# KINEMATICS OF TRANSFEMORAL AMPUTEES DURING THE SIT TO STAND MOVEMENT

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## INTRODUCTION

Sit to stand movements are a determinant of functional independence and have limited study in transfemoral (TF) amputees. The biomechanics of sit to stand of persons with a TF amputation have been studied; however microprocessor knees were not utilized by subjects (Burger,et al.2005). Recently, the kinetics of microprocessor prosthetic knee users during sitting and standing movements have been studied (Highsmith, et al. 2011), however, kinematics were not reported. Therefore, the purpose of this study is to report the kinematics and associated asymmetry in sit to stand with TF amputees utilizing microprocessor knees.

## METHOD

Subjects: The protocol was approved by the University of South Florida's Institutional Review Board. Twenty subjects (15 amputees; 5 controls) gave informed consent to participate. The five control subjects were young healthy, non-amputee college students. Of the 15 amputee subjects, five wore a Power Knee (Ossur; Reykjavik, Iceland), five wore a C-leg (Ottobock; Duderstadt, Germany), and five wore a Mauch SNS (Ossur; Reykjavik, Iceland) prosthesis.

Apparatus: A reflective passive marker set was placed on subjects to record motion. An eight infrared camera Vicon motion analysis system (Oxford, UK) was used for data collection.

Procedures: Subjects completed three sit to stand trials. Each subject was asked to stand from a platform adjusted to a height where the initial knee flexion was $90^{o}$. The trials were recorded and range of motion (ROM) of the hip, knee, and ankle joint angles in the sagittal plane as well as the degree of asymmetry of the ROM were computed. The three trials were averaged and shown in the results. A one-way ANOVA was conducted to determine if statistically significant differences existed between the means of each group. A Bonferroni post-hoc test was used for pair-wise comparison of the means.

## RESULTS

Figure 1 shows the average ROM of the ankle, knee and hip of both legs for each group. There was a significant difference (p=.033) found between the Control group's dominant side hip ROM and the C-Leg group's sound side hip ROM as well as for the degree of asymmetry of the hip ROM between the control and C-Leg groups. There were no significant differences between the groups for any other ranges of motions.

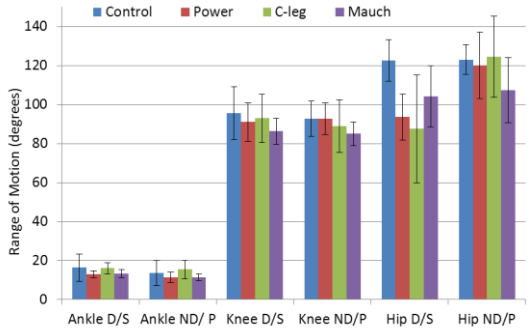


Figure 1. The average range of motions of ankle, knee, and hip of the each group during sitting to standing. D/S: Dominate / Sound Side, ND/P: Non-Dominate / Prosthetic

## DISCUSSION

It has been previously reported that TF amputees show a greater degree of asymmetry toward the sound side in hip and knee moments in the sagittal plane when compared to control groups (Highsmith, Kahle, et al. 2011). Kinematically, however, the C-Leg group showed a greater asymmetry toward the prosthetic side compared to the Control group. Movement strategies in the lower functioning C-Leg user group were quite variable. Therefore it is difficult to generalize how a singular movement pattern impacted kinetic asymmetry. Therapeutic interventions should consider instruction of a movement pattern more typical of the symmetric, non-amputee. It would then be more feasible to 1) determine the specific contribution kinematics have on kinetic asymmetry and 2) to understand if a specific movement pattern could optimize kinetic symmetry and protect joints.

## CONCLUSION

There was not a significant difference between non-amputees and amputees in the kinematics of standing with the exception of the hip on the sound side while using the C-Leg. This makes observational and kinematic only based analysis of standing difficult. It may not be possible to objectively qualify asymmetry of standing without kinetic and temporal data.

## REFERENCES

Highsmith MJ et al., Gait Posture **34**(1): 86-91, 2011.
Burger AD et al. Prosthet Orthot Int **29**:139-51, 2005.

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