



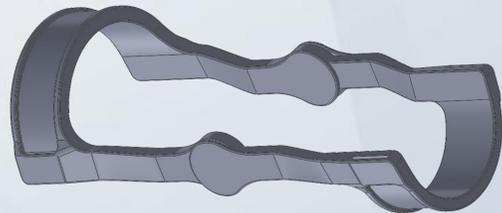
ACL Recovery Buddy

Ammad Hussain, Hamza Rasheed, Faith Tan,
Nityanand Rewankar, Sajida Chowdhury
Integrated Engineering - University of British Columbia



Components

Brace: Our 3D-printed brace protects the knee during exercise from re-injury & houses the other physiotherapy components in our solution

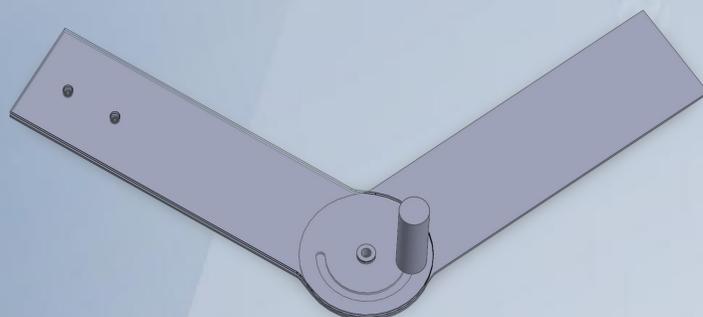


NMES sends electrical impulses to nerves, causing contraction. This is commonly used by physiotherapists for maintenance of muscle mass and strength during prolonged periods of immobilisation.



BFR: Blood Flow Restriction uses a tourniquet cuff system to partially restrict blood flow in working musculature during exercise, promoting hypertrophy. Similar to high altitude training, BFR puts muscles into an oxygen deprived state which allows for greater strength training.

Adaptable Resistance: This is our project's equivalent of a leg extension / curl machine meant to increase quadricep and hamstring strength in a controlled environment.



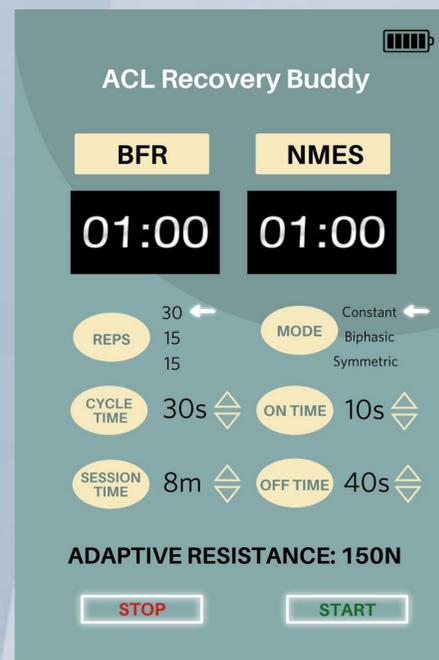
Problem Statement

In Canada **250,000 people experience an ACL injury per year**. In the recovery process, consistent exercise and strength building is crucial, but going to a physiotherapy clinic 3 times a week can be inconvenient. Approximately **1 in 5 appointments are cancelled**, wasting clinics' time and money. Without the consistent support of physiotherapy, **full recovery is not possible** as patients may suffer from **decreased strength, reduced range of motion, and loss of body awareness**. Part of the long recovery process is due to rehabilitation technology only being available through licensed physiotherapists.

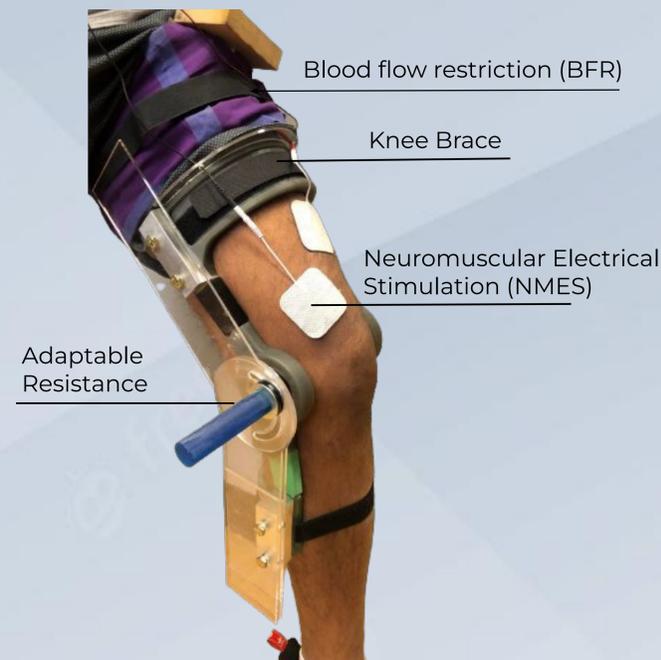
Our Solution

Our custom knee brace combines the tools of physiotherapy: electrical stimulation, controlled leg extensions and a pneumatic thigh cuff which promotes muscle growth. These all combine into one convenient user interface which provides simplicity, allows for use at home, and still has many of the same recovery benefits of going to a clinic.

User Interface



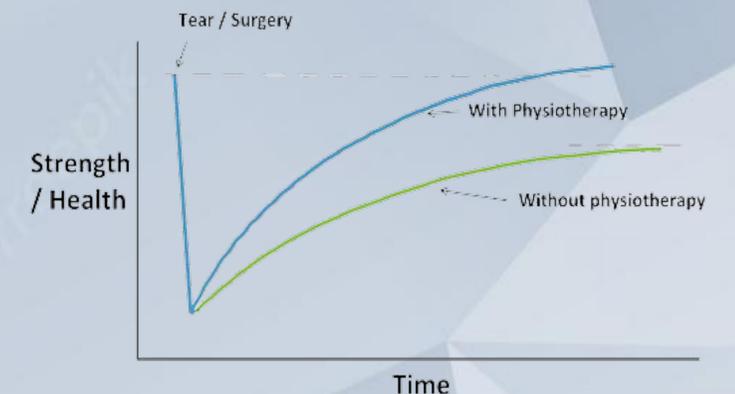
Full Device



User Benefits

- ❖ Faster recovery time
- ❖ Increased muscle strength
- ❖ Increased range of motion
- ❖ Increased body awareness
- ❖ Ease of use
- ❖ Protection from re-injury

ACL Recovery Process



Research & Testing

NMES Benefit: A study found that NMES + strengthening increased the candidates ability to apply isometric force relative to body weight by over 70%.

BFR Benefit: A study found that BFR increased the difficulty of the same exercise in ACL injured candidates by over 400%.



Adaptable Resistance Testing Setup: Through testing the adaptable resistance component, the maximum resistive moment exerted was greater than 25 lbs-in which was measured through a fish scale.

Adaptable Resistance Minimum Applied Resistance: We decided upon 25 lbs-in to be our minimum achievable resistance as based on our research, we found that training against a resistive moment of 25 lbs-in was comparable to performing daily activities.

Future Work

- ❖ Redesign brace-to-leg attachment mechanism to improve stability and fit.
- ❖ Add a dial for adaptable resistance to create distinct resistance levels.
- ❖ Integrate NMES and BFR controls into a functional remote based on our sole interface concept.
- ❖ Conduct a clinical trial with our prototype to ensure it elicits the same benefits as physiotherapy.

References:

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