

## Background

- Gait and balance, critical elements in independent living and quality of life, are severely impaired in persons with multiple sclerosis (MS).
- Gait analysis of persons with MS reveal abnormalities in speed, stride length, cadence, double support time, swing time, and significantly altered joint kinetics.
- Causes of gait dysfunction are complex; factors contributing may include slowed spinal somatosensory conduction and abnormal sensorimotor control.
- OBJECTIVE:** Examine relationship between neural control of muscle activation, as represented by sensorimotor delays, and gait mechanics in persons with MS.

## Methods

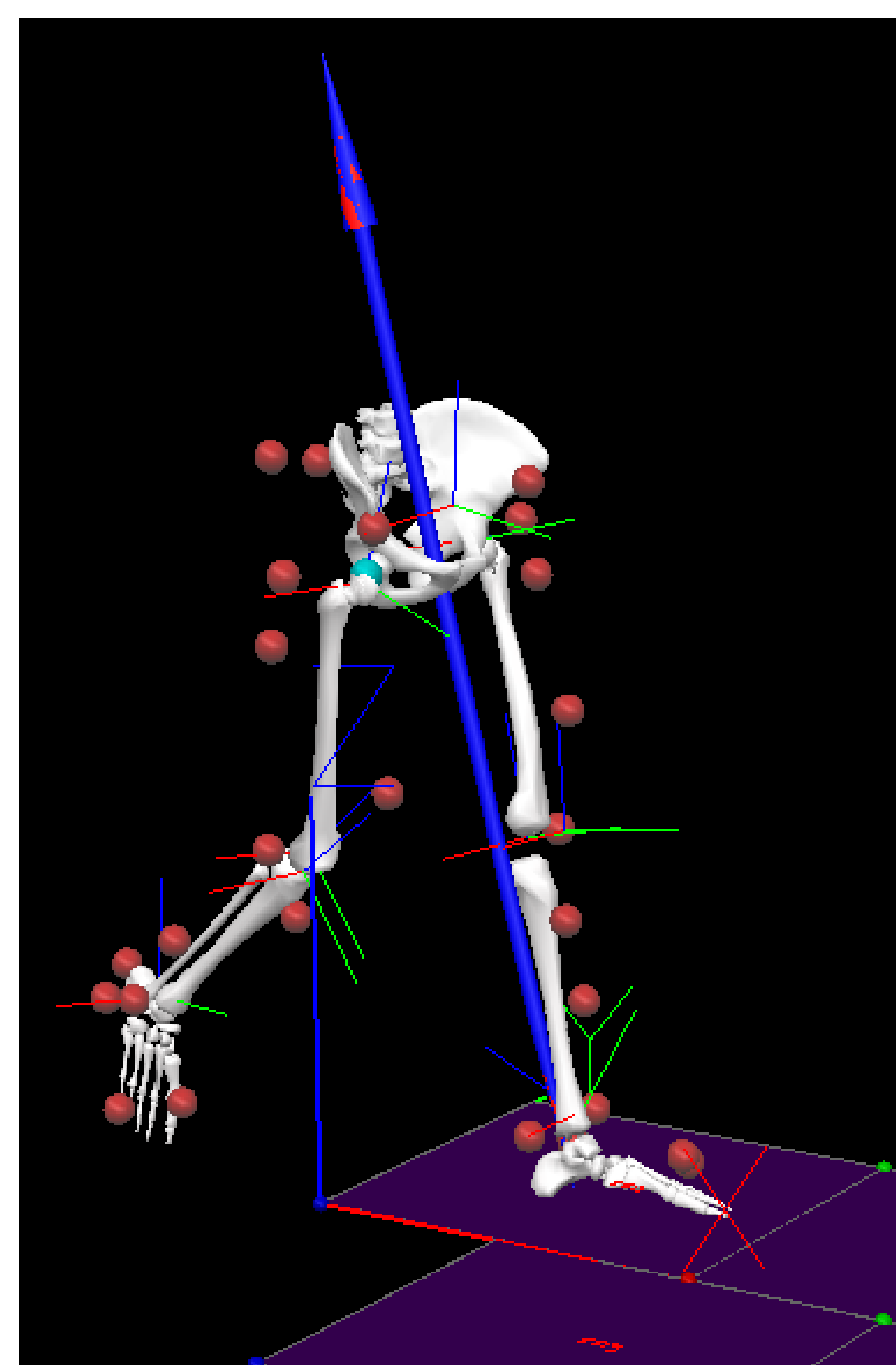
### Gait measurement

#### Subjects:

- 13 subjects with MS
- 45.8 ± 8.5 yrs, EDSS 2.3 ± 1.3

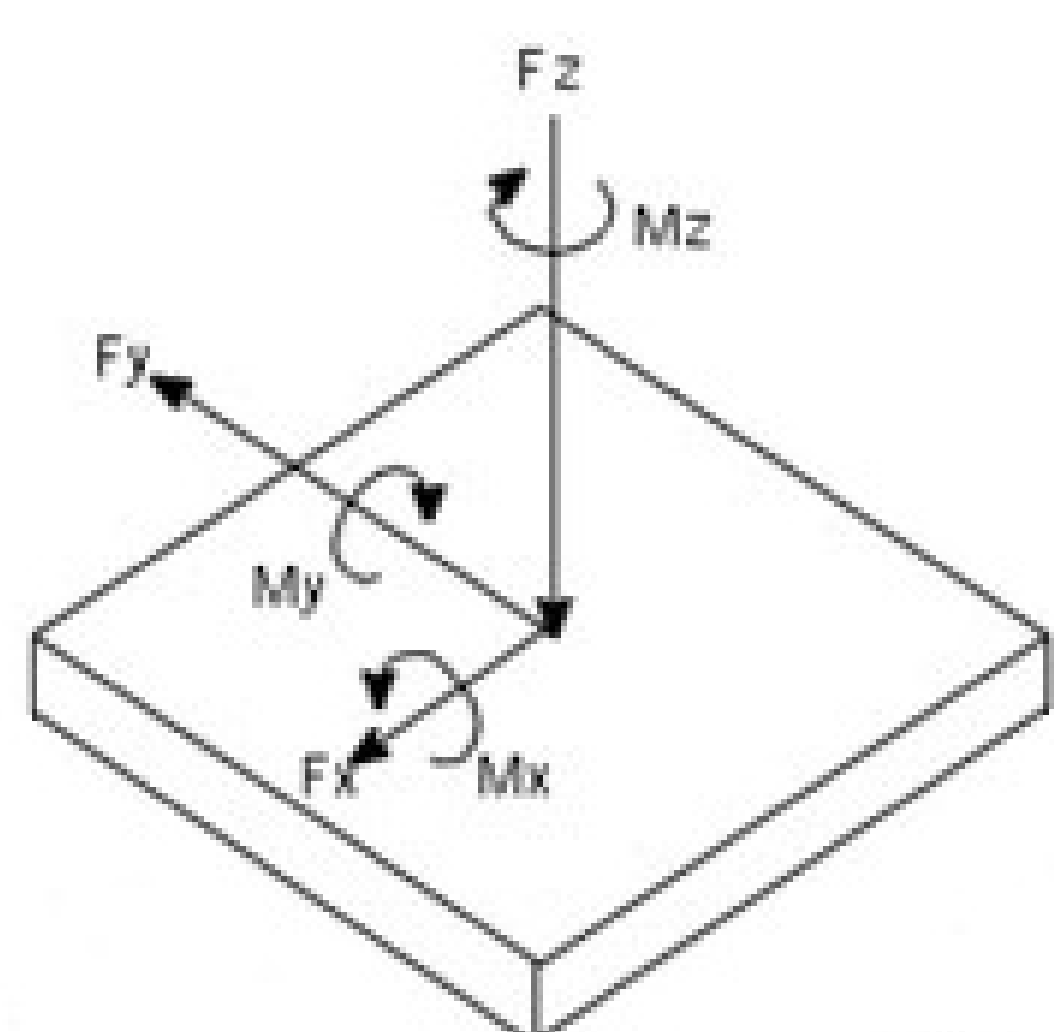
#### Gait Task:

- Overground walking across force platform (600 Hz) at self-selected pace.
- 10 total trials were completed for each subject.



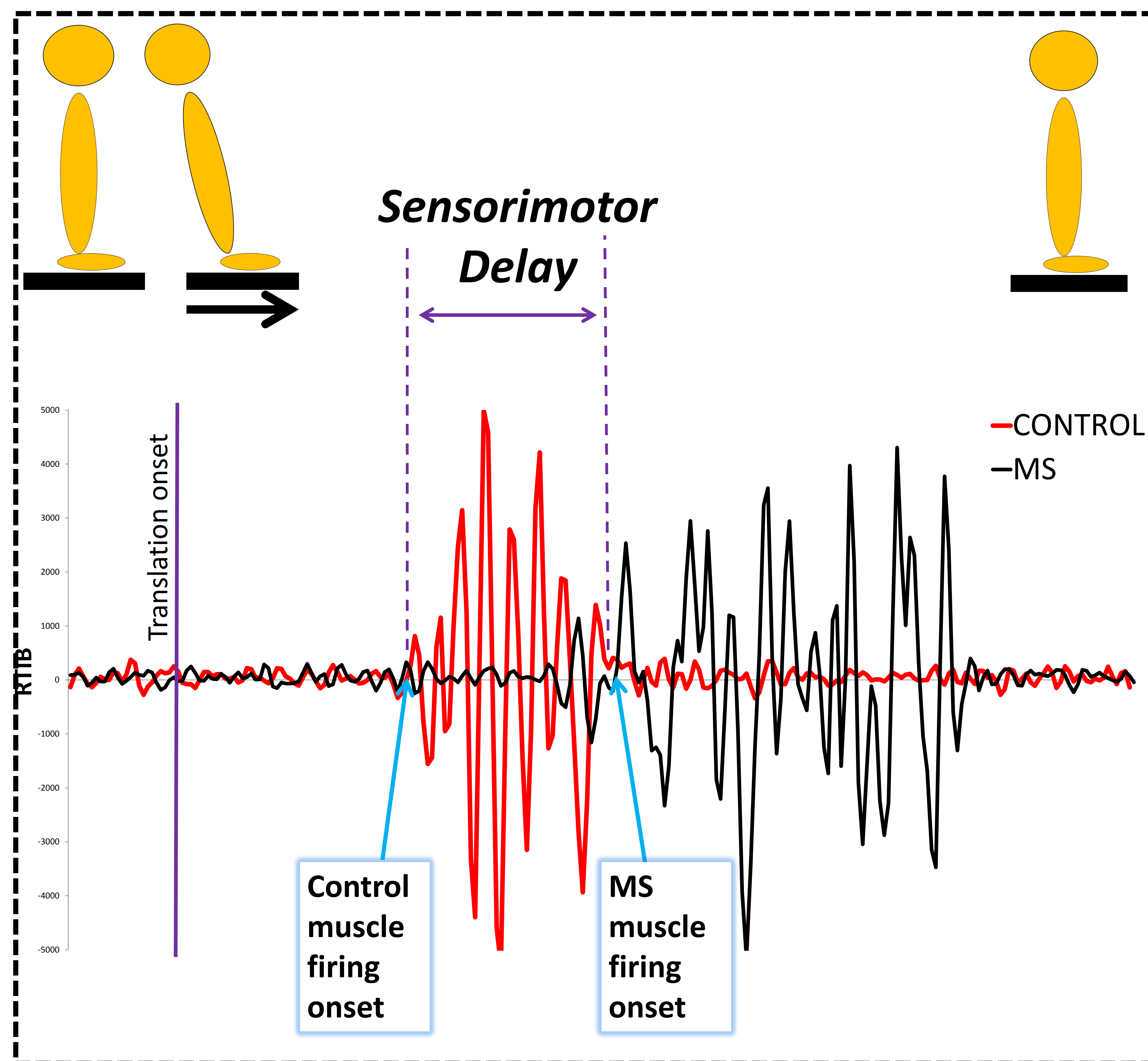
A subject's completed lower body model seen during completion of an overground walking trial.

- Calculated kinetic outcome variables:
  - Peak Torque:
    - Ankle Dorsiflexion (ADT)
    - Ankle Plantarflexion (APT)



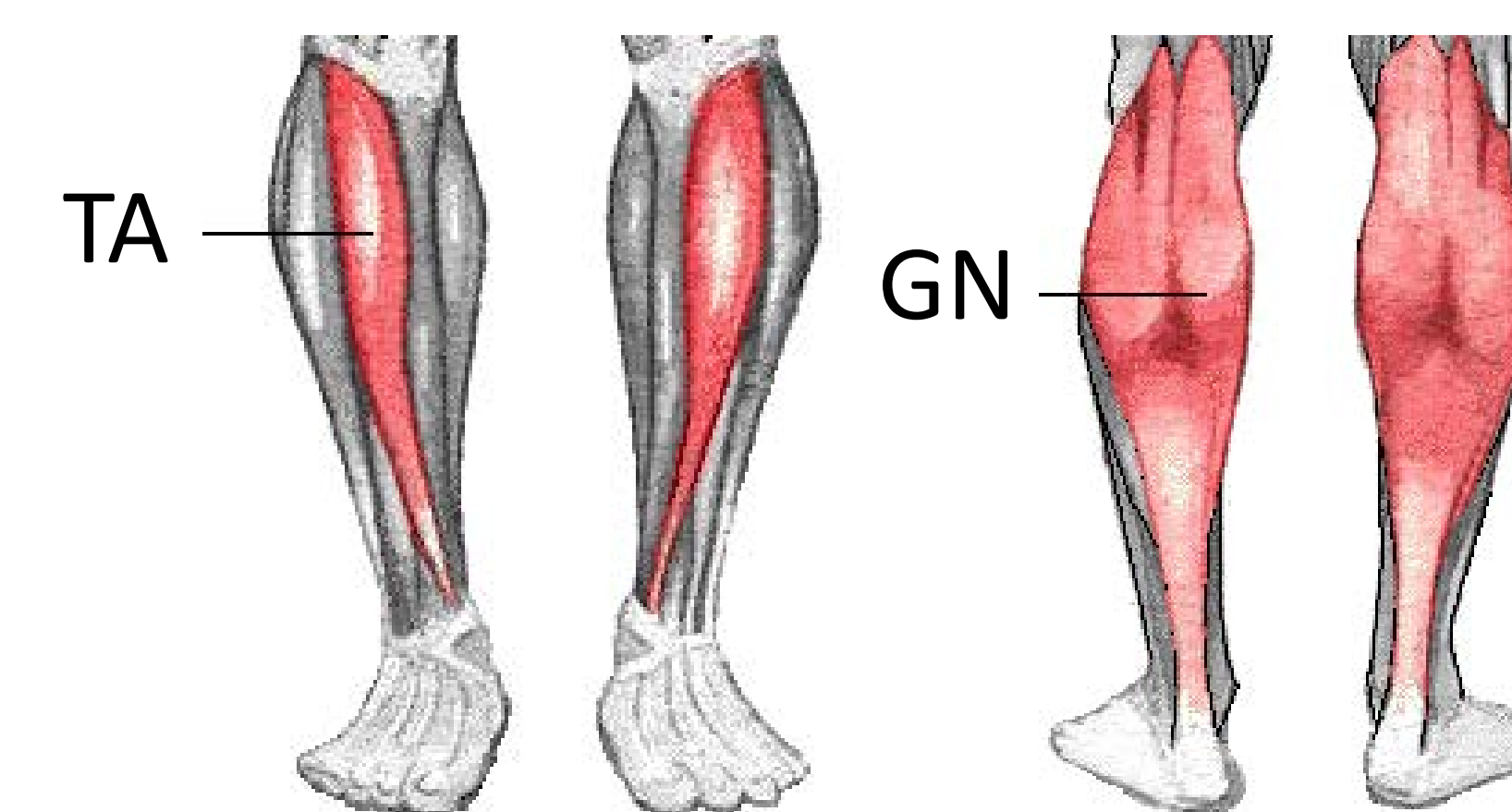
Peak joint torque was measured using an AMTI 6-axis force platform.

### Sensorimotor delay measurement



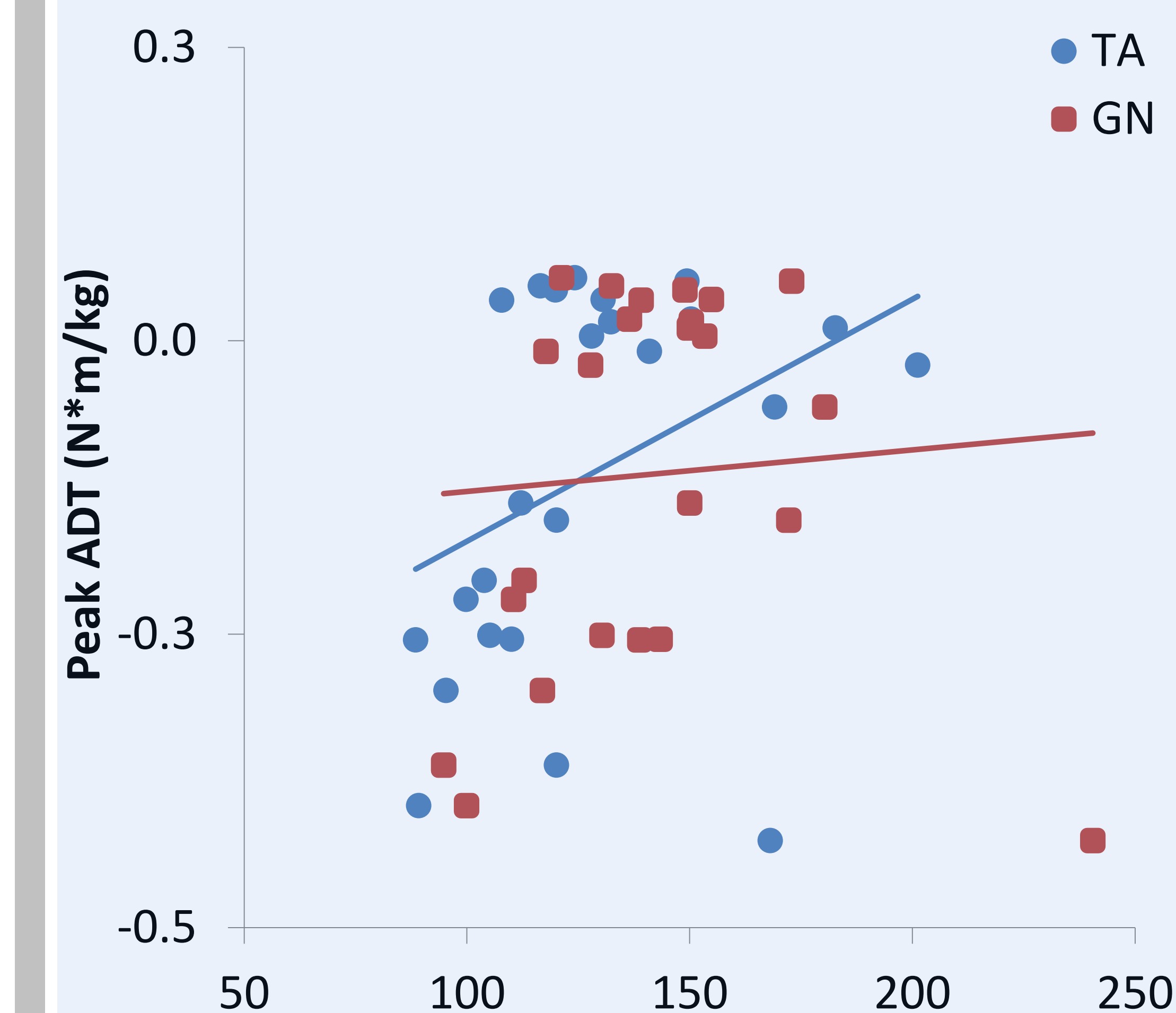
A subject prepares for a treadmill perturbation trial. The attached EMG sensors will identify the onset of activation of the TA and GN muscles.

- Forward translation occurred for 6 cm at 15 cm/s.
- Sensorimotor delays are measured from time of perturbation onset to first reactive EMG response in the tibialis anterior (TA) and medial gastrocnemius (GN).
- Average muscle firing onset time taken over three trials.



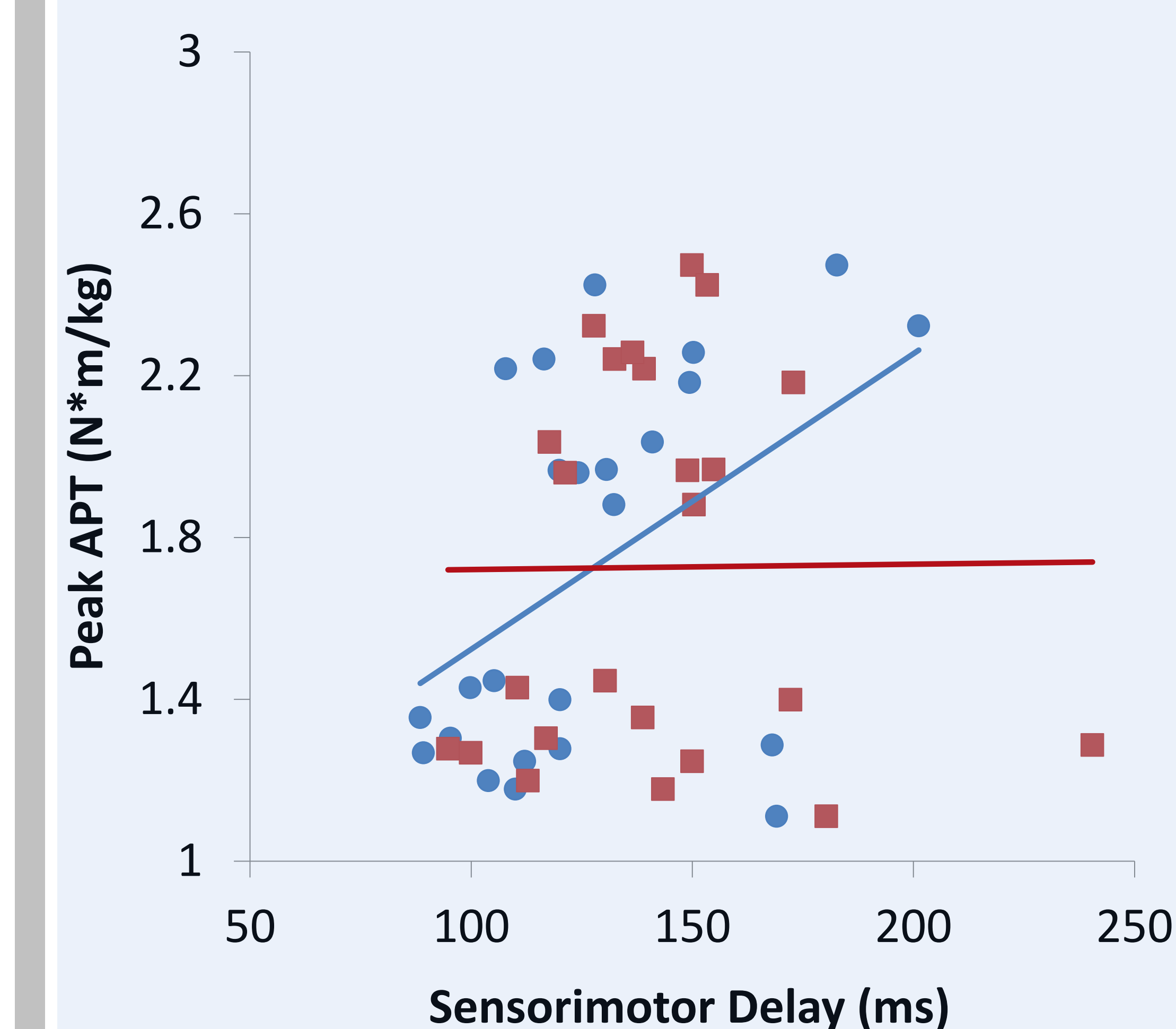
Front View  
Back View  
Delsys Trigno EMG sensors were affixed to the TA and GN muscles.

## Results



Mean Values	
TA delay (ms)	127.1 ± 27.4
GN delay (ms)	143.6 ± 30.7
Ankle plantarflexor torque (N*m/kg)	1.73 ± 0.47
Ankle dorsiflexor torque (N*m/kg)	-0.11 ± 0.16

Mean values for primary outcome variables.



Correlation	
	ρ
TA vs ADT	<b>0.579</b>
TA vs APT	<b>0.441</b>
GN vs ADT	0.225
GN vs APT	0.900

Values in green indicate significant correlation between sensorimotor delay and joint kinetics.

## Conclusions

- Results indicate that for persons with MS, sensorimotor delays are strongly related to deficits in dorsiflexor and plantarflexor torque at the ankle during stance.
- This indicates that it is likely not only strength deficits of the muscles of the lower limbs which contribute to changes in gait kinetics in persons with MS.
- Instead, delays in somatosensory feedback and motor responses in persons with MS directly contribute to changes in gait kinetics.

## Acknowledgements

Support for this work was provided by the National Multiple Sclerosis Society (RG4914A1/2) and by the Frontier's Clinical Pilot Award.