

## **Title: Assessment of Joint Kinematics in Response to Assistive Device Selection in those with a Plantar Flexion Contracture**

**Background/Introduction:** Plantar flexion contractures are a common structural abnormality that present in conditions including post-stroke hemiplegia. This contracture affects the position of the ankle during functional weight bearing activities and consequently impacts the kinematics of the knee and hip joint as well. These positional and kinematic abnormalities commonly lead to gait abnormalities and the corresponding risk of injury and falls. Assistive device prescription is often necessary to allow weight bearing activity with these individuals, however the research regarding which assistive device most normalizes these individual's gait pattern is limited. The purpose of this study is to assess the effect of a straight cane and rolling walker on the gait pattern of those with a plantarflexion contracture.

**Methods:** Two male subjects (24 and 23 years old) volunteered to participate in this study. The subjects were taped into ankle plantar flexion and inversion to mimic an ankle plantarflexor contracture on a single lower extremity. This simulates variability in dynamic postural sway/fall risk in those with a plantarflexor contracture, such as patients diagnosed with cerebral vascular disease. Each subject performed three trials per condition. Two of the trials were performed with their ankle placed in a contracted position while the subject ambulated several feet using a straight cane in the first trial and a front wheeled rolling walker in the second trial. The final trial, the participants ambulated without an ankle contracture and an assistive device to demonstrate their "normal" gait pattern. Data was collected as the subjects ambulated with an assistive device using a step through gait pattern and the results were compared to the subject's "normal" gait pattern. 3D imaging was used to determine joint kinematics in all 3 planes during their gait cycle. This data was used to quantify lower extremity kinematics during gait, based on peak/average joint angles in all planes during the gait cycle for the hip, knee, and ankle.

**Results:** After analyzing the data, we concluded that there are no significant differences, therefore we accept the null hypothesis. We compared the data within and against subjects as well as within and against the assistive devices used. Results varied between groups for which assistive device allowed for similarities to normalized gait. Changes in kinematics were not consistent between groups with each assistive device. Figure A demonstrates the most significant difference in gait while using a cane in subject 2, in comparison subject 1 had no significant deviations while using a cane as an assistive device. Figure B illustrates decreased knee rotation in subject 1 while using a walker, subject 2 had a more normalized gait pattern in all ranges we measures compared to the other subject. The significant differences that we found in both subjects can not be scientifically rationalized for based on the data that we collected. No one pattern was evident between subjects which could be accounted for by different compensation techniques. All in all, we conclude that neither the cane nor front wheeled rolling walker can be definitively stated as the better assistive device when trying to normalize gait in a subject with a plantarflexor contracture.

**Discussion/Conclusion:** The answer to our clinical question was not definitively satisfied. Though data collected from the knee could be important clinically, overall our data did not demonstrate any significant differences that could affect gait patterns in patients who require an AD to ambulate. Limitations in the study include that subjects improperly offloaded with the assistive device and

exhibited superfluous planar motion. The study's small number of subjects poses as another clear limitation which likely has skewed results. Limited trials were performed, along with simulation of the condition being done with ace bandage wrap. Takeaway points do include that assistive devices have been shown to decrease risk of falls but that an essential element in this is proper instruction by the clinician of assistive device use. Additionally, considering the patient in a more comprehensive way, and not limiting focus on one region or limiting condition (e.g. unilateral plantar flexor contracture) is essential to patient care. Areas for future research may include examining the differences in ground reaction force in subjects using different assistive devices and further assessing multi-planar movement and balance in a larger study sample.

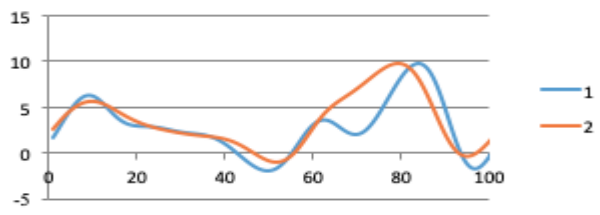
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### **Appendix:**

A.)

**Right Transverse Hip Angle**



B.)

**Right Transverse Knee Angle**

