Effect on stance phase timing asymmetry in individuals with amputation using hydraulic ankle units

Authors: R. Moore[1]

[1]Luton and Dunstable Hospital NHS Foundation Trust, Luton UK

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Summary

The gait kinematics of a number of lower limb amputees were measured with their conventional feet (i.e. non-hydraulic ankle), before a period of acclimatisation with a hydraulic ankle prosthesis, after which their gait was reassessed. The focus of the study was directed towards gait loading symmetry, in particular the stance phase duration of the prosthetic and sound limbs.

Method

Components: Non-hydraulic feet, Echelon and Avalon feet.

Measurements: Temporal-spatial gait parameters and plantar pressure (using a Footwork Pro pressure plate)

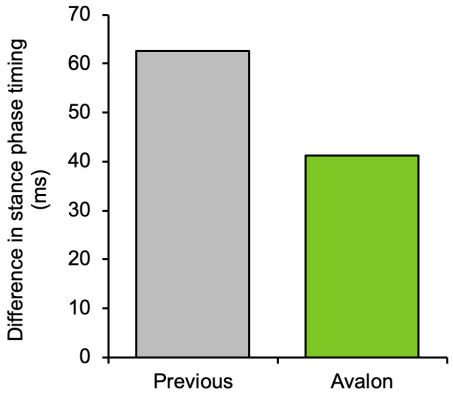
Subjects: Twenty-four lower limb amputees (22 male,2 female). Six excluded, final numbers:
K2: 4 unilateral trans-tibial, 1 bilateral trans-tibial, 3 unilateral trans-femoral
K3: 3 unilateral trans-tibial, 2 bilateral trans-tibial, 3 unilateral trans-femoral

Data collection protocol: Using their current prescription of non-hydraulic feet, amputees were asked to walk, at a self-selected walking speed, for five minutes, back and forth across a 6m level walkway with an integrated pressure platform. This time allowed for a large enough number of eligible steps on the platform. The K2 amputees were prescribed Avalon feet and the K3 amputees were prescribed Echelon feet. A four week acclimatisation period followed for the amputees' newly prescribed prostheses, after which the test protocol was repeated.

Analysis: Paired t-tests to determine significant changes from the before-and-after tests. Stance phase timing was the main outcome measure, with comparisons made between feet, within class of user, and between class.

Results

For all unilateral subjects, the sound side had a longer stance phase duration than the prosthetic side. For bilateral subjects, more time was spent on their "dominant" leg. When using the hydraulic ankle, the difference in the stance phase timing between the sound and prosthetic limbs decreased for 75% of the subjects that completed the study. For the Echelon subjects, six out of eight amputees showed improved symmetry, one saw no difference and the last one showed a symmetry decrease. There was no correlation between change in symmetry and amputation level. The mean stance phase difference was significantly decreased by 21.3ms (p=0.03) representing a 30% improvement. For Avalon subjects, the results were incredibly similar, with six improving, one remaining the same and one showing increased asymmetry. The mean stance phase difference was also reduced by 21.3ms (p=0.02) but due to a greater initial degree of asymmetry for the K2 users, this equated to a 34% improvement.



Conclusion

The author concludes that the results showed a statistically significant reduction in asymmetry of stance phase duration when using prostheses that included a foot with a hydraulic ankle unit. This improvement was irrespective of the patients' activity level. He further states that the results presented indicate that those using hydraulic ankles experience a more symmetrical stance phase duration, with all the benefits that entails, such as decreased sound side loading. He cites studies linking increased sound limb loading to degenerative changes and musculoskeletal problems, including increased risk of osteoarthritis and osteoporosis.

Products with Related Technology:

Linx, Echelon, Elan, EchelonVT, EchelonVAC, Avalon