Therapeutic Exercise Cage for Muscle Development

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Date: March 29th - April 4th, 2017

Problem Statement:

A spider cage is a device used by therapists to work with individuals (usually children) who have cerebral palsy. The cage supports the patient's weight with the use of bungee cords that are connected to a custom suit that allows the patient to work on building leg and arm strength. This product is available commercially but it is quite expensive. The client is looking for a design that is relatively inexpensive, transportable via trailer, able to fit through a standard doorway, and customized to meet the needs of one particular person.

Last Week's Goals

- Continue Testing

Summary of Team Role Accomplishments

- *Leader* - Send progress report to client, TA, and adviser.
- *BWIG* - Uploaded progress report
- *BSAC* - No meetings attended.
- *Communicator* - Made sure Amanda and her assistant, Jennifer, were able to get to the correct room for our meeting

- *BPAG* - No additional expenses

Summary of Accomplishments:

The team has completed testing with two subjects at three different setup locations. The data has been collected from the dial indicators and organized into graphs on excel. The team was able to meet with Amanda and Jennifer on April 4, 2017 to clarify if the shorter subjects should be attached to the same location points as the taller subjects or if they should be attached to points lower on the cage to accommodate for height and weight differences. It was ultimately decided that the shorter subjects will be attached to the lower points on the sides of the cage instead on the top. Amanda and Jennifer suggested that the team add padding to the exposed extrusions on the cage to avoid injury. They also suggested that the team adds bearing to the carabiners to help reduce friction and breakage of the resistance bands. In addition to the testing already being conducted, it would be beneficial to test ankle support near the bottom of the cage (to keep patients' legs apart) and also test attachment points at waist level (for patients who only need stability and not so much support). The team will continue and finish testing with the three smaller subjects in the next two weeks.

Activities

Date	Person	Task	Time (hrs)	Weekly Total	Semester Total
3/30/17	Team	Testing/Data Recording and Organization	2		
3/31/17		Advisor Meeting	0.5		
4/4/17		Meeting with Amanda and Jennifer	1.5	4	16
	Kevin	Worked on DIY instructional	1	1	18

3/30	Darcy	Made simulation video for DIY instructional	1		15.5
4/4		Made initial graphic to display data more clearly	2	3	18.5
4/3/17	Sheetal	Data analysis	1	1	17
4/2/17-4/3/17	Breanna	ANOVA/statistical analysis research	1.5	1.5	20.5
	Stephen	No work was done outside class time for this week.	-	-	18

Team Goals

- Continue testing

Individual Goals

- *Kevin:* Research new carabiners for straps and for cage connection points.
- *Darcy:* Apply all setups with the new graphic template, research makeshift bearings for the resistance bands
- *Sheetal:* Data analysis on girls' deflection data
- *Breanna:* Begin statistical analysis on Kevin and Steve's deflection data
- *Stephen:* Research makeshift bearings for resistance bands, complete girls' testing.

Project Timeline

	January		February				March					April				May
Task	19	26	2	9	16	23	2	9	16	23	30	6	13	20	27	4
Project R&D																
Base Support	X	X														
Harnesses and Bands		X	X	X												
Padding					X	X										
Assembly Tools																
Fabrication																
Order Materials				X	X	x										
Create Fastener Hole		X														
Base Support						x	x	x								
Padding																
Assembly Tools																
Testing																
Slip Test							x	X	X	x	X					
Deflection Calculations									X	X	X					
Assembly Directions																
Redesign																
Deliverables																
Progress Report	X	X	X	X	X	X	X	X		X	X					
Individual Presentation				X	X											
Preliminary Presentation				X	X											
Preliminary Deliverables				X	X											
Poster																
Final Deliverables																
Meetings																
Advisor	X		X					X		X	X					
Client			X								X					
Team	X	X	X	X	X	X	X	X		X	X					
Website																
Update	X	X	X	X	X	X	X	X		X	X					
Colored Cells: Projected Timeline																
X: Completed Tasks																

Expenses

Fall 2016: University Funded Expenses: $1,702.75

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
Price Engineering Cage Materials & Shipping (Itemized BOM in separate file)	Price Engineering	N/A	N/A	1	1/1/2017	$1,702.75	$1,702.75
						Total	$1,702.75

Spring 2017: University Funded Expenses: $32.94

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
19/32 4'x8' OSB	Home Depot (IN STORE)	0000-339-696 5/8 OSB SQ	N/A	2	2/24/2017	$14.75	$29.50
TEE NUT ZINC 5/16-18 x 3/8"	Home Depot (IN STORE)	887480023114 TEE NUT	N/A	2	2/24/2017	$0.98	$1.96
HEX BOLT 5/16-18 x 3/4"	Home Depot (IN STORE)	AEE 5/16X3/4HBLT	N/A	8	2/24/2017	$0.16	$1.28
HEX BOLT 5/16-18 x 1"	Home Depot (IN STORE)	AFE 5/16X1HXBOLT	N/A	8	2/24/2017	$0.17	$1.36
						Total	$34.10

Spring 2017: Client Funded Expenses: $159.74

Description	Supplier	Part/Model #	Link to Part	QTY	Date	Price	Total
Harnesses	Zoro	Zoro #: G1320821 Mfr #: 1191209	https://www.zoro.com/protecta-full-body-harness-ml-420-lb-redgray-1191209/i/G1320821/?gclid=COn-5on-_NECFR61wAodtbMCkg	1	2/9/2017	$75.86	$75.86
Resistance Bands	Fitness Insanity	Unsure	https://www.amazon.com/gp/product/B01GCA4BJC?ref_=sr_1_7&qid=1486677502&sr=8-7&keywords=Fitness%20Resistant%20Bands&pldnSite=1	4	2/9/2017	$20.97	$83.88
						Total	$159.74

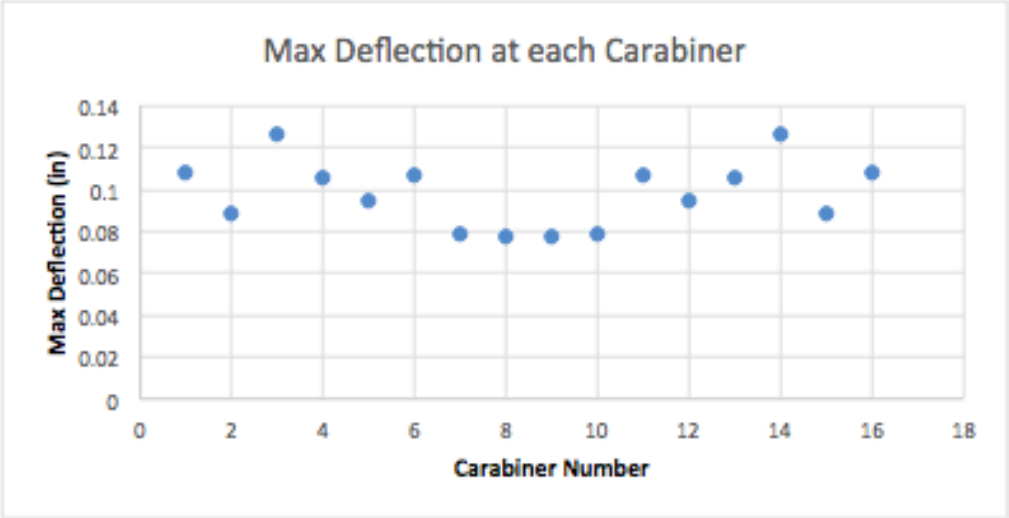
Total UW - Expenses: $1735.69
Total Client Expenses: $159.74
Total Expenses: $1895.43

ME Technical Section

Statistical Analysis

The experiment being completed on the spider cage this semester previously involved five different test setup positions but will now only include three due to time constraints. To determine if the deflection of each attachment point varies between the three testing setups, a statistical analysis must be run. The team has decided to conduct an ANOVA test on the collected data. ANOVA is an acronym for analysis of variance and is used to find the differences among group means [1]. An ANOVA test contains three basic assumptions: the distribution of the data is normal, sample cases are independent of each other, and variances across groups are to be approximately equal (homogeneity). There are three different ANOVA tests including the one-way, two-way, and N-way ANOVA. A one-way ANOVA has a single independent variable, the two-way has two independent variables, and the N-way has N independent variables [1]. The team has decided to go forth with a one-way ANOVA because there is only one independent variable in the study (location of carabiner attachment to the cage) and one dependent variable (mesh deflection).

The goal of testing is to determine if the deflection of the mesh at attachment location one of test setup one is significantly different from deflection of the mesh at attachment location one of test setup two and three (and so on with the other attachment locations and setups). Figure 1 shows a graph of one set of data that will be used in this statistical analysis and a diagram of the carabiner numbers relative to the top of the cage. The null hypothesis of this experiment is that there will be no significant differences in mesh deflection among groups and the alternative hypothesis states that there will be significant differences in mesh deflection among the groups. A 95% confidence interval will be used and if the calculated p-value is less than 0.05, the null hypothesis will be rejected and this indicates that there is a significant difference between the deflections. With the information from the statistical analysis, the team will be able to determine if there are significant differences between the mesh deflections of each attachment point for the three test setups. This information could then be used to determine which test setup is the safest.



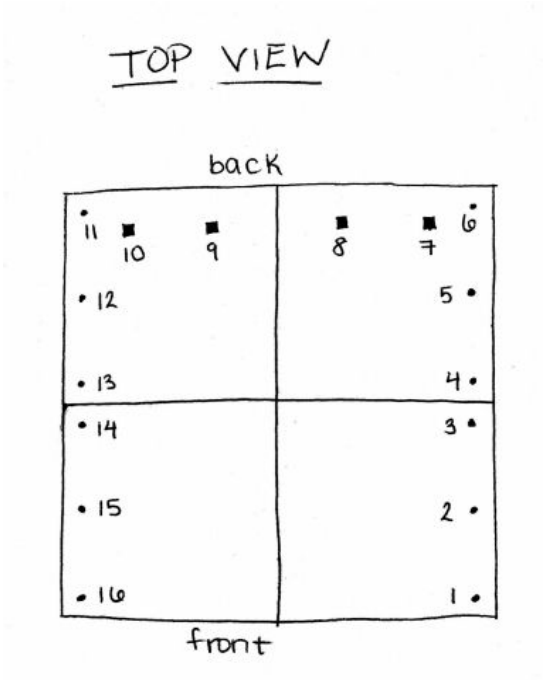


Figure 1. Top: Graph showing one set of data to be used in the one-way ANOVA test. Bottom: Diagram of the top view of the spider cage showing carabiner numbering. Circles indicate attachments to the top panel of the cage, squares indicate attachments to the side back panel of the cage.

[1] "ANOVA - Statistics Solutions", *Statistics Solutions*, 2017. [Online]. Available: http://www.statisticssolutions.com/manova-analysis-anova/. [Accessed: 04- Apr- 2017].

Written By: Breanna Hagerty

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