

EVALUATION OF DAILY PERFORMANCE IN UPPER LEG AMPUTEES USING ELECTRONICALLY AND NON-ELECTRONICALLY CONTROLLED PROSTHETIC KNEE HINGES

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INTRODUCTION

To date, objective evaluation of electronic leg prosthesis usage for patients with a transfemoral amputation mainly focuses on function and impairment rather than on activity and participation. Aim of this study is to determine the functional added value of an electronically controlled prosthetic knee hinge in daily life performance.

METHODS

Subjects

Twenty persons with a unilateral transfemoral amputation, classified as 'restricted outdoor walker' (Mobis[®] grade 2 (K2)), participated in the study. The subjects' leg prostheses were consecutively fitted with their own mechanically controlled knee hinge, an electronic stance and swing phase controlled and an electronic stance phase controlled knee hinge. Each prosthesis type was used for one week at home.

Instrumentation

Subjects wore a uniaxial accelerometer (Actigraph, MTI, Pensacola, Fl.) to establish a quantitative measure of the subjects' activity level (activity counts). Furthermore, a specifically designed 'participation circuit' analogous to the circuit described by Hemmen et al. [1] was used. The circuit consisted of 17 common daily activities, perceived by persons with an upper leg prosthesis as being most difficult to perform. Performance time during all activities was recorded.

Data analysis

The activity levels of the subjects for the three knee hinge conditions were compared in terms of total number of activity counts per day, the ratio of resting time and active time per day and the occurrence of peak activity values.

The 17 simulated daily activities from the participation circuit were grouped into three subgroups, using principal component analysis and varimax rotation. Differences in performance time relative to the subjects' mechanically controlled prosthesis were calculated.

RESULTS AND DISCUSSION

Table 1 represents the characteristics of the research population. The activity level data showed large between-subject variation, indicating a heterogeneous research population. Based on this data, the subjects could be divided into three subclasses, 'low', 'intermediate' and 'high' K2 walkers. No clear differences in activity levels were found

between the knee hinge conditions. However, a clear difference in mean total number of counts of activity per day between the three subclasses was found. The participation circuit data indicate that the subjects in subgroups 'intermediate' (o) and 'high' (Δ) improve their performance times when walking on an electronically controlled knee hinge. Data also show that the subjects classified as 'low' (+) K2 walkers are less likely to benefit from using an electronically controlled knee hinge (see figure 1).

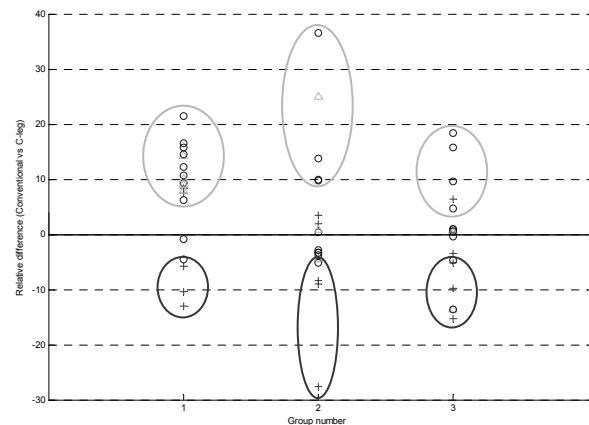


Figure 1: Relative change in performance time: conventional prosthesis versus electronically controlled prosthesis. 0% indicates that no difference in performance time exists between the use of a conventional knee hinge versus an electronically controlled prosthesis.

CONCLUSIONS

The group of K2 walkers is a heterogeneous group and can be further divided into the subclasses 'low', 'intermediate' and 'high' using accelerometer data. The K2 group showed no clear differences between the three prosthesis types when evaluating measures at function level (e.g. activity monitoring). However, qualitative measures like the participation circuit clearly indicate that after one week of home use a difference in performance occurs when using an electronically controlled prosthesis. A possible functional added-value of an electronically controlled prosthesis seems to depend on the K2 subclass of the prosthesis user.

REFERENCES

Hemmen B, et al. Proceedings of 12th ISPO congress, Vancouver, Canada, 2007.

Table 1: Participant characteristics

N	Gender		Age (years)	Weight (kg)	Post-amputation time (years)	Cause of amputation		
	Male	Female				Trauma	Vascular	Cancer
20	15	5	59.8 (±13.0)	74.8 (±11.5)	21.5 (±17.1)	14	5	1