MobiLUS

Leg-Up Solution

University of Colorado, Boulder

Engineering for Social Innovation (ESI)

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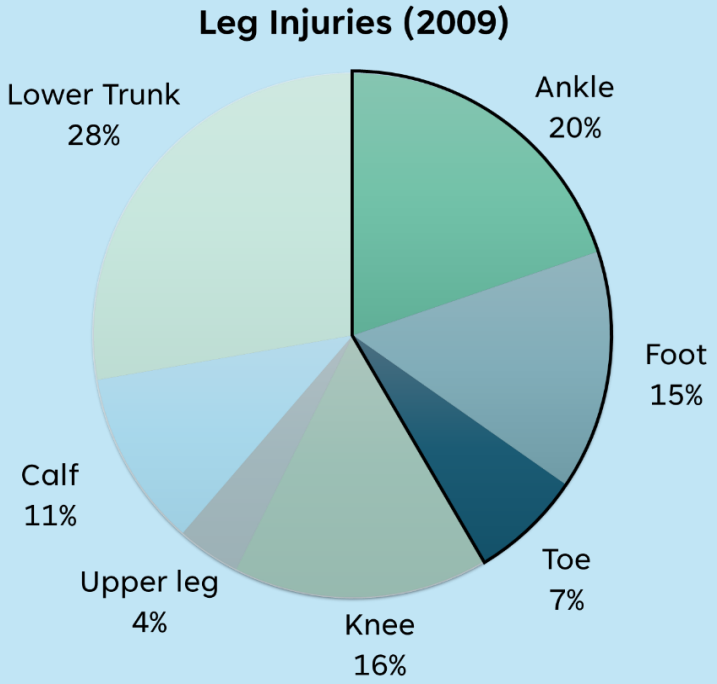
Background and Motivation

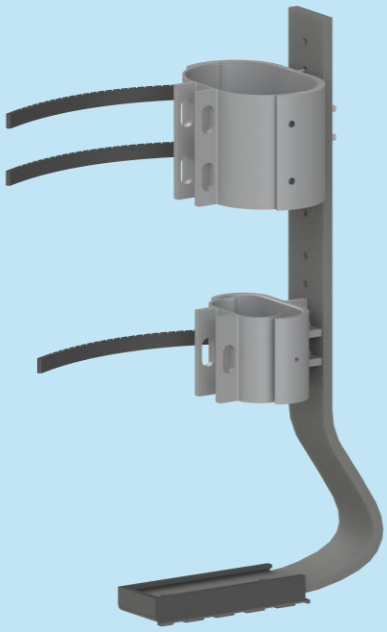
The Problem

Lower-leg injuries are among the top occurring injuries in the US. There were 119,815 patients in the United States admitted to the emergency room with lower leg injuries. 20% of the admitted were ankle injuries, 11% were lower leg injuries, and 7% were toe injuries. Of these, ankle strains or sprains were the most common injuries in the ankle at 72%. Given these injuries' prevalence, there are a handful of mobility aids commonly recommended by physicians. Many of these devices limit the user's ability to easily navigate places they could before the injury.



The Solution

The "Leg-Up" solution is a device that would fit comfortably around the calf and allow a near-normal walking posture while keeping weight off of the injured foot or ankle. MobilUS' goal is to provide a product that enables the user to have a more active lifestyle while preventing any inaccessibility that a knee scooter would cause.



Design Overview

The Design

The design of Leg-Up integrates various elements to help with mobility. The fiberglass blade is designed for impact absorption with its structure carefully laid up onto molding foam and cured with epoxy resin. The tread sole, designed for maximum traction, is 3D printed using thermoplastic polyurethane (TPU). Additionally, a tread adapter printed from polylactic acid (PLA) enables easy replacement of the sole. The cuff straps (repurposed from skate straps) offer easy adjustability. The cuffs themselves are made of flexible TPU for conformity to the wearer's leg to ensure comfort and stability.

Design Requirements

- Relocate pressure from walking from foot to leg
- Be more ergonomic than current market solutions
- Be easy to learn and operate
- Enable use of stairs
- Enable a natural walking gait
- Be operable on all surfaces/terrain

Manufacturing Considerations

➢ Cuffs

- Lightweight and strong upper and lower cuffs must support the user's leg effectively, minimizing exertion. Flexible TPU was selected as it is able to easily conform to user's legs of many different shapes and sizes

➢ Fiberglass Molds

- Fabrication using fiberglass sheets requires mold creation using polystyrene or expanding foam with an acrylic template, laser cut in the Idea Forge.

➢ Attachment Brackets

- Attachment brackets are made of 6061 Aluminum plate, that can easily and meticulously be machined on a mill.

➢ Batch Manufacturing Considerations

- All components are designed for batch manufacturing. That is, injection molding for the cuffs out of a flexible TPE, CNC machining for the attachment brackets, overmolding for the tread assembly. Fiberglass layup can be streamlined for batch manufacturing with the implementation of a layup process using "pre-impregnated" fiberglass plies. That is fiberglass that has already been soaked with resin, the only process that needs to be done is layup and vacuum sealing.

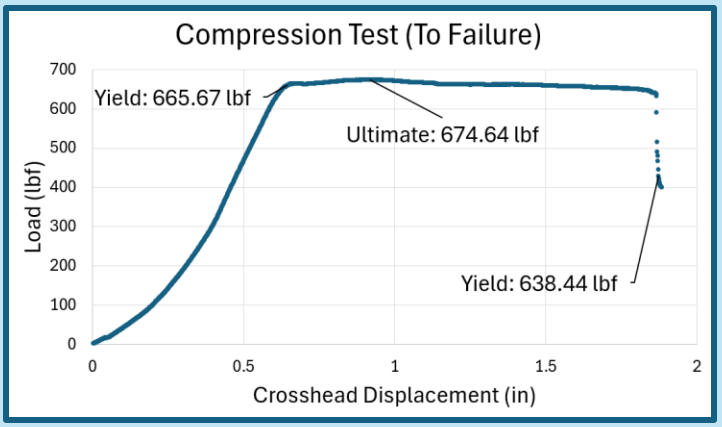
Testing Results

➢ Dimensioning and Tolerancing:

- Over the course of prototyping, the group's understanding of part tolerancing has evolved, allowing for tight tolerances on highly precision machined parts to looser tolerances on 3D printed parts.
- The fiberglass blade was the most challenging component for meeting tolerances, but through careful mold construction and post processing, it passed inspections.

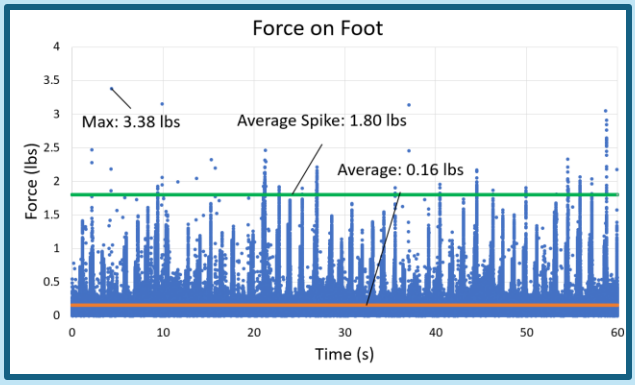
➢ Assembly Fitment:

- The device allows for the cuffing mechanism to be adjustable to accommodate any person within the 80th percentile.
- The device is convenient to use, weighing only 2.14 lbs. and maintaining a low overall profile compared to other solutions.



➢ Device Performance:

- There is a moderate learning curve showcased by declining completion times of the walking course. Final times indicate this device takes about 9.5% more time to move around with than usual.
- Device performance with stairs is possible with a 91.1% increase in time to walk up stairs with the device compared to without.
- Participant feedback illustrated a small amount of discomfort and abrasions after a long time using the device.
- Device effectively suspends foot with an average force of 0.1% body weight (BW), average spike of about 1.5% BW, and maximum spike of 2.8% BW.



- The device's traction capabilities are impressive with a friction coefficient 12% higher than an average shoe.
- The fiberglass blade can suspend up to 665.7 lbf. before yielding, demonstrating a factor of safety of 1.90.

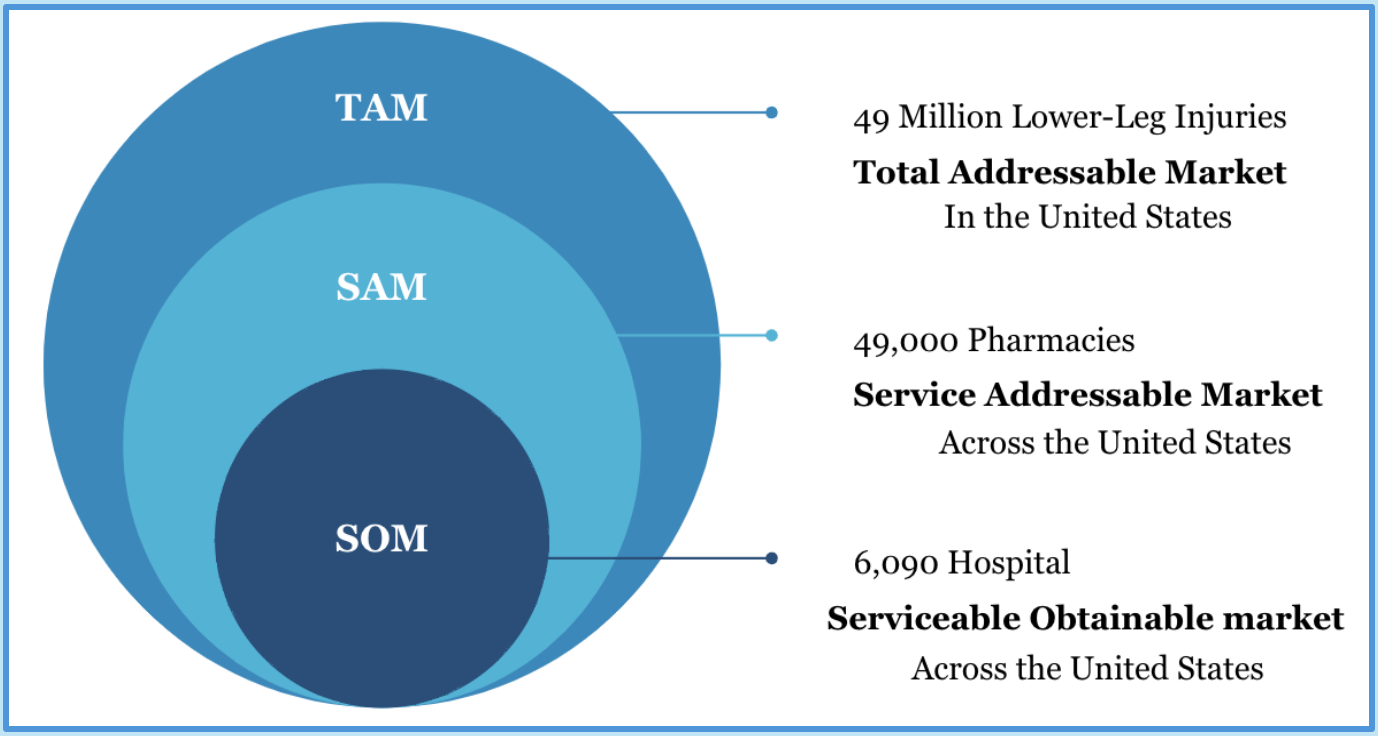
Business Considerations

➢ Market Opportunity

- MobilUS plans to launch an Ecommerce business in the year 1 to get the product out into the market for easy access for users. It will allow users to get familiar to the Leg-Up Solution. During Year 2 of running an Ecommerce business will partner with physical therapists and hospitals. With this plan of action it will allow for Leg-Up to be prescribed to users right away when they go into hospital for treatment. In year 3 Leg-up will become available in pharamacies. With ease of access in pharamacies many users will benefit from Leg-Up.

➢ Users and Users Case

- Leg-up was designed for any working class adults. Leg-up's goal is to help working adults continue their normal lives whether it is working in a kitchen, an office or staying activitly fit. Leg-up is easy to use and many adults will benefit from it.



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