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)*
Tyler Max	*tmax@wisc.edu (BPAG)*
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Date: *February 7th, 2014 – February 14th, 2014 (Week 3)*

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)

- Hold first weekly team meeting
- Develop schedule for semester
- Revise problem statement to reflect new goals for this semester (optimization, fabrication, testing, etc.)
- Begin brainstorming optimizations to implement in current design

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

- Meet with Dr. Halanski with a detailed list of topics and specific questions that need to be addressed for this semester
    - Develop schedule for semester following this meeting
- Obtain cast material and/or components to make cast material, contact Dr. Puccinelli about procedure for scheduling use of the MTS machine in Shared Lab ECB 2005
    - would like testing data and bending stiffness value for cast material to include in Mid-semester presentation
- Finalize strategy for preliminary testing of device to break mathematical cycle preventing exact specification of a target value for the maximum load on the centerpiece –OR– decide to be content with rough target values, gather information

about what range these values should be in, finalize these values, and proceed to optimization of design to reach this rough target

This Week's Accomplishments

- Met with Dr. Halanski to discuss goals for semester and any concerns that he has about the design as it currently stands
- Dr. Halanski can obtain a wide variety of cast materials for us to use in testing
- Emailed Dr. Puccinelli about using the MTS machine in ECB 2005
- The team decided to use a testing-based strategy this semester to set the criteria for "Performance Requirements" of this design
- The team revised the wording of the 45° bending requirement in the PDS as per last week's advisor meeting
- The team has modified the design

Project Difficulties

- none at this time

Next Week's Team Goals

- Complete Design Matrix
- Complete SolidWorks analysis of torsional strength of current centerpiece
- 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

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 begun work on the Design Matrix for this semester and the Midsemester Presentation

Expenses

- none at this time

Schedule for Spring 2014

Task															
Groundwork															
Set Meeting Time															
Brainstorming															
Biomaterials Lab Access															
Testing															
Cast Material															
Braided Structure															
Prototype															
Prototyping															
Order Materials															
Build Prototype															
Test Prototype															
Deliverables															
Progress Reports															
Notebooks															
PDS															
Midsemester Presentation															
Midsemester Report															
Final Poster															
Final Report															
Meetings															
Advisor Meeting															
Team Meeting															
Client Meeting															
Website															
Update															

Activities

Person(s)	Task	Time (hrs)	Weekly Total	Semester Total
Evan	*Team Role (Leader)*		4.0	11.0
	Weekly progress report	1.0		
	Developed next week's team goals	1.0		
	Other			
	Weekly Team Meeting	2.0		
Karl	*Team Role (Communicator)*		6.5	10.0
	Emailed Dr. Puccinelli	0.5		
	Other			
	Weekly Team Meeting	2.0		
	Client Meeting	1.0		
	Design Matrix	3.0		
Tyler	*Team Role (BPAG)*		3.0	5.0
	n/a			
	Other			
	Weekly Team Meeting	2.0		
	Client Meeting	1.0		
Sarah	*Team Role (BWIG)*		2.5	5.0
	Updated design website	0.5		
	Other			
	Weekly Team Meeting	2.0		