adjusted OR 1.506, $p = 0.016$). The association was stronger among patients aged ≥ 65 years, those with > 10 year diabetes duration, those without peripheral arterial disease (PAD) and men.

Comment: This retrospective study investigates the association between TyG index and the severity of DFUs in Southeast China. The TyG index, a simple surrogate for insulin resistance, has been linked to cardiovascular disease. Research indicates a significant association between TyG index and Wagner classification of DFUs, independent of traditional risk factors for diabetic foot. This suggests that the TyG index could serve as an additional factor to assess the severity of DFUs. Importantly, this is the first study to examine this connection. The study highlights that higher TyG index values are associated with more severe insulin resistance, which in turn is associated with adverse cardiovascular and metabolic outcomes. The study highlights the clinical importance of the TyG index in the assessment of peripheral vascular injuries, particularly given its possible association with diabetic foot complications. Interestingly, the study found no significant difference in PAD in logistic regression models, possibly because PAD severity was not stratified. The study's subgroup analysis shows that the TyG index appears to be more sensitive for predicting DFU risk in older males. Therefore, it could be a promising screening tool to assess the risk of future DFUs.

Reference: *J Foot Ankle Res.* 2023;16(1):68

[Abstract](#)

Foot health and quality of life in women with breast cancer undergoing chemotherapy

Authors: Veiga-Seijo R et al.

Summary: The objective of this cross-sectional study was to determine the prevalence of foot health problems in women with breast cancer undergoing chemotherapy (n=117). Foot health problems were highly prevalent in this population, including neuropathic symptoms (75.2%), xerosis (62.4%), nail colour changes (59.8%), onychocryptosis (39.7%) and plantar fasciitis (12.8%). Foot pain was reported by 77.8% of patients, 65.8% felt limited in their walking, and 56.4% described their foot health as fair or poor. Overall, footwear yielded the lowest score in the Foot Health Status Questionnaire.

Comment: The aim of this study was to examine foot health, functionality, pain and quality of life in women with breast cancer undergoing chemotherapy. This is the first comprehensive study to address the negative impact on foot health in cancer patients, focusing on participants' perceptions of their foot health and quality of life. The study found that foot problems, including nail and skin disorders and peripheral neuropathy, were common side effects of chemotherapy. These findings are important because they impact on patients' quality of life and overall well-being. Chemotherapy-related foot problems, as found in this study, are not only common but also have an impact on patients' daily lives. The research also showed that foot problems can lead to dosage adjustments or treatment suspensions, highlighting the importance of addressing these issues to maintain treatment effectiveness. These results are consistent with previous studies highlighting the need for early dosage adjustment and supportive measures to relieve pain and discomfort associated with foot problems. Additionally, the study highlighted the detrimental impact of foot health problems on the quality of life of breast cancer patients. These problems affect multiple domains including foot pain, foot function, footwear and general health, highlighting the importance of foot health in this population.

Reference: *J Foot Ankle Res.* 2023;16(1):52

[Abstract](#)

Off-loading and compression therapy strategies to treat diabetic foot ulcers complicated by lower limb oedema

Authors: Tansley J et al.

Summary: The evidence for off-loading and compression therapy strategies in patients with DFUs and lower limb oedema was explored in this scoping review of relevant literature. A total of 522 publications were identified; 51 were included. The data indicated that compression therapy for oedema management should be avoided in patients with severe PAD. In addition, when off-loading DFUs in those with lower limb oedema, knee-high devices should be employed with caution. Researchers reported that there was a gap in the literature regarding treatment options to concurrently manage these conditions, and they encouraged physicians to rely on their own clinical discernment alongside guidance from specialist colleagues to guide personalised treatment for each patient.

Comment: This scoping review examined available offloading and compression therapy strategies for the treatment of DFUs complicated by lower extremity oedema. Regarding offloading strategies, international guidelines recommend the use of a non-removable knee-high cast, such as a total contact cast (TCC), as a first-line treatment for DFUs, with a knee-high walking cast as a second-line alternative if a TCC is not tolerated. However, conflicting opinions have been presented in the literature regarding the role of knee-high removable casts/walking aids in the treatment of DFUs with lower extremity oedema. Regarding compression therapy strategies, although there are no current guidelines for the use of compression therapy in DFUs with oedema, its benefits are recognised in the literature. A full-strength multilayer bandaging was recommended for patients without arterial compromise, a reduced-strength bandaging was recommended for patients with reduced arterial blood supply, and the use of compression was cautioned against in cases of severe arterial compromise. Compression hosiery have been suggested to treat lower extremity oedema with a DFU. Some studies demonstrated safety in participants with diabetes, but the effect of hosiery on DFU outcomes has not been examined. To promote wound healing and prevent major amputations, pneumatic compression has been proposed. Although the majority of the literature agreed on the potential benefits, the evidence was of low methodological quality. Sixteen complementary strategies were identified, including integrated working, patient-specific treatment plans and use of wound and leg assessment tools. Although these strategies were suggested by experts, there was no strong scientific support.

Reference: *J Foot Ankle Res.* 2023;16(1):56

[Abstract](#)



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Effect of surgical approach on the treatment of Morton's neuroma

Authors: Zhang J et al.

Summary: This was a systematic review with meta-analysis which compared outcomes following dorsal or plantar approaches to the surgical resection of Morton's neuroma. The final analysis included five studies (58 feet via plantar approach; 189 via dorsal approach). Patients who underwent a plantar approach to surgery had a significantly increased risk of scar-related problems compared to the dorsal approach (OR 2.90, p=0.004), however, there were no significant between-group differences in adverse events, deep vein thrombosis, incision infection or sensory loss. Due to the low quality and paucity of evidence, other outcome indicators were not able to be compared. Researchers hypothesised that these two approaches result in similar rates of adverse events, yet the types of adverse events may vary between them.

Comment: The aim of this study was to compare two surgical approaches to the treatment of Morton's neuroma and to evaluate the associated adverse events. Adverse events following surgical removal of Morton's neuroma typically included scar problems, loss of sensation, incision infection, missing nerve, deep vein thrombosis, activity limitations, and reoperation due to pain or recurrence. The dorsal approach to neuroma removal involves release of the intermetatarsal ligament, and being that the incision is on the non-weight bearing surface, this facilitates early weight-bearing rehabilitation. The plantar approach keeps the intermetatarsal ligament intact, leading to better cosmetic results. However, it results in a longer non-weight-bearing rehabilitation and a higher occurrence of incision infection, haematoma, and scar problems. The systematic review suggests that despite variations in outcomes, both approaches appear to be effective for treating Morton's neuroma.

Reference: *J Foot Ankle Res.* 2023;16(1):57

[Abstract](#)



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Age-associated changes in lower limb weight-bearing strategy during walking

Authors: Foroughi F et al.

Summary: These researchers investigated how ageing impacts on the contributions of sagittal and frontal plane joint moments to weight-bearing at different walking speeds. Weight-bearing was assessed by vertical ground reaction force (VGRF). A total of 24 young and 17 healthy older participants were included. Among younger adults, the primary contributors to leading limb weight-bearing were hip abduction and knee extension moments, however in older adults the primary contributor was hip extension moment. In trailing limb weight-bearing, the main contributor was ankle plantarflexion moment in younger adults, and hip flexion moment in older adults. Changes in knee extension moment were the primary contributor to changes in the trailing limb weight-bearing in younger adults when increasing walking speed, yet the primary contributor in older adults was change in hip extension moment.

Comment: This study used a public online dataset to examine how ageing affects the contribution of joint moments in the sagittal and frontal planes to different peaks of VGRF at different walking speeds. Participants in the older group had good health and were able to walk at their preferred walking speed, and 30% faster on a treadmill. The results showed significant differences in joint moment contributions between younger and older individuals during walking. In the younger group, knee extension and hip abduction moments played a significant role in leading limb loading, while ankle plantar flexion moment was the main contributor to trailing limb loading. In contrast, the older participants followed a different strategy, with hip flexion moment being the main contributor to leading limb weight-bearing, and reduced ankle plantar flexion and knee flexion moments compared to the younger group. These results indicate that older individuals adapt different strategies for weight-bearing in both leading and trailing limbs. The study's findings suggest that ageing influences the distribution of joint moments and impacts on weight-bearing strategies during walking. It highlights the importance of understanding how joint moment contributions change with age, which may have implications for rehabilitation and interventions for older individuals. Additionally, the influence of handrail use on joint moment contributions was explored, further expanding the understanding of age-related gait changes. These results suggest that older people use different strategies for weight-bearing in both leading and trailing limbs.

Reference: *Gait Posture*. Published online 6 October, 2023

[Abstract](#)

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Outcomes after hallux interphalangeal joint arthrodesis

Authors: Braswell MJ et al.

Summary: This retrospective review of an institutional database assessed the non-union and complication rates following hallux interphalangeal joint arthrodesis, and risk factors for treatment failure. Among a total of 227 primary procedures, the non-union rate was 25.5% and reoperation rate 21.1%. Patients with diabetes had a higher risk of non-union ($p=0.014$). There were no significant differences in non-union rates based on smoking status, inflammatory arthritis or implant type (single screw, multiple screws, screw + other, non-screw fixation). Non-union rates were comparable between patients who had undergone a prior hallux metatarsophalangeal joint arthrodesis and those who had not. The risk for reoperation was significantly higher among those with non-union ($p<0.0001$).

Comment: The study failed to find statistically significant differences in non-union rates based on type of arthrodesis fixation, which may be due to small subgroups for specific fixation techniques. Most patients underwent bone-preserving flat incisions before definitive fixation, and there were higher rates of non-union in the multiple screw and non-screw fixation groups, although these results should be interpreted with caution due to the small sample size and construct heterogeneity. Reoperations were required in 21.1% of patients, and this rate was similar to other studies. Patients with radiographic non-union had a higher risk of reoperation than patients with radiographic non-union, and reoperations were often necessary due to hardware-related symptoms and wound healing or infectious complications despite successful arthrodesis. Overall, this study provides insights into non-union rates and risk factors associated with arthrodesis procedures in the hallux interphalangeal joint.

Reference: *Foot Ankle Int*. Published online 29 September, 2023

[Abstract](#)

Lower leg lateral chronic exertional compartment syndrome

Authors: van Zantvoort APM et al.

Summary: These researchers investigated the patient characteristics and surgical treatment outcomes following a fasciotomy for lower leg lateral chronic exertional compartment syndrome (lat-CECS). Among a total of 881 patients with anterolateral exertional lower leg pain and possible lower leg CECS, 88 met the diagnostic criteria for lat-CECS. Of these, 10 were diagnosed with isolated lat-CECS, 54 with lat/anterior CECS, 19 with lat/anterior/deep posterior CECS and five with lat/deep posterior CECS. Patients reported often experiencing severe pain during exercise, and moderate tightness during rest. Researchers analysed a sub-group of 28 patients who underwent fasciotomy (49 legs). No cases of superficial peroneal nerve damage were reported, and complications were minor. A good or excellent outcome was rated by 64% of patients at 1 year following surgery, and 71% reported participating in sports activities once again. It was concluded that in most patients, fasciotomy is a safe and effective treatment option.

Comment: The aim of this prospective case series was to provide insight into lat-CECS, a condition often overshadowed by anterior and deep flexor variants. Of the 88 lat-CECS patients, only 10 had an isolated form of lat-CECS, while the majority had combinations with other types of CECS, often anterior CECS. Patients typically experienced severe pain and tightness during exercise, but also reported persistent mild to moderate discomfort at rest and at night. In addition, 8 of 10 patients with isolated lat-CECS experienced bilateral symptoms, including pain and tightness at rest and at night. The study examined the effectiveness of lateral compartment fasciotomy in 28 patients (49 legs) with lat-CECS. The procedure proved to be safe and there were no nerve damages or follow-up operations. One year after surgery, the study reported a 64% success rate, defined as self-reported excellent or good results, with 71% of patients returning to exercise to the desired extent.

Reference: *Foot Ankle Int*. Published online 19 September, 2023

[Abstract](#)