Optimization of Gait through Smart Release of Stance Phase
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Microprocessor control of the stance phase has been shown to significantly improve lower limb stability across various terrains. However this improved stability can be at the expense of a more restricted and less energy efficient gait.

This study follows the development of a transfemoral control device that undertakes to address this problem by using smart programming techniques to optimize the point of stance support release in the gait cycle. A new wireless goniometry system (Pegasus) is used to measure joint angles of both limbs over a period of 6 hours in all terrains. Subjects who are mainly K2-K3 amputees of mean age under 50 years old, with medium stump length were asked to wear the device for a day so that measurements for all cadences during activities of daily living can be obtained.

The device enables establishment of gait symmetry and phasing to verify the outcome measures. 6 amputees using different microprocessor knee control were examined in details. The data collected are compared with that of normal population as well as transtibial amputees and non microprocessor knee control such as progressive stabilizing knee or weight activated knee used for stabilisation of stance control on transfemoral amputees. Detail outcome of the study and statistically significant differences will be presented.

It was hypothesized that the biomechanics of walking in conjunction with continuous intelligent gait monitoring algorithms could determine the stance support selection and release points that would give unimpeded initiation of flexion and limb extension without compromising stability and safety.

A hydraulic stance, pneumatic swing control device was developed that employed automatic stance selection and release determination by monitoring actual gait characteristics during walking. Initially 13 devices were fitted to predominantly K3 category amputees for periods in excess of 1 month. Early indications from measured and qualitative feedback showed that an optimized release point not only reduced energy expenditure but also enhanced proprioception.

Further analysis highlighted that this optimal release point varied with walking mode. Greater degree of symmetry of sound limb stance duration and prosthetic side stance is noted as direct consequence of smart release. Phasing and stride symmetry as well as improvement in balance loading were measured using in the laboratory gait analysis to determine kinetic parameters such as sound side and prosthetic side loading are measured. This was in order to validate the kinematic and temporal parameters from symmetry measurements.

Outcomes so far:
1. By optimizing the point of release of a stance supporting resistance to flexion a more energy efficient and natural gait can be achieved without compromising stability or safety.
2. The optimal point of stance support release varies according to the mode of walking.
3. Self-selection of the stance release point achieved by intelligently monitoring the gait cycle during walking can enhance proprioception.
4. Greater degree of gait symmetry achieved during walking down the ramp, stairs descent with smart release control.
5. Walking slowly for transfemoral amputees was noted to be more symmetrical with optimized stance control.