



# Quantifying Variations in Prosthetic Sock Thickness over Time

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## INTRODUCTION

Prior research has shown sock ply is not a direct indication of sock thickness across different materials<sup>[1]</sup>. This study is an expansion of previous research to examine the effect of normal use on sock thickness and elasticity.

## METHOD

**Subjects:** A total of 37 used socks from 20 subjects were tested over a 9 month period. Sock age ranged from 0.5 to 60 months (Mean 10, SD 16) and Ply ranged from 1 to 6 (Mean 3, SD 2).

**Procedures:** Sock stretch while donned was marked and measured both axially and circumferentially when patients entered the lab. Socks were doffed and placed into a knitting hoop, replicating the measured stretch. Thickness was measured at pressures from 4 to 100kPa using an apparatus and data analysis method described in a previous publication<sup>[1]</sup>.

## RESULTS

The mean donned sock stretch was 11.5% for single fiber socks (SD 3.8, range 2.0 - 13.1) and 24.6% (SD 15.2, range 11.1 - 53.9) for multi-fiber. The average single fiber sock was 15 months old and 59% (SD 16%) of its original thickness. Multi-fiber socks were 6 months old on average and 41% (SD 19%) of their original thickness.

Uncompressed thickness of used socks decreased significantly relative to new socks and had the appearance of becoming thin and stiff (Figure 1). However, the average sock stress-strain response between new and used socks was roughly constant for both single and multi-fiber socks (Figure 2).

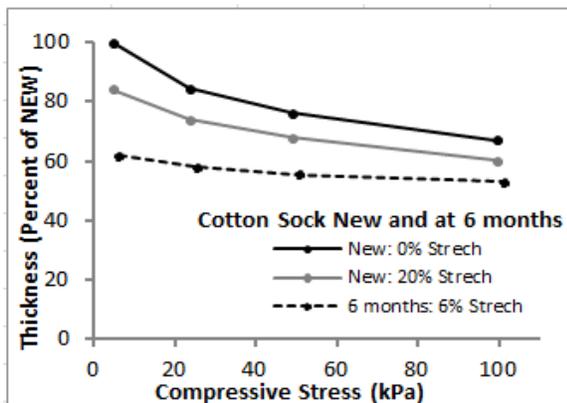


Figure 1: Thickness comparison of a new and used 3-Ply Cotton Sock. Exemplary result.

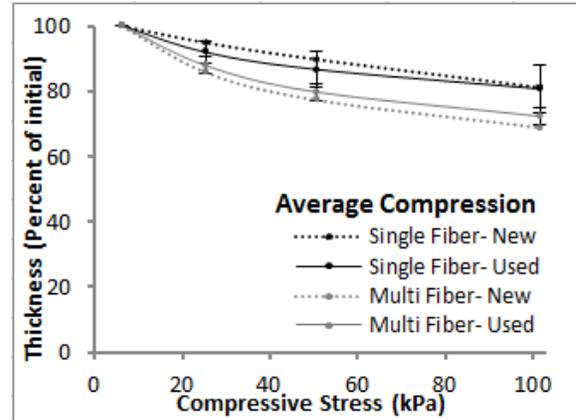


Figure 2: Stress response of new and used socks

Socks lost thickness quickly and inconsistently; five single fiber socks were less than a month old and had reduced to the group average of 41% of original thickness. Single fiber socks tended to age better than multi-fiber socks, only 1 of 6 socks had reduced to less than 50% and it was 5 years old.

## DISCUSSION

The larger and less predictable loss of thickness seen in multi-fiber socks compared with single fiber socks may be a result of wear to the soft synthetic components (e.g., Lycra<sup>®</sup> Spandex) woven into most multi-fiber socks<sup>[1]</sup>. However, even with the more consistent aging of single fiber socks, we still did not see a strong quantitative trend relating reduction of sock thickness to time. In future studies activity during sock use will be monitored in an effort to develop a model to predict sock thickness reduction based on sock model, age, and wearer activity.

## CLINICAL APPLICATIONS

In clinical practice single fiber socks such as wool and cotton are prescribed on a per patient basis. They require specific measurements and individual orders. Synthetic multi-fiber socks are typically purchased in bulk over a limited number of sizes (S, M, L, etc). Their stretchability makes them easy to conform to a wide range of limb sizes with no measurement. While multi-fiber socks are easier to fit and less expensive, their lifespan is usually shorter and less consistent. Since socks are only reimbursed in limited quantity each year, taking the time to fit patients with a primary single fiber sock might increase overall comfort.

## REFERENCES

<sup>1</sup> Sanders, JE. Prosth & Orthot Int, 36(1):77-86, 2012.