Referent/in
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Titel
Biomimetic outcomes through advanced prosthetic knee and ankle technology during standing on non-level ground

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Zusammenfassung
The inter-limb loading and balance ability of five transfemoral amputees, for four prosthetic conditions were measured while standing on a sloped surface and compared to able-bodied controls. The combination of advanced knee and ankle technologies achieved the most biomimetic outcomes.

Einführung
The centre of mass of transfemoral amputees (TFA) is higher than that of able-bodied people. Consequently, they are less stable during quiet standing and they exhibit an increased dependence of their sound limb for support [1]. The latest generation of microprocessor knees (MPK) provide enhanced standing support by increasing the resistance knee flexion. In terms of prosthetic ankle/feet, hydraulic ankles have shown to improve standing balance in transtibial amputees, on a variety of gradients [2].

Methodik
A mixed cohort of K2 and K3 TFAs (n=5), along with able-bodied controls (n=5), volunteered for this study. Each TFA was fitted with an MPK with enhanced standing support (Orion3, Endolite). Two different prosthetic feet were tested in a randomised order; a hydraulic ankle (HA – Echelon, Endolite) and a rigid ankle (RA – Elite, Endolite). The participants stood facing down a 5° slope for a total of 45 seconds. For the TFAs, four conditions were performed: standing support on and off for each of the two feet. Both participant and experimenter were blinded as to whether standing support was activated. The ground reaction force (GRF) and centre-of-pressure (COP) under each foot was measured and compared for symmetry. Kinematics were recorded to identify compensatory strategies.
Ergebnisse
In terms of kinematic compensations, only the change in foot had an effect. With a RA, the amputees commonly flexed their prosthetic knee and residual hip in order to achieve prosthetic foot-flat. The HA complied with the slope, allowing an upright posture. With the RA, the addition of standing mode to the MPK exhibited a general increase in the prosthetic side loading and a decrease in sound limb loading, reducing the degree-of-asymmetry (DOA) between the limbs. When standing mode was off, the change from RA to HA had the same effect, presenting reduced DOA with the HA. The effect of the foot was highlighted further when examining the COP excursion under foot, for each condition. While the addition of standing mode reduced COP RMS [3] by ~10%, the HA reduced it by ~24%. The combination of the two technologies was closest to that of the controls: 7.2mm compared to 5.9mm.

Schlußfolgerung
This study found that both advanced prosthetic knee and advanced prosthetic ankle technologies improve balance and weight distribution for TFAs. In fact, the combination of these technologies presented outcome measures that were closest to those of the able-bodied subjects – something that is widely considered the ultimate goal when rehabilitating amputees. Improvements in balance are beneficial for TFAs, as they are particularly susceptible to the risk of falling. Symmetrical loading is believed to help combat the development of back pain, osteoarthritis and osteoporosis. The prescription of advanced technology could be beneficial to a patient’s quality of life by reducing the likelihood of falls injuries and comorbidities associated with long-term prosthesis use.

Literaturreferenzen

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