



NeuroRehabilitation and Robotics
Motion Analysis
NeuroScience Center
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Gait Analysis Report

The purpose of this Gait Study was to examine possible differences or changes in basic Temporal-Spatial parameters, Joint Kinematics, Joint and Ground Reaction Forces (GRF), EMG (Muscle activation), and Joint Moments walking with and without the MedPro.

The data collection was conducted on one female participant with no known orthopedic or neurological conditions. The participant was familiar with wearing the device so no familiarization period was needed. Multiple conditions were collected (and will be analyzed more closely later) but for the purpose of this report, the focus was on walking. Additional data collected was going up and down stairs, performing an overhead squat, performing a single leg step test, and a sit-to-stand.

Temporal-Spatial Parameters

Walking Speed 1: 1.48 ± 0.042 m/s

Walking Speed 2: 1.25 ± 0.022 m/s

The speed of the current foot based on the stride time and stride length

	Left	Right
Stride Length 1	1.50 ± 0.040 m	1.53 ± 0.027 m
Stride Length 2	1.39 ± 0.032 m	1.39 ± 0.049 m

The distance along the line of progression from current foot contact to the next current foot contact.

Step Length 1	0.76 ± 0.028 m	0.75 ± 0.018 m
Step Length 2	0.68 ± 0.033 m	0.70 ± 0.011 m

The distance along the line of progression from opposite foot contact to current foot contact.

With respect to temporal-spatial parameters, the most notable changes occurred in step length which will then impact changes in stride length. Due to the nature of the resistance from the MedPro, the individual adopted more of a mid-foot strike as opposed to the more natural heel strike, therefore shortening the step length. A stride is defined as 3 consecutive steps i.e. left-right-left. One stride, from initial contact to initial contact on the same side, was also shorter due to the steps being shorter. Shorter steps at the same relative speed indicate a higher turnover rate. Although this was not seen wearing the device it was a result of not controlling the speed of the individual walking. Shorter steps mean a faster turnover rate, resulting in less time in contact with the ground. Although this was seen, I am not sure if those values were significant. In conclusion, shorter steps mean less of a heel strike force (less dorsiflexion) which translates up the chain through the joints.

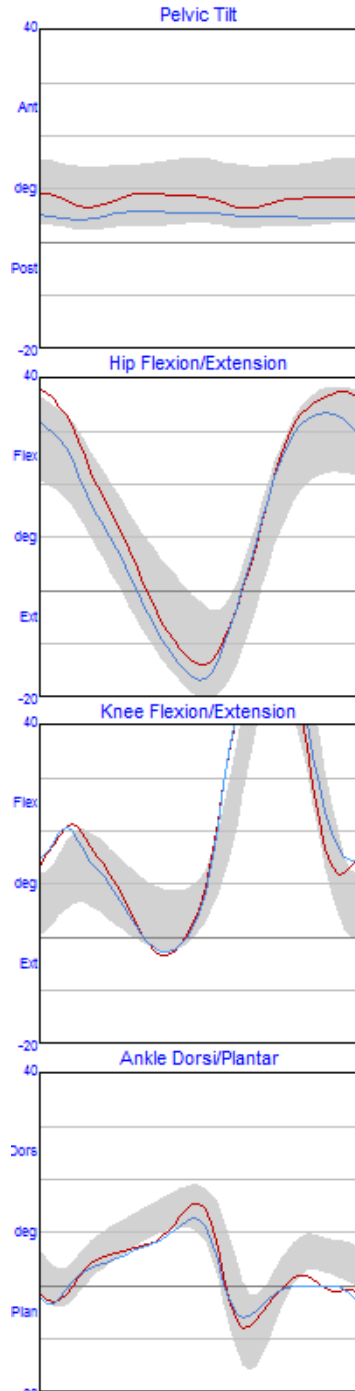
Joint Kinematics

Most notable changes in Joint Kinematics (angles) were seen in the sagittal (side):

Left

Red Condition 1

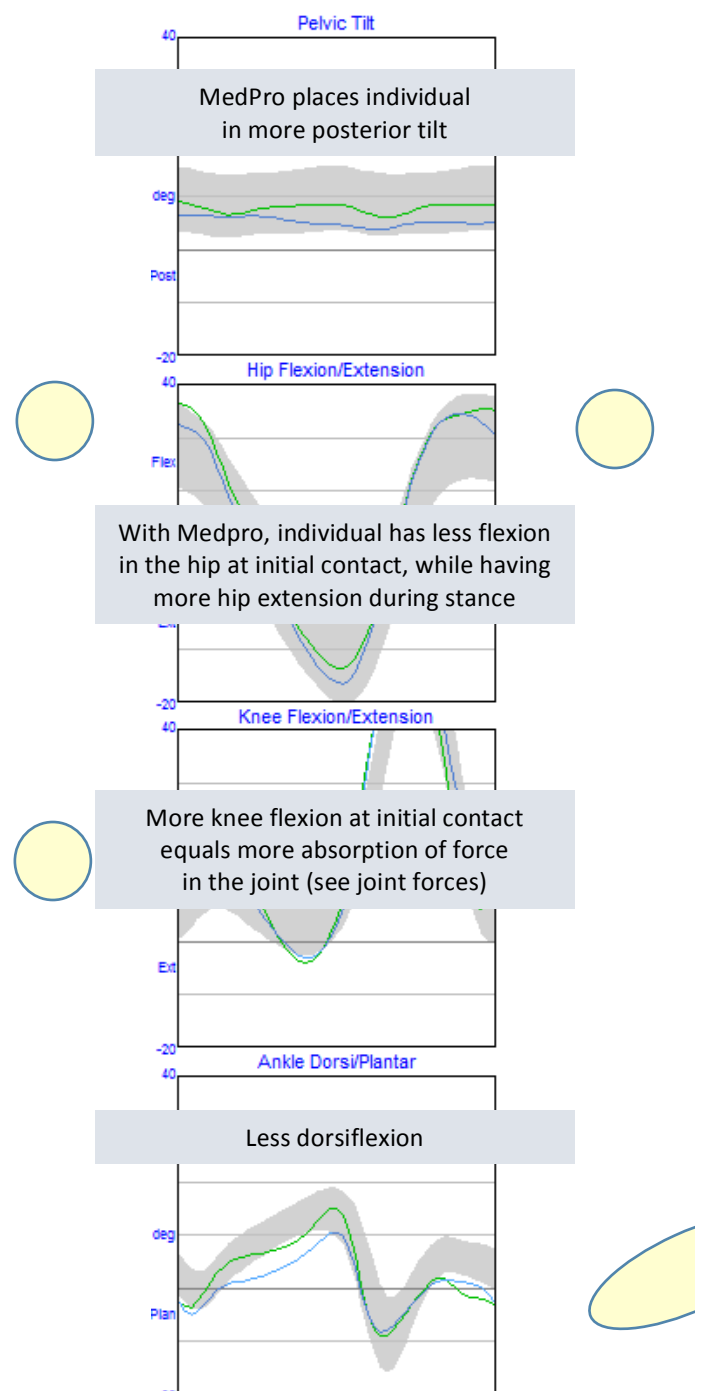
Blue Condition 2 with MedPro



Right

Green Condition 1

Blue Condition 2 with MedPro

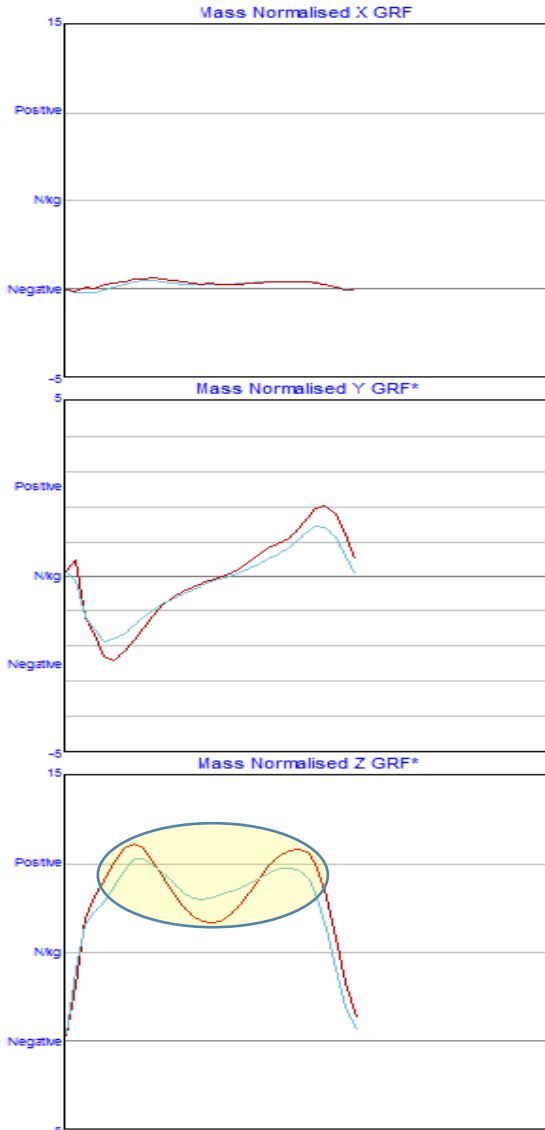


Ground Reaction Forces

Left

Red Condition 1

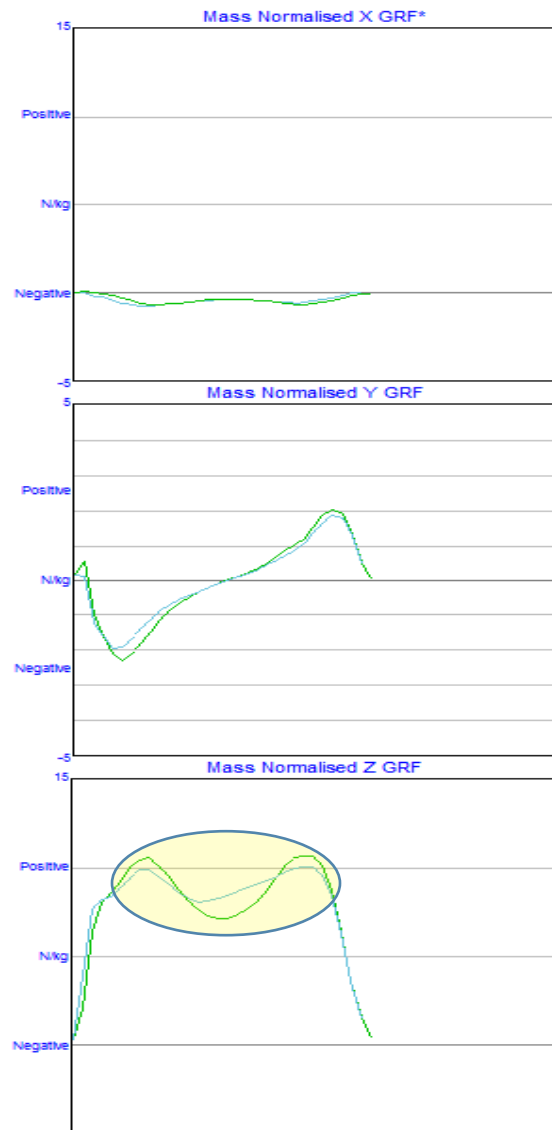
Blue Condition 2 with MedPro



Right

Green Condition 1

Blue Condition 2 with MedPro

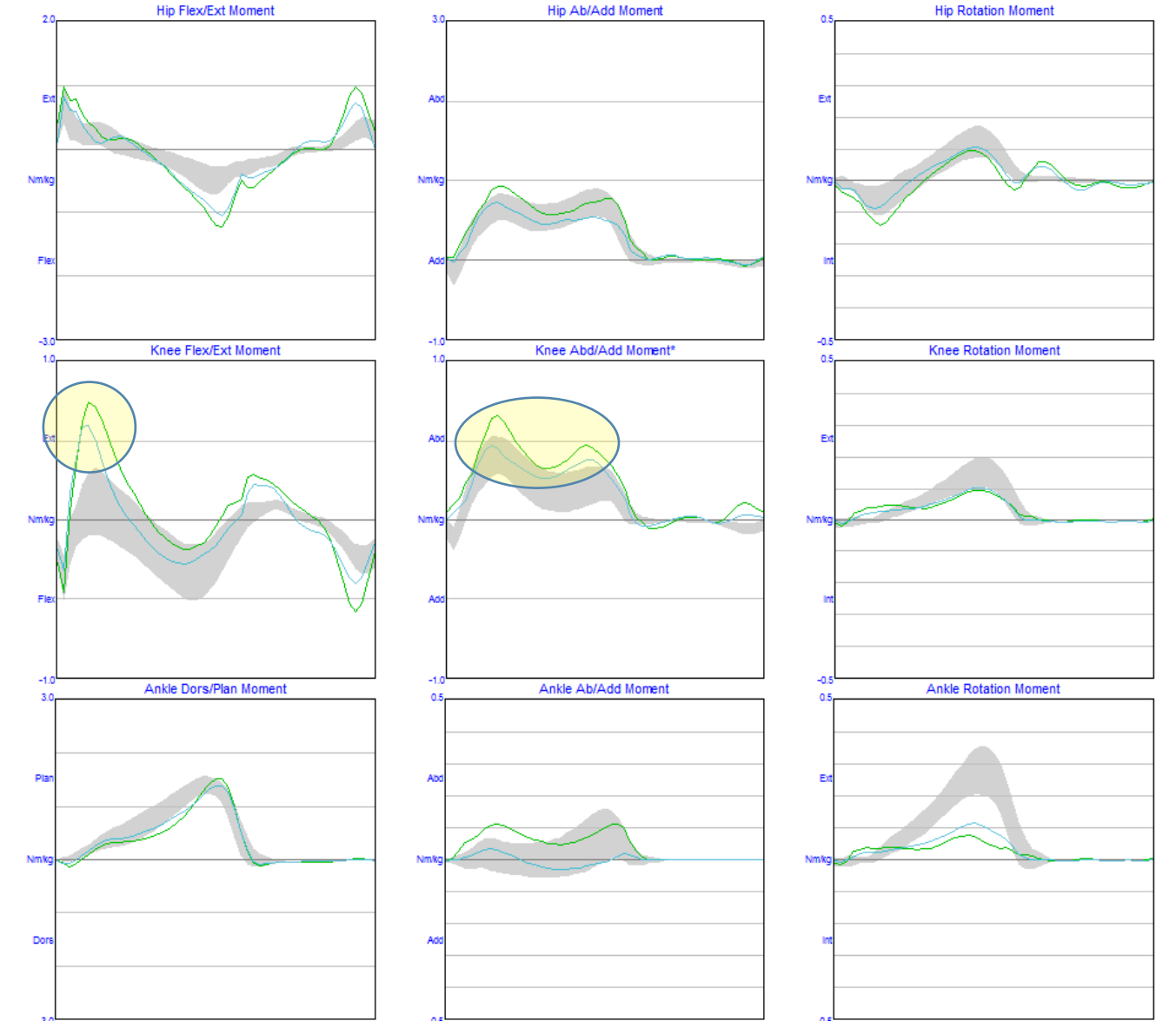


The peaks of the forces above in the Z direction are not as high at both initial contact and toe-off, resulting in less braking and acceleration forces creating compression on joints.

Right Side Joint Moments

Green Condition 1

Blue Condition 2 with MedPro

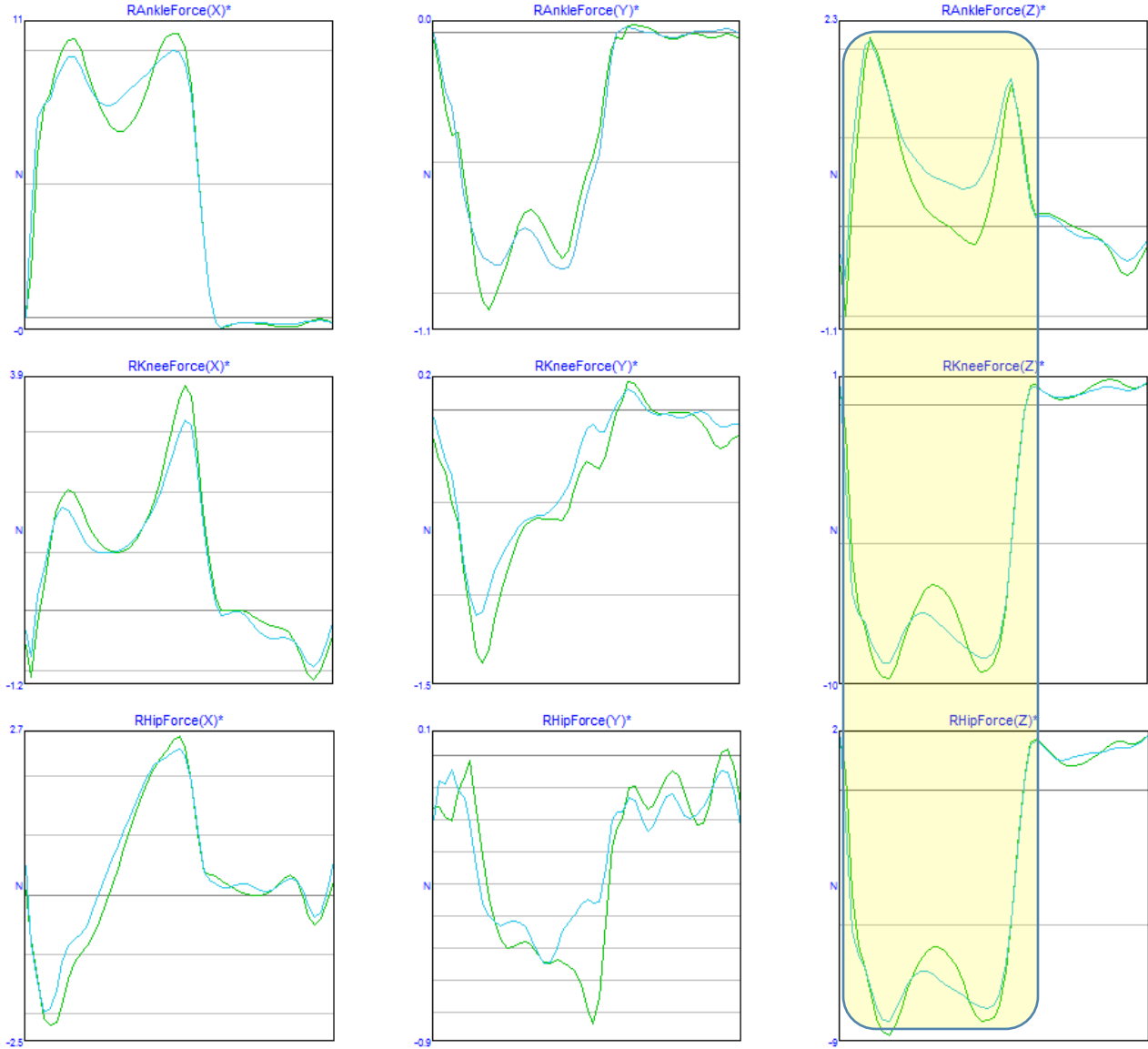


Note: Moments can be defined as a force being applied some distance away from a joint (fulcrum), causing a tendency to rotate the joint in the direction of the force. *Rule of thumb:* The active muscle is always the one on the opposite side of the joint to the GRF. There is less of an extensor moment because the hamstrings are not actively creating the internal moment and the quads have to activate more to overcome assistance of the device acting as hamstrings.

Right Side Joint Forces

Green Condition 1

Blue Condition 2 with MedPro



All forces in the Z (vertical) direction are diminished at initial contact, mid-stance, and toe-off. This is an indication of less impact forces (braking) and more absorption through stance phase of the force. Note the direction of the forces for the knee and hip are reverse due to nature of the Z force being equal but “opposite” in direction of the applied force.

In conclusion, the findings of this study do suggest some changes are occurring in the gait characteristics of someone walking with and without the MedPro trainer. However, IU Health cannot make claims on whether these changes would actually happen in all people or whether the changes seen can be labeled as significant until further statistics are done.

In my opinion the data presented does suggest changes are occurring and warrants a further look into the other conditions as well as collecting data on more than one subject. Ideally a study conducted using a subject with known OA complete a gait study without the device and then train for 6 to 8 weeks with the device and then do another gait study without the device to see if training with the device actually changed gait kinematics, forces and muscle activation. Ultimately you would then want to look at multiple people running through this protocol as well as having a control group who didn't use the device and collected data pre/post-therapy to know for sure if the hypothesized changes seen in those who used the device truly were from using the device and not other interventions that may have been utilized with traditional OA rehab.

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