A More Durable Prosthetic Knee Sleeve
By Team Longevity

Problem Statement
Our challenger, Caleb Brewer, is a combat veteran and a double leg amputee who wears prosthetics. A main tool he needs to utilize his prosthetics and maintain his active lifestyle is a prosthetic suspension knee sleeve. He currently goes through two knee sleeves per month for his left prosthetic due to rubbing and stretching which results in puncturing and just overall wear and tear. We were tasked with coming up with a More Durable Prosthetic Knee Sleeve and have done so.

Caleb’s Setup
Below Caleb’s setup can be seen - the prosthetic is connected to a socket wherein the residual limb would reside; the prosthetic knee sleeve acts to ‘merge’ them with the help of a vacuum pump. The result is a stable and functional prosthetic limb.

Final Product Design
We decided to incorporate a mesh fabric within the silicone to make our knee sleeve more puncture resistant and durable.
We've also decided to incorporate a removable knee brace in order to provide extra stability and prevent excessive buckling when necessary.

Prototype Iteration (Sleeve & Brace)

Prototype 1
Our first prototype was made utilizing silicone sheeting via layer adhesion. This approach proved to be way too stiff.

Prototype 2A
We pivoted in our second prototype by using uncured liquid silicone whereby we poured into a mold and cut out the cured result.

Prototype 2B
In the version B of prototype 2 we decided to change the outer fabric for flexibility. The silicone seeped through the unfortunately.

Prototype 3
In prototype 3 we used scuba fabric for flexibility/durability and brushed silicone onto it before pouring - this approach proved to be successful.

Prototype 1
Our initial knee brace idea was quite bulky and after input from Caleb we decided to go with a smaller, more modular, and optional knee brace design.

Prototype 2

Prototype 3

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Spring 2021