Tibial Stent Design Team Progress Report

Client: *Dr. Matthew Halanski*
Advisor: *Dr. Wan-Ju Li*

Team:	*Evan Lange*	*elange2@wisc.edu (Team Leader)*
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Date: *November 22th, 2013 – November 29th, 2013*

Problem Statement

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.

The goal of this semester is to improve the existing device by improving its fixation and adding more radial force thereby advancing this project toward clinical use.

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

- Order all components of device by Monday (11/18/13) after integrating Dr. Halanski's feedback
    - number of copies of device components to be determined – allow for assembly error
- Order metal ribbon material to attempt to make a biaxial braided sleeve
    - thickness and width to be determined
- Draw up a protocol for testing the device
    - flowchart diagram for testing this device
    - what equipment is necessary? how will the device be inserted? etc.
- BME 300 team members attend Welding 1 seminar and gain experience welding small objects
- We do not anticipate receiving parts from the fabrication firm until next week; however, if parts do arrive, we will *immediately* proceed to device assembly to begin testing as soon as possible

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

- Finish SolidWorks by Friday (11/22/13) and contact fabrication firms
- Order materials and parts by Friday (11/22/13)
- Contact shop about setting up welding seminar
- Create final protocol for testing the device
- When parts arrive begin assembly and testing immediately

This Week's Accomplishments

- Assembly of SolidWorks components completed for segmented centerpiece with mid and end caps added
- Attempting SolidWorks modeling of braided cylinder to possibly integrate into the assembly
- Fabrication firms unable to make parts before presentations; most booked through December – plan to order the device over winter break so that it can be assembled and ready for testing at the beginning of next semester
- Began simulations of SolidWorks assembly – plan to test:
    - yield strength of joints of centerpiece
    - potentially attempt virtual three-point bend test
- BME 300 members have been trained in MIG welding and received the Welding 1 upgrade from the COE student shop
- Completed detailed protocol for testing & MATLAB code, which will be used next semester
- Completed invention report to submit to WARF

Project Difficulties

- No fabrication firms available to make the device this semester
    - Because of this, we plan to extensively define the testing protocol to include in future work, complete the SolidWorks model for all components of the device, conduct simulations on assemblies of components in SolidWorks for preliminary design evaluation, and order the device from a fabrication firm over winter recess

Next Week's Team Goals

- Complete poster and prepare for poster presentation
- Complete SolidWorks simulations
- Begin work on Final Report
- Discuss further optimizations to the design that could be implemented prior to sending the drawings in for fabrication

Summary of Design Accomplishments

- The team is meeting weekly to accelerate the design process
- The team has met with previous semester design team to better understand where the project currently stands
- The team has completed the problem statement and the PDS
- The team has used a design matrix to select the design alternative for the final design that best addresses the needs for the project
- The team has completed the Midsemester Presentation and Midsemester Report
- The team has ordered TechFlex Flexo Braided Stainless Steel sleeves for preliminary testing
- The team met with Dr. Yen (Biomechanics) who consulted on this project previously to discuss options and methods for mechanically testing axial rotation of the device inside of the bone canal
- The team is having regular meetings more frequently to further accelerate the design process
- SolidWorks models complete

Expenses

- TechFlex Flexo-Braided Stainless Steel from wirecare.com - $47.15

Schedule for Fall 2013

Task	*September*				*October*				*November*					*December*	
	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13
Groundwork															
Set Meeting Time	X	X													
Brainstorming	X	X	X	X	X			X	X						
Biomaterials Lab Access										X					
Research															
Tibia Fractures	X	X	X	X											
Stent Protocol	X	X	X	X	X										
Fixation Methods	X	X	X	X	X	X									
Contextual Research	X	X	X	X	X	X									
Prototyping															
Order Materials															
Build Prototype															
Test Prototype															
Deliverables															
Progress Reports	X	X	X	X	X	X	X	X	X	X	X	X	X		
Notebooks	X	X	X	X	X	X	X	X	X	X	X	X	X		
PDS			X	X	X	X	X	X	X	X	X	X	X		
Midsemester Presentation				X	X										
Midsemester Report				X	X	X									
Final Poster												X	X		
Final Report												X	X		
Meetings															
Advisor Meeting	X	X	X	X	X	X	X	X	X	X	X	X			
Team Meeting	X	X	X	X	X	X	X	X	X	X	X	X			
Client Meeting				X							X				
Website															
Update	X	X	X	X	X	X	X	X	X	X	X	X	X		

Activities

Person(s)	Task	Time (hrs)	Weekly Total	Semester Total
Evan	*Team Role (Leader)*		19.5	145.5
	Weekly progress report	1.5		
	Developed next week's team goals	1.0		
	Assigned team member responsibilities	1.0		
	Other			
	SolidWorks Modeling/Simulation	12.5		
	Welding Seminar	2.5		
	Invention Report	1.0		
Karl	*Team Role (Communicator)*		6.5	95.5
	n/a			
	Other			
	Welding Seminar	2.5		
	SolidWorks	1.0		
	Invention Report	1.5		
	Schedule for week	1.5		
Tyler	*Team Role (BSAC)*		6.5	66.5
	n/a			
	Other			
	SolidWorks Modeling	4.0		
	Welding Seminar	2.5		
Sarah	*Team Role (BWIG)*		4.5	70.0
	Update Website	0.5		
	Other			
	Poster	4.0		
Lida	*Team Role (BPAG)*		6.0	57.5
	n/a			
	Other			
	MATLAB code and testing protocol	6.0		