Design of a Low-cost Unilateral Hip Brace for Gait Training

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PURPOSE

- To present the development of a passive unilateral hip brace for gait training
- Long-term objective: use the hip-brace in a future research study to influence asymmetric gait patterns by introducing errors

INTRODUCTION

Why design a passive unilateral hip brace?

- Many individuals with neurological diseases (e.g.., Multiple Sclerosis or Stroke) experience asymmetric gait patterns [1,2]
  - ➡ Reduced overall preferred walking speed
  - ➡ Reduced lower extremity ROM (affected limb)
  - ➡ Reduced step lengths (affected limb)
- Robotic exoskeletons (wearable devices) have proven successful at influencing the kinetics and kinematics of walking gait [3,4]
  - ➡ However, the cost of materials, the time to set-up such devices, and the time to prepare subjects themselves is significant
- Passive exoskeletons reduce the price of materials and offer a less-time consuming method for influencing gait
  - ➡ Offers the possibility of wearing the device for an extended period outside of a lab environment
- "Error augmentation" offers a promising avenue to treat asymmetric gait patterns
  - ➡ Increasing walking errors (i.e., moving limbs from their normal trajectories) [4]
  - ➡ The brain develops new patterns (neural motor pathways) through error – providing an interesting research avenue for new rehabilitation protocols [3,5]

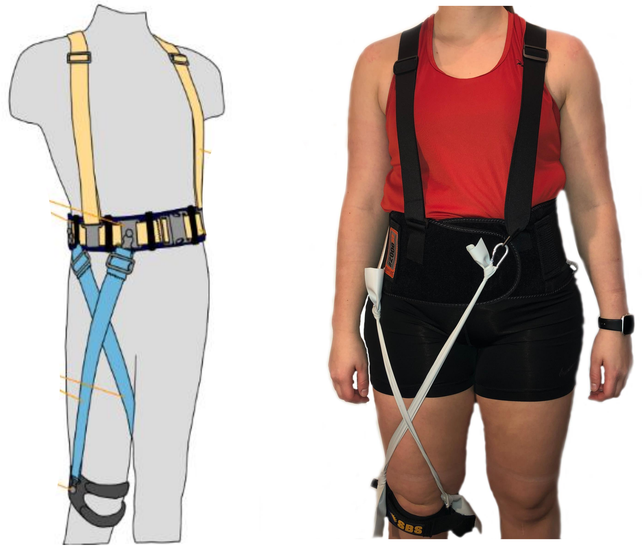

Figure 1: Example of a previous design (left) of a unilateral exoskeleton and the design of the proposed exoskeleton (right) [2]..

METHODS

Distal Connection	➡	Two SBS Surfer Calf Straps
Elastic Elements	➡	Two TheraBand® Strips
Proximal Connection	➡	Proflex® Back Brace with Built-in Suspender Straps
Carabiner Hooks	➡	Allows for a quick connection to the distal and proximal segments of the exoskeleton

RESULTS & DISCUSSION

Basis for Brace Design

- The brace design is based on a previous research design by Neuman et al. seen in Figure 1 on the left
- The device successfully assisted hip flexion in Multiple Sclerosis patients – displaying the designs effectiveness [2]

Planned Use for Error Augmentation

- Bands will be stretched past optimum actuation pretension
  - ➡ Increases errors experienced at the hip during walking
- Providing suboptimal actuation assistance was found to impede walking [6]
- Using the bands to create more errors rather than for assistive purposes establishes a method to impose error augmentation on walking gait
- The bands seen in Figure 1 resist hip extension during walking gait
  - ➡ We expect that, once removed, exaggerated hip extension will occur – possibly restoring symmetry

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