

### The role of the external lever arm of the foot in walking efficiency in people with diabetes

Petrovic M<sup>1</sup>, Brown SJ<sup>1</sup>, Bowling FL<sup>2</sup>, Deschamps K<sup>3</sup>, Verschueren SM<sup>3</sup>, Maganaris CN<sup>4</sup>, Boulton AJM<sup>2</sup> & Reeves ND<sup>1</sup>. <sup>1</sup>Manchester Metropolitan University, UK, <sup>2</sup>University of Manchester, UK, <sup>3</sup>Katholieke Universiteit Leuven, Belgium, <sup>4</sup>Liverpool John Moores University, UK

**Background:** The external lever arm of the foot around the ankle joint plays a key role in the amount of force applied to the Achilles tendon, with higher forces helping to improve the efficiency of walking through increased storage of elastic energy in this tendon. Diabetes may alter the external lever arm of the foot through foot deformities and also altered gait characteristics. The aim of this study was to examine potential alterations to the external moment arm during walking in people with diabetes. **Methods:** Here we presented pilot data as part of an on-going analysis, from 2 groups: patients with diabetes (DM; mean age: 60 years; n=5) and non-diabetic controls (Ctrl; mean age: 56, n=5). All participants wore standardised shoes while walking at their self-selected speed over force platforms on a 10-metre walkway in a gait laboratory. The external moment arm was measured as the perpendicular distance between the ground reaction force acting on the foot and the ankle joint centre. Group differences were tested using an independent samples Student's t-test. **Results:** Diabetes patients walked slower than controls, albeit not reaching significance likely due to the small sample size (DM: 1.28; Ctrl: 1.85 m/s; P>0.05). Foot length was similar between groups (DM: 25; Ctrl: 27 cm; P>0.05). The external moment arm of the foot was significantly larger at the moment when the foot left the floor at the end of the stance phase (DM: 7.2; Ctrl: 5.0 cm; P<0.01). The mean external moment arm (DM: 7.24; Ctrl: 6.48 cm; P>0.05) and the range of external moment arm values observed across the stance phase (DM: 12.88; Ctrl: 12.17 cm; P>0.05) were not significantly different between groups. **Conclusions:** The external lever arm of the foot around the ankle joint is a parameter that can influence the energy cost of walking via the amount of force applied to the Achilles tendon. In turn, this may play a key role in the greater perception of effort experienced during walking by diabetes patients. In the pilot data presented here no significant differences are observed between a diabetes and control group, but this may be limited by the sample size currently analysed. We do, however, observe a larger external lever arm of the foot at 'toe-off' just before the foot leaves the ground. This indicates diabetes patients perform less 'propulsion' with the foot by not raising the heel as high and not flexing the metatarsal-phalangeal joint as much as controls. Instead, diabetes patients may 'lift' the foot off from the ground further away from the toes, towards the mid-foot region.

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