The Effect of the C-Leg on Sensory Dependency During Posturography

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INTRODUCTION

Community ambulating transfemoral amputees (TFAs) fall frequently. Several studies have demonstrated that microprocessor-prosthetic knees (MPK), such as the C-Leg, reduce falls. However, mechanistic explanations for such safety improvements are not widely available. It would be extremely helpful to gain a mechanistic understanding so that therapies and prostheses can integrate this information within their design.. Therefore, the purpose of this study was to determine which sensory systems' dependency is heightened following C-Leg accommodation.

METHOD

This is a secondary analysis of a cross-over trial (Kaufman et al 2007). Subjects were studied using non-MPKs then fit and aligned with a C-Leg and allowed time to accommodate before repeat testing. Four calculations (Table 1) were used to determine sensory dependency levels during standing balance from each of the following systems: somatosensory, vestibular, and visual. The 4th score, the preference score and indicates affinity for visual contributions to balance regardless visual input's validity.

System Score:	Calculation:
Somatosensory (SOM)=	SOT Condition 2 Score ÷ Condition 1 Score
Visual (VIS)=	SOT Condition 4 Score ÷ Condition 1 Score
Vestibular (VEST)=	SOT Condition 5 Score ÷ Condition 1 Score
Preference (PREF)=	SOT Condition 3 Score + Condition 6 Score ÷ Condition 2 Score + Condition 5 Score

Table 1. Sensory Dependency Score Calculations.

Subjects: 16 unilateral K3/4 TFAs consented. Mayo Clinic IRB approved the protocol.
Apparatus: Equitest Dynamic Posturography Platform.

Procedures: SOT testing on non-MPKs then again on C-Leg, 4 sensory dependency calculations (Table 1) were applied to individual SOT condition scores. Trials in which subjects stepped or touched the wall to avoid falling were assigned a zero score and classified as a fall.

Data Analysis: Comparisons between prosthetic knees for sensory dependency scores and average number of falls were completed using paired *t*-tests. Significance was 0.05. Effect sizes (Cohen's D) were calculated post-hoc.

RESULTS

Fifteen TFA's of varied etiology completed the study. One male subject was withdrawn. While using C-Leg, there was a 3% increased reliance on somatosensory system input (p=0.047). Reliance on visual with vestibular and vestibular input alone were both greater (3% [p=0.41] and 1% [p=0.15] respectively) with C-Leg use but differences were not statistically significant. Effect sizes were small for the 4 sensory dependency comparisons. When utilizing C-Leg, there was a statistically significant 33% reduction in the number of falls among the group (p=0.03). The effect size for this comparison was also small.

DISCUSSION

This study's findings demonstrate that somatosensory system dependence increased significantly with C-Leg use. Prosthetic side somatosensation has been shown to increase along with the weight-bearing aspect of balance maintenance. With C-Leg training and accommodation, as fewer falls are experienced, confidence likely increases further contributing to increased prosthetic reliance while moving. Nederhand et al. explain that part of an amputee's continued improvement in weight-bearing symmetry is attributable to central reorganization, including decreased reliance on active cognition and visual input.

CONCLUSION

After receiving a C-Leg, subjects rely significantly more on their somatosensory system than other systems evaluated. This data provides a mechanistic explanation for improved TFA balance performance.

CLINICAL APPLICATIONS

Prosthetists will benefit from knowing why safety is improved with select components such as C-Leg.

REFERENCES

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