INTRODUCTION
Spinal cord injury (SCI) affects both sensory and motor signals; potentially causing abnormal gait and sensory impairments (Kirshblum et al., 2011). Patients with neuromuscular impairment, like lower level SCI, are commonly prescribed lower limb orthoses to promote a functional walking pattern. Specific examples of orthoses prescribed to patients with SCI may include ankle-foot-orthosis (AFO), knee-ankle-foot orthosis (KAFO), or a stance control orthosis (SCO). The design chosen must find a balance between assisting with mobility and maintaining joint integrity while minimizing the burden of use for the wearer (e.g. device bulk, energetic costs, etc.).

The purpose of this study is to investigate how the relative benefits and drawbacks associated with the more conservative approach of using AFOs versus the potential benefit of knee control with the more complicated SCO would affect the gait of someone with incomplete SCI. Relevant clinical outcome measures were used to increase reproducibility by practitioners, therefore making our study more clinically relevant.

METHOD
Subject: 25 year old female (5’2” & 110lbs), with no gait impairments was used to provide baseline data for a person with an incomplete L1 spinal cord injury. The subject with SCI (incomplete at L1 level) has been recruited but data has not yet been collected. Fabrication: The SCI and control subject were evaluated by a certified orthotist and a Becker stance-control-orthosis was customized to the fit and a custom solid AFO was fabricated and fitted.

Apparatus: The 2-minute walk test and Physiological cost index (PCI) were the two primary outcome measures. Six retroreflective markers were applied bilaterally to the following landmarks: apex of the lateral malleoli, ASIS, and PSIS. Markers were tracked via a twelve camera motion capture system (Vicon Inc., Oxford, UK). A gait real time analysis interactive lab (GRAIL, Motek Medical B.V., NL) system was used which consisted of a 50 cm x 200 cm, split- belt treadmill synchronized with a motion capture system that allows for self-paced walking by adjusting belt speed to keep the person in the middle of the treadmill, and virtual reality immersion through a 180 degree, 3D projection screen. The subject was attached to a safety harness to prevent injury. The PCI was calculated by (beats/m) = (walking heart rate (beats/min) – resting heart rate (beats/min)) / walking speed (m/min).

Procedures: Three trials were taken, one with no orthoses, one with an AFO, and one with SCO. The two minute walk test was performed using the self-paced treadmill, and person’s heart rate was taken before the test began and 30 seconds before the test ended for the PCI.

Data Analysis: The minimum detectable changes for the two minute walk test (±42.5m) (Bohannon et al., 2015) and the PCI (±.07 b/m) (Hagberg et al., 2011) were compared to demonstrate if there was a clinically relevant difference between the device conditions.

RESULTS
The results for the control subject showed that with no orthotic intervention, the subject walked 284m in the 2-minute walk test and scored .38 b/m on the PCI. With an AFO, the subject walked 209m and scored .48b/m on the PCI. Using SCO the subject walked 185.7m and scored .57b/m on the PCI.

DISCUSSION
The differences regarding the PCI and 2-minute walk test between the baseline and device conditions were greater than the minimum detectable change indicating that wearing the device increased energetic costs for the control subject. This could be due to this control subject being a healthy adult and is not indicated for any assistive device. The benefit to someone with a SCI will become clearer once additional data has been collected on people with SCI.

CONCLUSION
This pilot study demonstrated the validity of our methodology and provides baseline data to compare to a larger sample containing people with low level incomplete SCI.

CLINICAL APPLICATIONS
This study demonstrates how clinically available outcome measures can be used to determine if the patient will benefit from SCO or AFOs.

REFERENCES