Moisture Wicking Prosthetic Sleeve for Lower Limb Amputees

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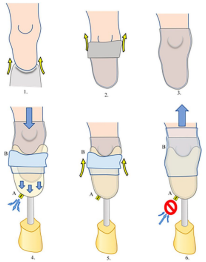
Background

23% to 56% of lower limb amputees experience hyperhidrosis (excessive sweating) that impedes prosthesis use and causes discomfort.

Potential skin conditions include:

- Foul odors
- Maceration
- Dermatitis
- Fungal Infection
- Ulceration
- Blistering
- Chafing
- Prosthetic limb falling off



K. Sasaki et al. (2019)

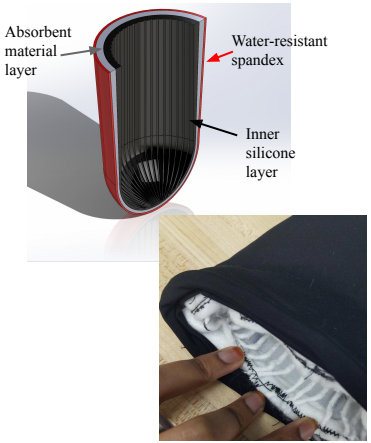
Current solutions include antiperspirant sprays, which are inexpensive but ineffective, Botox injections in the residual limb, which are more effective but very expensive and not approved by the FDA.

Needs Statement

A practical, low cost prosthetic liner for lower limb amputees fabricated from materials that will reduce heat build up between the prosthetic and the limb, minimizing moisture accumulation, risk of infection, and pain/discomfort due to sweat and use.

Proposed Design

- Inner silicone layer (black) with channels
- Channels are filled with absorbent fabric that carries moisture up through capillary action (not shown)
- Moisture is carried Through the channels into a full layer of absorbent fabric (gray)
- An outer sleeve (red) holds everything in place and interfaces with the prosthetic



Patentability and Costs

Patentability

- Patents exist for other liners as an interface between amputee and prosthetic limb
- Our design still has the novel form and function to be patentable
- Channels in the silicone
- Use of capillary action to move moisture to a reservoir

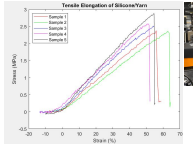
Cost

- We expect a moisture-wicking prosthetic liner to covered by Medicare.
- Current liners without moisture-wicking properties are covered
- Goal is to maintain a price similar to that of current liners, should be included under the code for the prosthetic sheath/sock.
- Expected cost of manufacturing is $100 per liner

Testing Results

Tensile Test of Liner Materials

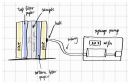
- ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomer--Tension



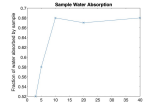
Samples exhibited an average Young's Modulus of 5.2 MPa, which is higher than that of other silicone prosthetic liners, ranging from ~0.2-0.5 MPa

Variable Sweat Rate Absorbency Test

Goal: To determine liner absorbency at varying levels of physical activity



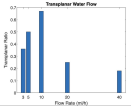
Pictured right: Testing setup, where liner is sandwiched between filter paper. Bottom FF mimics skin. Syringe pump applied to front to recreate different sweat rates



Liner absorbency is consistent up to extremely high activity

Whole-Liner Absorbency Test

Transplanar Ratio is a measure of water wicked away from skin. **The liner functions best at low-medium activity levels - suitable for most exercise uses.**



Results
Drip test showed pooling at 15 mL of fluid at a rate of 60mL/hr

We expect the compressive forces provided by the residual limb to increase absorbency in reality.

Washability Test

Acknowledgments

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