Project Statement

A Model to Demonstrate Compression Sleeve Technology on the Lymphatic System
Team #12
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Project for Client: Susan Callison

Client Contact:
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Statement of Need

The client has requested a model to demonstrate how a micromassage compression sleeve can dissipate the swelling that is associated with lymphedema. This sleeve, specialized for lymphoma suffers, is a similar model to compression garments have been designed to help athletes as well as people subjected to cellulite. The goal of all these garments are to keep a constant movement of fluid, whether it be lymph, blood, or toxins throughout the limbs into the trunk of the body, and different garment designs have been tested to see which pressure gradient and fabric design works best on the human arm. These products were previously tested on human models, running experiments while a subject was wearing the garment. The goal of this design is to simulate what happens to the fluid in the arm using a physical model with specific elastic and pressure parameters from a 15-21mmHg compression garment sleeve, rather than testing a human subject wearing the garment. The design will demonstrate that lymph fluid can continue to filter through the lymphatic system and reduce chance of edema within the arm using the 15-21mmHg model rather than the higher and more uncomfortable 20-30mmHg models.

Introduction and Overview

Lymphedema is a disease in which the lymphatic fluid in one’s body is no longer filtered by the lymph nodes often causing swelling in various regions of the body eventually leading to hardening of the tissue near the area of swelling, called fibrosis. Lymphedema most often occurs in life as a result of using radiation to treat cancer as well as by some surgeries, burns, and other injuries.

Previous techniques to combat the swelling that occurs in people with lymphedema have been the use of a compression sleeve along with being administered a lymphatic massage. Because the lymphatic system is a pumpless system, tissue typically acts as a means to increase pressure to push fluid along from the arterial capillaries to the venous system when various muscles contract in close proximity to it. When the tissue is unable to add pressure caused by swelling from lymphedema, a compression sleeve can be used to increase the pressure placed on the fluid to increase movement of the lymph toward the venous system. Because the compression sleeves cause constant pressure over the entire area, some capillaries inferior to the skin will compress and collapse rather than be pressurized to increase fluid flow. Using Manual Lymphatic Drainage, a light, pressurizing technique similar to a massage, allows these capillaries to be activated to increase the flow of lymph through the area. While the compression sleeve and Manual Lymphatic Drainage, or MLD, can be effective when used together, the compression sleeve can be found uncomfortable due to the amount of pressure it applies to the skin and MLD cannot be consistently administered all the time.

The lymphedemasleeveco.com uses a compression sleeve founded by Solidea, a company that sells their compression sleeve as a means for weight loss and decreasing cellulite. The new compression sleeve contains wave-shaped ribbed fabric that is believed to act as a micromassage
similar to a MLD treatment. The pressure exhibited by the compression sleeve is less than that of previous compression sleeves yet has been found to decrease the amount of fluid buildup in various areas that lymphedema often causes.

The compression sleeve is believed to work due to the ribbing of the fabric inside the sleeve in merriment with movement of the arm as it contracts and relaxes in regular day to day movement. The goal of this project is to design a model to show how the ribbing of the fabric causes movement of lymphatic fluid from the area of swelling when paired with movement of the arm. In doing this, the design will prove there is a more comfortable and effective technique to combat the pains and swelling caused by lymphedema.

**Realistic Constraints:**

One of the realistic constraints of concern is the economic value of the project. An economic concern is the number of garments that must be used to run a physical model on a repeated basis.

Another constraint would be the sustainability of the garments being used. According to lymphedemasleeveco.com, the garment can be used for about four to six months with repeated washing after each use before it has to be replaced. There is a question of how long each garment can be used for physical testing before it cannot be used for testing again.

Another constraint is the manufacturability, or the creating a model that will give repeatable results. If a physical model is constructed, it must be able to gain consistent results when multiple trials are run using the same type of compression garment. The physical model must work in conjunction with a air compressor and a microcontroller to coordinate systems in the limb to make a rudimentary model similar to that of an actual human arm.

There are also environmental restraints relating to building a physical model. The model must be within similar temperature range and pressure as the lymphatic system within the arm when at rest and during activity.

Finally, there is a concern of the political constraint. The compression sleeve originates from a company called Solidea located in Italy, who is using it for different reasons. There may be a constraint in being allowed to present any information learned testing and designing. Furthermore, the composition and any other known testing done on the compression sleeve is unknown because it is owned by Solidea.

**Other Information**

Susan Callison is the founder of Lymphedema Sleeve Company, a company located in West Hartford, CT that provides stylish and comfortable compression garments with a goal of reducing lymphedema in lifelong sufferers. Susan started this company after battling breast cancer from October 2008 to 2009. After going through cancer treatments and having 32 lymph
nodes removed from under her arm, she began to experience lymphedema in May of 2009. She began wearing compression garments to help alleviate the swelling, aching and temperature changes she felt in her arm associated with the condition, but felt that the garments were unattractive and too uncomfortable for her. She started to contact companies trying to find more discrete and comfortable ways to manage her lymphedema, and she came across a company from Italy called Solidea. Solidea originally designed stylish compression garments for women trying to smooth and slim out their skin from cellulite. Susan then took the company’s design and transformed the garments into products that cancer survivors and lymphedema sufferers could use every day to reduce and manage their swelling in the affected areas of the body. Susan wants this design model to be completed so she can show her customers the effectiveness of her compression sleeves when combating lymphedema.

**Questions**

- What kind of tests have been done on previous compression sleeves to prove that they work?
- What kind of tests have been done to prove that compression sleeves work better overall with the MLD technique?
- Is a physical model too tedious with respect to creating an environment similar to the human arm in comparison?
- Is a computer model feasible when recreating the human arm?
- How can data be collected about the compression pressure as well as the affect from the pulling of the skin from the waves integrated in compression garment?
- What kind of knowledge could be gained from contacting Solidea?
- What kind of rights are we allowed for testing a Solidea product?
- How much does the compression sleeve change over time due to wear?
- What kind of environment should we be testing the sleeve under?
**Specifications:**

**Physical:**
- Magic

<table>
<thead>
<tr>
<th>Solidea Silver Wave Slimming Sleeve - Micromassage</th>
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<tr>
<td>Size: Medium</td>
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<td>Compression: 15/21 mmHg</td>
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**Mechanical:**
- TBA

**Environmental:**
- Garment Testing Temperature: 20-25 °C (room temperature)

**Software:**
- User Interfaces: Solidworks control panel, keyboard, mouse
- Programs: Solidworks, MATLAB, LabVIEW
- Computer Requirements:
  - Operating System: Windows 7/Vista/XP

**Hardware:**
- Hardware Interfaces: Monitor

**Safety:**
- Glasses and gloves (for testing material properties)

**Maintenance:**
- TBA