LEST
(Lower Extremity Strength Tester)

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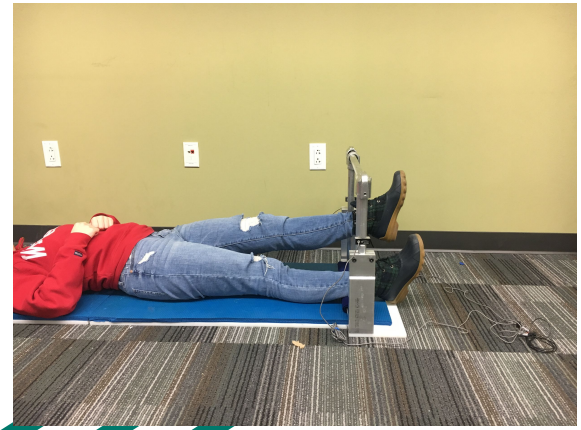
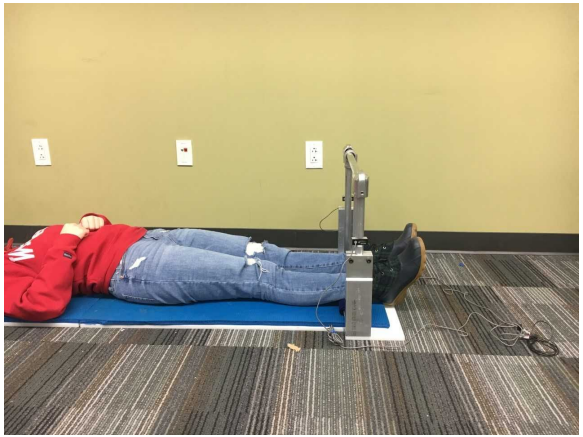




Presentation Overview

- Problem Statement
- Background
- Product Design Specifications
- Existing Device
- PDS: The Bike
- PDS: The Crutch
- PDS: Cufflink
- Design Matrix
- Proposed Final Design
- Future Work
- Acknowledgements

Problem Statement

- Pelvic instability: Loss of strength in the muscles of the pelvic girdle.
  - Commonly experienced by women during and after pregnancy.

- The maximum voluntary contraction (MVC) of the hip flexor muscles has been shown to be associated with pelvic instability [1].

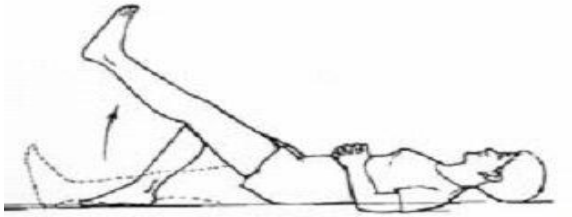


Figure 1: Straight leg raise [2]

Background

- Effects of childbirth on pelvic floor muscles
- Current test for pelvic instability is very subjective.
  - Client would like to measure quantitatively
- Straight leg raise
  - Hip flexor (iliopsoas) contracts to raise the leg
  - Knee extensors (quadriceps, rectus femoris) stabilizes the leg
  - Tests pelvic instability
- Testing procedure

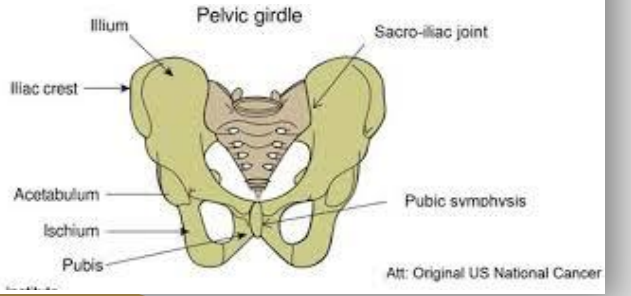


Figure 2:Pelvic girdle [3]

Product Design Specifications

- Portable between SARC and field locations.
- Able to withstand MVC from an adult female (264.8 N) [4].
- Accurately measures forces applied by the ankle within 5%.
- Easily adjustable for ankle height of adult US female (3.058”) [5][6].
- Comfortable
- Budget of $488.16
- No additional support for the patient.
- Integrated load cells must measure MVC’s and integrate with testing setup at lab locations.

Existing Device

- Physically fully functional
- Electronics
  - Load cell
  - SST Transmitter (not working)
  - Arduino
- 47 lbs.
- Areas of improvement include reducing weight and flexion of the base plate.

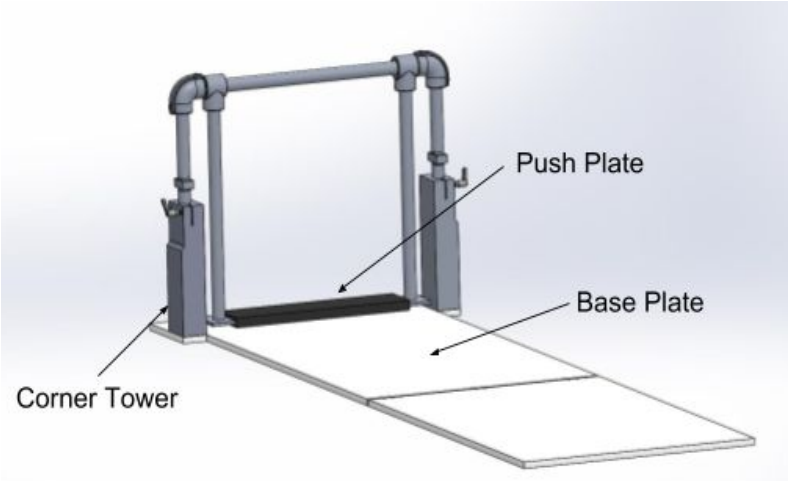


Figure 3: Existing device

Proposed Design Modifications: The Bike Mod

Figure 4: Model of the Bike Mod

- Hollow tubing
- Quick-adjustment shaft collars.
- Metal plates on bottom

Proposed Design Modifications: The Crutch

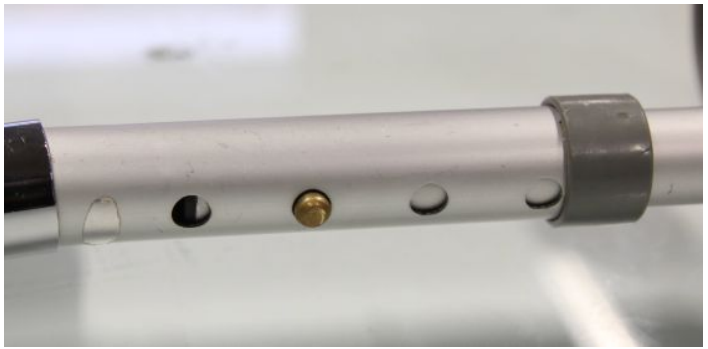


Figure 5: A crutch leg.

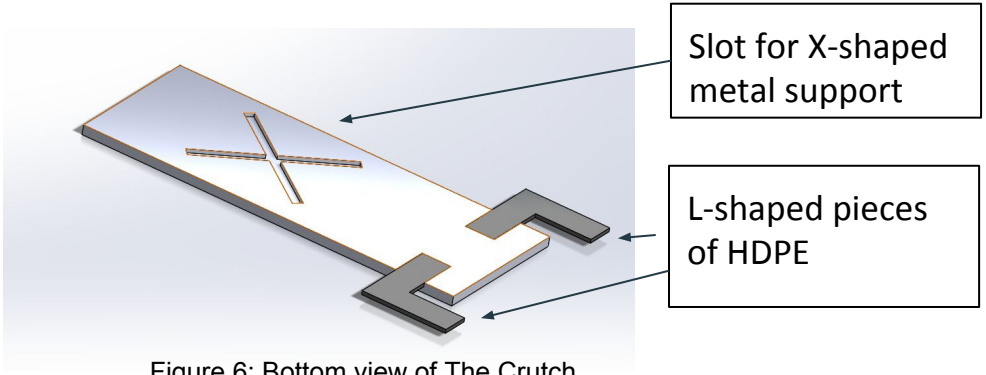


Figure 6: Bottom view of The Crutch.

- Replacement for corner towers
- Bottom view of the base plate

Proposed Design Modifications: The Cufflink

- Cuffs that can attach to user's legs
- Heart rate monitoring system

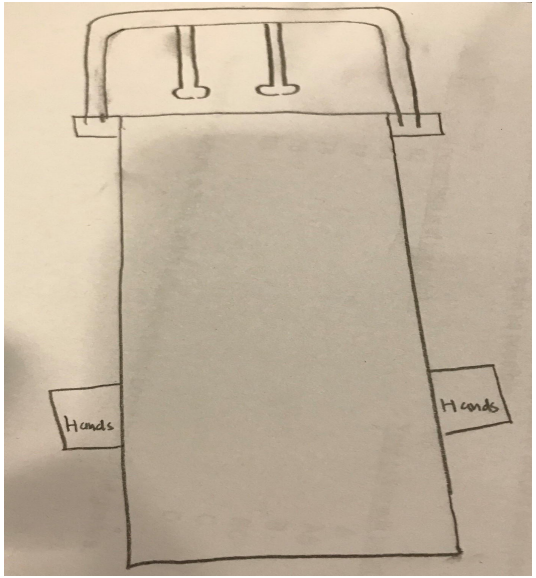


Figure 7: The Cufflink

Design Matrix

Updated Matrix-

Design Criteria	Modification One - The Bike Mod	Modification Two - The Crutch Design	Modification 3 - The Cufflink Design
Weight Reduction (25)	5/5 25	5/5 25	3/5 15
Quickness of data collection after fatiguing task (25)	5/5 25	4/5 20	3/5 15
Reducing Base Plate Flexion (10)	5/5 10	4/5 8	1/5 2
User Comfort (10)	4/5 8	4/5 8	3/5 6
Ease of Fabrication/Assembly (10)	3/5 6	2/5 4	5/5 10
Cost (10)	3/5 6	4/5 8	4/5 8
Aesthetics (5)	4/5 4	4/5 4	5/5 5
Safety (5)	5/5 4	4/5 4	3/5 3
Total (100)	88	81	64

Figure 8: Updated Design Matrix

Proposed Final Design

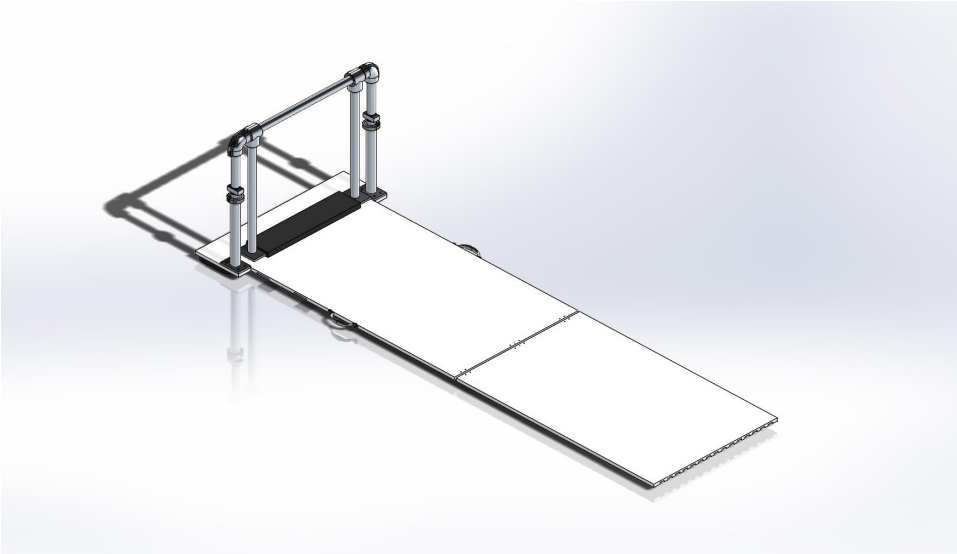
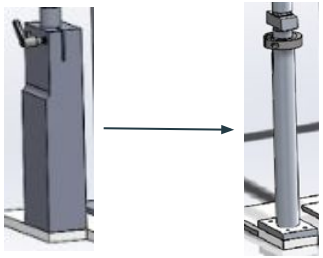


Figure 10: Model of the proposed final design.

- Features the modifications included in the bike mod.
- Additional features
  - Base plate side handles
  - Vacuum cups
- Overall weight: 34.43 lbs

Future Work

Modify corner towers



Make additions to the base plate

[6]

[7]

Modify Electronics

Arduino → **ADC Board**

Modify metal frame and push plate

Acknowledgements

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Dr. Darilis Suarez-Gonzalez, UW-Madison Department of Biomedical Engineering

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Dr. Rita Deering, Marquette University Department of Physical Therapy

Dr. Bryan Heiderscheit, UW-Madison Department of Orthopedics and Rehabilitation

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