

# Footwear for people with diabetes: Where are we now?



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In 1996, an American orthopaedic foot surgeon reported that he was disheartened because the approach to prescribing therapeutic footwear for the person with diabetes had remained unchanged during the past 20 years (Conti, 1996). Now, some 10 years later, there are glimmers of hope that progress is being made. Advances in the last decade have been marked by the identification of knowledge gaps and by new understanding of how some key problems can be solved.

## Research

Footwear for people with diabetic foot problems is not a particularly flourishing area of research, which means that the pipeline of new ideas flowing to the marketplace is running at a trickle. But the situation is improving; a comprehensive PubMed search using well-constructed search strings combining the terms footwear and diabetes yielded 239 hits in the decade 1988–1997 and 573 hits for 1998–2007. Footwear was an incidental part of many of these articles and around half of them (approximately 25 articles a year) were devoted to the topic of footwear for people with diabetic foot problems.

As part of an effort to establish a more standardised approach to treatment of the diabetic foot, the International Working Group on the Diabetic Foot convened to review the literature on footwear and to make evidence-based recommendations for clinical practice. The report from the group (Bus et al, 2008) concluded that ‘the best support from the evidence gathered is for the use of non-removable devices such as TCC and non-removable walkers in the treatment of neuropathic plantar foot ulcers. High-quality studies are urgently needed to confirm the promising effects of footwear and offloading interventions designed to prevent ulcers, heal ulcers, or reduce plantar pressure that have been demonstrated in the controlled and uncontrolled studies reviewed here’.

As the consensus report suggests, preventing

recurrent ulceration remains one of the most significant unsolved issues in the care of those with diabetic foot complications and there has been frustratingly slow progress on this topic in the last decade. Maciejewski et al (2004) mentioned that the evidence for footwear efficacy from well-controlled studies remains limited. In fact, one clinical trial showed no effect of therapeutic footwear – although this finding may have arisen from study design issues (Reiber et al, 2002).

A former Surgeon General of the United States, Charles Everett Koop, once said that the major problem in the treatment of diabetic foot disease was that people were often put back in the same shoes that caused them to ulcerate. Uccioli et al (1997) found that such an approach more than doubles the number of recurrent ulcerations, and Busch and Chantelau (2003) reported a more than five-fold increase in re-ulceration at 12 months in a control group of individuals compared with a group in therapeutic shoes.

## Footwear design and manufacture

There is no doubt that the lack of a standardised approach to design and manufacture of footwear interventions remains a barrier to progress. The terms ‘therapeutic shoe’, ‘diabetic shoe’, or ‘orthopaedic shoe’ are virtually meaningless, but, for many practitioners, they represent the full extent of details provided in a prescription. What these terms do have in common is that they imply that additional space is provided in the interior of the shoe for an insole that can offload high plantar pressures from critical areas and redistribute them to other, less vulnerable, areas. But it is in the design of the therapeutic insole where research needs to provide more guidance to supplant the trial and error process commonly used. A number of studies have shown that the margin of error in placement of offloading structures, such as metatarsal pads and bars, is small. This finding implies that design by guesswork is often likely to fail. For

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example, Hsi et al (2005) showed that a 5 mm movement of a metatarsal pad could render the intervention almost ineffective. Similarly, Hastings et al (2007) found that the same intervention could actually increase pressure at vulnerable areas if incorrectly placed.

All of this leaves one wondering how many people are actually having their situation made worse by a footwear intervention that is intended to help them. The obvious way to improve this situation is by making it a good-practice standard for physicians or any allied health professionals who see people with diabetic foot problems to routinely measure the offloading capacity of footwear before it is dispensed. I was encouraged at the 2006 Malvern Diabetic Foot Conference to learn of a footwear supplier who measured the in-shoe plantar pressure of every footwear intervention at the time he delivered it to the individual. At present, the equipment to take such measurements is expensive and in many countries reimbursement is limited. Both of these factors need to change if such measurement is to be more widely used.

The emphasis of our own work in diabetic footwear science has been an attempt to break the tradition of prescription of insoles based only on foot shape. We have shown that a system for therapeutic insole design based on measurements of plantar pressure during walking in addition to foot shape can produce offloading that is superior to that provided by shape-based systems alone (Cavanagh and Owings, 2006; Botek et al, 2007). The insole is then designed and manufactured by a systematic computer-aided design and manufacture approach, which removes a great deal of the guesswork from the process.

## Concordance

Every clinician knows that getting people to wear their prescribed footwear consistently is challenging and that assessing their actual footwear use is difficult. We have now learned just how bad such patient concordance can be. Armstrong et al (2003) reported the discouraging finding that people with a foot ulcer took more steps with their protective footwear device off than with it on. In fact, the device was worn on average for only a third of the total daily steps. Although wound-healing devices can be made irremovable to enforce concordance, the conventional footwear prescriber does not have that luxury. Knowles and Boulton (1996) estimated that only 22 % of their sample regularly wore their prescribed footwear. Some insight into concordance was provided recently by Williams and Nester (2006), who found that only 11 % of people

with rheumatoid arthritis named style as the most important component of a shoe whereas 35 % of people with diabetes identified style as their number-one determinant. Most shoes for people with diabetic foot problems could still be described as ugly and this perception remains a major factor in concordance with prescription footwear use.

It would seem elementary that people should be fitted with appropriately sized shoes, but a recent report has cast doubt even on this basic assumption. Harrison et al (2007) found that only 24 % of individuals wore shoes that were of the correct length and width for both feet. Clearly, there is an urgent need for more attention to detail in prescribing shoes for this high-risk group.

## Summary

The last decade has seen a welcome growth in awareness of the importance of footwear for people with diabetes. But even as related areas – such as athletic footwear – have enjoyed widespread positive publicity and continued innovation and development, the field of diabetic footwear has not experienced the type of dramatic advances that would change the landscape of footwear manufacture and prescription. The area has been underserved by research, but this situation is changing and there are great opportunities for advancement in the next decade. By 2017, I hope to see some or all of the following improvements: more electronics embedded in footwear to monitor concordance in wearing them; the emergence of ‘intelligent’ shoes that can adapt to changing biomechanical circumstances; and greater application of technology in the prescription, manufacture and evaluation of diabetic footwear. Most importantly, I expect that we shall see evidence from collaborative clinical and biomechanical studies showing that footwear that has been quantitatively designed and consistently worn can offer primary and secondary prevention of ulceration in people with diabetes. ■

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