

Therapeutic Exercise Cage for Muscle Development

Client: Mr. Matt Jahnke - mattjahnke@ucpdane.org

Advisor: Joseph Towles - towles@wisc.edu

Team: Kevin Collins - kdcollins2@wisc.edu (Team Leader)

Darcy Davis - darcy.davis@wisc.edu (Communicator)

Sheetal Gowda - sjgowda@wisc.edu (BSAC)

Breanna Hagerty - bhagerty@wisc.edu (BWIG)

Stephen Kindem - kindem@wisc.edu (BPAG)

Date: April 5th - 11th, 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* - Signed up for ME design symposium
- *BPAG* - No additional expenses

Summary of Accomplishments:

This week the team finished the slip test with all subjects. The deflections were measured using a dial indicator and graphs were created on excel to display the deflection at each carabiner position. A one-way ANOVA test using R was conducted on the setup used for taller subject and it was noted that the greatest amount of deflection occurred when the carabiners were attached further from the extrusions versus closer. The foam flooring was also cut to fit the base of the cage and in the coming weeks the team will address the concerns of the client and work on assembling/disassembling the cage.

Activities

Date	Person	Task	Time (hrs)	Weekly Total	Semester Total
4/6/2017	Team	Testing	2		18
	Kevin	Extra Testing	1	1	19
4/6/2017	Darcy	Continue creating graphics for data sets	2		
4/11/17		Set up foam flooring, made map of foam flooring and took pictures for assembly instructions	1	3	18.5
4/11/17	Sheetal	Data analysis	1.5	1.5	18.5
4/9/2017	Breanna	Executive Summary	1		
4/11/2017		Statistical analysis	1.5	2.5	23

4/6/2017	Stephen	Extra Testing	1	2	20
4/11/2017	Stephen	ME Technical Section	1		

Team Goals

- Address issues noted by client
- Coat wood flooring
- Work on assembly instructions

Individual Goals

- *Kevin*: Begin Assembly instructions
- *Darcy*: Finish graphics for data, create graphic of foam flooring for assembly instructions
- *Sheetal*: Finish data analysis and begin assembly instructions
- *Breanna*: Continue working on statistics
- *Stephen*: Address issues discussed with client, coat flooring

Project Timeline

Task	January		February				March					April				May
	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											X	X				
Assembly Tools																
Testing																
Slip Test							X	X	X	X	X	X				
Deflection Calculations									X	X	X	X				
Assembly Directions																
Deliverables																
Progress Report	X	X	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						
Client			X								X					
Team	X	X	X	X	X	X	X	X		X	X	X				
Website																
Update	X	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
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Total UW - Expenses: \$1735.69
Total Client Expenses: \$159.74
Total Expenses: \$1895.43

ME Technical Section

The group was able to meet with the main two therapists that will be using the cage at Continuum Therapy. The therapists discussed the cage's functionality with the team and took note of current issues and potential issues with the cage. The main problems that the team will aim to fix in the coming weeks are the lack of padding on the interior face of the framing members, wear that develops in the bands due to friction with the carabiners, and noticeable wear on the mesh coating from attaching/detaching the carabiners. These issues need to be address before the end of the semester to ensure a safe and durable cage.

The lack of padding was noted when one of the therapists was supported in the cage and attempted to test how close her head could get to sides. In her setup, she was not able to reach the sides of the cage with her head, but was easily able to reach the top of the cage. Additionally, patients vary drastically in weight, height, and required support, so some patients may not be supported adequately (although their support is adequate for their desired exercises) to avoid hitting the sides of the cage with their head. The group plans to address this issue by using the extra pieces of the floor padding to line the inside of the frame. The padding will be cut into strips and applied to the frame by using either adhesive or tape.

The second issue was noted after visual inspection of the resistance bands showed that friction between them and the carabiners was starting to cause wear. Since the bands are longer than necessary, each end was connected to the mesh and a carabiner was added in the center to attach to the harness. This setup can be seen in figure 1. The friction between the carabiner and band has begun to wear out the bands. The group plans to address this problem adding makeshift bearings to either the carabiners or the bands themselves. The bearings will prevent direct contact between the bands and carabiners as well as allow for even tension throughout the bands.



Figure 1: Depiction of carabiner on resistance band ready to attach to the harness.

The third issue was observed during the group's statistical mesh testing when the ends of the bands were being attached/detached to the mesh. The carabiners have small slots with sharp edges to ensure they are secure when closed (see figure 2). These sharp edges tend to scrape and cut the mesh coating unless they are attached/detached with caution and knowledge of the issue problem. The wear of the mesh can be seen in figure 3. The group plans to address this issue by either recommending new carabiners or adding an additional coating, possibly made of rubber, to the areas of the mesh that will be used most frequently. Either solution would likely work individually, but the group would like to implement them both.



Figure 2: Current carabiners with sharp slots circled in red.



Figure 3: Damaged to mesh from attaching/detaching resistance band carabiners.

Addressing these issues will help ensure that the cage will remain functional for as long as possible without additional maintenance.

Written by: Stephen Kindem

Reviewed by: Darcy Davis