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: *April 18th, 2014 – April 25th, 2014* *(Week 13)*

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 (14-21 days ago)

- Obtain quote for caps or obtain more nuts, ream them out, and glue them together for use as caps
- Maintain communication with Suhner® to provide information about the requirements of the drive shaft and obtain information about the type of end that the drive shaft will have on it
- Obtain a socket for the end of the drive shaft and draw up an adapter or necessary modifications for use with the drive shaft end

This Week's Goals/Individual Goals (14-0 days ago)

- Obtain all materals and begin fabrication as soon as possible
- Contact COE Student Shop personnel regarding TIG welding of braid to cap circumference
- Prepare SawBone models for testing
    - cut the bones at the fracture point
    - drill 8mm hole at 45˚ angle at top of canal

This Week's Accomplishments

- Obtained flexible drive shaft from Suhner
- Glued four small nuts together to serve as "nut" for device
- Contacted COE Student Shop re: soldering braid to cap and soldering hex broach to drive shaft
- Prepared SawBone model for testing
    - cut 45˚ angle at fracture point (mid-bone)
    - drilled 8mm hole at 45˚ at top of canal

Project Difficulties

- Delay/issue with hex broach – more information from company Friday morning

Next Week's Team Goals

- Complete device fabrication
- Complete device testing
- Complete poster for poster presentations

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
- The team has conducted bend testing of K-wires and finalized 2 candidate diameters that are ideal for use with this device
- The team has ordered caps for both 3/32" and 5/64" diameter K-wires
- The team has ordered a flexible hollow drive shaft and a hexagonal brooch to implement the device inside the tibia canal

Expenses

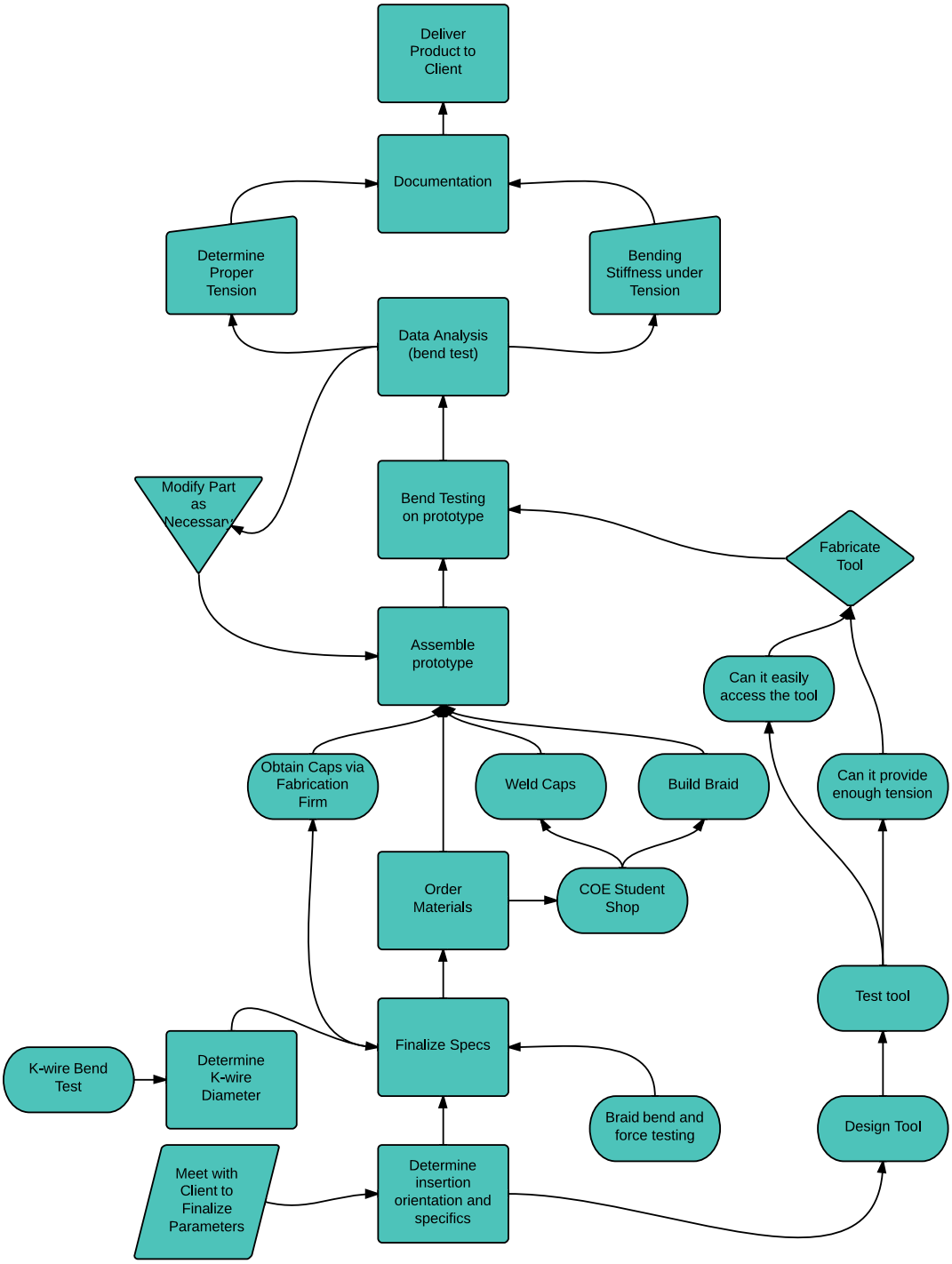
- ACE Hardware - $6
- Polygon Solutions - $330 (external hex broach)
- Casperson - $669 (caps)

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	X	X	X	X	X	X	X	X	X		
ECB 2005 Access	X	X	X	X												
Testing																
Cast Material					X	X	X									
Braided Structure					X	X	X									
Prototyping																
Order Materials						X	X	X								
Build Prototype							X	X	X	X	X	X	X	X		
Test Prototype								X	X	X	X	X	X	X		
Deliverables																
Progress Reports	X	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	X		
PDS	X	X	X	X												
Midsemester Presentation				X												
Midsemester Report				X	X											
Final Poster														X		
Final Report														X		
Meetings																
Advisor Meeting	X	X	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	X	X		
Client Meeting			X			X			X				X			
Website																
Update	X	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)*		8.5	95.0
	Weekly progress report	1.0		
	Developed next week's team goals	1.0		
	Other			
	Executive Summary	4.5		
	Weekly Team Meeting	1.0		
	Prepare SawBone for testing	1.5		
Karl	*Team Role (Communicator/BSAC)*		16.0	108.0
	Maintained contact with fabrication firms	1.0		
	Reschedule client meeting	0.5		
	Synthes for information on elastic nails sales	0.5		
	Other			
	Executive Summary	1.0		
	Final Paper	3.0		
	Prepare SawBone for testing	1.5		
	Various Research	2.5		
	Generate expenses table	0.5		
	Practice using developing prototype with SawBone	0.5		
	Nut Fabrication	3.0		
	Clean K-wires	1.0		
	Weekly Team Meeting	1.0		
Tyler	*Team Role (BPAG)*			55.0
	n/a			
	Other			
Sarah	*Team Role (BWIG)*		4.0	61.5
	Updated design website	0.5		
	Other			
	Weekly Team Meeting	1.0		
	Nut Fabrication	2.5		


Deliver Product to Client
Documentation
Determine Proper Tension
Bending Stiffness under Tension
Data Analysis (bend test)
Modify Part as Necessary
Bend Testing on prototype
Fabricate Tool
Assemble prototype
Can it easily access the tool
Obtain Caps via Fabrication Firm
Weld Caps
Build Braid
Can it provide enough tension
Order Materials
COE Student Shop
Test tool
K-wire Bend Test
Determine K-wire Diameter
Finalize Specs
Braid bend and force testing
Design Tool
Meet with Client to Finalize Parameters
Determine insertion orientation and specifics