Assessment of the Impact of Loading Pressure on Endothelial Function in Diabetic Foot

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Foot ulcers occur on plantar and dorsal surfaces of diabetic feet. In addition, a relatively higher prevalence of non-plantar ulcers (Figure 1) and lower healing rates of dorsal ulcers have been reported in literature (Prompers et al. 2007).

However, all studies and guidelines have so far focused on plantar pressure measurements and relief (Figure 2) for ulcer prevention and treatment with no assessment of the dorsal surface.

Simultaneous in-shoe pressure on dorsal and plantar surfaces of the right foot were investigated among 13 healthy volunteers using the Pedar in-shoe pressure system (Figure 4a) within participants’ own comfortable shoes (Figure 4b) and orthopaedic shoes (Figure 4c) which are frequently prescribed to patients with diabetes.

Whilst a significant difference in in-shoe peak pressure was detected between participants’ shoes and orthopaedic shoes on dorsal surface ($p<0.001$), no significant difference detected on plantar surface ($p=0.252$). Furthermore, removing one of the extra insoles supplied with the orthopaedic shoes revealed significant reduction in peak pressure on dorsal surface ($p=0.046$) with a significant increase in plantar pressure ($p<0.001$) when compared to full insole orthopaedic shoes. The same relationship with significant differences was observed between participants’ shoes and the orthopaedic shoes minus one insole on both dorsal ($p<0.001$) and plantar ($p=0.003$) surfaces.

This study aims to investigate two factors which are thought to contribute to diabetic foot ulceration: microvascular dysfunction, assessed during iontophoresis, and pressure application on dorsal and plantar surfaces (Figure 3).

Although, orthopaedic footwear can significantly reduce dorsal pressure, plantar pressure measurement is an essential prerequisite to adjust insole requirements in-order to reduce plantar pressure. Measurement of Dorsal pressure and determination of its effect can provide a reliable tool for assessment of diabetic foot.

References

Figure 1: a Dorsal/interdigital toes, b plantar toes, c plantar forefoot/midfoot, d plantar hindfoot, e heel, f dorsal/lateral aspect foot (Prompers et al. 2007).

Figure 2: Different interventions for plantar pressure relief

Figure 3: Laser Doppler Flowmetry (LDF) probe with ion chamber and pressure delivery device for iontophoresis during pressure application (Flynn et al. 2014).

Figure 4: a Pedar Insole system, b measurement in participants’ shoes, c orthopaedic shoes

Figure 5: In-shoe pressure recorded on dorsal and plantar surfaces