

OFFLOADING STRATEGIES FOR THE DIABETIC FOOT

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Diabetic foot ulcers frequently occur on weight bearing areas of the foot which are subjected to high pressure. Relieving pressure (offloading) is essential in the prevention of ulceration and/or as part of any management plan that aims to facilitate the healing of diabetic foot ulceration. This paper explores various offloading strategies for the diabetic foot.

Foot ulcers are among the most common complications of diabetes (Lavery et al, 2007), with approximately 12–25% of people with diabetes developing foot ulceration during the course of their disease (Singh et al, 2005). Sensory neuropathy (nerve dysfunction) is often a major factor in the development of foot ulceration. As individuals lose their protective pain sensation they become unaware of inadvertent trauma or injuries to the foot that can lead to ulceration.

Diabetic foot ulcers (DFU) are frequently located on weight bearing areas of the foot which are subjected to high pressure. Hence, relieving pressure (offloading) on the ulcerated area is absolutely crucial in the treatment of DFU to prevent further trauma, reduce pressure and shear to the area and facilitate wound healing (Frykberg et al, 2006). Offloading must therefore be addressed in a timely manner in the treatment of all diabetic neuropathic foot ulcers.

Charcot foot

Another complication that is associated with diabetic neuropathy can be the development of Charcot foot. Approximately 1% of people with diabetes suffer from

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Charcot foot (Jones, 2005). Charcot foot is a progressive condition whereby the foot is prone to spontaneous fracture with little or no trauma, joint subluxation and severe, debilitating foot deformity. *Figures 1a and 1b* illustrate common foot deformities associated with Charcot foot, where subluxation of the joints of the midtarsal joints of the foot

can be seen in the image as a 'collapsed' arch. At this stage the foot is very unstable and offloading is essential to prevent further debilitating deformities.

Offloading strategies for the diabetic foot

There are a number of offloading modalities available for the management of DFU and Charcot foot, ranging from irremovable and removable devices through to insoles and orthoses. Choice of modality will be dependent on a range of patient-related factors; for example, concordance with the device, the patient's mobility and their regular activities of daily living.

Irremovable devices

The total contact cast (TCC) is an irremovable cast, often manufactured from plaster of Paris. The TCC has been suggested as the 'gold standard' method of offloading DFU after randomised controlled trials demonstrated 84–92% pressure reduction at the site

of ulceration (Armstrong et al, 2001; Armstrong et al, 2005). However, in the presence of infection and/or ischaemia (poor blood perfusion to the foot) the TCC is contraindicated (National Institute of Health and Clinical Excellence [NICE], 2004) and alternative strategies that allow regular visual examination of the DFU should be considered. In the case of acute Charcot foot, NICE guidelines (2004) advocate immediate total contact casting to offload the foot and reduce the risk of spontaneous fracture and gross deformity.

While the TCC is seen to be the best method to offload DFU, a recent study highlighted that less than 2% of specialist centres in the United States used the TCC for the majority of diabetic foot ulcers (Wu et al, 2008). This may be due to available resources because application of a TCC must be undertaken by a skilled practitioner, for instance a plaster technician, and because it is more time-consuming to apply than other devices. Patients may also be reluctant to wear a TCC for the duration of their ulcer, particularly as one study found that patients wearing a TCC were much less active than those wearing removable devices (Bus et al, 2008).

Removable devices

There are a number of removable devices that are available to offload the diabetic foot, some of which are outlined below.

Removable walkers

Removable walkers are

Table 1

Examples of removable walkers

Pneumatic walker/air cast boot

A pneumatic walker is an example of a controlled ankle motion walker (CAM). There are inflatable sections within the walker, once inflated these sections hold the foot and ankle in position thus limiting motion. The pneumatic walker also offloads the plantar aspect of the foot (sole of the foot) by achieving total contact with the plantar surface of the foot, thus redistributing forces as widely as possible across the entire plantar surface

Charcot restraint orthotic walker (CROW)

The CROW is a bivalved ankle foot orthosis that aims to limit all ankle and foot motion. It is used to stabilise a Charcot joint and can also offload particular areas of the plantar aspect of the foot. Because it renders the foot immobile, a rocker sole is required to allow forward motion. It is similar to a TCC, but it is removable and lasts for a longer period

Patella bearing AFO (ankle foot orthosis)

A patella tendon bearing AFO is used to aggressively offload the planter aspect of the foot or the heel. It utilises prosthetic socket design to load body weight through the anatomy around the knee joint. It is an extensive, expensive custom device for long-term management of an ulcer or chronic fracture

designed to work in a similar way to the TCC in that they restrict motion at the foot and ankle, and try to redistribute forces across the entire plantar aspect of the foot. The main advantage of removable walkers is that the device can be removed to allow for regular wound inspection. There are a number of different removable walkers available, some of which are discussed in *Table 1* and illustrated in *Figure 2*.

The main disadvantage of removable devices is that they can be removed by the patient. One study explored activity patterns of patients with diabetic foot ulceration and found that patients prescribed removable pressure-relieving modalities only use these devices for a minority of steps taken each day. This may explain why the irremovable TCC has been found to be more effective than other offloading

strategies (Armstrong et al, 2003).

Temporary footwear

Footwear and offloading techniques are commonly used in clinical practice for the management of DFU. Temporary footwear, as illustrated in *Figure 3*, can be a useful short-term measure to accommodate bulky dressings or insoles/orthoses until healing has occurred. The insole illustrated within *Figure 3* is a useful layered insole that allows the practitioner to remove plugs of material for targeted offloading. The advantage with such a device is that it can be rapidly tailored to the patient at the chair side.

Foot orthoses

Foot orthoses are essentially inserts that can be fitted into the shoe. Orthoses can prove beneficial particularly in the prevention of ulceration, or in the prevention of ulcer



Figure 1a and b. Foot deformity associated with Charcot foot.



Figure 2. Examples of the pneumatic walker.

recurrence in those patients with a history of DFU. Orthoses can be designed and manufactured to relieve a specific area on the plantar aspect of the foot, for example, a site of high pressure or previous ulceration, to achieve partial or complete offloading. Such orthoses can be prescribed by an orthotist and/or a podiatrist following a comprehensive assessment of the patient, which should include gait analysis, assessment of the structure and function of the foot, and footwear assessment. Published literature supports the use of orthotic intervention as an integral aspect of the treatment regime for patients with diabetic foot disease (Bus et al, 2008). One study found improvements in health status both physically and mentally, for patients who received orthotic intervention (Davies et al, 2000).

Selecting an appropriate offloading device

Ideally podiatrists and orthotists should work together to identify the most appropriate device. It is imperative to achieve effective offloading in a timely manner to facilitate wound healing, or in the case of Charcot foot to minimise the risk of severe deformity. Selection of an offloading device must always be undertaken in consultation with the patient to try to achieve concordance with the device.

Conclusion

Effective offloading of the diabetic foot is essential in the management of diabetic foot

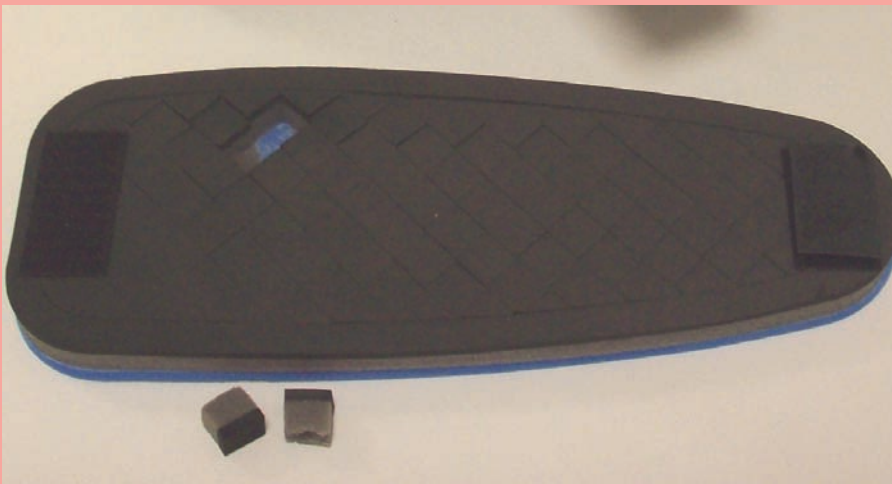


Figure 3. Temporary footwear and offloading insole.

ulceration to facilitate wound healing, and in the management of the Charcot foot to prevent severe deformities. There are a number of offloading modalities available, each with varying levels of evidence to support their clinical effectiveness. It is imperative that patients with diabetic foot complications who require offloading are referred to the specialist multidisciplinary foot care team in a timely manner where a podiatrist and/or an orthotist

can undertake a thorough assessment to determine the most appropriate device. The choice of offloading device will depend on a number of factors including patient mobility, their regular activities of daily living and their concordance with the device. Achieving effective offloading can prove difficult if patient concordance is poor, therefore a patient-centred approach must be adopted to achieve effective offloading of the diabetic foot. **WE**

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