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Improving Balance and Mobility in People with Multiple Sclerosis

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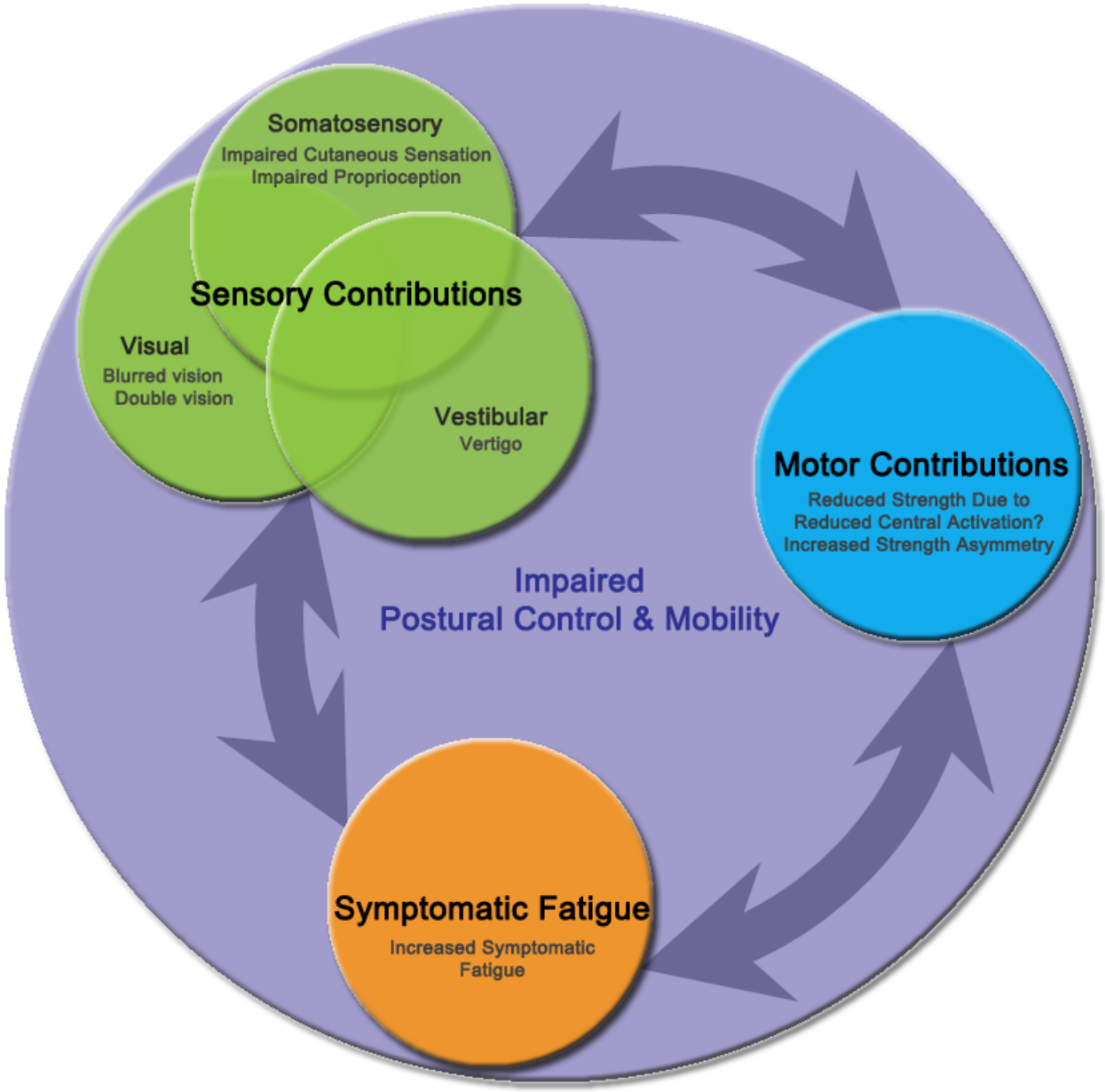
Overview

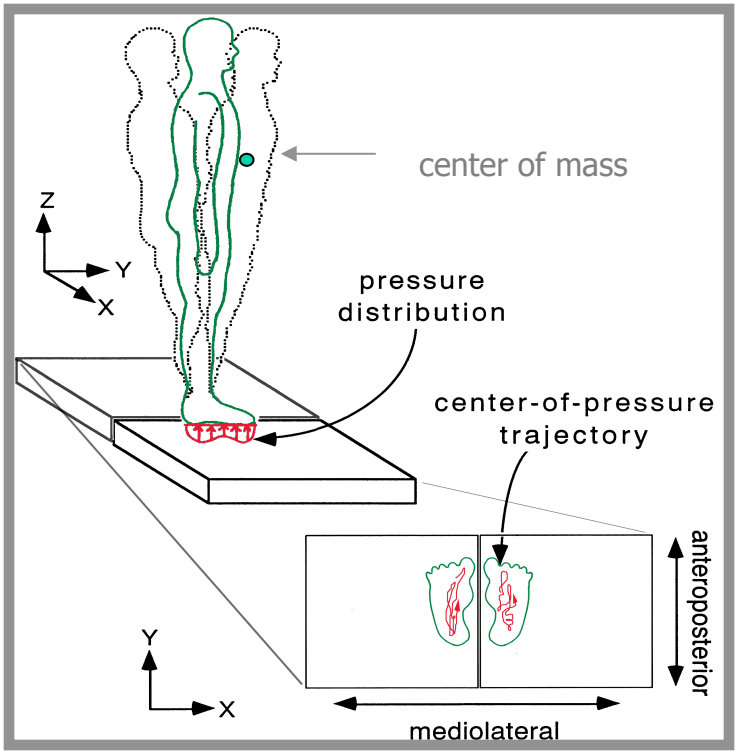
- Postural and gait impairments in MS
- Interventions to improve balance and gait

Disclosure: *I have no financial disclosures to report regarding this presentation*.

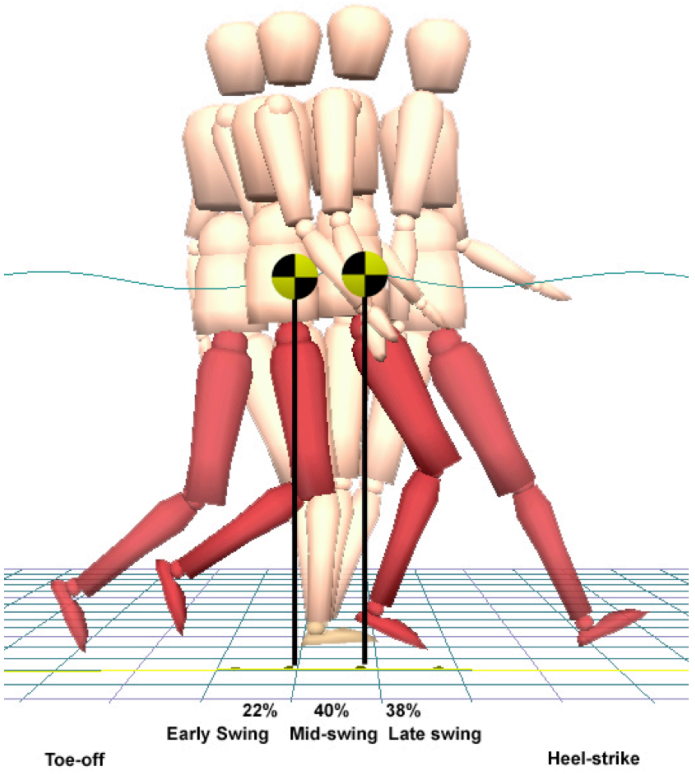

Somatosensory
Impaired Cutaneous Sensation
Impaired Proprioception
Sensory Contributions
Visual
Blurred vision
Double vision
Vestibular
Vertigo
Motor Contributions
Reduced Strength Due to
Reduced Central Activation?
Increased Strength Asymmetry
Impaired
Postural Control & Mobility
Symptomatic Fatigue
Increased Symptomatic
Fatigue

Postural control and walking in MS

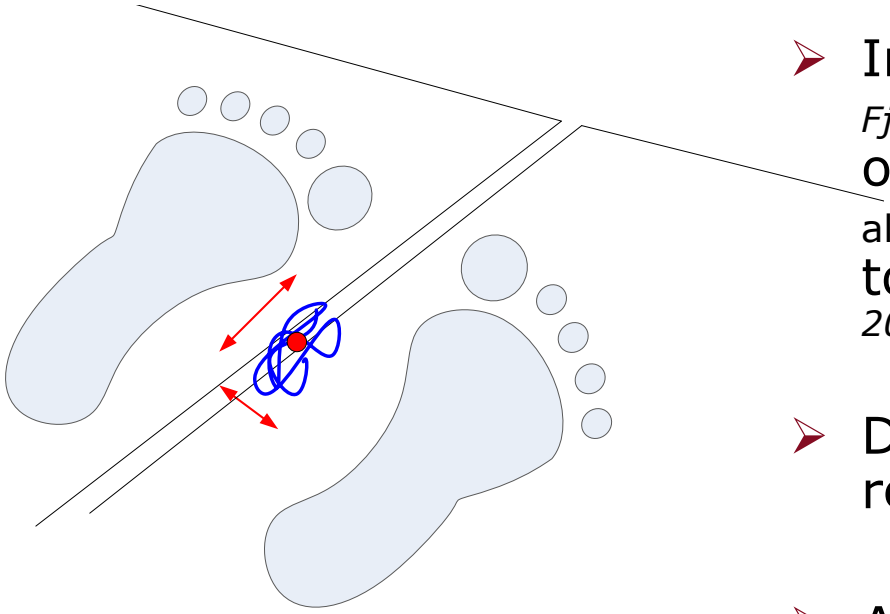
Postural control



Control of walking

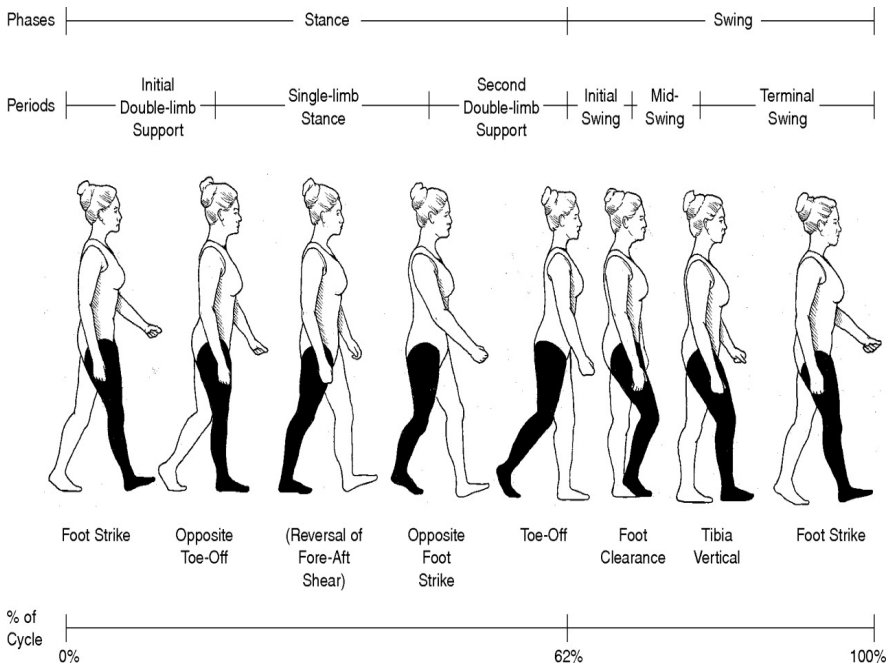


Postural Changes in MS



- Balance dysfunction has been reported by up to 90% of individuals with MS (Ford et al., 2001; Hemmet et al., 2004)
- Increased CoP sway *(Chung et al., 2008; Fjeldstad et a., 2009)*; changes with level of disability (Boes et al., 2012; Corporaal et al., 2013); reduced temporal margins to stability boundary *Van Emmerik et al., 2010; Cattaneo et al., 2012)*
- Delayed automatic postural responses (Cameron et al., 2008)
- Association between lower limb muscle power asymmetry and postural instability/fatigue (Chung et al., 2008)

Changes in stride parameters during walking

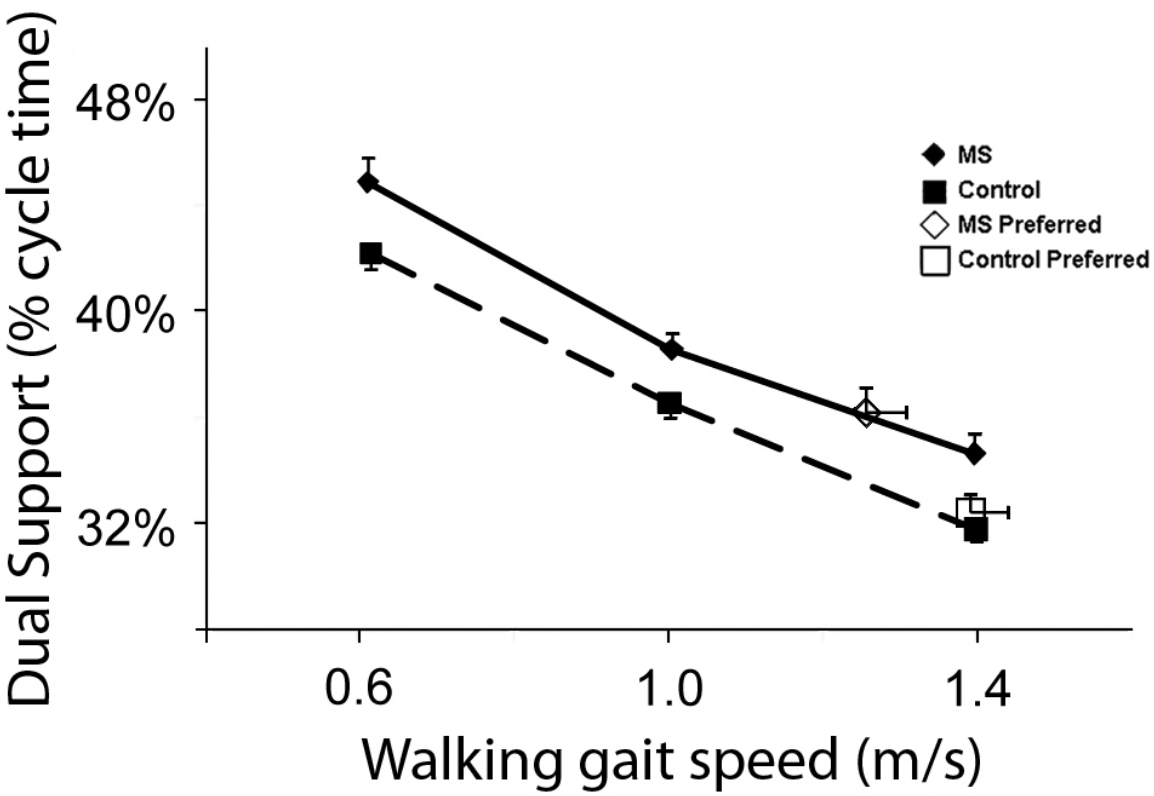


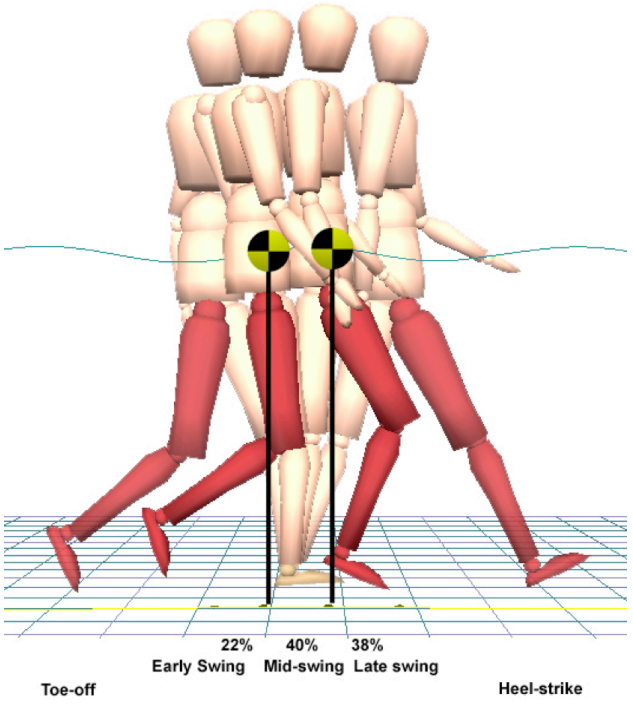
The Normal Gait Cycle, adapted from Sutherland et al., 1994

- Slower preferred speed
- Shorter stride length
- Wider stride width
- Longer dual support time

Benedetti et al. (1999); Martin et al., (2006); Kelleher et al. (2010); Remelius et al. (2012)

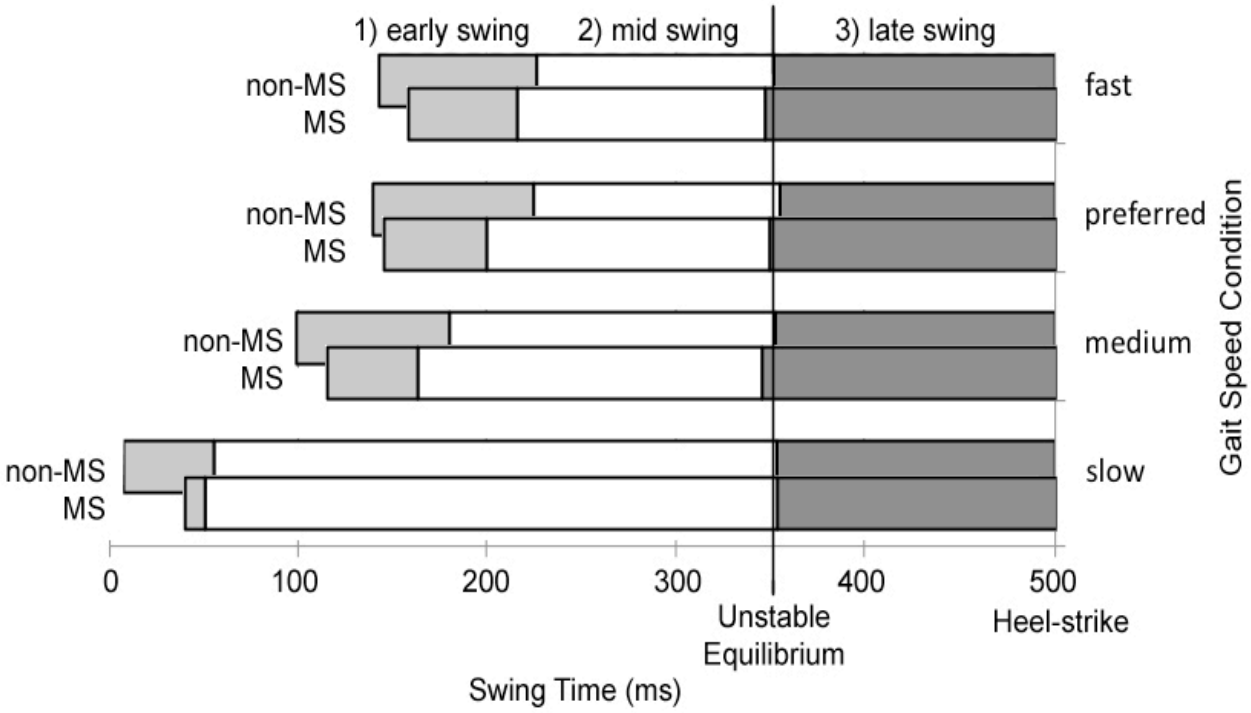
Longer dual support: all speeds

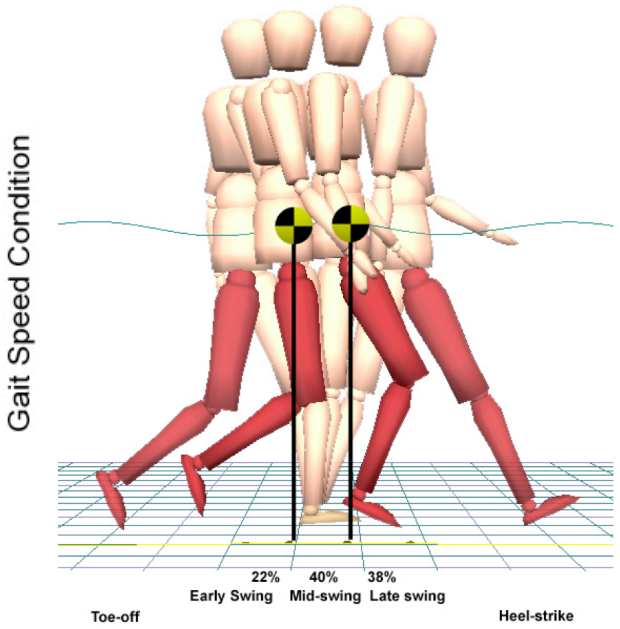




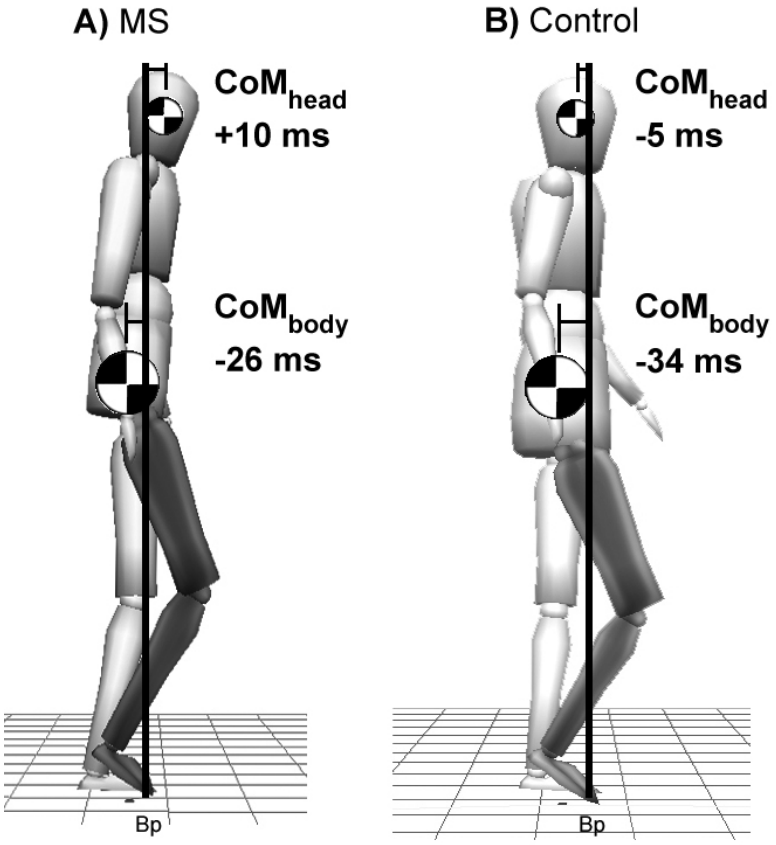
Remelius et al. (2012) Archives of Physical Medicine and Rehabilitation

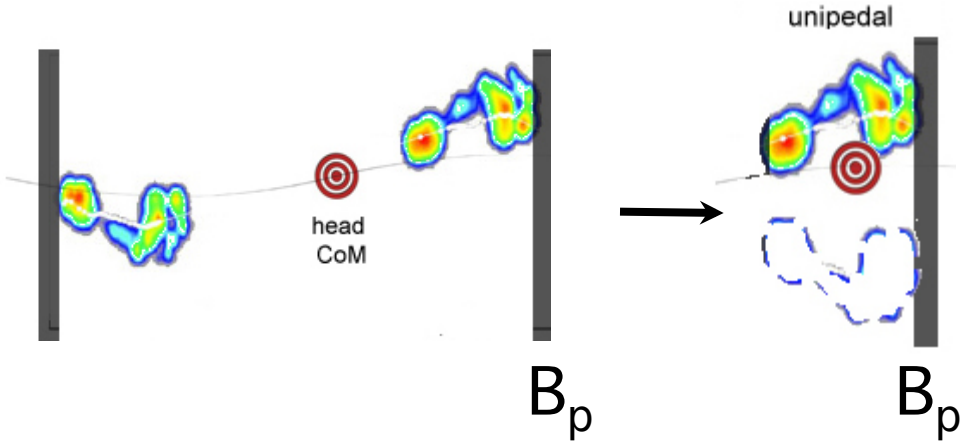
Swing phase of walking





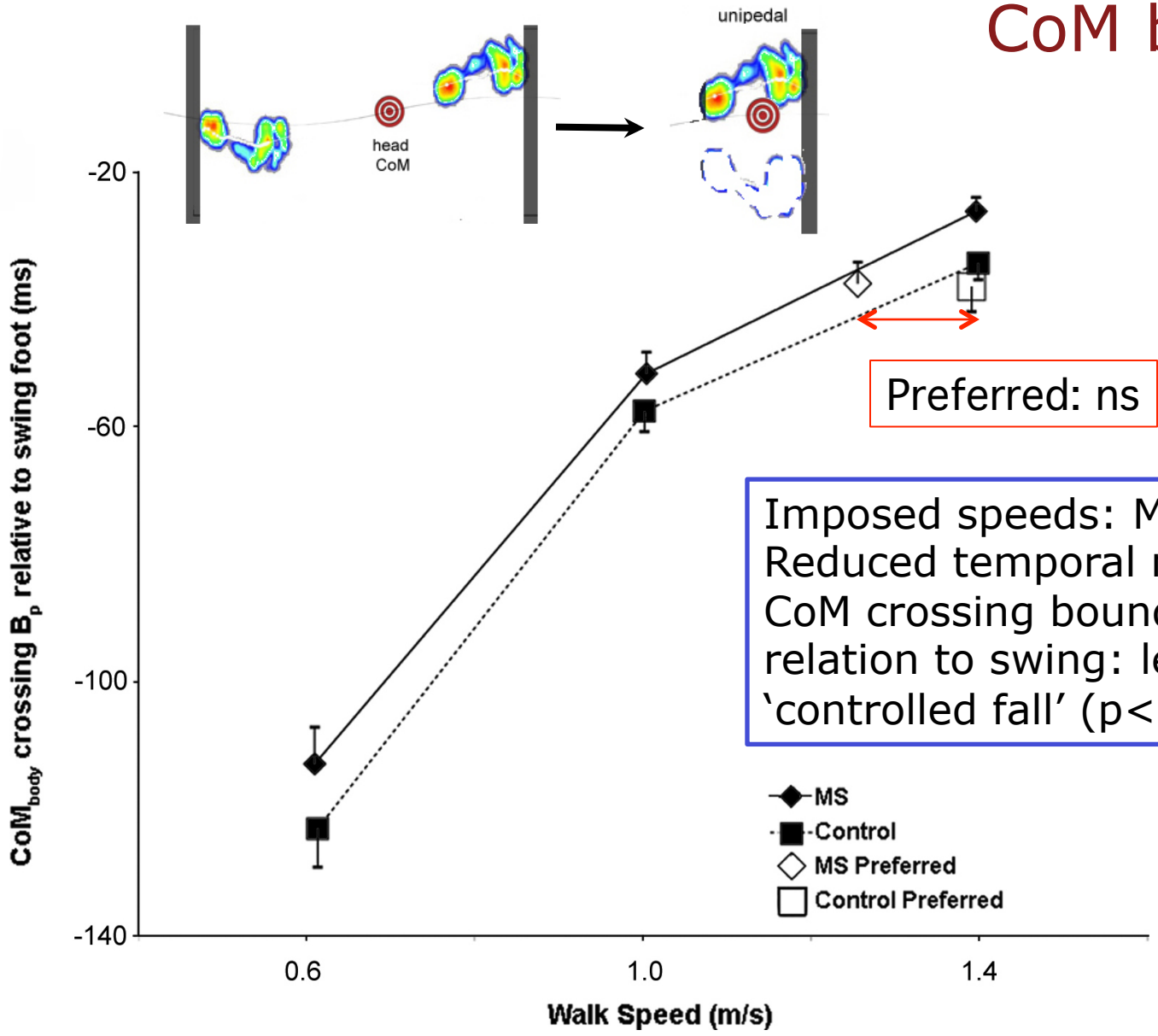
Approach of CoM/swing foot to unstable equilibrium





B_p=physical (toe) boundary

CoM body

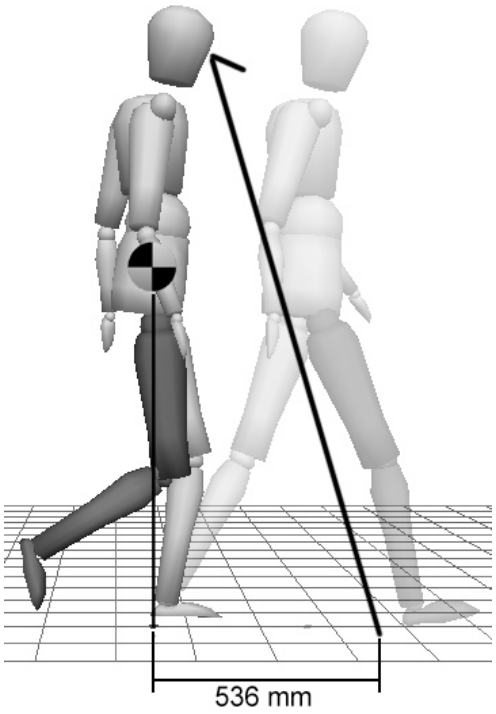


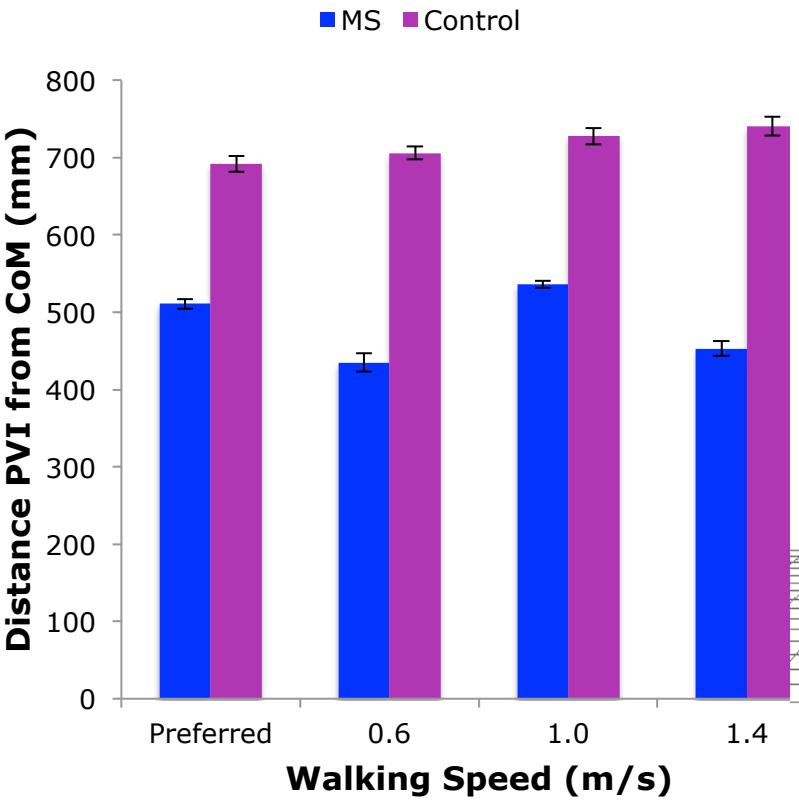
Preferred: ns

Imposed speeds: MS group: Reduced temporal margin of CoM crossing boundary in relation to swing: less of a 'controlled fall' ($p<.005$)

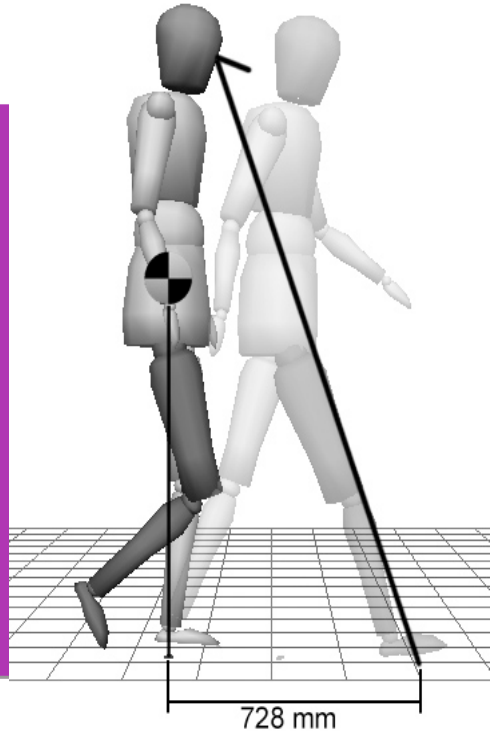
Head motion: projection on ground

MS





Control



Balance and mobility intervention research

- Review exercise interventions (aerobic exercise; flexibility; strength; balance training); while each has proven beneficial in MS, a more comprehensive intervention program for individuals with MS is needed that integrates all (Asano et al. 2009).

- An 8-week intervention that used a combination of aerobic, resistance, and balance training to reduce symptom severity: improved mobility and strength (Motl et al., 2012).

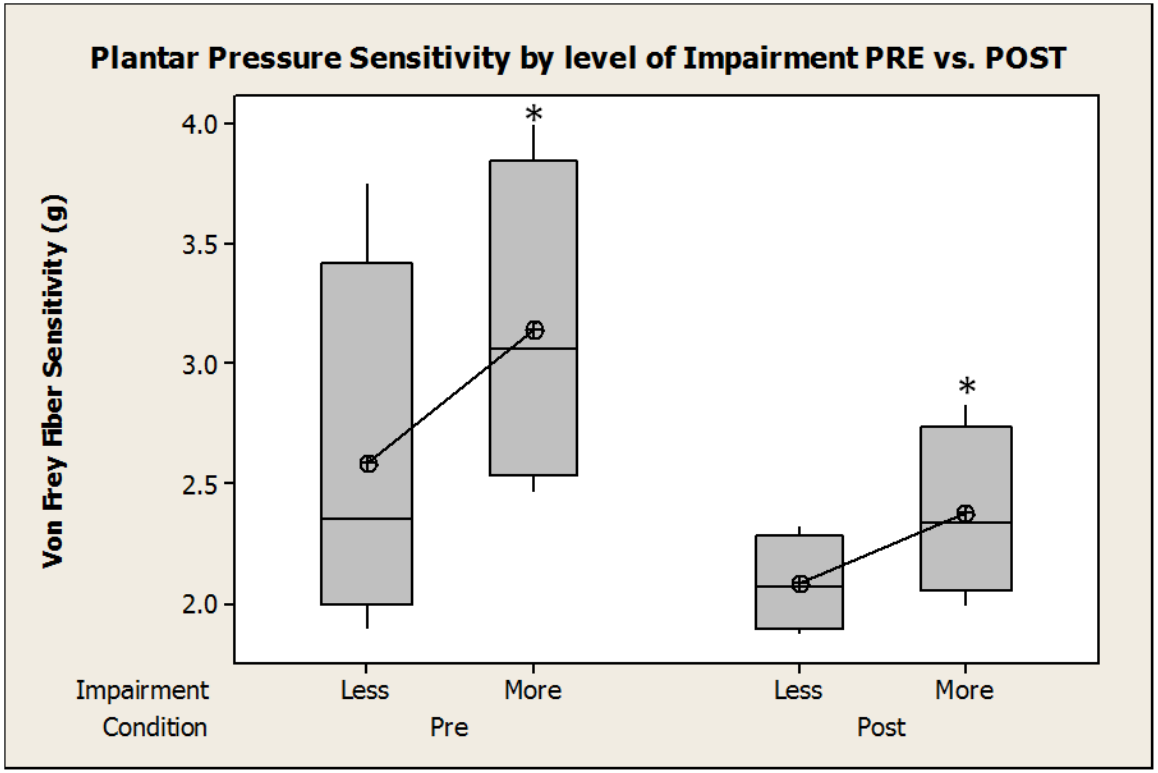
- Tai Chi intervention: Increases in 25ft walk speed; Hamstring flexibility; psychosocial wellbeing; Reduction in depression and improved balance (Husted et al., 1999; Mills et al., 2000).

Tai Chi and MS

- Tai Chi intervention: 3-week intervention (standing meditation; Tai Chi slow walking) with balance, gait, strength and neural drive assessments (Averill, 2013; n=8)

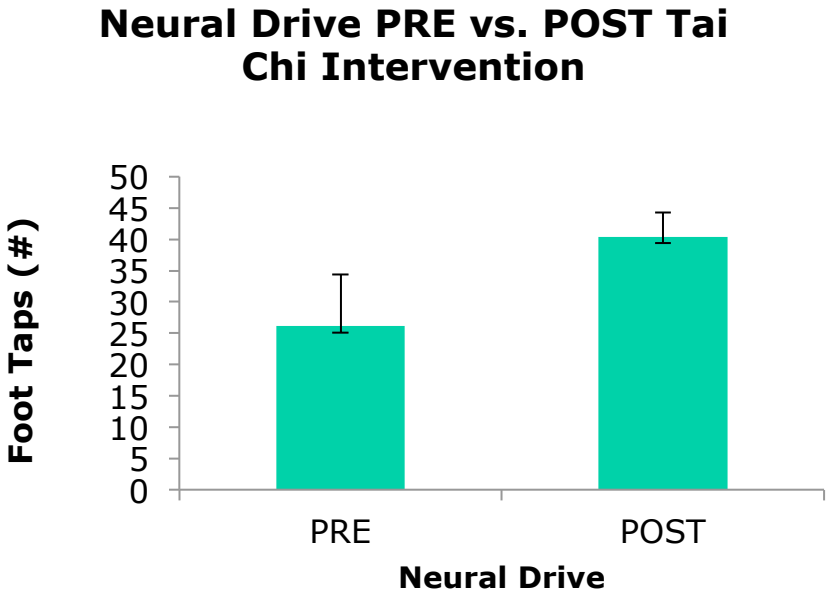
- Pre-post intervention comparisons of:
  - Sensorimotor and functional assessments – plantar sensation; chair rise time (strength) and toe taps (neural drive)
  - Postural control – static and dynamic
  - Psychosocial wellbeing (Multiple Sclerosis Impact Scale -MSIS-29)
  - Fatigue (Fatigue severity score – FSS)

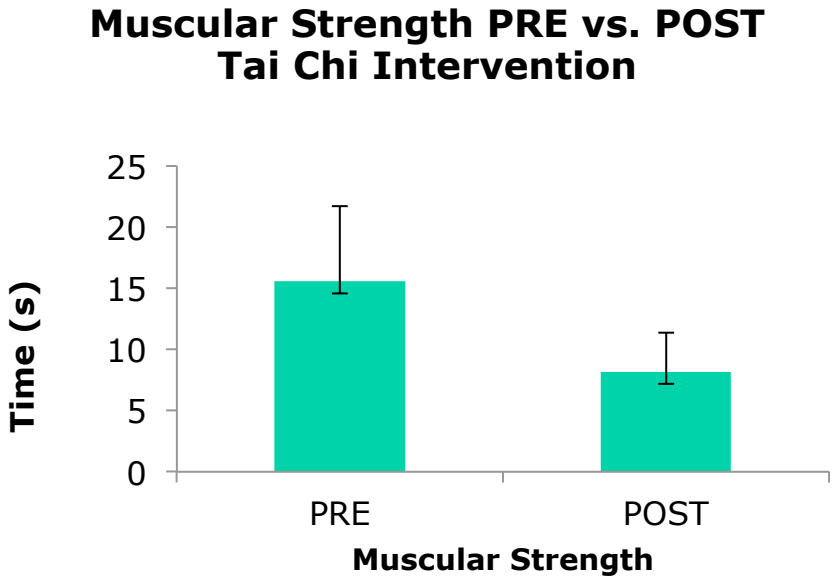
Tai Chi intervention: pressure sensitivity



Increased plantar pressure sensitivity (decreased threshold) in more impaired foot after intervention (p=.02)

Tai Chi intervention: Functional assessments

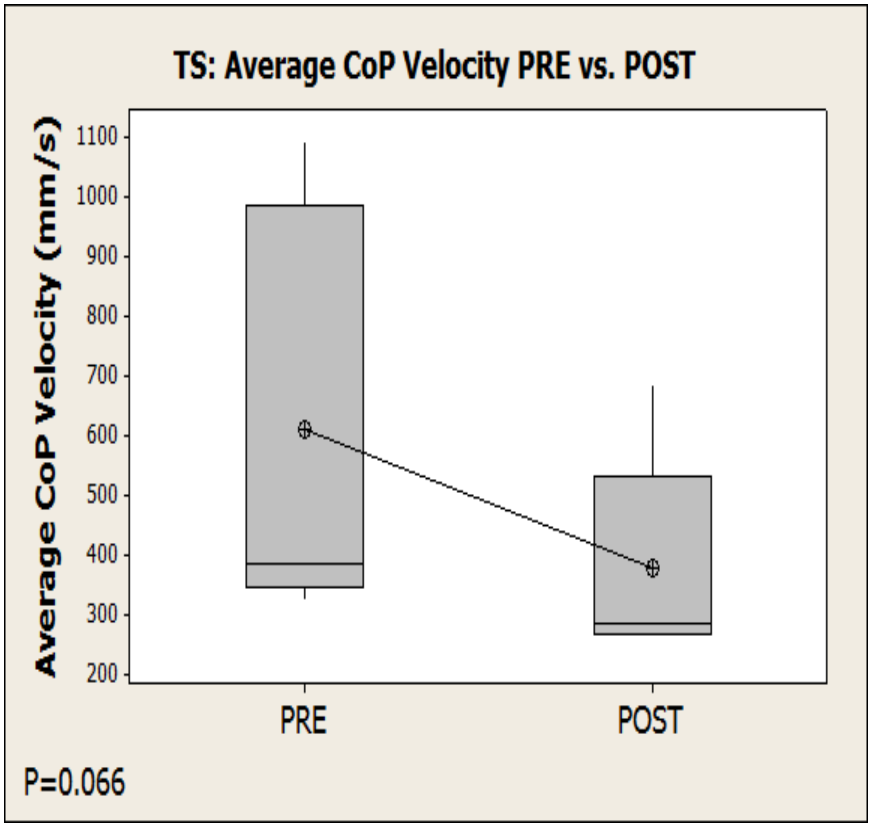




Increased in neural drive
foot taps (p=0.024)

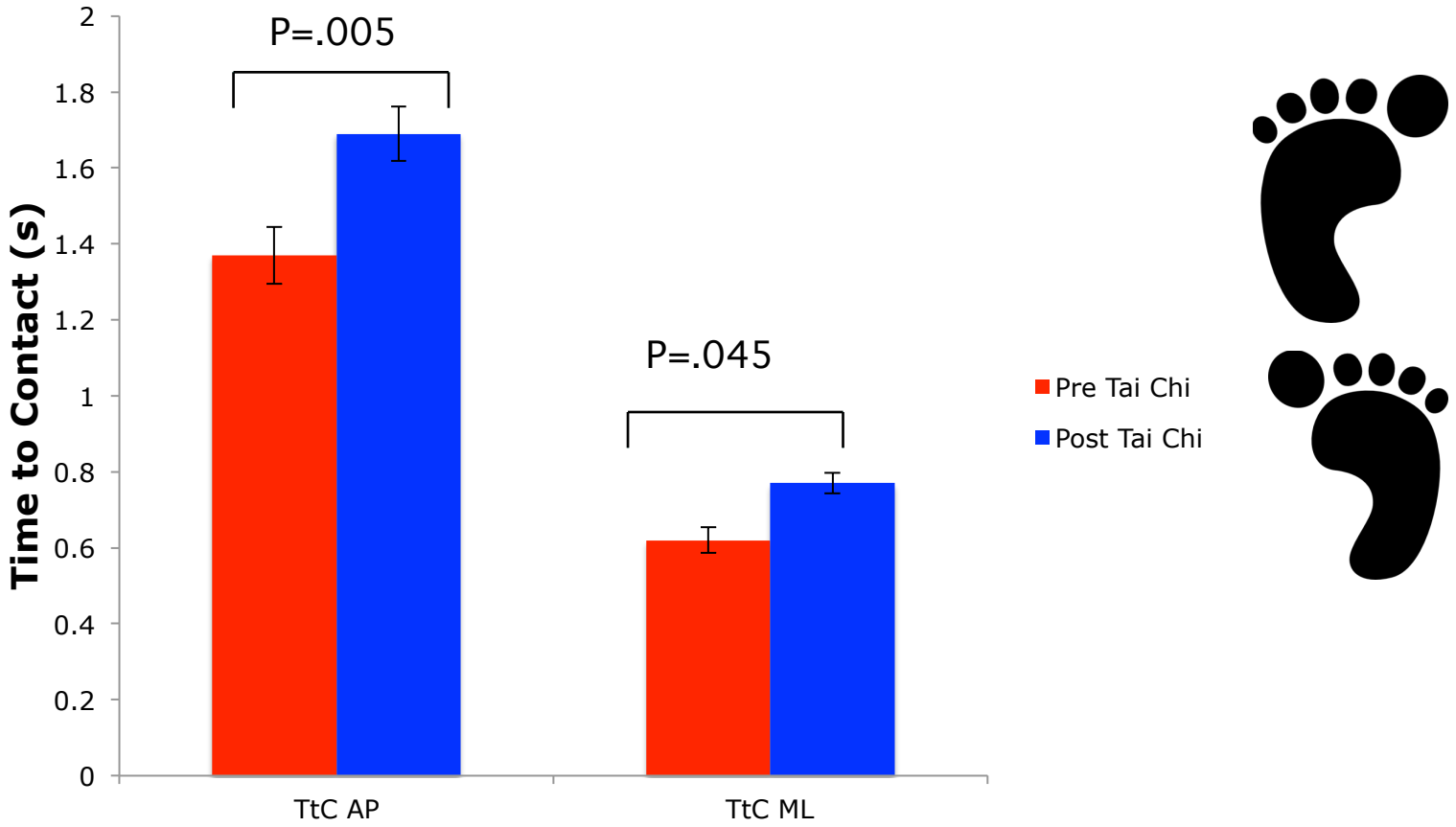
Decreased time to complete 5 chair raises
-> increased muscular strength (p=0.025)

Tai Chi intervention: postural control

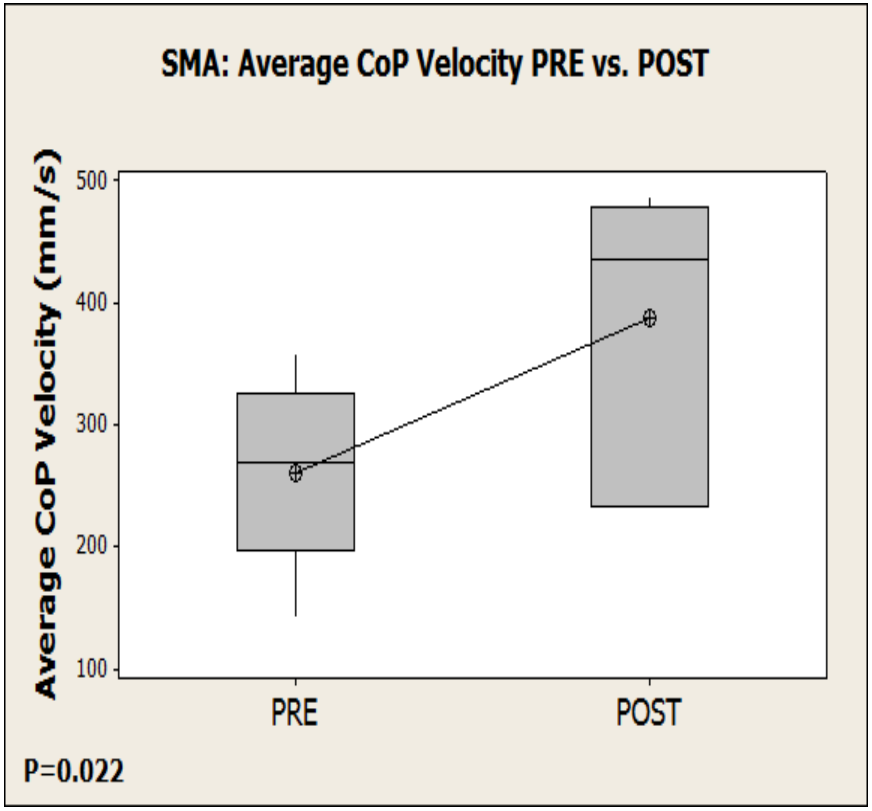


Static balance : tandem stance; Postural sway velocity decreased (p=.066), showing increased static balance control

Tai Chi intervention: Tandem Stance



Tai Chi intervention: postural control



Dynamic balance: standing mediation with arms movement; CoP velocity increased (p=.022), showing increased dynamic balance control

MSIS and symptomatic fatigue

- Total psychosocial wellbeing (MSIS) increased (p=0.032) after the Tai Chi intervention

- No changes in general fatigue or leg specific fatigue were observed after the intervention. Fatigue Severity score (FSS; Krupp et al., 1988)

	PRE	POST	P	95% CI
FSS General Score	44.29±11.89	37.86±15.22	0.132	-2.59 to 15.45
FSS Leg Score	29.29±7.11	28.71±10.47	0.855	-6.76 to 7.90

Conclusions

- Developing body of knowledge of postural and gait impairments in people with MS
- Walking speed is decreased; this could be due to changes in neural drive, muscle contraction speed/atrophy, different use of vision, and/or fear of falling
- Functional adaptations exist through increased dual support times. However, this may result in a potentially less stable swing phase through altered coordination of center of mass and and swing foot during the controlled forward ‘fall’
- Head motion is modulated in MS to have field of view closer to body and sooner after toe-off; possible compensation for loss of cutaneous and proprioceptive systems

Conclusions

- Tai Chi intervention can potentially improve multiple functional systems (somatosensation; neural drive; strength and balance) and reduce fear of falling
- Larger scale intervention studies needed to assess the effects of integrated aerobic exercise, flexibility, strength and balance training programs
- Physical activity and fitness are associated with lower incidence of morbidity and mortality from major chronic disease (DiPietro, 2001)

Acknowledgements

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