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)*
Sarah Dicker	*sdicker@wisc.edu (BWIG)*

Date: *January 31st, 2014 – February 7th, 2014 (Week 2)*

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)

- Assign team roles
- Create website
- Establish time for weekly team meetings in addition to advisor meeting
- Contact client to set up meeting

This Week's Goals/Individual Goals (7-0 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 Accomplishments

- Confirmed meeting time with Dr. Halanski for Wednesday Feb. 12th 2014 at 9:00am
    - only two team members can be present, so the team will generate a list of specific topics and questions that Dr. Halanski needs to address during the weekly team meeting on 02/10/14
- Revised problem statement (see above) to reflect new goals for this semester

- Investigated casting material and discussed where to obtain casting material for testing
    - Plan to ask Dr. Halanski if he can provide us with some – if not, we can purchase Plaster of Paris and make our own cast to test
- Discussed testing methods that would allow us to break out of our futile design cycle
    - The main issue causing this cycle is not knowing how much load the centerpiece of the device must withstand. By establishing the connection between the bending stiffness of the stent implanted into the bone and the amount of load applied to the centerpiece empirically, we will be able to compute the amount of force that our centerpiece must hold (+ factor of safety) in order to achieve the same bending stiffness as a cast

Project Difficulties

- none at this time

Next Week's Team Goals

- 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

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

Expenses

- none at this time

Schedule for Spring 2014

currently under development – to be finalized by Week 3 progress report
(would like to decide on which directions to pursue this semester before creating a schedule – need feedback from meeting with Dr. Halanski)

Activities

Person(s)	Task	Time (hrs)	Weekly Total	Semester Total
Evan	*Team Role (Leader)*		4.0	7.0
	Weekly progress report	1.0		
	Developed next week's team goals	1.0		
	Other			
	Weekly Team Meeting	2.0		
Karl	*Team Role (Communicator)*		2.5	3.5
	Contacting Dr. Halanski	0.5		
	Other			
	Weekly Team Meeting	2.0		
Tyler	*Team Role (BPAG)*		2.0	2.0
	n/a			
	Other			
	Weekly Team Meeting	2.0		
Sarah	*Team Role (BWIG)*		2.5	2.5
	Updated design website	0.5		
	Other			
	Weekly Team Meeting	2.0		