

Tracheotomy tube security device

Client: Dr. Timothy McCulloch

Team Members: Katie Pollock (Leader)

Becca Clayman (Communicator)

Kim Safarik (BWIG)

Paul Fossum (BSAC)

April 17 to April 23, 2009

Problem Statement

In patients who have had a tracheotomy performed, a major post surgery problem is discomfort from the tracheotomy collar. The collar must be secured tightly to keep the tracheotomy tube in place so the patient can breathe. However, if the collar is kept at the proper tension, it can cause ulcers on the patient's skin. Our goal is to design a tracheotomy strap that is comfortable, easy to clean, and equipped with monitoring devices to ensure that proper pressure is exerted on the tube and neck.

Last Week's Goals

- Define and begin testing methods for absorbancy and force/stretch testing on balloons.
- Complete further math on force and pressure.
- Obtain information about getting a phantom for the final presentation.
- Determine which materials in the strap will be reusable and which will be disposable.
- Begin work on poster

Summary of Accomplishments

- On Sunday the group met and fabricated the majority of the circuit with a new medical battery we bought which supplies an adequate voltage to power the LED light. We will need to solder the circuit eventually. We also fabricated 3 identical balloons for use in the back of the strap.
- On Monday Kim and Katie met with Prof Thompson to discuss appropriate math for the project, and determined the minimum pressure necessary to keep the

tube in was .11 N, this is also applied to the back of the neck. In order to ensure patient safety, we will end up tripling this number to securely hold the tube in place.

- On Tuesday, the team met to conduct further fabrication and testing on the strap. We completed absorbance testing which showed that equal areas of our mesh fabric and the old cotton strap had very different absorptive values. A 2.25 in section of our mesh absorbed only .2ml, while an old cotton strap of the same length absorbed 1.0ml.
- We also attempted to test the balloons stretching capabilities. We used water as our weight unit because 1ml of water weighs about a gram, which corresponds to a force of .01 N. We placed the balloon in a stationary chamber with fixed walls and a sliding top. We applied force to the top by placing the bag on it, with a volume of water that corresponded to the force we wished to apply. However, when force was applied that corresponded to .11N, the minimum pressure on the neck, no deformation occurred. The same was true for values up to about .99N of force being applied. We attempted several strategies to reduce the area of the balloon, none of which really worked.
- In our original circuit design, foil was attached to the balloon in order to complete the circuit when the balloon expanded. However, when the foil is attached to the balloon, it does not expand at all in that direction.
- We are looking at redesigning our circuit so that the circuit is completed in the strap (via the sides of fabric getting closer to one another) rather than being attached to the balloons. We will need to complete further testing on this to evaluate how well this strategy may work.
- We brainstormed on Wednesday and will be attempting to resolve these issues on Thursday and Friday.
- The poster has been started and the background section is nearing completion.
- We obtained a phantom for the presentation. The phantom is a CPR dummy, so it does not actually have a hole in its neck. Rather than connecting the tracheotomy tube, we will be constructing a plastic insert the same size as the tube support that we will use to demonstrate with.

This week's goals

- Resolve circuit triggering problems
- Complete balloon testing and do more trials of absorbance testing
- Finish construction of strap
- Finish poster, print, and prepare for presentation

Project Difficulties

Based on the math that we have completed, the force required to secure the tracheotomy tube is not great enough to sufficiently distort the balloons in order to trigger the circuit to turn on. We need to re-evaluate the circuit connections and where we wish to make them.

Activities –Team total should be added to each individual total

Member	Activity	Hours	Cumulative
Katie Pollock	Math/pressure research	1	16.25
	Prof Thompson meeting	1.25	
	Testing prep	.75	
	Brainstorming	.5	
	Progress report	.5	
Becca Clayman	Poster work	1	12.00
	Brainstorming	.5	
	Communication	.5	
	Pricing research	.5	
Kim Safarik	Update website/email prof Thompson	.5	10.00
	Prof Thompson meeting	1.25	
	Brainstorming	1.5	
Paul Fossum	Plastic trach tube replacement	1	10.00
	Brainstorming	.5	
TEAM	Team meeting/fabrication – Sunday	1.5	29.575
	Team meeting/fabrication – Tuesday	1	
	Team meeting/fabrication - Thursday	1	

Project Schedule

Number	Task	Start	End	Duration	1/23	1/30	2/6	2/13	2/20	2/27	3/5	3/13	3/20	3/27	4/3	4/10	4/17	4/24	5/1	5/8	
1	Assign teams and duties	1/23/09	1/21/09	1																	
2	Research project statement and contact client	1/23/09	1/30/09	7																	
3	Initial Brainstorming Client meeting, obtained basic materials	1/30/09	2/13/09	14																	
4	Refined brainstorming	2/4/09	2/5/09	1																	
5	PDS	2/5/09	2/27/09	22																	
6	Design Matrix	2/13/09	2/20/09	7																	
7	Select final idea	2/21/09	2/27/09	5																	
8	Work on mid semester presentation	2/27/09	3/5/09	7																	
9	Mid semester report	3/5/09	3/11/09	7																	
10	Mid semester presentation	3/5/09	3/11/09	1																	
11	Order materials	3/11/09	3/14/09	3																	
12	Spring break	3/14/09	3/22/09	8																	
13	Fabrication of strap	3/22/09	4/10/09	18																	
14	Common testing/safety evaluation	4/10/09	4/11/09	2																	
15	Redesign	4/11/09	4/24/09	13																	
16	Final testing	4/24/09	4/25/09	1																	
17	Final presentation	4/24/09	5/1/09	4																	
18	Report	5/2/09	5/2/09	1																	

We are still a little behind schedule. Fabrication has begun, but isn't quite finished yet. We are testing, but are having to redesign a few things regarding the circuit.

Expenses

Item	Amount	Price
Jersey mesh fabric	0.5 yds	\$1.50
Box to store materials	1	\$0.99
Sponge(as back up)	1	\$1.95
Glue (Liquid Nails)	1	\$3.47
Eyehooks(no longer using)	1 bag	\$0.98
Nylon gloves	6 (1 pack)	\$2.47
Heat shrink tubing(large)	1 pack	\$1.97
Heat shrink tubing(small)	1 pack	\$1.95

LED lights	2 lights	\$1.57
Battery	1 6V medical battery	\$5.49
Duct tape	1 roll	\$6.99

Total : \$29.33