INTRODUCTION
People with transfemoral amputation (TFA) experience impairments in ambulation, such as lateral trunk lean, hip hiking, and circumbduction. These gait deviations may lead to excessive center of mass (COM) movements reflecting detrimental changes in gait quality and postural stability when walking. Position of the COM can be estimated from the weighted averages of body segments (Dempster, 1967) and is typically centered behind the umbilicus. COM position may be altered in people with TFA because of mass asymmetries between the prosthetic and intact limbs.

Currently, there is no consensus on the best modeling approach for persons using a prosthesis, and methods for estimating COM position from prosthetic-side mass distributions are often not reported (Kent, 2011). The magnitude of difference in COM outcomes between modeling methods for persons with TFA is needed to inform methodological decisions in quantitative gait analysis and to more accurately measure biomechanical outcomes in this population. Therefore, the goal of this study was to compare COM parameters derived using anatomical and component-specific models in people with TFA to better quantify observed gait deviations.

METHOD
A traditional, anatomical model was first created using mass distributions equivalent to the non-prosthetic side. Two component-specific (PRX) models were then created using a range of prosthetic-side weight distributions based on available componentry and estimates of the residual limb mass. These models demonstrated the effects of heavy (Heavy-PRX) and light (Light-PRX) prosthetic limb weights on COM outcomes.

Subjects: Four adult participants with unilateral TFA attended a single testing session at the University of Washington Human Motion Analysis Lab. All participants used a microprocessor-controlled prosthetic knee.

Apparatus: 3-D marker position data was collected at 120 Hz using an 8-camera Qualisys Motion Capture System (Gothenburg, Sweden). Kinematic data was processed using Visual 3D motion analysis software (C-Motion, Inc., Rockville, MD).

Procedures: Walking was assessed on a flat, firm surface. Biomechanical outcomes, including COM displacement in the mediolateral direction and peak inclination angle during single limp support (SLS) on the intact side were derived with each model (Anatomical, Heavy-PRX, and Light-PRX).

RESULTS
Preliminary results in four participants suggest that COM parameters were affected by the model applied. Differences were observed between the Anatomical and the Light PRX models and were generally greater in magnitude for inclination angle than displacement parameters (Figure 1).

DISCUSSION & CONCLUSION
Participants’ COM shifted upward and laterally toward the intact limb with the PRX models. This shift was more pronounced when there was a greater difference in weight distribution between the prosthetic and intact limbs (i.e., heavier individuals, Light-PRX model) Comparisons of the Anatomical and PRX models resulted in potentially important differences in COM outcomes. After analysis of additional participants, this study might suggest that it is less critical to use a component-specific gait model if COM excursion is a primary outcome of interest. However, if inclination angle is to be used as an indicator of postural stability, the model selected may have a greater effect on the data obtained.

REFERENCES