

Tibial stent: Designing a novel fixation device for pediatric orthopaedic tibia fractures

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Design Team:

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Project Overview

Create expandable implant for tibia fractures in children that aligns and supports the bone

Requirements

- Must avoid growth plates
- Must be biocompatible
- Must have sufficient stability

Background

- Tibial fractures constitute 5% of all fractures in children
- Current procedure utilizes elastic nails
- Difficult to implant and align
- \$259-328 for titanium and \$78 for stainless-steel

Design



Flexible Wires

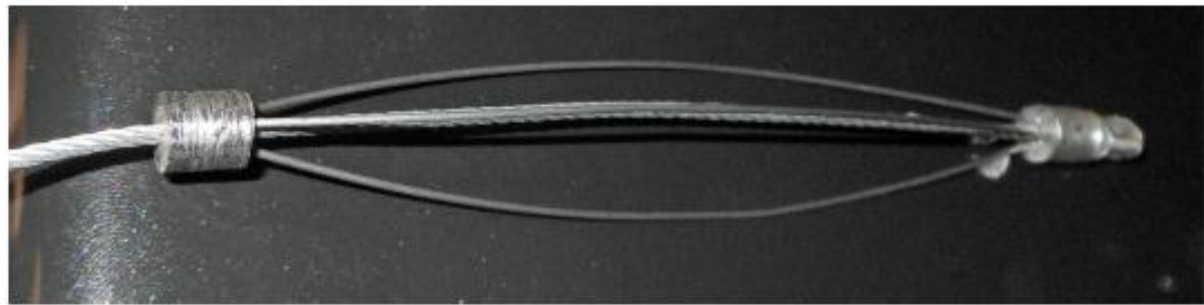


Mid Cap



End Cap

- Vertical compression creates horizontal expansion



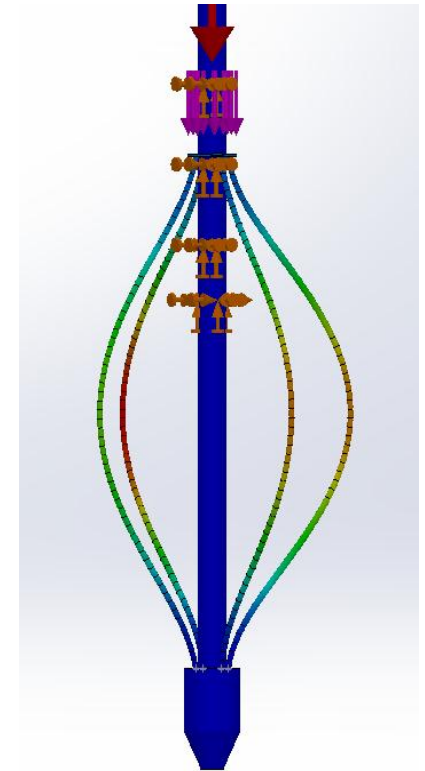
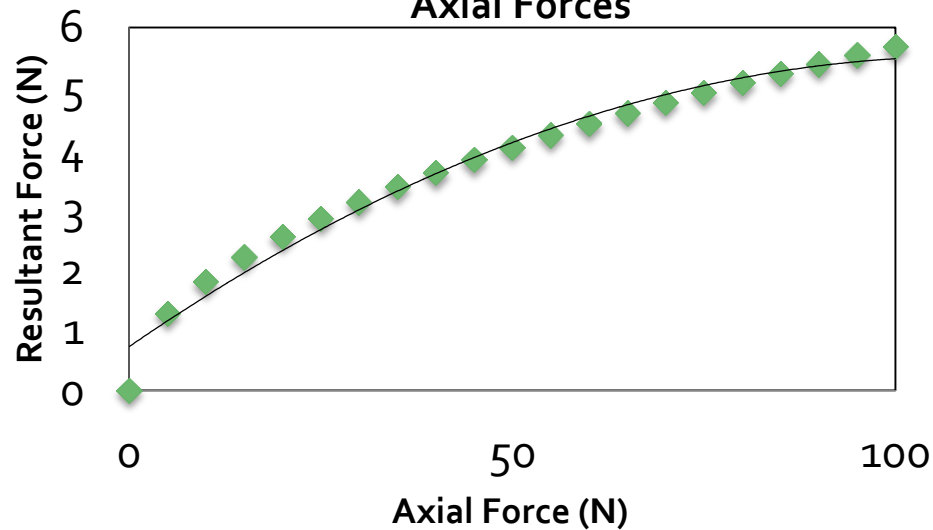
Current Prototype

Design Evaluation

Implantation Test



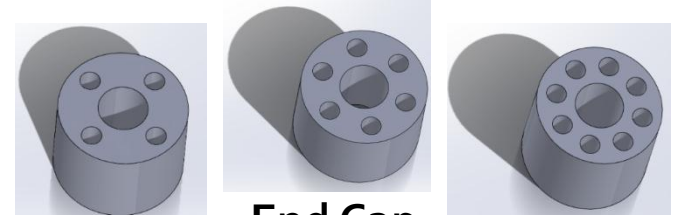
Resultant Force From Varying Axial Forces



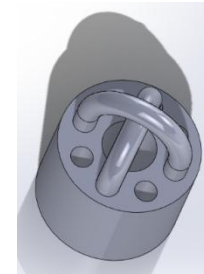
SolidWorks Analysis

Design Improvements

- New Designs will include more wires
- Loops of wire will be used at the end cap and distal cap to secure the device and facilitate removal
- A handheld tensioning device will be used during implantation



End Cap



End Cap



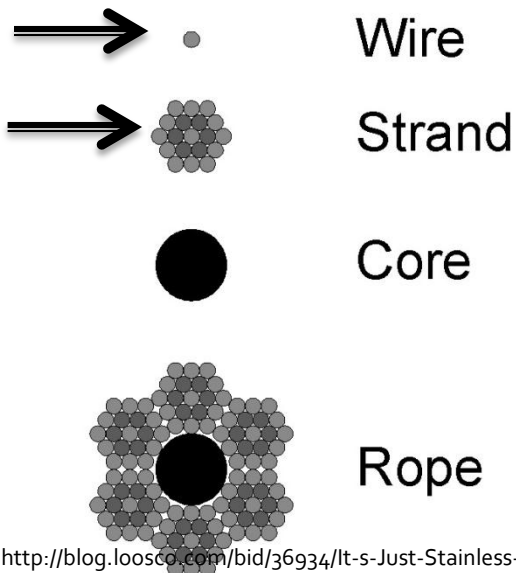
Mid Cap



Installation device

Fabrication

- Components will be machined on a Micro mill
- All components grade 304 Stainless Steel
- Wires will be welded into sockets using 304 Stainless Steel electrodes



Flexible Spring

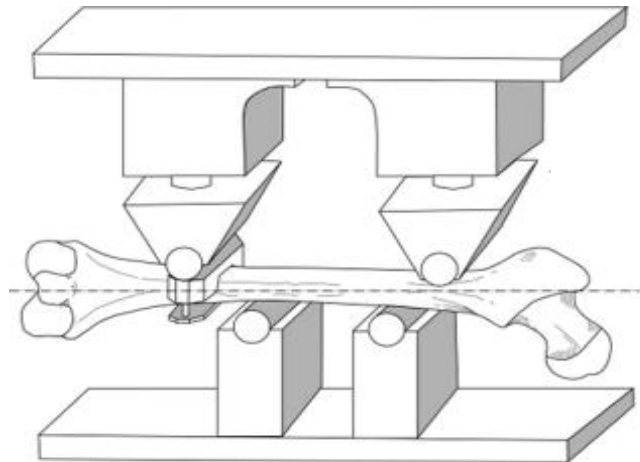


Future Testing

- Biomechanical Analysis in Animal Model
 - Rotational Stability
 - Axial Stress Durability
 - 4 – point bending: Sagittal and Coronal Plane



<http://grabcad.com/library/mts-machine>



https://www.biomedtown.org/biomed_town/LHDL/Reception/collection/FourPointBendingOfLongBones

Final Product

Packaging

- Sterile
- Surgical Grade
- Individually wrapped (one time use)

Cost

- | | |
|---------------------------------------|-----------------|
| ▪ 304 Stainless Steel Rod Stock 1/4 " | \$0.50 |
| ▪ 304 Stainless Wire x 4 | \$4.00 |
| ▪ 304 Stainless Strand 1/16 " | \$4.81 |
| ▪ Manufacturing | \$200.00 |
| ▪ TOTAL | \$209.31 |

Special Thanks

- Dr. Matthew Halanski
- Prof. Tracy Puccinelli
- Prof. Darryl Thelen
- Prof. Hiedi Ploeg



References

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Questions

