Evaluation of the Effect of Removable Cast Walkers on Spinal Alignment and Gait

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Introduction

- Offloading is a critical part of treating the diabetic foot ulcer (DFU)
- Removable cast walkers (RCW) are commonly used to offload DFU
- Treatment adherence with RCW can be problematic[Crews et al, 2016, Armstrong et al 2003]:
  - only 28% on average and high adherence was considered 60% (n=20, 7 day monitoring period)[Armstrong et al 2003]
  - ~60% on average (n=79, 6 weeks monitoring period)[Crews et al, 2016]

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Causes for non adherence

- Induced limb length discrepancy (LLD) causing
  - Knee and hip pain [Defrin et al 2005]
  - Increased demand on knee extensors [Zhang et al 2006]
  - Increased oxygen consumption and perceived exertion [Gurney et al 2001]
- Gait and postural instability [van Deursen et al 2008, Crews et al 2016]
- Limited evidence exists on effects of RCW on spine alignment during gait

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Purpose

Objectively evaluate the effect of

- RCW
- Contralateral limb lift

on spinal alignment and gait

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Methods

	Mean	SD
Age (years)	24.33	2.47
BMI (Kg/m^2)	23.71	2.80

- 15 participants (13M; 2 F)
- <u>Inclusion Criteria:</u>
  - 18 years of age or older
  - Ambulatory without need for assistive device (cane/crutch)
- <u>Exclusion Criteria:</u>
  - Previous diagnosis of scoliosis
  - LLD that required treatment/intervention
  - History of back or lower extremity neuromuscular/skeletal surgery

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Methods

- Three different footwear conditions were evaluated:
  - Laboratory standardized shoes
  - RCW with standardized shoe on contralateral foot
  - RCW and standardized shoe plus lift on contralateral foot
- Quiet standing and treadmill walking was assessed in each condition

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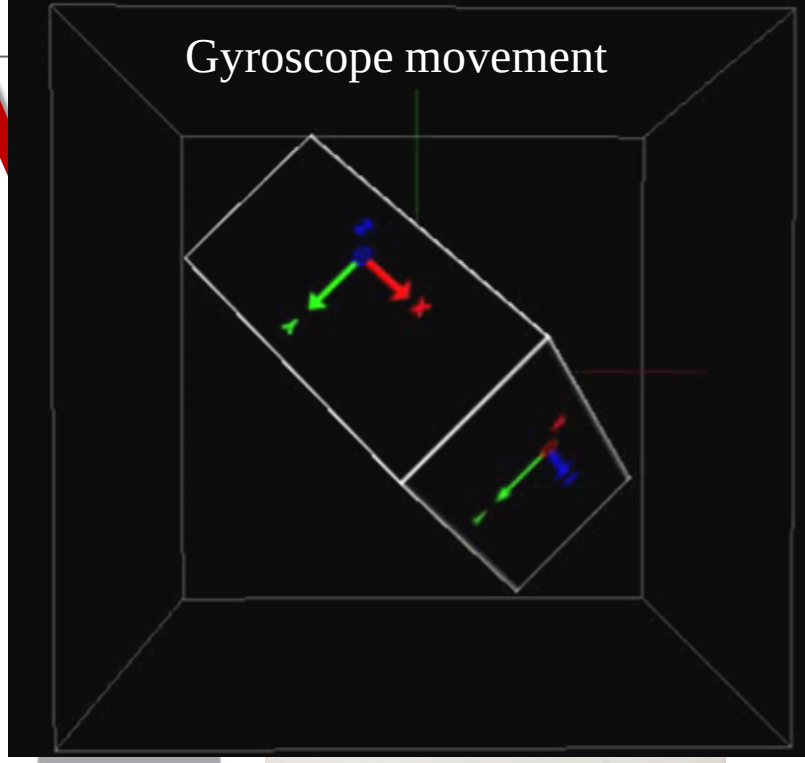

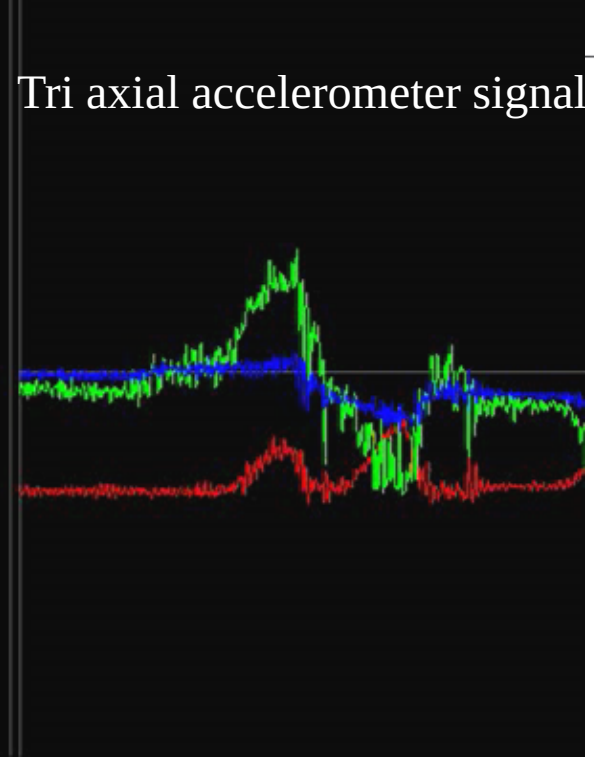

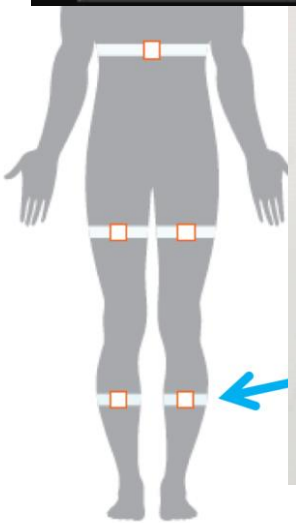

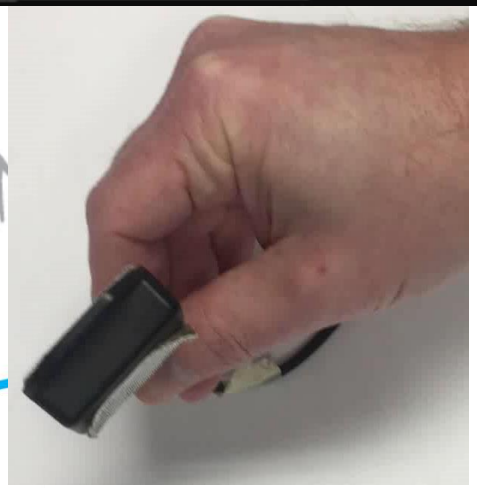

Variables measured:

- Stride length
- Swing and Stance
- Knee range of motion
- Center of mass displacement

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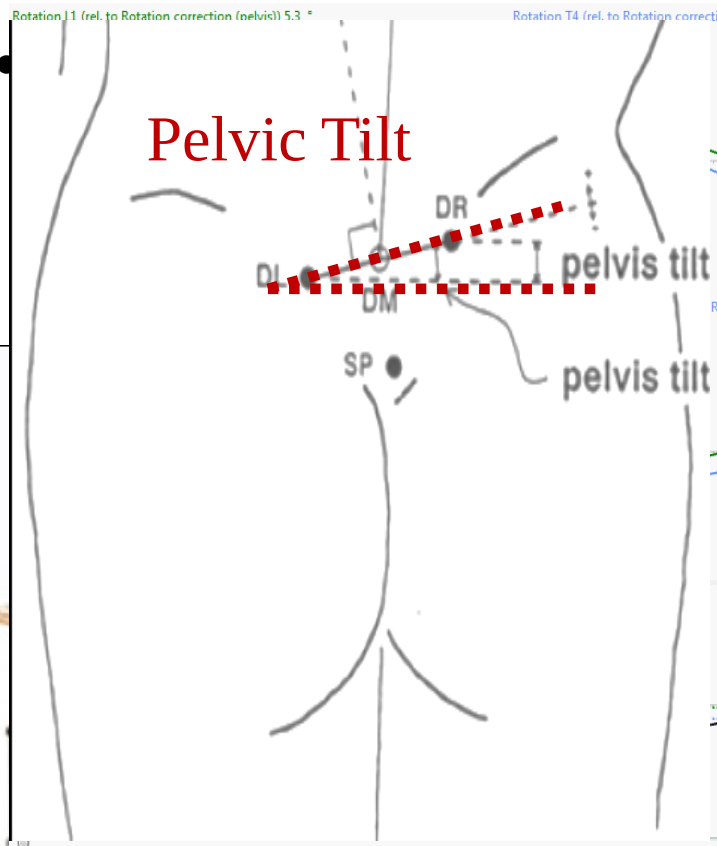
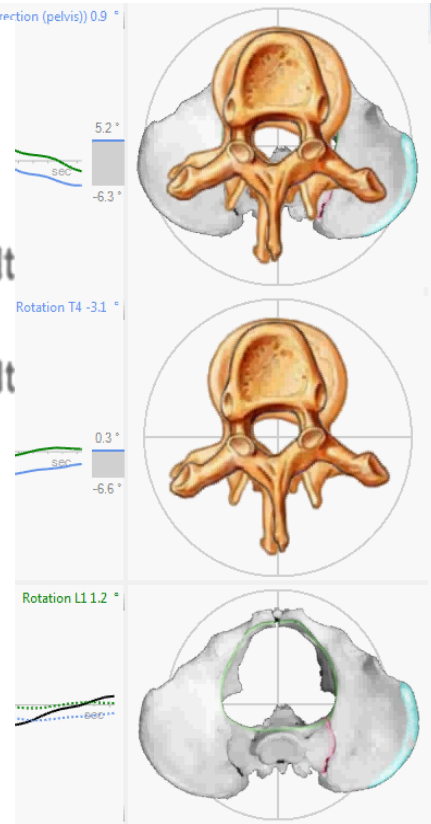
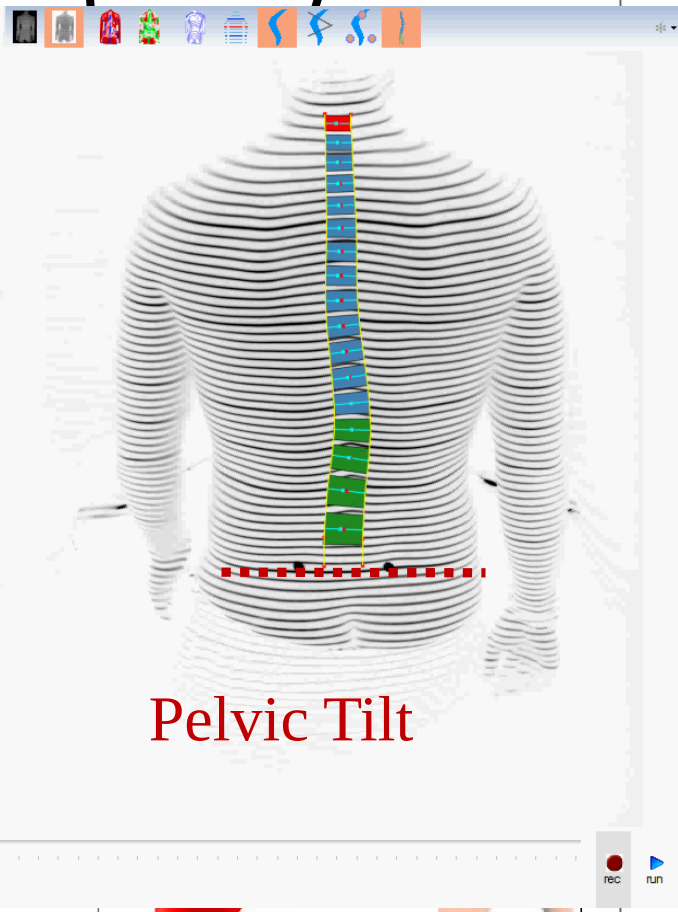
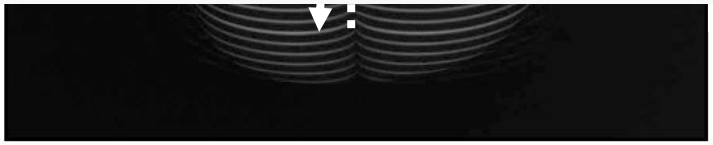
Methods









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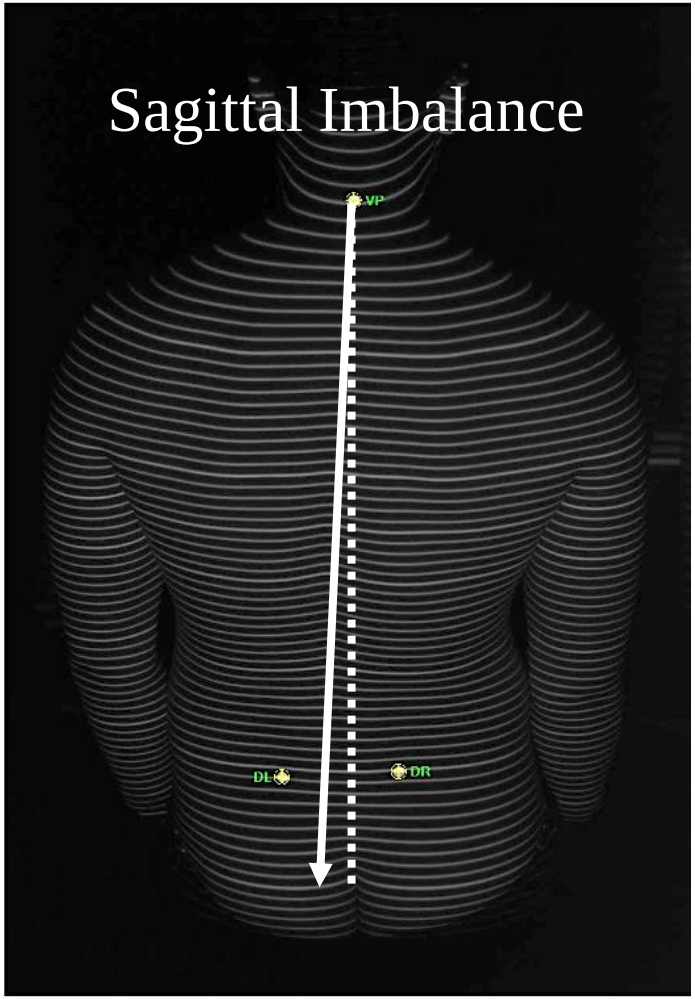
Results

Quiet standing:

Compared to control condition of *Standardized Shoes*

- Sagittal imbalance was significantly altered with *RCW+Shoe* (ANOVA, p=0.026)
- No significant changes with *RCW+Lift* (ANOVA, p>0.05)



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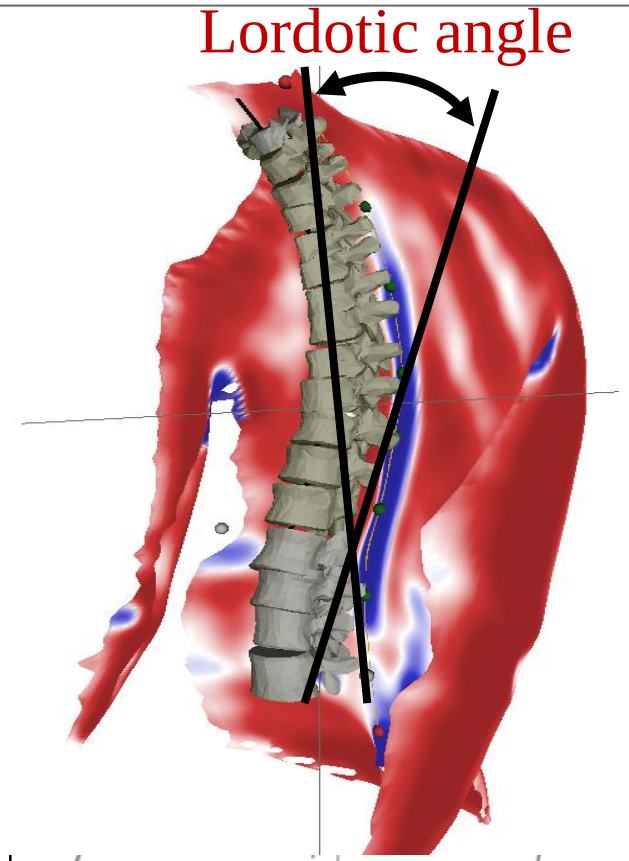
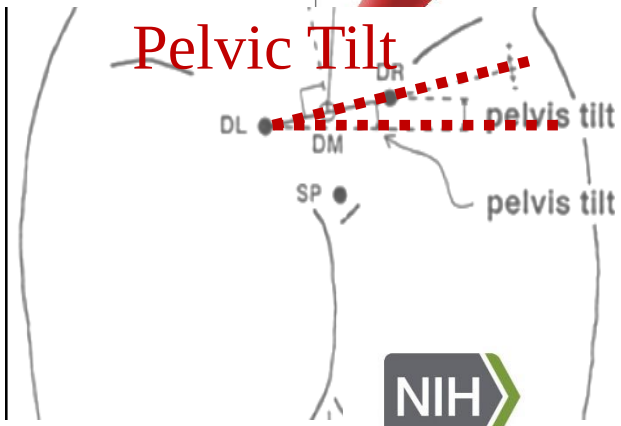
Results

<u>Walking</u>:

Compared to control condition of *Standardized Shoes*

- Pelvic tilt (ANOVA, p=0.003) and lordotic angle (ANOVA, p=0.033) altered with use of *RCW+Shoe*
- No significant changes with *RCW+Lift* (p>0.05)





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Results

Gait parameters:

Compared to control condition of *Standardized Shoes*

- No significant differences were found in Knee range of motion (ROM) and Center of Mass displacement (CoM D) compared to *RCW+Shoe* and *RCW+Lift* (ANOVA, $p>0.05$)

n=10	Standard Shoe	RCW+Shoe	RCW+Lift
Knee ROM (º)	**69.28±11.54**	**64.49±9.96**	**66.61±8.86**
CoM D (cm)	**0.87±0.28**	**0.321±0.396**	**-0.062±0.38**

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Limitations

- Young healthy participants
- Single RCW was evaluated
- Contralateral lift was not customized to match RCW/Shoe offset
  - However, lift is inexpensively and commercially available
- Assessments limited to initial exposure to device, long term adaptations uncertain

Discussion/Conclusion

- The RCW induced changes in spinal alignment that could contribute to back pain and subsequently poor RCW adherence
- However, a contralateral lift may improve RCW adherence by mitigating spinal alignment which may increase adherence
- This study lays a foundation for future studies to explore functional and behavioral adaptations to RCW use and the efficacy of using a contralateral lift

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Thank you

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