Tibial Stent Design Team Progress Report

Client: *Dr. Matthew Halanski*
Advisor: *Dr. Paul Thompson*

Team:

Evan Lange	*elange2@wisc.edu (Team Leader)*
Karl Kabarowski	*kabarowski@wisc.edu (Communicator/BSAC)*
Tyler Max	*tmax@wisc.edu (BPAG)*
Sarah Dicker	*sdicker@wisc.edu (BWIG)*

Date: *February 21st, 2014 – February 28th, 2014 (Week 5)*

Problem Statement

(revised 02/03/14)

Tibia fractures are common in children, and these injuries are currently managed nonoperatively using casts; however, a surgically implanted device would provide more structural stability and aid the healing of the fracture. Adult patients with this injury typically have a rigid intramedullary device implanted into their tibia bone. Unfortunately, these implants cannot be used in pediatric patients due to the presence of growth plates at the implantation site. A previous design team produced a working device that can enter the medullary canal through a hole in the side of the bone and then expand outward to stabilize the fracture, held in place by static friction against the canal wall. This device is flexible enough to fit into the canal, yet rigid enough to maintain fracture reduction, can be secured in place with screws, and can be removed from the canal when desired; however, the device is not fully fixated against the walls of the bone canal, and the friction force of the device is not sufficient to prevent axial rotation within the canal. This rotation can lead to device failure resulting in unnecessary pain for the patient and extra surgery to correct the issue. Last semester, this team designed a theoretical device consisting of a threaded segmented centerpiece inside of a metal biaxial braid. When the centerpiece is rotated, the braid experiences a compressive load, which causes it to expand radially. This radial expansion would ultimately provide the force to stabilize the fracture; however, the current design does not allow for sufficient force to be applied to the centerpiece.

The goal of this semester is to improve the design from last semester by strengthening the centerpiece joints, which will give us the ability to build and test a prototype, and develop a novel tool that can rotate the centerpiece when the implant is placed into a bone.

Last Week's Goals (14-7 days ago)

- Complete Design Matrix
- Complete Midsemester Presentation
- Potentially conduct testing of braid using PVC mock-up and testing apparatus on MTS machine
- Potentially conduct testing of cast material on MTS machine

This Week's Goals/Individual Goals (7-0 days ago)

- Finalize specifications of final design
- Meet with Dr. Heidi Ploeg to discuss tibia models for testing
- Begin ordering materials
- Begin brainstorming for method to tighten nut on centerpiece

This Week's Accomplishments

- Met with Dr. Heidi Ploeg to discuss tibia models for testing
    - Advises not to use cadaveric tissue for mechanical testing – exponentially increases variability in data

- Bending stiffness of cast is probably not appropriate benchmark for design success this semester due to the vastly different mechanisms of stabilization of a cast and our design
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Project Difficulties

- The team experienced a setback this week when Dr. Ploeg seriously questioned the ability to compare the bending stiffness of the cast to the bending stiffness of our device given the different mechanisms by which a cast and our device function. Thus we are searching for a new way to obtain an acceptable bending stiffness for our device.

Next Week's Team Goals

- Complete SolidWorks modeling of cap designs
- Contact fabrication firm
- Obtain new K-wires from Dr. Halanski
- Complete bend testing of K-wires and determine appropriate diameter to use as centerpiece for this design

Summary of Design Accomplishments

- The team is meeting weekly to accelerate the design process
- The team has a meeting scheduled with the client to discuss goals for this semester and to obtain information about quantifying device performance constraints
- The team has met with Dr. Halanski to discuss goals for this semester
- The team has completed the Design Matrices for this semester and the Midsemester Presentation
- The team has completed the Midsemester Report

Expenses

- none at this time

Schedule for Spring 2014

Task	*January*	*February*				*March*					*April*				*May*	
	31	7	14	21	28	7	14	21	28	31	4	11	18	25	2	9
Groundwork																
Set Meeting Time	X	X														
Brainstorming	X	X	X	X	X											
ECB 2005 Access	X	X	X	X												
Testing																
Cast Material					X											
Braided Structure					X											
Prototyping																
Order Materials																
Build Prototype																
Test Prototype																
Deliverables																
Progress Reports	X	X	X	X	X											
Notebooks	X	X	X	X	X											
PDS	X	X	X	X												
Midsemester Presentation				X												
Midsemester Report				X	X											
Final Poster																
Final Report																
Meetings																
Advisor Meeting	X	X	X	X	X											
Team Meeting	X	X	X	X	X											
Client Meeting			X													
Website																
Update	X	X	X	X	X											

Activities

Person(s)	Task	Time (hrs)	Weekly Total	Semester Total
Evan	*Team Role (Leader)*		20.0	41.0
	Weekly progress report	1.0		
	Developed next week's team goals	1.0		
	Other			
	Midsemester Presentation Preparation	7.0		
	MTS Machine training	1.0		
	Writing Midsemester Report	3.0		
	Weekly Team Meeting	0.5		
	Editing Midsemester Report	6.0		
	Meeting with Dr. Ploeg	0.5		
Karl	*Team Role (Communicator)*		16.0	41.0
	Contacted Dr. Puccinelli about MTS machine	0.5		
	Contacted Dr. Halanski about K-wires and meeting	0.5		
	Other			
	Midsemester Presentation Preparation	7.0		
	MTS Machine training	1.0		
	Writing Midsemester Report	3.5		
	Editing Midsemester Report	2.5		
	Weekly Team Meeting	0.5		
	Meeting with Dr. Ploeg	0.5		
Tyler	*Team Role (BPAG)*		11.5	27.0
	n/a			
	Other			
	Midsemester Presentation Preparation	7.0		
	MTS Machine training	1.0		
	Writing Midsemester Report	3.0		
	Meeting with Dr. Ploeg	0.5		
Sarah	*Team Role (BWIG)*		12.5	29.0
	Updated design website & troubleshooting	1.0		
	Other			
	Midsemester Presentation Preparation	9.0		
	MTS Machine training	1.0		
	Editing Midsemester Report	1.0		
	Meeting with Dr. Ploeg	0.5		