

INDIVIDUALIZED FINGER PROSTHESIS

Team Phalanx Flexors

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Abstract

Current finger prostheses options rarely combine aesthetics with functionality. Therefore, this team is designing a mechanically functional finger prosthesis that will integrate a compact mechanical unit into the existing, incredibly detailed silicone prostheses that are crafted by Mr. Gion at the Medical Art Prosthetics clinic.

Background

Finger movement by tendons that are regulated by muscles in the forearm

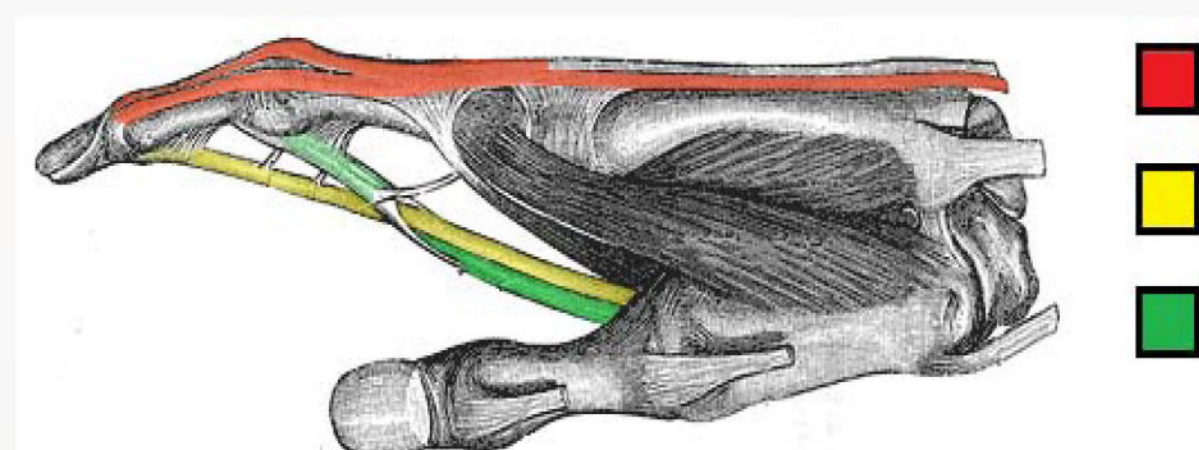


Fig. 1

- Extensor Digitorum
- Communis
- Flexor Digitorum Profundus

Design Criteria

Two Part Assembly:

1. Mechanical element
2. Silicone finger sleeve

Must withstand daily normal use:

- Experimental stress experienced by an index finger:
 20.2 ± 11.8 N (Male)
- Average temperatures:
 $0^{\circ}\text{C} - 40^{\circ}\text{C}$

Motivation

There is an average of 50,000 new partial hand amputations per year.^[1] Finger prostheses typically offer only active (fig.1) or passive (fig.2) function.

Mechanical

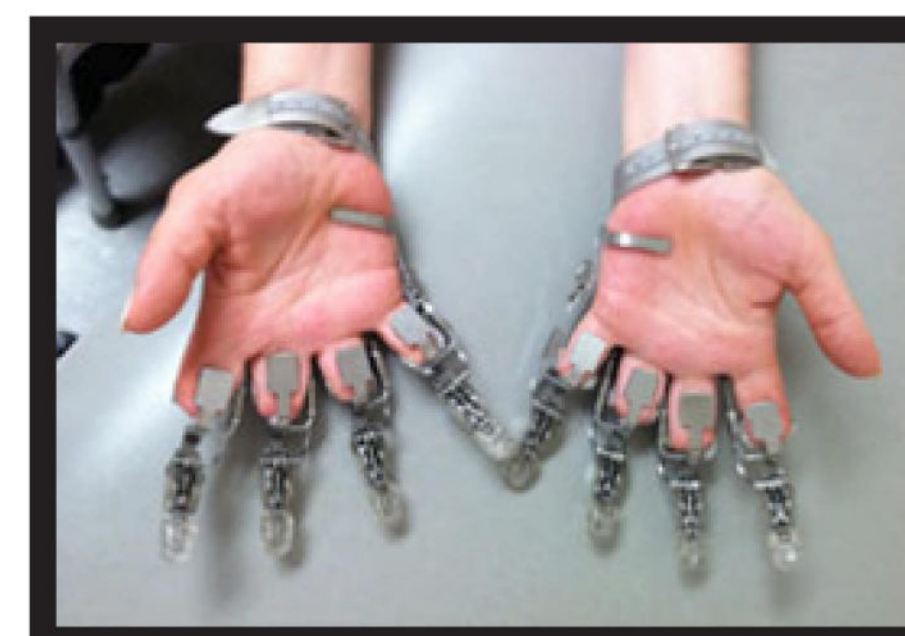


Fig. 2

Aesthetic Appeal

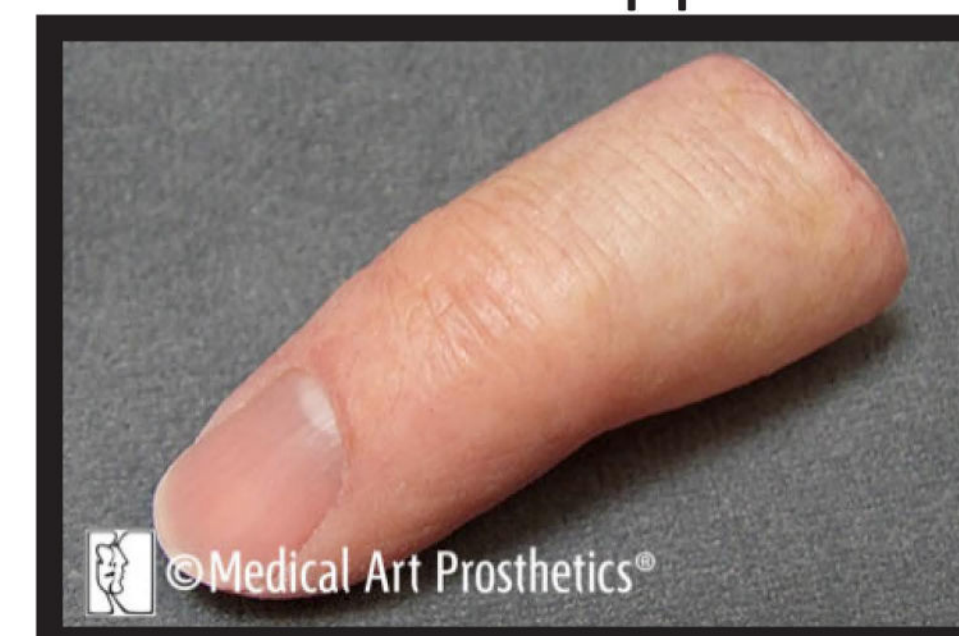


Fig. 3

Final Design

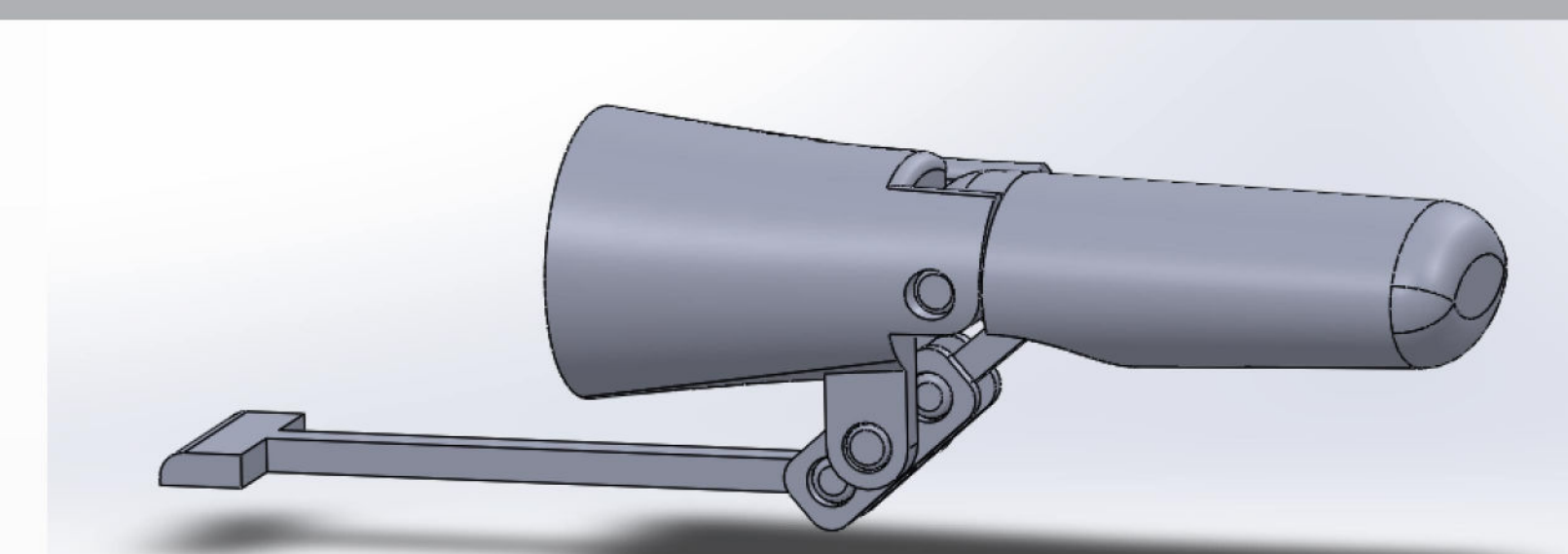
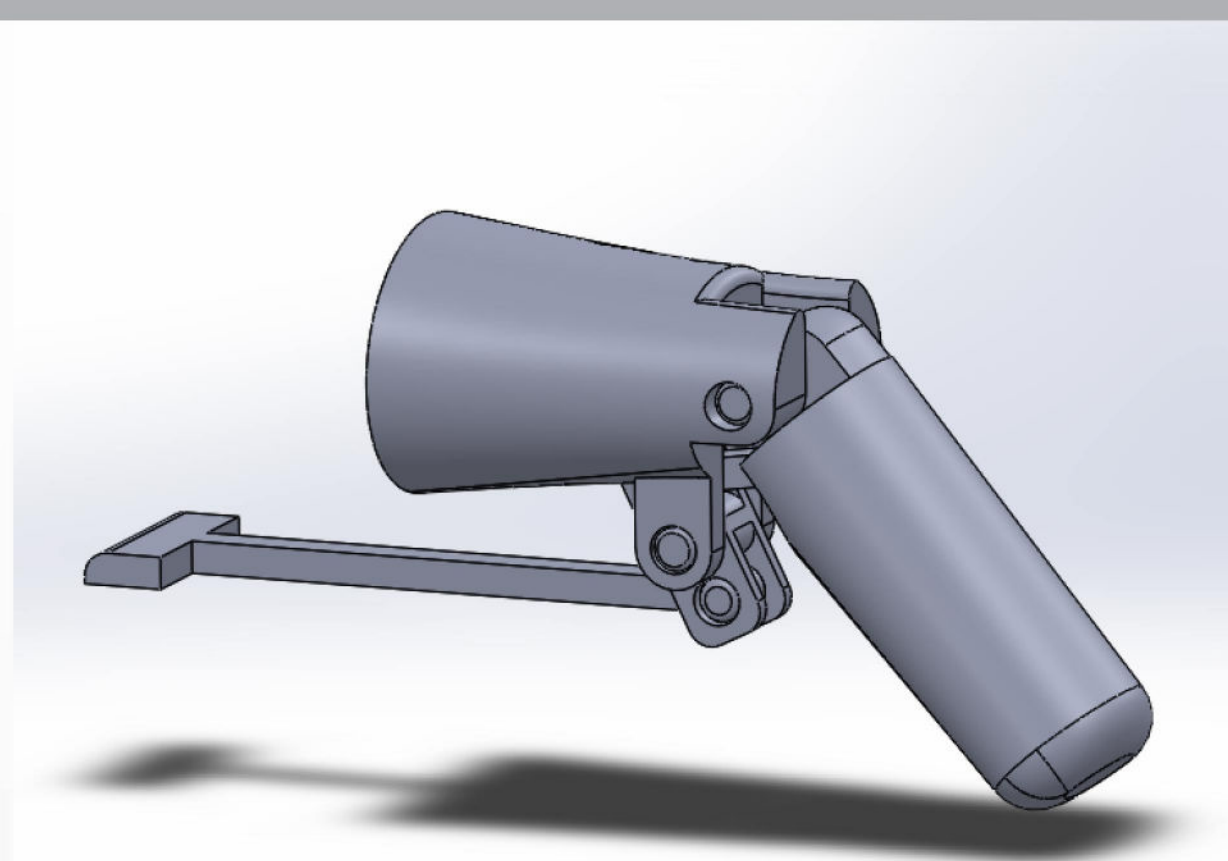


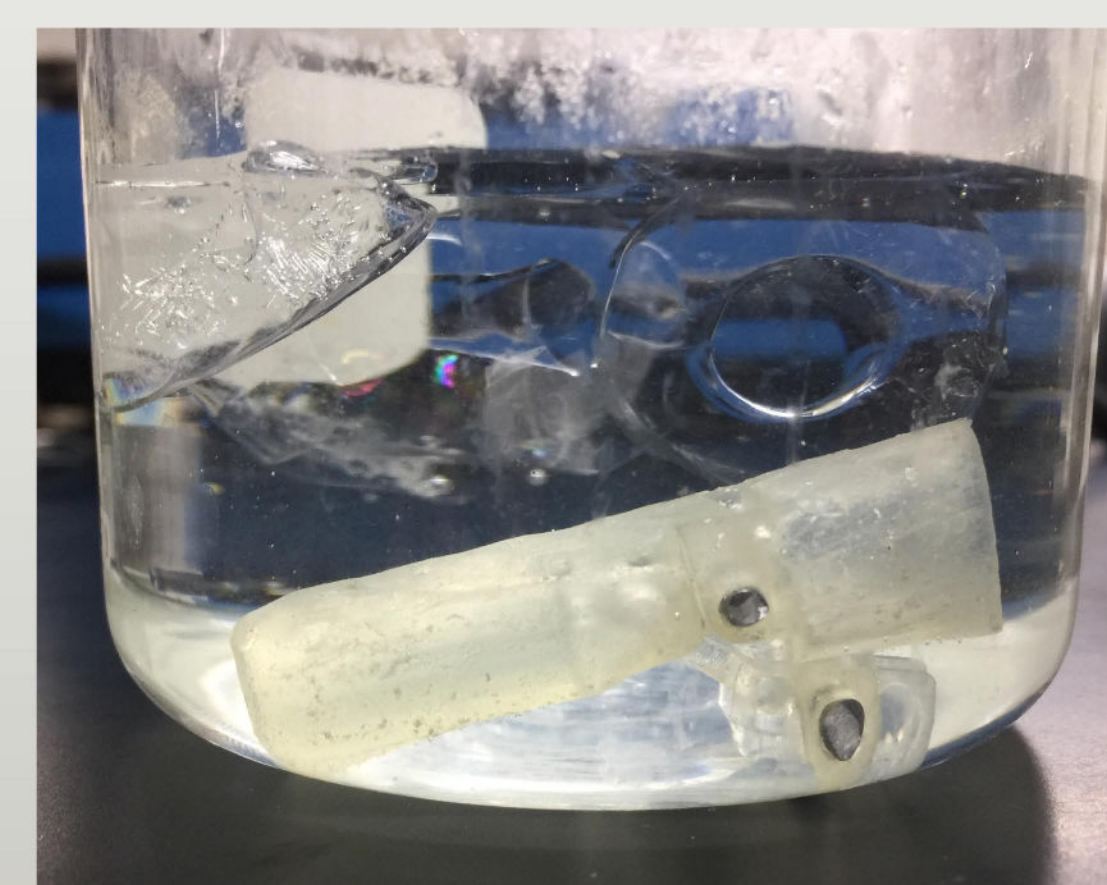
Fig. 4

CW starting from upper left:
Flexed Render, Extended Render, 3D Printed Prototype, and the Arm-10 DLP Stereolithography 3D printer

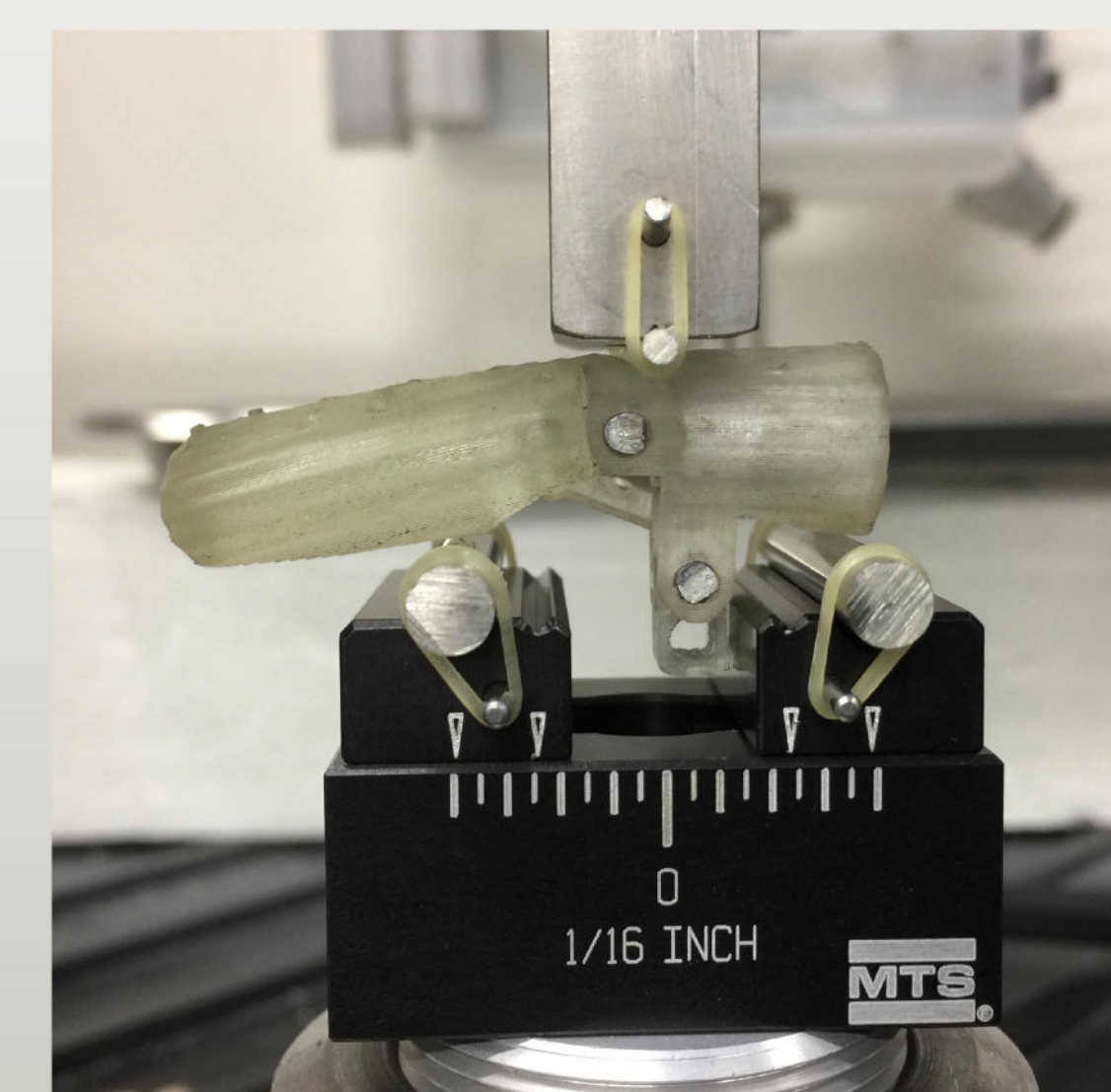
Testing

Three Point Transverse Stress Testing

- Control Test
- Hot Bath: 50°C
- Cold Bath: 0°C

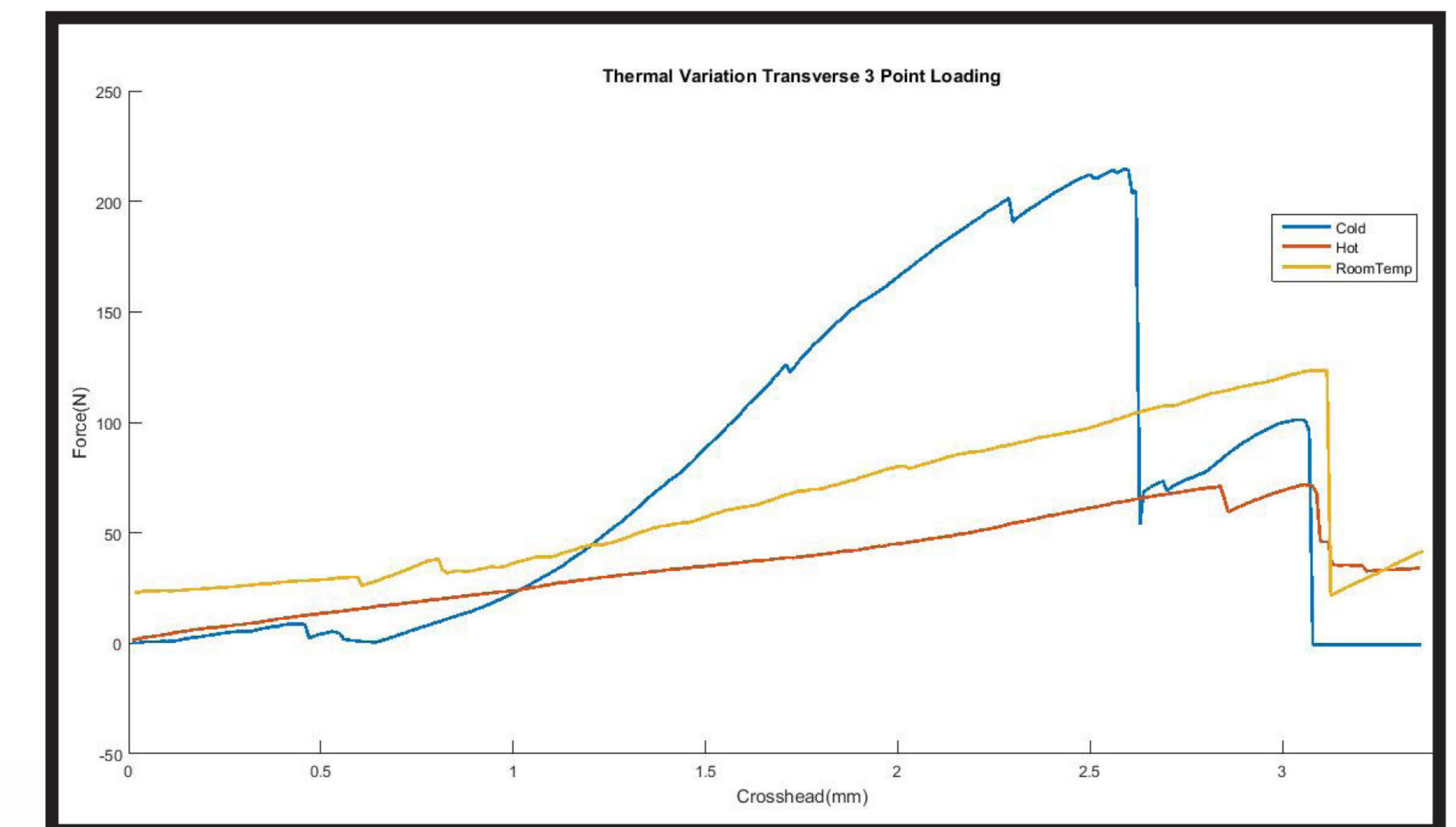


Thermal Test: Ice Bath



Three Point Stress Test

Results



- Comparison of three thermal conditions on prosthetic finger hinge
- Cold test provided the greatest stiffness but failed with the least strain
- These results are in line with our product design specifications
- Prototype failed on the wall of the central hinge due to the minimal thickness at that location

Future Work

- Reduce mechanism width and height
- Improve durability: use metal instead of plastic
- Increase flexion angle: optimize design
- Provide an array of finger cap sizes to fit a range of patients

References

- [1] "Statistics on Hand and Arm Loss", ISHN, 2014
[Fig. 1] Anatomy of the Hand
[Fig. 2] Rhode Island Limb Prosthetics and Orthotics
[Fig. 3] Medical Art Prosthetics, Mr. Greg Gion
[Fig. 4] Arm-10 3D Printer, Ronald DGA