

**Are shear forces elevated at the foot-ground interface during gait in patients with diabetic neuropathy?**

Reeves ND<sup>1</sup>, Brown SJ<sup>1</sup>, Handsaker JC<sup>1</sup>, Bowling FL<sup>2</sup> & Boulton AJM<sup>2</sup>.

<sup>1</sup>IRM, Manchester Metropolitan University, UK; <sup>2</sup>Faculty of Medical and Human Sciences, University of Manchester UK.

**Background:** High plantar shear pressures have long been thought to play an important role in the development of diabetic foot ulcers, despite no supporting data. The lack of data is largely due to in-shoe plantar pressure systems only being able to measure vertical and not shear forces. Force platforms however, allow shear forces to be studied at the foot-ground interface. The aim of this study was to examine whether shear forces at the foot-ground interface are elevated in patients with diabetic peripheral neuropathy (DPN) during different gait tasks. **Methods:** Here we present pilot data from 3 groups: patients with diabetes and moderate-severe neuropathy (DPN; mean age: 56 years;  $n=14$ ), patients with diabetes but no/only mild neuropathy (DM; mean age: 58 years;  $n=15$ ) and healthy non-diabetic controls (Ctrl; mean age: 48 years;  $n=15$ ). All participants wore standardised shoes while descending and ascending a staircase and walking on a level walkway in a gait laboratory. Ground reaction forces were measured from force platforms embedded into the walkway and the steps of the staircase and resolved into shear (anterior-posterior and medio-lateral) and vertical force components. **Results:** When descending stairs, peak anterior-posterior propulsive forces were lower in the DPN compared to Ctrl group (Ctrl: 1.19, DM: 1.1, DPN: 1.0 N/kg;  $P<0.05$ ). Medio-lateral force-time integrals were higher in the DPN compared to DM and Ctrl groups (Ctrl: 0.33, DM: 0.38, DPN: 0.46 N/kg/s;  $P<0.01$ ). When ascending stairs, peak shear forces were not different between groups. The anterior-posterior (Ctrl: 0.23, DM: 0.26, DPN: 0.29 N/kg/s;  $P<0.05$ ) and medio-lateral (Ctrl: 0.26, DM: 0.26, DPN: 0.37 N/kg/s;  $P<0.01$ ) force-time integrals were higher in the DPN compared to DM and Ctrl groups. While walking on level ground, peak anterior-posterior propulsive forces were lower in the DPN compared to Ctrl group (Ctrl: 2.1, DM: 2.0, DPN: 1.6 N/kg;  $P<0.01$ ). The medio-lateral force-time integrals were significantly higher in the DPN compared to DM and Ctrl groups (Ctrl: 0.2, DM: 0.24, DPN: 0.29 N/kg/s;  $P<0.05$ ). **Conclusions:** Whilst peak shear ground reaction forces were either no different, or lower in patients with DPN across the gait tasks, shear force-time integrals were significantly elevated in DPN patients. Although the specific area of the foot affected is not known from these measurements, our results highlight that shear ground reaction forces are applied on the foot of DPN patients for longer, potentially playing an important role in the development of diabetic foot ulcers. **Acknowledgements:** EFSD clinical research grant funding.