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The Role of Orthotics in Diabetic Feet: A Surgeon's Perspective (Experts Comments)

Andrea Veljkovic[1*], Alastair Younger[1], Kevin Wing[1], Jeff Nacht[1], Murray Penner[1] and Peter Salat[2]

[1]St. Paul's Hospital, Division of Distal Extremities, Department of Orthopaedics, University of British Columbia, Canada

[2]Department of Radiology, University of Calgary, Foothills Medical Centre, Calgary, Canada

[*]**Corresponding author:** Andrea Veljkovic, St. Paul's Hospital, Division of Distal Extremities, Department of Orthopaedics, University of British Columbia, 1000-1200 Burrard Street, Vancouver, BC V6Z 2C7, Canada, Tel: (778) 379-7771; E-mail: docveljkovic@yahoo.com

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Introduction

Diabetic foot ulcers are an increasingly common clinical problem that presents a complex management challenge. Orthotics technologists play a crucial role in appropriately offloading diabetic feet that are at risk for ulceration. In 2014, the prevalence of diabetes in America was 29.1%. Although the disease is more prevalent in those 65 years and older, with 25.9% of this age group suffering from diabetes, 4.1% of those 20-44 years of age have also been diagnosed with diabetes [1]. With rising obesity rates, the risk of adolescent Type 2 diabetes is also increasing dramatically amongst adolescent North Americans [2,3].

The end organ complications of diabetes, which are primarily nephropathy, retinopathy, neuropathy, peripheral vasculopathy, and cardiovascular disease, with the resultant diabetic foot complications, are growing yearly. Diabetic neuropathy and loss of growth factors stimulating skin and bone healing can lead to decreased protective plantar sensation, which in association with foot deformity can increase plantar pressures [4,5] and predispose to ulceration [4]. Diabetic microvascular disease is also known to predispose to recurrent ulceration [4,6].Diabetic foot complications, which include foot ulceration, are associated with increased morbidity and mortality. In fact, diabetic foot ulceration is highly associated with risk of death, with 5% of those with newly diagnosed foot ulcers dying within 12 months of diagnosis and 42.2% dying within 5 years [7].

Younger diabetic patients in their most productive stage of life, have a 5-15% risk for developing foot ulceration [7,8].Thus, prevention in this age group is a high priority to keep them in the work force. In addition to the cost of hours lost from work, there is also a heavy financial and care burden on the health care system arising from increased treatment costs [9,10]. Pressure relieving treatments such as offloading casts, and Achilles tendon lengthening have been highly effective in treating ulcers [11].However, it would be more efficacious to prevent primary and recurrent ulcers in diabetic patients at high risk.For high-risk patients, it may be beneficial to consider therapeutic footwear with custom insoles to offload plantar pressures [12-14]. Further, there may be a role for night splints to help stretch Achilles contractures, which are three fold more common in diabetics [15]. Achilles contractures result in equinus deformity of the ankle, which is manifested by limited ankle dorsiflexion.In diabetics, Achilles contractures result from non-enzymatic glycosylation of the tendon that alters the structure and function of its collagen and results in increased stiffness [16-18]. As a result of the ankle equinus, plantar forefoot pressures are elevated, further increasing the risk of forefoot ulceration [15,19].

The authors/surgeons approach

When a diabetic patient who is a potential candidate for offloading insoles and shoes presents to the office, a complete assessment is required. This includes the overall alignment of the foot, the degree of gastrocnemius contracture, the peripheral circulation, inspection of plantar callosities, and examination of peripheral sensation for signs of neuropathy. Foot and ankle alignment can be neutral, planovalgus (flat), or cavovarus (high arch) alignment **(Figure 1).**

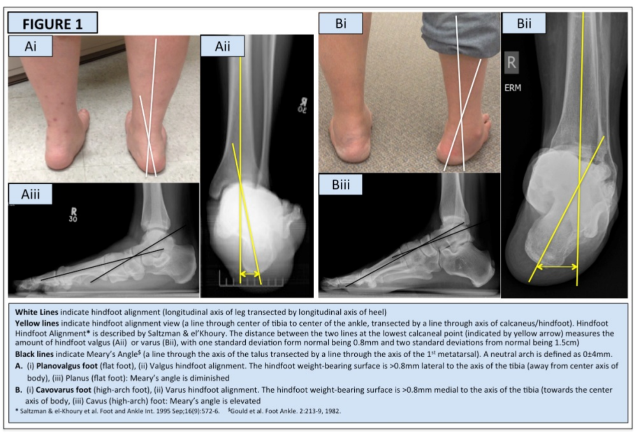

Figure 1: Foot and ankle alignment.

Orthotics is the mainstay of conservative treatment in diabetic feet.Indications for orthotics are any painful foot in which realignment or offloading offers symptom relief

[13,20-26]. There are important factors that may influence orthotic management of foot conditions.

Age of the patient, and previous treatment does not tend to influence the use of orthotics, as these are the mainstay of initial conservative treatment in any age range presenting with a painful foot. However, previous prominent surgical incisions may need to be offloaded if present on the plantar aspect of the foot with appropriate accommodation and potentially gel underlying.

Trophic changes and ulceration are not contraindications to orthotics but must be addressed with the appropriate accommodation and offloading with underlying gel.In the case of ulceration and trophic changes, hard orthotics should be avoided, instead cushioned trilaminate orthotics should be used [27].

Limitations of orthotics are based on the compliance/rigidity of the foot and success of orthotic intervention is based on appropriate assessment of the pathomechanics, a diagnosis amenable to mechanical offloading, and proper posting of the orthotics based on the pathomechanics present [20]. Rigid planovalgus and cavovarus feet may have difficulty tolerating corrective rigid orthotics that may even cause injury [28], therefore in these feet softer more accommodative orthotics should be utilized if tolerated at all.If trophic changes or ulceration progress with current orthotics, these orthotics should be appropriately revised and made softer with further offloading. Should ulceration and trophic changes progress subsequent to revision, or if the ulcer has significantly deepened prior to revision, the orthotics should be discontinued and surgical intervention is warranted.

In the neutral foot, a standard accommodative tri laminate orthotic with a good stiff sole extra-depth shoe is beneficial, as best results have been found with multi density orthotics [23,27] and soft polyethylene foams have been found to have better pressure-distribution characteristics [29].

Any evidence of 2nd-5th metatarsal head callosities and overload require metatarsal head offloading with a metatarsal pad proximal to the metatarsal heads.

Cushioning can be achieved with a gel pad under the metatarsal head.If clawing of the lesser toes is present, additional offloading can be achieved with a combination of extra forefoot depth and a simple toe-crest to elevate and protect the distal phalanges from plantar contact pressures.If there is an Achilles contracture, which is more likely in planovalgus foot, a heel lift [20] may need to be incorporated in the insole or shoe. Ideally the shoe should have a rocker bottom sole with an extra-depth toe box. The sole should be stiff and the shoe made with minimal seams (so as not to place pressure points on the skin).

In the cavovarus (high-arch foot), the deformity is either forefoot or hindfoot driven. A forefoot driven foot has a plantar flexed first ray causing the hindfoot to go into varus.In these fore foot driven feet, a Coleman block test can be used to ensure that there is not a hind foot component **(Figure 2).**

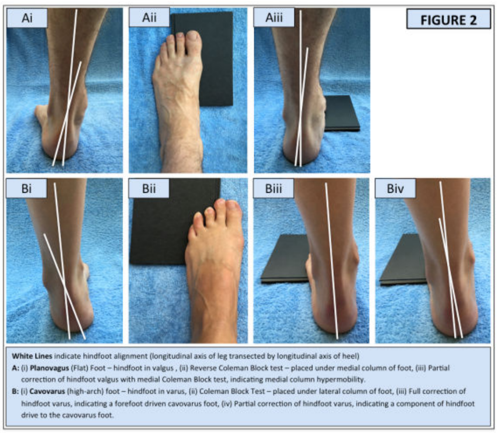

Figure 2: Coleman block test.

The Coleman test[30] is performed by placing a block under the 4th and 5th rays with the 1st ray unsupported. If the hindfoot completely corrects with the laterally placed block, then the deformity is forefoot driven.In these cases, a trilaminate, possibly semirigid [13], orthotic with a lateral forefoot post under the entire 4th and 5th ray to taper like a wedge by the 1st ray may suffice [24]. In the cases where the 1st ray is extremely plantar-flexed, in addition to the lateral forefoot post, one may need to add 1st ray cutout [24] with a pocket and gel pad under the 1st metatarsal head.In the cases where the hindfoot does not correct or only moderately corrects, the hindfoot is the source of the cavus. In these hindfoot driven cavovarus feet, a deep heel cup will be required to counter the hindfoot varus with lateral hindfoot posting.In some cases, the cavovarus foot is extremely rigid, and in these cases the orthotic needs to be accommodative and possibly have lateral border of foot accommodation and cutout with as much shock absorptive material as possible.

The planovalgus foot, may be flexible or rigid. Some flexible flat feet have a hypermobile medial column. In flexible feet, the deformities correct with evident motion of the joints [22]. A reverse Coleman block test is used (Figure 2), which is placed under the medial column of the foot with the 4th and 5th ray unsupported. If the medial column is hypermobile, a portion of the hind foot valgus will correct with the medially placed forefoot block. In the flexible foot with medial mobility, the treatment is an orthotic with a medial forefoot post [20] under the entire 1st ray to taper like a wedge laterally by the 4th and 5th ray. If, the entirety of the hind foot valgus does not correct with the block, which is generally the case, a deep heel cup orthotic is required to counter hind foot valgus with a medial hind foot post. In the rigid foot, a deep heel cup orthotic is required to counter the hindfoot valgus with a soft interface [20], and forefoot accommodation may be required to deal with the resultant forefoot supination caused by correcting the hind foot.A medial forefoot post is added to the orthotic. If the forefoot does not supinate as a result of attempting to correct the rigid hind foot, then the orthotic should accommodate the deformity and potentially offload the medial column.Like the cavovarus foot, a shock absorbent trilaminate orthotic is better than a rigid one.

Surgery is indicated when the symptoms of the metatarsalgia, planovalgus and cavovarus feet are no longer ameliorated by the orthotic. In addition, significant ulcer progression and concerning trophic changes with underlying hemosiderin staining that herald a pending ulcer are indications for surgical intervention.

Pre-ulcer diabetic feet are an important population in which to consider preventative insoles and appropriate offloading shoes. Due to increased plantar pressures from underlying foot deformities and Achilles contractures, it is vital that correction of underlying deformities be achieved with the orthotic as much as possible while a night splint might be used to help relax the Achilles. It is hoped that by using these preventative measures as adjuncts to appropriate medical care and glycemic control, foot ulcer formation may be delayed or potentially prevented, allowing these individuals to lead more productive and full lives. Further studies are warranted to assess the benefits of orthotics in diabetics as there is currently a paucity of literature [31].

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