INTRODUCTION  An increase in the debate regarding sub-ischial (SI) socket design for trans-femoral amputees has emerged since the advent of elevated vacuum suspension. Are amputees afforded the same capacity for dynamic stability when ambulating with a SI socket?

Elevated Vacuum  The residual-limb socket interface air pressure undergoes cyclical patterns that correspond with the stance and swing phases of gait. The residual limb length-circumference ratio, tissue density, gait pattern, and prosthesis weight all affect the degree of vacuum pressure variance during the gait cycle. It is hypothesized that an increased level of vacuum pressure deviation is associated with increased prosthetic interface pressure which is a contributor to residual limb skin breakdown.

Dynamic Stability  It is possible to examine an individual’s perceived level of stability according to the variability of stride-to-stride temporal-spatial gait kinematics. Humans tend to ambulate with a wider and more variable step width when ambulating without visual feedback and tend to walk with decreased step width variability and increased external lateral stabilization. Older adults and individuals with neurodegenerative disease ambulate with increased temporal gait variability and step length variability. Trans-tibial amputees who report frequent falling ambulate with greater variability in their temporal swing phase mechanics than those who express rarely falling. Gait symmetry and stride regularity is less among trans-femoral amputees than among a non-amputee control population. Temporal-spatial kinematic variability can be used as an assessment of trans-femoral socket design for the optimization of dynamic stability and minimization of energy consumption.

METHOD

Subjects:  A convenience sample of seven unilateral trans-femoral amputee subjects included five males and two females. Six were resultant of traumatic etiology and one was secondary to osteosarcoma.

Apparatus:  Stride-to-stride temporal-spatial gait variability was measured using a Gaitrite™ portable floor pressure sensing walkway while elevated vacuum pressure was measured with the Ohio Willow Wood Company LimbLogic™ VS Communicator.

Procedures:  Repeated measures from seven unilateral trans-femoral amputees were collected over 10 walking trials with sub-ischial elevated vacuum suspension (SIV) and ischial containment elevated vacuum suspension (ICV) sockets. New prosthetic sockets were fabricated and fit for each subject using Omega® Tracer® Cad/Cam and only the socket trimline height was altered between the trials.