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

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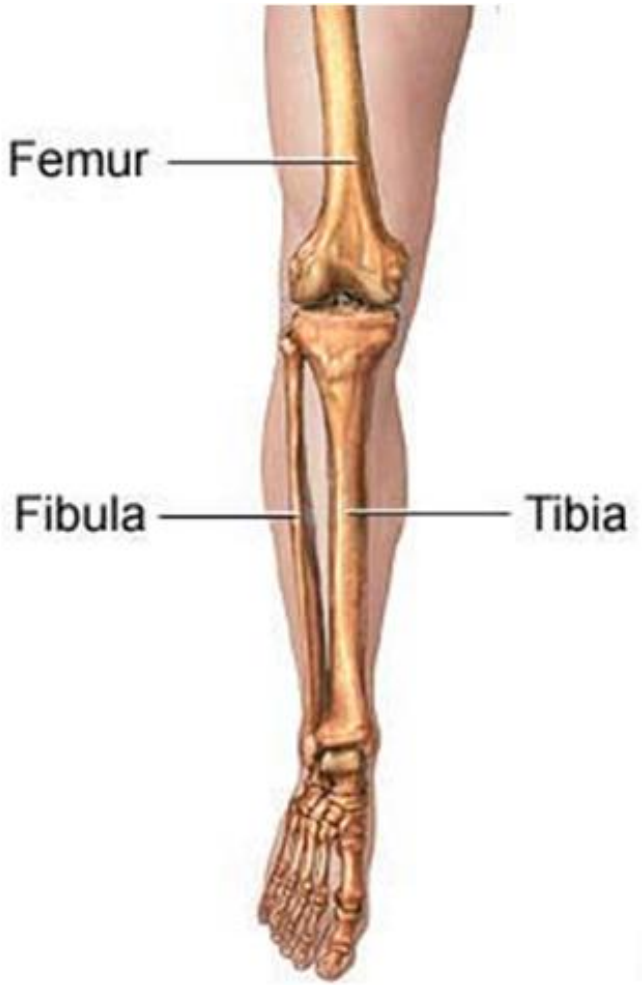
Overview

- Project Summary
- Current Practices
- Design Requirements
- Alternative Designs
- Design Matrix
- Testing and Future Work

http://www.harlandlawfirm.com/PracticeAreas.htm

Project Summary

- Create expandable implant for tibia fractures in children
- Implant sets fracture while providing stability
- Create device/method for implantation



http://www.pennmedicine.org

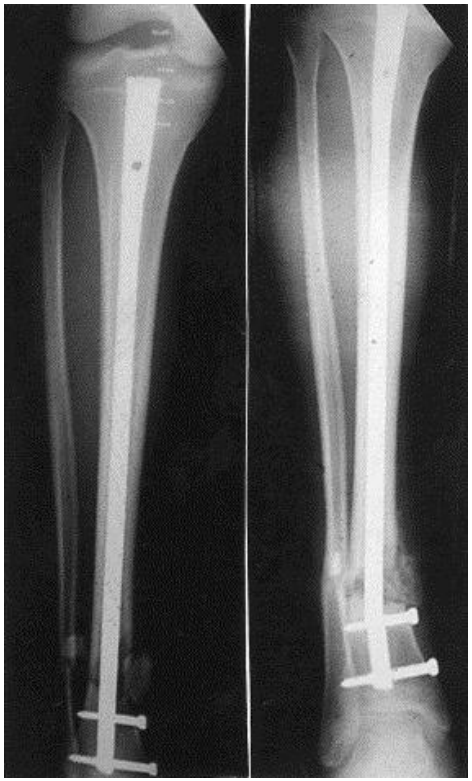
Background

- Tibia fractures are common in children
- Important to set bones for proper healing
- Children's tibias contain growth plates that must be avoided

http://www.wheelessonline.com/ortho/pediatric_tibial_fracture

Current Practices

Adult Intermedullary Stent



http://www.sciencedirect.com/science/article/pii/S0020138300000024

Pediatric Intermedullary Stent

http://www.aaos.org/news/aaosnow/apr12/clinical2.asp

Design Requirements

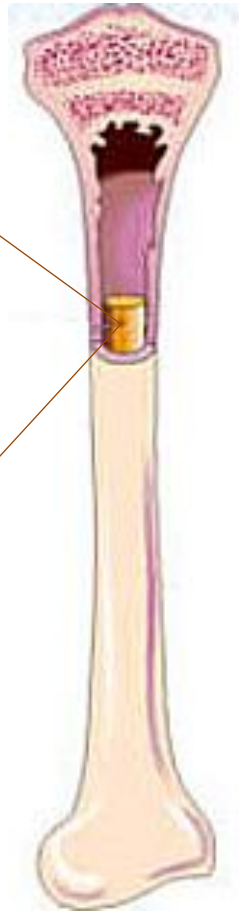
- Must span tibial break
- Must have enough stability to align bone
- Must be implantable at distal or proximal location
- Must have a diameter of less than 1 cm
- Must be biocompatible

Alternative Designs

- Expanding Foam
- Balloon Induced Stent
- Expanding Stent

Expanding Foam

- Foam activation within medullary canal
- Contained in bladder for directed shape



Pros

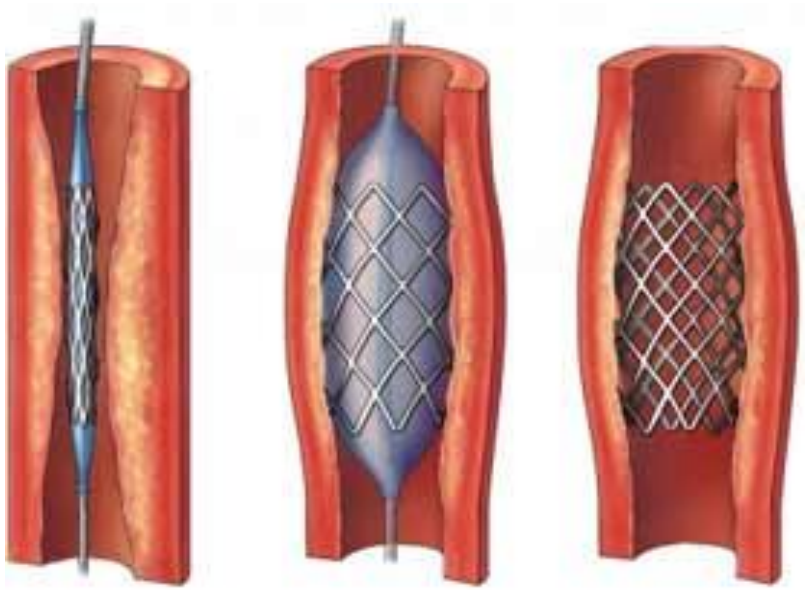
- Biodegradable
- Form fit

Cons

- Difficult proof of concept
- Limited Strength

Balloon Induced Stent

- Modeled after arterial stent
- Mesh cylinder inserted into intermedullary canal
- Inflated by removable balloon



Arterial stent: http://www.beliefnet.com/healthandhealing/getcontent.aspx?cid=14867

Pros

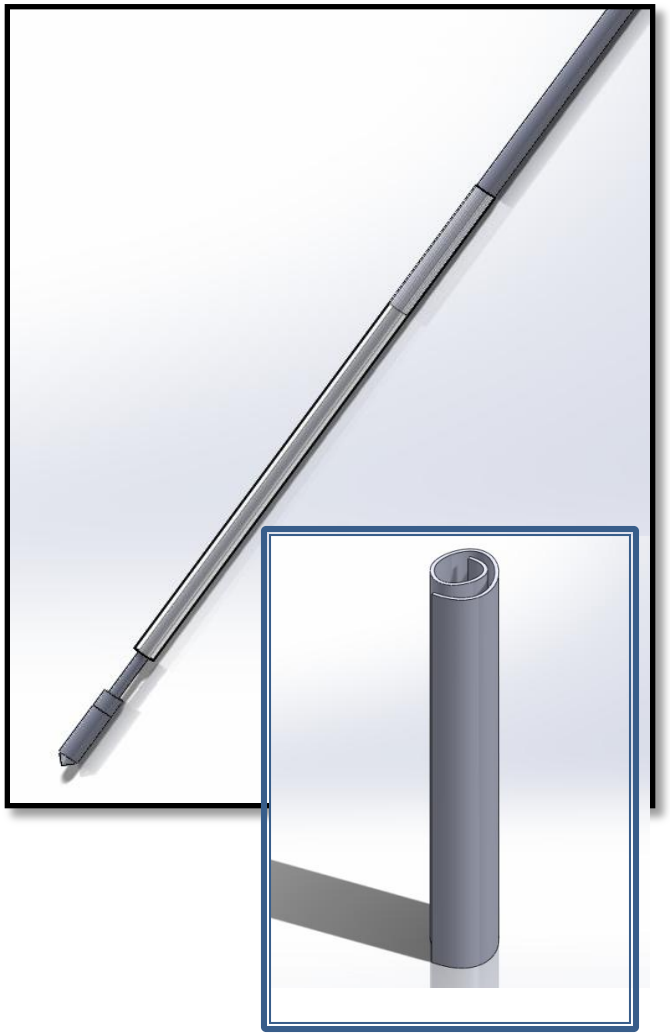
- Proven design concept
- Ease of implementation

Cons

- Fabrication
- No lateral force

Expanding Stent

- Has a natural propensity to expand
- Uses a sheath to control expansion



Pros

- Continuous Lateral Force
- Expansion Control
- Form fit

Cons

- Fabrication
- Optimization

Design Matrix

Parameters	Total Weight	Balloon Stent	Expanding Stent	Expanding Foam
Fixation	10	2	3	1
Client Preference	5	2	3	1
Ease of Implantation	5	3	3	2
Safety	5	3	3	1
Feasibility	5	2	3	1
Cost	3	2	3	1
Total	99	76	99	38

Future Work

- Talk to professors to determine adequate materials
- Manufacture spring component
- Mechanically test prototype in saw bones
- Refine prototype based on testing results

http://www.mts.com/mtscriterion/applications/metals/

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- Prof. Hiedi Ploeg

http://theweinblog.wordpress.com/2011/08/03/

Questions????

http://www.mrmediatraining.com/index.php/tag/question-of-the-week/