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Title
Does use of a hydraulically articulating prosthetic ankle-foot device improve gait and walking performance in individuals with lower activity levels?

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Summary
This study investigates the effects of a hydraulically articulating ankle-foot device compared to an identical, rigidly attached, foot in individuals with unilateral transtibial amputation (UTA) who have lower activity levels. Results indicate that use of the hydraulic device improve gait function.

Introduction
Developments in prosthetic ankle-foot devices that incorporate a hydraulic articulation between the pylon and prosthetic foot are relatively new. These devices have been shown to benefit the gait of more active (K3) lower limb amputees [1], improving progression and limb loading symmetry. Recently, it has been reported that individuals with UTA who have lower activity levels (K2) self-report a preference for such hydraulically attached devices [2]. Despite this, the functional benefits of using hydraulic ankle-foot devices in individuals with a UTA with lower activity levels are yet to be determined. Therefore the aim of the current study was to compare the gait of such individuals with lower activity levels (K2) when using a non energy storing and returning foot attached to the prosthetic shank pylon via a hydraulic component, compared to the same rigidly attached foot, during level walking.

Methods
A nine camera motion capture system (Qualysis) and two floor mounted force plates (AMTI) recorded three-dimensional kinematic and kinetic data respectively as five individuals with UTA, deemed K2 activity level by their prescribing physician, performed two two-minute walk tests (2MWT) followed by ten overground gait trials. Participants performed these activities under two conditions; using a hydraulically articulating ankle foot device (AvalonK2) and using a rigidly
attached ankle foot device (Navigator; both Chas A. Blatchford & Sons, Basingstoke, UK). These feet were identical save for the attachment to the prosthetic shank pylon. No inferential statistical tests were carried out. Differences between conditions were described/quantified using effect size d.

**Results**

On average, walking speed was increased by 6.5%, when participants completed the 2MWT while using the hydraulic device, compared to the rigidly attached device (d = 0.4). Participants loaded the intact and affected limbs more symmetrically (d = 0.8), increased minimum forward centre of pressure velocity (d = 0.8), increased peak shank rotational velocity (d = 1.0) and decreased prosthetic energy efficiency (d = 0.7) when using the hydraulically articulating ankle foot device compared to rigidly attached device.

**Conclusion**

Results from the current study show that individuals with UTA walk faster, and thus further during a 2MWT, when using a foot with a hydraulically articulating attachment when compared to the same foot rigidly attached.

This effect was consistent across all participants and supports previous reported of patient preferences for such devices [2].

This increase in walking speed was likely a result of a reduced braking effect in early stance phase, due to the action of the hydraulic component present in the articulating attachment, and subsequent improvement in progression. This is similar to the effects of using a hydraulic ankle-foot device in more active (K3) individuals [1]. The results of this study suggest that use of hydraulically articulating ankle-foot devices may benefit the wider population of individuals with UTA and have the potential to increase activity levels and improve the mobility of less active individuals.

**References**