Foot & Ankle Research Review™

Making Education Easy

Issue 31 – 2017

In this issue:

Abbreviations used in this issue
EMG = electromyography
EVA = ethylene vinyl acetate foam
RA = rheumatoid arthritis
RCTs = randomised controlled trials
RR = Risk Ratio

Welcome to Issue 31 of Foot and Ankle Research Review.

Thank you for your feedback on the previous issue of the review. I start 2017 with a controversial area of clinical practice, with all articles in the review focusing on foot orthoses. I enjoyed compiling this review, as it is indeed a difficult area of research due to the complexities of designing robust methods of studying foot orthoses. The evidence continues to grow to support the use of foot orthoses, but with every question that is answered, many more questions are generated. My personal highlight of the review is the qualitative research by Williams et al., who investigated the factors that influence practitioners when prescribing foot orthoses.

I hope you enjoy the selection of studies in this review. I look forward to your feedback.

Kind regards,

Dr Matthew Carroll
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Effectiveness of foot orthoses and shock-absorbing insoles for the prevention of injury: a systematic review and meta-analysis

Authors: Bonanno DR et al.

Summary: This systematic review and meta-analysis investigated the evidence relating to the effectiveness of foot orthoses (11 trials) and shock-absorbing insoles (7 trials) for the prevention of musculoskeletal injury. Among the trials evaluating foot orthoses, the median Physiotherapy Evidence Database (PEDro) score was 5 (range 3-8/10) and for the shock-absorbing trials was 3 (range 1-7/10). According to the meta-analysis, while foot orthoses were not effective for preventing soft-tissue injuries (RR 0.79; 95% CI 0.55-1.14), they were effective at preventing overall injuries (RR 0.72; 95% CI 0.55-0.94) and stress fractures (RR 0.59; 95% CI 0.45-0.76). Shock-absorbing insoles were not found to be effective for preventing overall injuries (RR 0.92; 95% CI 0.73-1.16), stress fractures (RR 1.15; 95% CI 0.57-2.32) or soft-tissue injuries (RR 0.92; 95% CI 0.74-1.15).

Comment: This well-constructed review establishes that foot orthoses prevent injuries in a broad sense. Evidence suggests foot orthoses reduce the risk of shin pain, stress fractures of the tibia, femur and metatarsals. The review also presents evidence that shock-absorbing insoles were not found to be effective in preventing overall injuries, stress fractures or soft-tissue injuries. The meta-analysis demonstrated reductions in the incidence of injuries but also displayed a high degree of variability amongst the studies. This included variations in participants, the participant setting (e.g. military personal), footwear, variations in types and prescription of foot orthoses and differences in definitions of injury. This review raises further questions for me particularly surrounding the role of material property choice for foot orthoses.

Reference: Br J Sports Med. 2017;51(2):86-96

Abstract

'Trial and error…', '…happy patients' and '…an old toy in the cupboard': a qualitative investigation of factors that influence practitioners in their prescription of foot orthoses

Authors: Williams AE et al.

Summary: This study, using a qualitative approach, was undertaken to explore, for the first time, the influences on orthotic practice. Two focus groups (16 consenting participants including 15 podiatrists and one orthotist) were asked the question '*What factors influence your orthotic practice?*', followed by trigger questions, which were used to maintain focus. A thematic framework was used to analyse the data from the groups' responses. Five themes were identified: (i) influences on current practice, (ii) components of current practice, (iii) barriers to technology being used in clinical practice, (iv) how technology could enhance foot orthoses prescription and measurement of outcomes, and (v) how technology could provide information for practitioners and patients. The researchers and the participants agreed on a final global theme: *'Current orthotic practice is variable and does not embrace technology as it is perceived as being not fit for purpose in the clinical environment. However, practitioners do have a desire for technology that is usable and enhances patient-focussed assessment, the interventions, the clinical outcomes and the patient's engagement throughout these processes'*. The practice of prescribing foot orthoses was found to vary considerably due to multiple influences. The researchers identified that the measurement of outcomes from orthotic practice is a priority but that there are no current norms for achieving this. Practitioners have attempted to integrate technology into their practice, but with largely negative experiences. Furthermore, the process of technology development needs to improve and needs to be more practice than technology focused.

Comment: This great piece of qualitative research brings to the forefront the factors that influence decision-making in the prescription of foot orthoses. Highlighting that there is no one algorithm by which foot orthoses are prescribed, with multiple influences guiding prescription. 'Trial and error' being the foundation for how clinical experience is blended with a formal understanding of foot structure, biomechanics and orthotic principles. The research also suggests a shift in clinical practice focus away from achieving a defined biomechanical objective with foot orthoses, towards delivering what patients want. There was also evidence of orthotic practice having evolved due to changes in professional roles, with orthotic practice moving beyond the provision of a "biomechanical device" towards "counselling" of patients. There was evidence of consideration of wider issues such as levels of activity and weight management as being interrelated factors that affect foot or lower limb health. Practitioners are providing care that blends mechanical intervention with appropriate health behaviour and self-management strategies. I think this research reflects nicely the shift that has occurred in the past decade in NZ as well.

Reference: J Foot Ankle Res. 2016;9:11
Abstract

Foot orthotics for low back pain: The state of our understanding and recommendations for future research

Authors: Papuga MO and Cambron J

Summary: These researchers evaluated the available literature to determine the current state of knowledge on the benefits of foot orthotics for low back pain related to biomechanical mechanisms and clinical outcomes, and aimed to make specific recommendations for future research. They discovered a lack of high-quality RCTs. They argue that foot orthotics are experimental, investigational or unproven for low back pain due to lack of sufficient evidence for their clinical effectiveness, but that there is extensive research on biomechanical mechanisms underlying the benefits of orthotics that may be used to address this gap. Furthermore, promising pilot studies are emerging and ongoing large-scale RCTs are addressing the effects of foot orthotics on chronic low back pain. The authors present recommendations for future research on the use of foot orthotics for low back pain.

Comment: If you have an interest in orthotic management of lower back pain this review provides a good summary of the proposed mechanisms by which foot orthoses influence such pain. This includes the shock absorbing properties of orthoses and their ability to reduce heel strike force, the role of foot pronation and link to poor shock absorption, the effect of foot posture and increased dynamic foot pronation, and the coupling mechanism between the foot and the lumbo-pelvic complex. The review also proposes some potential recommendations for further research. I particularly like the suggestion to include patient outcomes in future research. The review also details the results of meta-analyses that have assessed foot orthoses for their role in reduction and prevention of lower back pain.

Reference: Foot (Edinb) 2016;26:53-7
Abstract

The effect of different foot orthosis inverted angles on plantar pressure in children with flexible flatfeet

Authors: Bok SK et al.

Summary: This study evaluated the effects of different foot orthosis inversion angles on plantar pressure during gait in 21 children (mean age 9.9 years) with flexible flatfeet. During walking on a treadmill, plantar pressures were measured for the rearfoot, medial and lateral midfoot, and medial, central and lateral forefoot during the following three conditions: while wearing shoes only and shoes with (i) orthosis with no inverted angle, (ii) orthosis with a 15° inverted angle, and (iii) orthosis with a 30° inverted angle. Mean values of each orthotic condition were compared via a one-way repeated measures analysis of variance (ANOVA) with the Bonferroni-adjusted post-hoc test. The peak pressure decreased significantly ($p < 0.05$) under the medial forefoot and rearfoot with all foot orthoses when compared with the shoe only condition, but there were no significant differences in the peak pressure under the medial forefoot and rearfoot between the different foot orthoses. A significant ($p < 0.05$) increase in the contact area under the medial midfoot and rearfoot was observed with all the foot orthoses when compared with the shoe only condition. There was also a significant increase in the peak pressure under the medial midfoot with all foot orthoses, with no difference between the orthoses, and a maximal increase in the peak pressure was obtained with a 30° inverted angle orthosis.

Comment: This study delves into a very controversial area of practice, the supposition being that a flatfoot increases load to foot structures and over time increases mechanical load to the knees, hips and lower back. The study is underpinned by the Blakes inverted orthotic theory, whereby greater degrees of rearfoot inversion exert greater control over pronatory motion. Despite the study showing that peak pressures significantly decreased under the medial forefoot with the use of the three differently posted orthoses, compared to footwear, no significant differences in pressure redistribution were demonstrated between the foot orthoses with differing degrees of rearfoot posting. The results should be considered in light of the potentially underpowered study design and lack of footwear standardisation. The main question I have following review of this article is how significant is modifying plantar pressure in the pediatric flatfoot?

Reference: PloS One 2016;11(7):e0159831
Abstract

Effects of taping and orthoses on foot biomechanics in adults with flat-arched feet

Authors: Bishop C et al.

Summary: This biomechanical multi-segment foot study examined the effect and relationships between foot taping and customised foot orthoses in 18 flat-arched adults. Customised foot orthoses delayed peak eversion versus a neutral athletic shoe (44% stance vs 39%; $p = 0.002$). In a neutral shoe with tape, midfoot and medial longitudinal arch deformation was reduced with both low-Dye taping (2.4°; $p < 0.001$) and a modified taping technique (5.5°; $p < 0.001$). Peak dorsiflexion of the first metatarsophalangeal joint was increased by all interventions (1.4°-3.2°; $p < 0.001$-0.023). The biomechanical response to taping predicted changes with foot orthoses (R^2 0.08-0.52; $p = 0.006$ to <0.001).

Comment: Foot taping is often used as a first line intervention with the biomechanical changes elicited thought to be suggestive of those that can be achieved by foot orthoses. This study identified that both taping and foot orthoses significantly alter foot kinematics in adults with flat-arched feet, but their effects appear region specific. Foot orthoses exerted their effect on the hindfoot, whereas the effects of taping were confined to the midfoot and medial longitudinal arch. The authors reach a bold conclusion that the biomechanical responses to foot taping and foot orthoses were significantly related, supporting the premise that the biomechanical outcomes of foot orthoses intervention can be predicted based on the response to foot taping. Although the study demonstrated a statistical relationship, there is still a great deal of research required to determine the differing mechanisms by which foot taping and foot orthoses exert their biomechanical effect. Specifically, there is building evidence that foot orthoses have a relatively small kinematic effect.

Reference: Med Sci Sports Exerc. 2016;48(4):689-96
Abstract

Independent commentary by Dr Matthew Carroll

Matthew 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. He is Head of Podiatry and Senior Lecturer at Auckland University of Technology, Director/Treasurer of the Australia New Zealand Podiatry Accreditation Council and a Board member of the Podiatrists Registration Board of New Zealand. He has a special interest in inflammatory arthritis and is active in research in rheumatoid arthritis, gout and lupus.

The effect of foot orthoses with forefoot cushioning or metatarsal pad on forefoot peak plantar pressure in running

Authors: Hähni M et al.

Summary: This study in 13 female and 10 male asymptomatic runners assessed whether metatarsal pad (MP) or forefoot cushioning (FC) foot orthoses was better at reducing forefoot plantar pressure during running on a treadmill (2.78 m/s) for 2 min. Peak forefoot pressure was lower with FC orthoses (281 kPa; 95% CI 246-315) versus control (313 kPa; 95% CI 283-343; $p = 0.003$) and MP orthoses (315 kPa; 95% CI 280-350; $p = 0.001$). There was no difference between control and MP. Peak pressures under the total foot were 364 kPa for control (95% CI 328-399), 357 kPa with MP (95% CI 326-387) and 333 kPa with FC (95% CI 298-368). Median Insole Comfort Index sum scores were 50, 49 and 64, respectively.

Comment: Forefoot cushioning and metatarsal padding are commonly applied foot orthotic modifications used in the management of various forefoot pathologies. Whilst a small amount of evidence exists as to the efficacy of FC and MP, this study demonstrated that forefoot pressures were lower with the use of forefoot cushioning compared to cushioning with the addition of MP. Interestingly, and in contrast to existing research, the foot orthoses with MP showed no significant alterations to forefoot pressures when compared to the control participants. A major factor to consider when interpreting studies examining forefoot padding and specifically MP, is the placement of the padding. For more information surrounding the placement of metatarsal padding, I refer you to the following article: Lee PY et al. J Foot Ankle Res. 2014 *Comparison of the pressure-relieving properties of various types of forefoot pads in older people with forefoot pain, Journal of Foot & Ankle Research.* The manuscript aptly describes the methodological limitations, but I am left wondering what type of cushioning is the most effective in reducing forefoot pressure.

Reference: J Foot Ankle Res. 2016;9:44
Abstract

Foot orthoses in the management of chronic subtalar and talo crural joint pain in rheumatoid arthritis

Authors: Gatt A et al.

Summary: In a 3-month pilot study, semi-rigid Subortholene™ orthoses and soft EVA orthoses were compared for their effect on pain, disability and functional limitation in nine females (mean age 52.2 years; mean weight 71 kg; mean height 160 cm) with chronic rheumatoid hindfoot pain (mean RA duration 11.7 years; mean ankle/subtalar joint pain duration of 5.7 years). Mean Foot Function Index score improved with both orthoses ($p = 0.001$) and there were reductions in pain, disability and functional limitation and improvements in the Ritchie Articular Index with both interventions.

Comment: This study adds further weight to the use of foot orthoses as a frontline non-pharmacological management strategy in RA. Over a 3-month period, significant reductions in foot pain levels were observed. Although limited by the sample size, the casting and orthotic materials chosen for the study were reflective of clinical practice. Whilst the study demonstrated reductions in pain, considerable pain still existed in the participants following the study period. It should also be noted that the effects of the two types of foot orthoses used in this study are unknown beyond a 3-month timeframe. However, it is pleasing to see a further study with evidence to advocate the use of foot orthoses in the management of RA.

Reference: Foot (Edinb) 2016;27:27-31
Abstract

Effects of foot and ankle devices on balance, gait and falls in adults with sensory perception loss: a systematic review

Authors: Paton J et al.

Summary: This review considered experimental and epidemiological study designs, except case series, individual case reports and descriptive cross-sectional studies, to examine the use of foot and ankle devices for fall prevention and balance and gait improvement in adults with sensory perception loss. Methodological quality of the available studies was poor, with no randomised controlled trials available and no follow-up period or testing in the context of the intended clinical environment. Across nine trials including 238 patients with sensory perception loss, (multiple sclerosis, idiopathic peripheral neuropathy, diabetic neuropathy) and 58 controls, data analysis suggested that postural sway improved with vibrating insoles and ankle-foot orthoses, whereas changes in top cover softness and texture had no effect on postural sway. Step-to-step consistency was improved by wearing footwear over long distances or ankle-foot orthoses, and foot and ankle device did not have a negative effect on balance or gait.

Comment: This well-constructed review provides a narrative synthesis of the evidence surrounding insoles with vibrating component, insole top cover materials, footwear for people with diabetes and neuropathy and ankle-foot orthosis for people with sensory perception loss. The article concludes with a series of important considerations for prescribing orthoses to people with sensory loss. Based on the evidence the following recommendations were made: (1) there are no disadvantages to balance or gait from using compliant or hard covers for people with sensory loss, (2) thick covers are advocated in people at risk of neuropathic foot ulceration, (3) foot and ankle devices improve static balance; however, no clear recommendation can be made surrounding the type of device.

Reference: JBI Database System Rev Implement Rep. 2016;14(12): 127-62
Abstract

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Effects of two types of foot orthoses on lower limb muscle activity before and after a one-month period of wear

Authors: Moisan G and Cantin V

Summary: In a study of 21 healthy participants, two types of foot orthoses were tested to determine effect on muscle activity during walking before and after a one-month period of wear. Between-test-session variability was considered unacceptable, so no comparisons of the effects of the experimental conditions between testing sessions was attempted. Foot orthoses with a lateral bar decreased peak amplitude and mean activity of peroneus longus during combined midstance/terminal stance phase, and compared to a control condition foot orthoses decreased peak amplitude and mean activity of tibialis anterior during the contact phase.

Comment: The study was based on the premise that foot orthoses can effect lower limb muscle activity. Specifically, that the addition of a lateral bar to foot orthoses increases pronatory movement across the subtalar joint axis and therefore decreases the activity of pronatory muscles, such as the peroneal group. The results highlight the difficulties of assessing muscle activity with EMG, this was shown by the great variability between the testing sessions, leading to an inability to compare the majority of the muscle activity results at the 1-month follow up. Whilst the results report that with the addition of a lateral bar, peroneus longus muscle activity decreased, I would be very cautious to prescribe foot orthoses based on this effect. If we are indeed seeing activity decreases in the pronatory muscle groups would we not also expect alterations to the supinatory muscles?

Reference: Gait Posture 2016;46:75-80
Abstract

Foot orthoses research: identifying limitations to improve translation to clinical knowledge and practice

Authors: Griffiths IB and Spooner SK

Summary: Research on foot orthoses has increased significantly over the last 20 years, using 'placebo' and 'sham'-controlled trials. However, predictive models are insufficient for a large range of musculoskeletal injuries being evaluated and our understanding of orthotic design variables that affect tissue biomechanics is inadequate.

Comment: This editorial provides the clinician with some interesting thoughts to ponder when trying to interpret the latest research into foot orthotics. Of particular note is the argument that foot orthoses can only exert a psychological or kinetic influence. The authors also argue against the use of sham devices used for controls in foot orthotic research. Whilst some will view the editorial as controversial, it does relay some of the difficulties in producing a robust research design for the study of foot orthoses.

Reference: Br J Sports Med. 2016;Oct 27 [Epub ahead of print]
Abstract