

# BME Design-Spring 2023 - Dana Stumpfoll

## Complete Notebook

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**Team contact Information**

Oscar Zarneke - Mar 24, 2023, 9:06 AM CDT

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Heller	Lauren	BSAC	lheller@wisc.edu	(414) 731-8249	
Bah	Abdoulahi	BWIG	anbah@wisc.edu	(608)-338-2428	
Makonnen	Rebekah	BPAG	rmakonnen@wisc.edu	763-445-0305	



## Project description

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Oscar Zarneke - Mar 24, 2023, 9:03 AM CDT

**Course Number:** BME 402 Design

**Project Name:** Improved Method of Securing Surgical Drains

**Short Name:** Drain Pain

**Project description/problem statement:**

The current method of securing surgical drains can be painful for patients and require a lot of post-operative care to keep the drain functional. Sutures are commonly used and get tugged on when following post-operative care of "stripping" the drain tubing, OT treatment plans, daily activities, and exercise. Drains are in place for patients for a month or more until drainage gets to a consistently low volume. Clots may develop and may not be able to pass through drains because sutures can constrict the tubing. Since drain sites are open wounds, infection risk should also be considered for an improved method of securing surgical drains.

**About the client:**

Dr. Katie Kalscheur is a professor at UW Madison in the engineering department. She has her PhD in Civil and Environmental Engineering and mainly teaches the interdisciplinary freshman design course. She has tasked us with developing a new and more comfortable method for securing surgical drains.



## 2023/02/03 - Client Meeting

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Dana Stumpfoll - Feb 03, 2023, 12:31 PM CST

**Title:** Client Meeting

**Date:** 02/03/2023

**Content by:** Dana

**Present:** Dana, Abdoulahi, Oscar, Lauren, Beki

**Goals:** Update client on the plan for the semester.

**Content:**

- We met with Dr. Katie Kalscheur to give her an update on the plans for the semester.
- She said she thought our plans sounded good and she is looking forward to seeing our progress throughout the semester.
- She likes the idea that we are writing a journal article as this is good practice for those who want to pursue graduate school.
- She said if she has any input or questions she will email us.

**Conclusions/action items:**

Keep Dr. Kalscheur updated on the project. Reach out to her if we need any advice or guidance.



## 2023/02/03 - Advisor Meeting (Semester Goals, Research Journal Choice, Preliminary Presentation Prep)

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LAUREN HELLER - Feb 08, 2023, 12:40 PM CST

**Title:** Advisor Meeting 2

**Date:** 02/03/2023

**Content by:** Lauren Heller

**Present:** All team members present.

**Goals:** Establish semester goals and future plans with Dr. Puccinelli.

**Content:**

- BME Outreach will be completed on March 24.
- Initial communication with the IRB was established. They initially stated that we would need to go through a lengthy approval process, however we believe there was some misunderstanding in what testing goals we had. Dr. Puccinelli will be in communication with them to clarify plans and see if there is a change in requirements.
- Oscar and Beki will be reaching out to connections at 3M and Molnlycke to get information on fabrication or possible outsourcing of the double-layered adhesive fabrication.
- Preliminary presentations will be held on Friday Feb 10. Once slides are completed, they will be emailed to Dr. Puccinelli for feedback. With remaining time, edits can be made prior to presentations in the upcoming advisor meeting. Dr. Kalscheur is unable to attend, but will be briefed afterwards.
- The refined clip design was shown, and the team plans to print new clips in the week following preliminary presentations.

**Conclusions/action items:**

**The main priority currently is to get an idea of what should be accomplished each week for the duration of the semester. Quotes should also be done on materials needed from Staples for the outreach event. Once presentations are complete and the outlined timeline is approved, the team will begin working on testing protocols.**



## 2023/02/17 - Advisor Meeting (Progress made on Project)

---

ABDOULAHY BAH (anbah@wisc.edu) - Feb 17, 2023, 2:08 PM CST

**Title:** Advisor Meeting 3

**Date:** 02/17/2023

**Content by:** Abdoulahi Bah

**Present:** Dana, Lauren, Rebekah, Oscar, Abdoulahi

**Goals:** Update Dr. Puccinelli on the current progress of the project

**Content:**

- showed Dr. Puccinelli the recent clip iteration that were printed
  - have new iteration that we are currently printing - these ones have a smaller diameter, and new material is more elastic not as stiff
- explained flow testing to Dr. Puccinelli
- Oscar reached out to a contact at Molnlycke
  - contact didn't have much information but will be reaching out to someone at the company
  - IV film - similar to the waterproofing bandage
    - might need to do force testing (yanking of clip) to see if adhesive is strong enough to hold the clip onto the adhesive bandage
  - Molnlycke recommended IV film from 3M
- IRB testing - having only a few student being tested, up to 10 students will not need further approval
  - Dr. Puccinelli highlighted we want to publish data so will need to further contact with IRB
- Journal Article - Team selected BMJ but Dr. Puccinelli said it has a very low impact factor, wants us to shot a little higher
  - BMJ is newer and a little vague
  - 3 or higher is the best

**Conclusions/action items:** The team will be meeting on Monday to perform flow testing on the new clip iteration printing today. In addition, the team will discuss more about which journal article we would want to do an entry for.



## 2023/02/24 Advisor Meeting (Testing Progression, IRB Consult Plans)

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LAUREN HELLER - Feb 25, 2023, 2:08 PM CST

**Title:** Advisor Meeting (Testing Progression, IRB Consult Plans)

**Date:** 02/24/2023

**Content by:** Lauren Heller

**Present:** Dana, Lauren, Beki, Oscar

**Goals:** Share progress regarding testing, discuss next options for getting IRB exclusion, and gain clarity on expectations for preliminary journal article draft.

**Content:**

- Informed of testing with different iterations of the clip with varying weights suspending.
- Updates with flow testing, will continue with testing using viscous artificial bodily fluid on Monday. Flow with water did not show significant impact based on clip diameter.
- Discussed next steps with IRB. Need to call for clearer direction, as the email response was not very clear. If they want to do a consultation, we will set one up, and Dr. Puccinelli would like to be included in the consultation.
- For the preliminary journal article submission, we need to complete the introduction and the materials/methods section. The other sections should be roughly drafted out. It is important that our subtitles in the testing section match the subtitles in the results section to make it easy to navigate to a section of interest for readers.

**Conclusions/action items:**

The team needs to call the IRB for further clarity on next steps for adhesive wear testing. Flow testing using the viscous liquid will be done in Monday's team meeting. Over the weekend, we will be working on the preliminary submission, and will wrap it up on Monday to have it edited and ready for submission by the Wednesday deadline.





## 2023/04/07 Advisor Meeting

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ABDOULAH BAH (anbah@wisc.edu) - Apr 10, 2023, 4:31 PM CDT

**Title:** Advisor Meeting 5

**Date:** 04/07/2023

**Content by:** Abdoulahi Bah

**Present:** All Team

**Goals:** Update Tracy on what we did this week

**Content:**

- shared with Dr. Puccinelli on how testing has been going
  - peeling of hydrocolloid - but we think it won't be problem when we attach it to the skin
  - adhesive test - looks good so far
    - some kind of comfort and ergonomics field data would be better
    - survey a medical professional to evaluate our design - if we do create a survey we will need to send to Dr. Puccinelli to have a look at it

**Conclusions/action items:** The team updated Dr. Puccinelli on the teams progress on the project this week. The team will continue doing the wear test and will discuss on weather a survey is feasible and what it would contain.



## 2023/04/14 - Advisor Meeting (Executive Summary Edits)

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ABDOULAH BAH (anbah@wisc.edu) - Apr 14, 2023, 2:11 PM CDT

**Title:** Advisor Meeting (Executive Summary Edits)

**Date:** 04/14/2023

**Content by:**

**Present:** All team members present

**Goals:** Update Dr. Puccinelli on progress of project and discuss edits on executive summary

**Content:**

**Executive Summary Edits:**

- team needs to add early research in the executive summary
- also need to be more detailed when explaining testing - the sentences are vague
- we could add the iterations - things that we have changed
- need to end a bit stronger and state that the design meets the needs of the client
  
- Sent an email of the survey to Dr. Wilke's assistant
  - Friday is not a good day to send things, so we should follow up on Monday. We could also call the assistant if we find their number
- explained how we will analyze the 2-week wear testing to Dr. Puccinelli
  - it would have been better if we all made ratings and averaged them
- the current data is very qualitative so it be important to highlight the quantitative data we did earlier in the project progression

**Conclusions/action items:** The team will make more edits to journal article draft and begin working on final presentations. The team will also make the edits that Dr. Puccinelli advised us to make.



## 2023/04/21 - Advisor Meeting (Pre-Final Deliverables)

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Dana Stumpfoll - May 03, 2023, 4:21 PM CDT

**Title:** Advisor Meeting (Pre-final deliverables)

**Date:** 04/21/2023

**Content by:** Dana

**Present:** Dana, Oscar, Abdoulahi

**Goals:** Update Dr. Puccinelli on progress of project and discuss poster presentations

**Content:**

- Gave Dr. Puccinelli an update on the status of our project including our survey for Dr. Wilke
- Waiting to hear back from Dr. Wilke but the bandage and survey were dropped off
- Asked questions about what should be included on the final poster
  - Need to incorporate a summary of last semesters work
- Dr. Puccinelli is free Wednesday to review the poster if we have any questions or want approval of anything

**Conclusions/action items:** The team will finalize the poster and print it. We will update Dr. Puccinelli on the survey sent to Dr. Wilke.



## 2023/01/30- Brainstorming Journals and Preliminary Presentation Preparation

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Rebekah Makonnen - Jan 30, 2023, 6:54 PM CST

**Title:** Brainstorming Journals to Submit

**Date:** 1/30/2023

**Content by:** Rebekah

**Present:** Dana, Abdoulahi, Oscar, Lauren

**Goals:** To get a preliminary list of journals and to begin working on the preliminary presentation

**Content:**

The team each did individual research on possible journals that the team can submit to and would be relevant for the project. Below is a bulleted list of the most relevant journals that the team has chosen.

- Jama Surgery Journal
  - Impact Score: 7.956
- Advances in Wound Care Journal
  - Impact Score: 4.947
- Advances in Skin and Wound Care
  - Impact Score: 2.373
- BMJ Surgery, Interventions, and Health Technologies
  - Impact Score: 0.77
- Breast Care
  - Impact Score: 2.86
- Pain Research and Management
  - Impact Score: 1.685

In addition to looking at journals, the team began working on completing the preliminary presentation and ways to refine the clip design. Some ideas include increasing diameter for drain tube, reducing the bulkiness of the clip, smoothing out corners on the clip. The team also discussed outreach and the determined a preliminary date that would work for everyone and we plan to reach out to set a date for outreach.

**Conclusions/action items:**

The team will look at articles published in each journal and choose a journal that is the most relevant to the project. The team will meet at the end of the week to choose the best journal for our project and meet with our advisor, Dr. Puccinelli, to get feedback on our selection. The team also plans to contact people at 3M and Moelnlycke to determine if it possible to outsource the fabrication of our project design. Contact the school that we plan on doing outreach at and determine a date.



## 2023/02/06- Preliminary Presentation Prep and Timeline creation

Dana Stumpfoll - Feb 10, 2023, 11:38 AM CST

### Title: Preliminary Presentation Prep

**Date:** 02/06/2023

**Content by:** Dana

**Present:** Dana, Abdoulahi, Oscar, Lauren, Rebekah

**Goals:** Get preliminary presentation and timeline finalized

### Content:

- The team met over zoom to go over the presentation.
- It was looking very bland so we fixed the slides and added a more visually appealing timeline.
- To do so, we came up with deadlines during each month to accomplish tasks such as writing protocols, testing, and data analysis.
- We are planning to focus on sterilization and outsourcing our product to develop a double layer adhesive for adhering the clip to the bandage material.
  - This will allow us to have a more sterilized design as well as the product could be created as one piece and the bandage wouldn't have to be opened separately to adhere the clip.

### Conclusions/action items:

The team will present the presentation on Friday 02/10 to Dr. Tracy Puccinelli in our advisor meeting. We will also ask questions about contacting the IRB to get that finalized and begin working on printing and testing our new 3D clip design. We will also reach out to our contacts for outsourcing the design for a more cohesive design that would be created as one piece.

Dana Stumpfoll - Feb 10, 2023, 11:39 AM CST



[Download](#)

**drain\_pain-BME402\_preliminary\_presentation.pdf (469 kB)** Preliminary presentation



## 2023/02/13 - Testing the New Clip

---

Dana Stumpfoll - Feb 13, 2023, 7:14 PM CST

**Title:** Testing the New Clip Iteration

**Date:** 02/13/2023

**Content by:** Dana

**Present:** Dana, Abdoulahi, Oscar, Lauren, Rebekah

**Goals:** Test the new clip design to determine if it is better than the previous design

**Content:**

- We conducted force testing on our new clip design to determine how well it holds the surgical drain tubing in place.

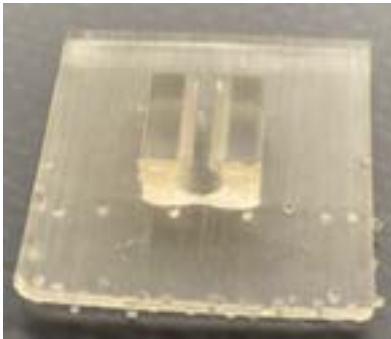


Figure 1: New 3D printed clip design.

- We did this utilizing our force testing protocol we created last semester.
  - Instead of our clip glued to a hydrocolloid bandage, we instead taped the clip to a vertical surface.

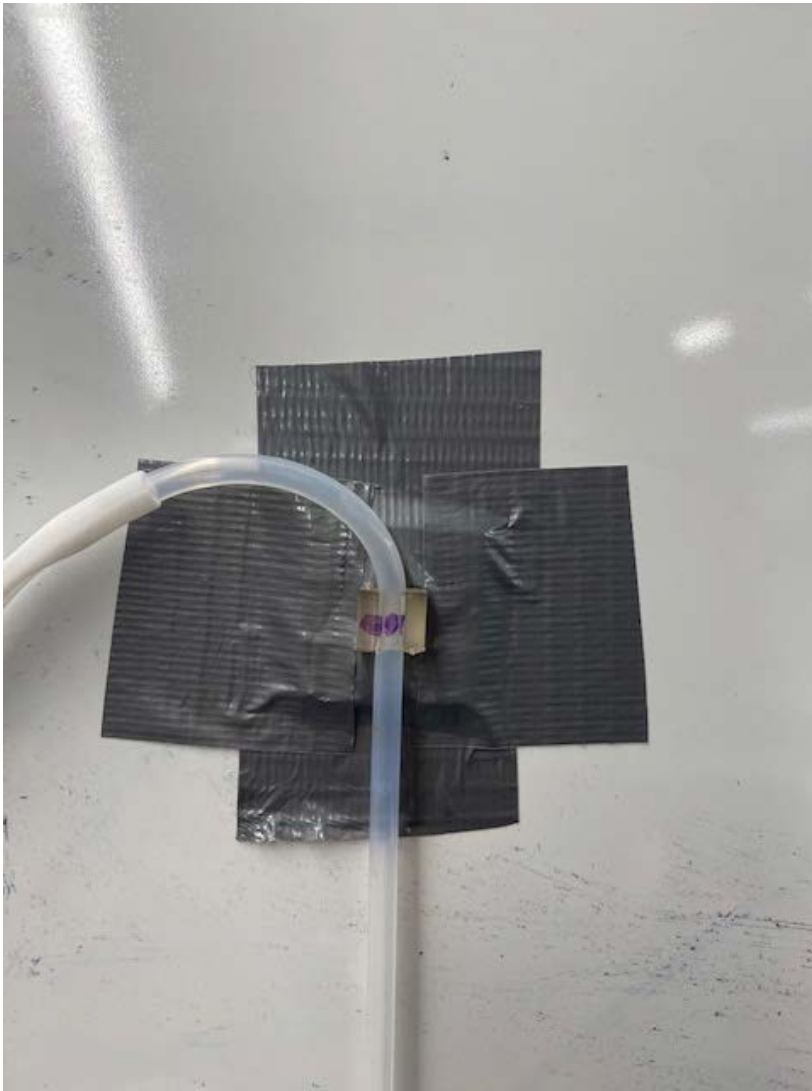


Figure 2: Model of clip taped to the board for force testing.

- The new clip design holds the surgical drain tubing tightly and does not compress the tubing as much as the previous clip did.

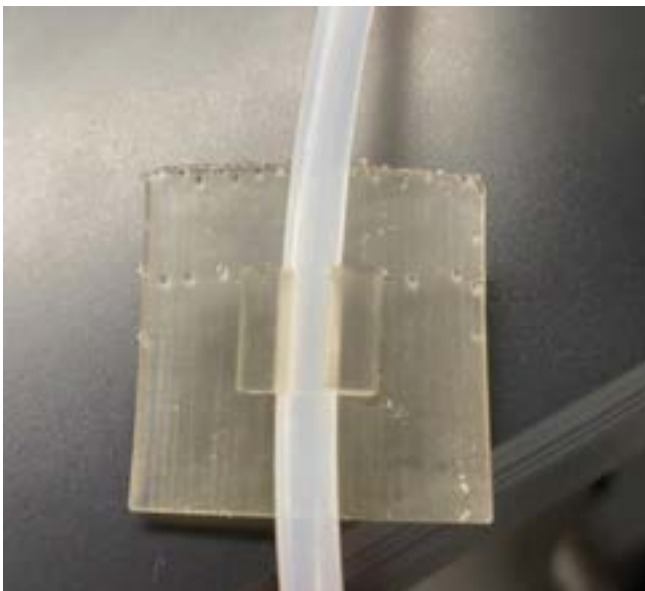


Figure 3: The tubing secured in the new clip design. The tubing is not being compressed and fits perfectly into the hole of the clip.

- We worked on filling out the form for the IRB consultation so we can get that process started sooner.
- We worked on drafting some human testing protocols as well for submittal to the IRB.
- The clips did not hold as well as we anticipated so we will be printing a new clip with a 3.75 mm, 3.5 mm, and 3.25 mm hole diameter to ensure we can get the correct sized clip.

**Conclusions/action items:**

The new clip design does not compress the surgical drain tubing where the flow would be obstructed like the previous clip design. This design was just a little too big to securely hold the drain so we will print new designs to test. We will also finish submitting the form for the consultation with the IRB.





## 2023/02/20 - Testing more clip designs

Dana Stumpfoll - Feb 20, 2023, 8:03 PM CST

**Title:** Testing more clip sizes

**Date:** 02/20/2023

**Content by:** Dana

**Present:** Dana, Oscar, Lauren, Rebekah

**Goals:** Test the new clip designs to determine the best diameter to use for the clip

**Content:**

- We conducted more force testing on 3 more clips with diameters of 3.25, 3.50, and 3.75 mm.
- The clips were printed using the Elastic material instead of the flexible material used with the previous clip of 4.0 mm diameter.
- We also created a thick viscous fluid to mimic the fluid that would flow out of the patient into the drain.
  - This will be used for later testing to determine if the clip inhibits the flow through the drain.
  - This solution was made with 3 parts corn syrup and 1 part water with a little bit of red food coloring.

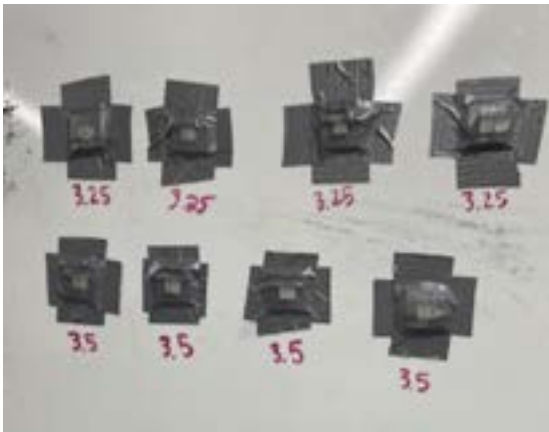


Figure 1: Testing setup with each clip in a vertical position.

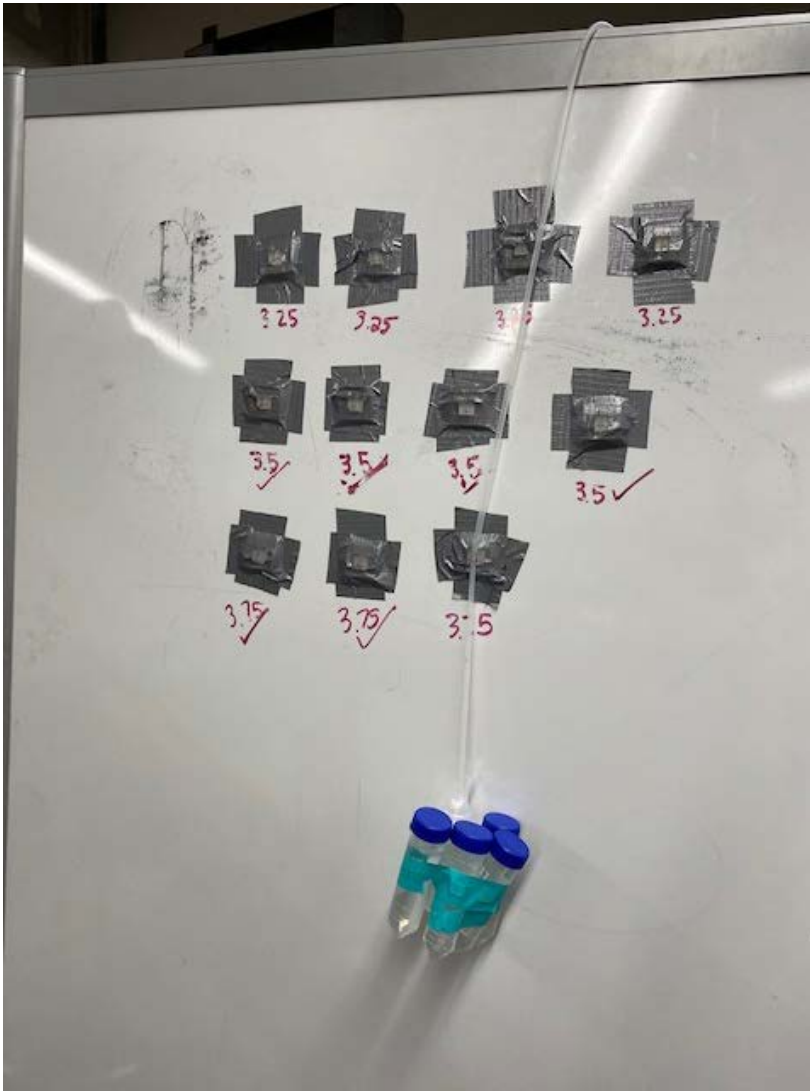


Figure 2: Testing setup showing all clips tested.

- The results showed that the 3.25 mm supported the most weight with an average of 485.42 g.
- Next the 3.75 mm held the second most and then the 3.5 mm held the least.
- We found it surprising that the 3.75 mm held more than the 3.5 mm.
- We will test the 3.5 mm and 3.75 mm with the flexible material to see if they still hold a reasonable amount of weight.

#### Conclusions/action items:

The new clip designs held more weight since the center hole where the tube comes into contact with the clip is stickier with the elastic material. We will use the viscous fluid we created to do flow testing. We will print more flexible material clips to see if they hold better than the elastic material clips.



**Title:** Fluid Flow Testing and Research Journal Article Draft Preparation

**Date:** 02/27/2023

**Content by:** Lauren Heller

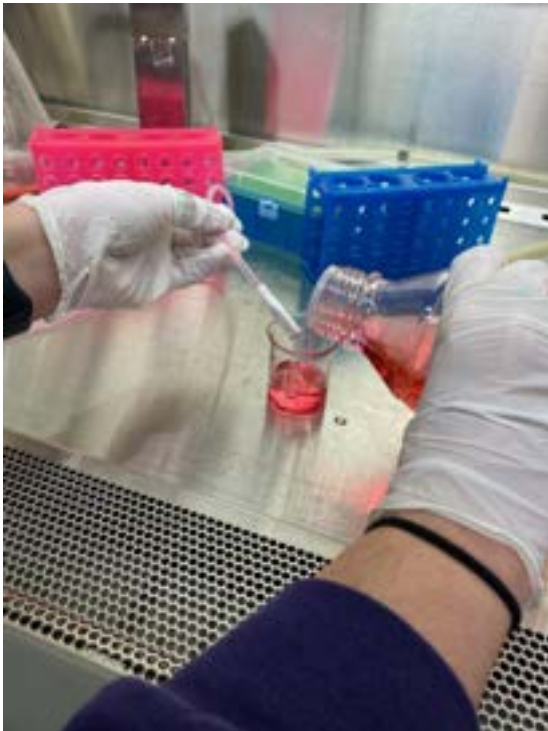
**Present:** Lauren, Dana, Beki, Oscar

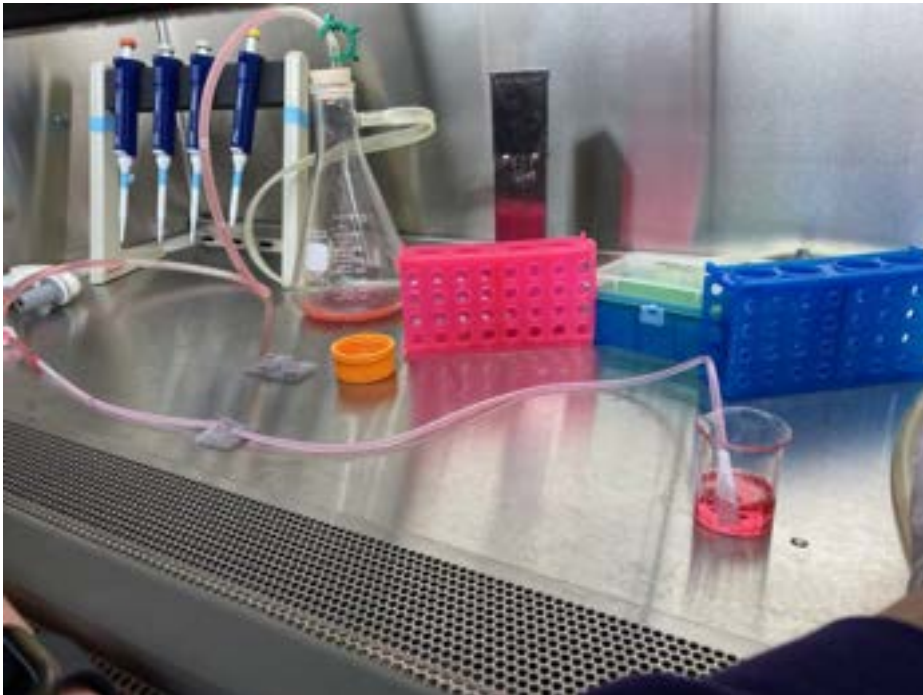
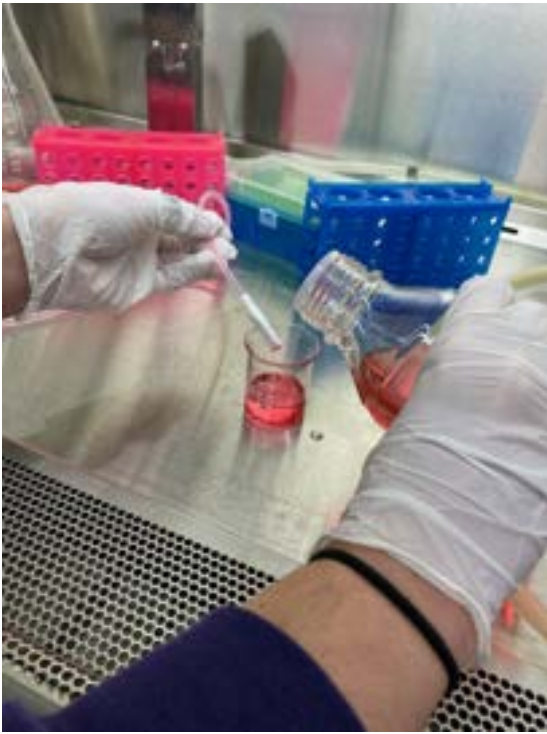
**Goals:** Conduct fluid flow test through the drain tubing with various diameters of clips attached to determine if diameter impedes fluid flow. Draft and edit sections of journal article for preliminary deliverable submission.

**Content:**

- Fluid flow testing was conducted using water and a more viscous glucose/water solution meant to mimic bodily fluid.
- Data was recorded in a spreadsheet and will be analyzed for statistical significance. The viscous fluid data will be more important, however water was also used to have a secondary test fluid.
- Tests were conducted on clips of diameters 3mm, 3.25mm, 3.5mm and 3.75mm. Four clips of each diameter were tested with 3 tests each, equating to 12 tests with each diameter.
- For the viscous fluid tests, 80mL of the solution were placed into the vacuum reservoir prior to beginning flow test rounds. This was done due to a irregularity found during the water tests, where the first one or two runs were abnormally long. The lack of fluid in the vacuum reservoir was leading to a lower vacuum pressure and was creating inconsistencies. The vacuum reservoir was reset to the baseline of 80mL at the beginning of testing each new clip diameter.
- Detailed testing protocols can be found in the Testing and Results folder.

Images taken during testing:



**Conclusions/action items:**

Continue editing journal article draft prior to Wednesday's submission deadline. Oscar will perform MATLAB analysis on obtained data from flow testing to look for statistical significance (if the change in flow rate at a diameter significantly varies from the control). This will allow us to determine the best clip diameter to continue with for the duration of the semester.



## 2023/03/06 - Sweat Testing Protocol Brainstorming and Outreach

---

Dana Stumpfoll - Mar 06, 2023, 8:46 PM CST

**Title:** Sweat Testing Protocol creation and Outreach Presentation

**Date:** 03/06/2023

**Content by:** Dana Stumpfoll

**Present:** Lauren, Dana, Beki, Oscar

**Goals:** Create sweat testing protocol and outreach presentation.

**Content:**

- Now that we have finished our flow testing and strength testing for each clip design, we are going to start a sweat test/water test to mimic daily activities such as showering and physical therapy.
- We would conduct this testing by attaching our design, the hydrocolloid bandage with the clip, a GripLok, and some elastic therapeutic tape to a vertical surface and running water and salt water (sweat mimic) solution over it one to two times a day to mimic showering and sweating during physical therapy.
  - This is the closest we will be able to get to mimicking the normal environment without human testing.
- Ideas we brainstormed included:
  - Using a flexible board to attach the bandages to to mimic movement
  - Placing the drain tubing in the securement mechanism to mimic tugging on the bandage
  - Creating a skin mimic using a recipe found in a research paper
  - Using the silicone suturing pad we have
  - Using pig skin or chicken skin
    - This would have to be kept wet so would bandages even stick to it?
  - Using tattoo skin found on amazon
- After brainstorming ideas we decided to go with silicone skin sheets we found on amazon that mimic skin
- These can be reused for testing multiple bandages and are said to mimic the texture of skin
- This way we have a similar model to the human body since we are no longer doing human testing with the IRB
- We also worked on completing our presentation for outreach and will have Dr. Tracy Puccinelli review it on Friday March 10th.
- We will be gathering our supplies as well and begin cutting out the hands for the outreach activity.

**Conclusions/action items:**

Beki will order the tattoo skin, more hydrocolloid bandages and more GripLok for this testing. We will also finalize the protocol and upload it to LabArchives. We will also find a recipe for a salt solution to mimic sweat. Have Dr. Puccinelli review outreach slides. Begin prepping supplies for outreach activity.



## 2023/03/20 - Outreach Preparation and Wear Test Protocol Drafting

---

LAUREN HELLER - Mar 21, 2023, 7:46 AM CDT

**Title:** BME Outreach Preparation and Wear Test Protocol Drafting

**Date:** 03/20/2023

**Content by:** Lauren Heller

**Present:** All team members present.

**Goals:** Prepare necessary materials for upcoming outreach activity and create formal test protocol for wear testing of our design.

**Content:**

Outreach Prep Summary: Team members modified the cardboard hand cutouts, cut straws and string, and placed materials needed for each student into individual bags to make distribution to students easier. We will be bringing some extra supplies and will be picking up candy for the activity. On Friday, we will be going to a local middle school to engage students in a hands-on activity related to biomedical engineering.

Test Protocol Writing:

- Following news from the IRB, the team is choosing to not use human participants in the testing of the bandage. Since we have a limited amount of time left in the semester, we decided it would be more efficient to create a mock scenario to test the wear of the bandages over several days.
- To best mimic conditions, the team will be applying a sweat solution (salt water) to imitate sweating during physical therapy, as well as running water over the bandage to imitate showering. The thin sheets of imitation skin are able to be flexed, so following each solution application we will be bending and flexing the bandages to show normal movement associated with daily activity.
- Detailed protocol is attached below, and can also be found in the testing folder.

**Conclusions/action items:**

**To prepare for testing beginning next week, all necessary samples will need to be prepped. Beki will be using the Cricut machine to cut out more bandages for testing, and Dana will be going to the UW Makerspace to print more clips to attach to the bandages. We will then fabricate the complete design and adhere the bandages and the GripLoks to the imitation skin sheets. Testing will begin next week Monday, and will continue for approximately two weeks.**

**Wear Test**

**Wear Tester: Tracy**

**Wear Materials:** 2mm x 4mm x 1mm x 1mm, 2mm x 4mm x 1mm, 2mm x 4mm x 1mm, 2mm x 4mm x 1mm

**Project Name:** Impact of Material for Seismic Hazard Mitigation

**Testing Details**

**Anticipated Challenge:** These tests require an experience that the test specimens had been subjected to before testing.

**Instructions/Comments:**

**Adherence:**

1	Wearage for 1000 cycles (1000-10)
2	The wear edge of wear and grinding on the bearings. Increased frequency.
3	Midpoint edge of wear and grinding on the bearings. Edge of the bearing appears to be.
4	Small edge of wear and grinding on the bearings.
5	The edge of wear and grinding on the bearings. Bearings look like a new piece of metal.

**Expected Steps of Wear Testing:**

1. Connect wear edge along with test piece.
2. Adhere the different bearings to the test piece (1) using the bearings on the long edge, in order from the short edge (1) to the long edge (1).

**Adherence:**

1. Place the test piece over the bearings (1) test.
2. Bend the test piece to half along the long edge (1) test.
3. Run the bearings according to the test piece after each test run.

**Flowing:**

1. Run the test piece over the bearings for 1000 cycles. (1) test.
2. Bend the test piece to half along the long edge (1) test.
3. Run the bearings according to the test piece after each test run.

4. Run the test piece over the bearings (1) test.

[Download](#)

**Wear\_test.pdf (29.7 kB)**



## 2023/04/03 - Prep for Wear Test #2 and Loop Tack Testing

---

ABDOULAH BAH (anbah@wisc.edu) - Apr 10, 2023, 4:38 PM CDT

**Title:** Prep for Wear Test #2 and Loop Tack Testing

**Date:** 04/03/2023

**Content by:** Abdoulahi Bah

**Present:** All team members present.

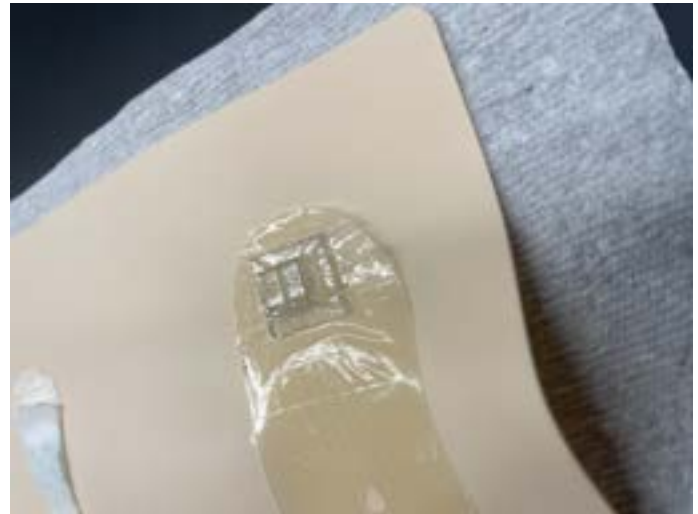
**Goals:** Prep another wear test and perform loop tack testing

**Content:**

### **Observations from Wear Test #1:**

- All of the hydrocolloid bandages are lifting at the edges - specifically the side of the clip due to tension
- The edges that lifted look very stiff, but are sticky and could possibly re-adhere
- Grip-Lock was still fully adhered to the tattoo skin





- Things that we changed in fabrication of hydrocolloid bandage
  - Made a cut out for the clip in the waterproof adhesive - this will help reduce the stretching and it was also easier to apply
  - Adhering the waterproof adhesive from the bottom of the clip and middle also reduced the stretching
    - There was still stretching being observed but not as much as the hydrocolloid bandages made for Wear Test #1

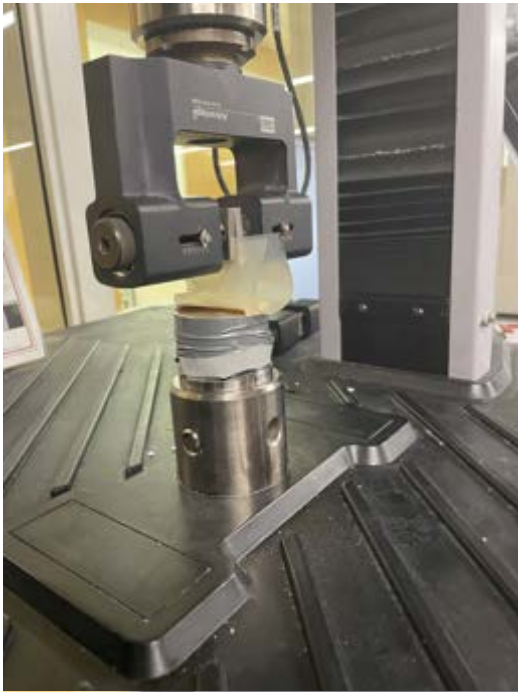


**Loop Tack Test:**



- A cut out of the tattoo skin (2cm x 5cm) was used as the base for the loop tack test

- The piece of tattoo skin was then attached to a compression fixture using duct tape
-





- The hydrocolloid bandage was then looped so that the grips of the MTS machine could hold it
- The MTS Machine was then lowered until the hydrocolloid has fully adhered to the tattoo skin to begin for testing
- MTS Machine is then lifted up (150 mm/min), until the hydrocolloid adhesive dissociates from the tattoo skin and the maximum force was recorded

- Did a loop tack test with the duct tape to compare the adhesive bandage



- Did a loop tack test with the packing tape to compare the adhesive bandage





**Conclusions/action items:** The team created new test samples for the wear test changing some methods of fabrication. Throughout the week the team will perform wear test on the new samples and previous ones. The team also began performing loop tack testing on hydrocolloid bandage, duct tape and packaging tape using the MTS Machine. The team will complete loop tack testing on Friday.



## 2023/04/07- Shear Adhesive Testing

Oscar Zarneke - Apr 10, 2023, 6:22 PM CDT

**Title:** Shear Adhesive Testing

**Date:** 04/07/2023

**Content by:** Beki

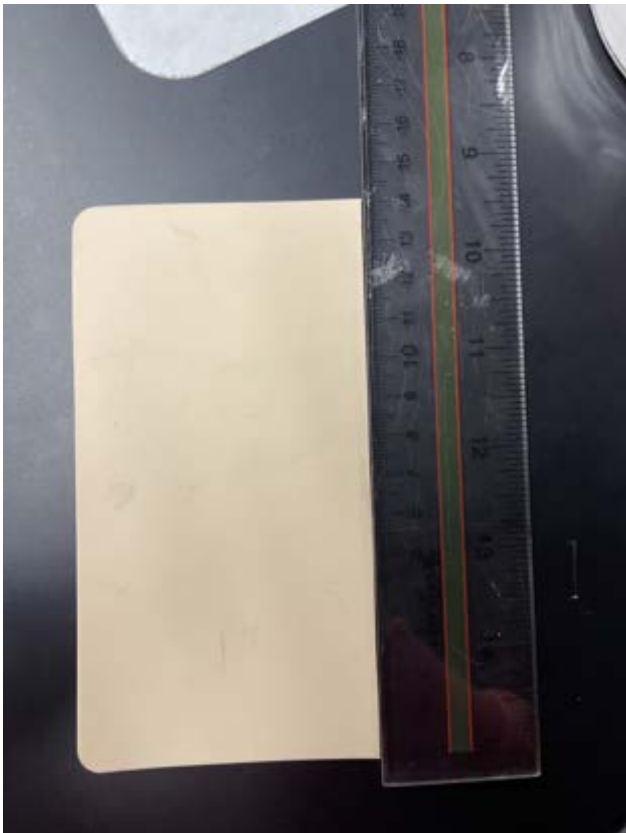
**Present:** Lauren, Beki, Oscar, Dana, Abdoulahi

**Goals:** Perform Shear Adhesive Testing

**Content:**

Shear Testing using MTS Machine

- Practice tattoo skin was cut in half into two pieces that were 7.5cm by 14cm



The test will be performed using 4 samples each of duct tape, hydrocolloid bandages, and shipping tape.

- a 3 cm by 5 cm piece of duct tape was used to connect the two halves of the practice tattoo skin
- the reconnected piece of tattoo skin was then placed into the MTS machine and pulled apart at a rate of 1mm/s
  - ethanol was used between each test to ensure there was no residual adhesive on practice tattoo skin





- practice tattoo skin connected using shipping tape



- practice tattoo skin connected using hydrocolloid bandage



**Conclusions/action items:**



## 2023/04/10 - Wear Test and Creating a Survey

---

ABDOULAH BAH (anbah@wisc.edu) - Apr 10, 2023, 8:32 PM CDT

**Title:** Wear Test and Creating a Survey

**Date:** 04/10/2023

**Content by:** Abdoulahi Bah

**Present:** All team members present

**Goals:** Create a draft survey for the device performance and discuss statistical analysis of the wear test

**Content:**

- the grip locks adhesiveness has not changed since being attached to the tattoo skin. However, the hydrocolloid is still peeling at certain edges
  - Unsure if there is any statistical significance - but will continue doing wear test
- Could possibly do a statistical test that compares the performance of the two samples in wear testing - the groups had a difference in fabrication
- discussed potential medical grade adhesives that could be used to attach the clip to the hydrocolloid bandage
  - Loctite
  - Infinity Bond
  - An adhesive that would use UV Curing - would need to determine if the clip will not degrade using UV
- the team worked on a draft survey for Dr. Wilke to grade our device - this would be done after we finalize the fabrication of full design

**Conclusions/action items:** The team completed creating a draft survey and sent it to Dr. Puccinelli. The team will continue to perform wear test and will research more in depth potential medical grade adhesives we can use to attach the clip to the hydrocolloid bandage.



## 2023/04/14 - Beginning Fabrication of Final Prototype

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ABDOULAHY BAH (anbah@wisc.edu) - Apr 17, 2023, 6:04 PM CDT

**Title:** Beginning fabrication of Final Prototype

**Date:** 04/14/2023

**Content by:** Abdoulahi Bah

**Present:** All team members present

**Goals:** Fabricate a final design to give to Dr. Wilke to complete the survey

**Content:**

- team made edits to the journal article based on Dr. Puccinelli comments
  - team is still unsure on how to determine the flow of the vacuum - there is no specifications on the vacuum and it would take some time to find a way to measure the actual flow of the vacuum
- Oscar sent an email to Dr. Wilke's assistant
- team submitted the outreach activity
- went to makerspace to cut out the hydrocolloid bandages out using Cricut
- team also did wear test, this will be the last round

**Conclusions/action items:** The team will fully assemble the prototype to be able to give to Dr. Wilke to analyze our product. The team will also further discuss how we can determine the flow of the vacuum.



## 2023/04/17 - Fabricating Final Prototype

ABDOULAHY BAH (anbah@wisc.edu) - Apr 17, 2023, 7:43 PM CDT

**Title:** Fabricating Final Prototype

**Date:** 04/17/2023

**Content by:** Abdoulahi Bah

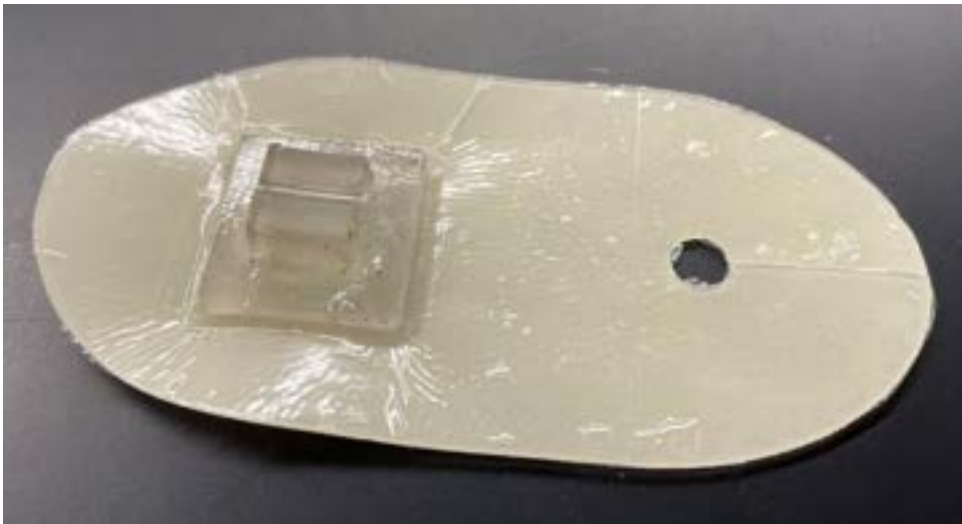
**Present:** All team members were present

**Goals:** The team will assemble the final prototype that Dr. Wilke will grade

**Content:**

**Fabrication -**

- Team moved the clip closer to the outlet hole of the hydrocolloid as this was one of the recommendations to potentially lessen the peeling at the edges near the clip on the hydrocolloid
- Team used a cyanoacrylate super glue to secure the clip onto the hydrocolloid - the super glue would be substituted with a medical grade cyanoacrylate on the complete device
- Team also decided to place the waterproof adhesive over the whole hydrocolloid bandage to secure the clip further



- Team also made final edits to the executive summary and then it was submitted onto the team website
- For statistics an ANOVA test was ran through MATLAB to see if at least one of the three groups Hydrocolloid Wear Test #1, Hydrocolloid Wear Test #2 and Grip-loc was statistically different in which another statistical test would be ran to see which group was statistically different

**Conclusions/action items:** The team has 4 fabricated final prototypes. One will be sent to Dr. Wilke to be graded using the product survey and the others will be used to present at the poster presentation. Final edits were made based on Dr. Puccinelli's comments. The team will start preparing for poster presentations.



## 2023/05/01 - Journal Article Writing and Editing

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LAUREN HELLER - May 01, 2023, 6:52 PM CDT

**Title:** Research Article Writing and Editing

**Date:** 05/01/2023

**Content by:** Lauren Heller

**Present:** All team members were present.

**Goals:** Update the research journal article with new testing, results, and a discussion section.

**Content:**

Following the conclusion of the design presentations, the team has been focused on finishing and editing the journal article for submission. Testing done after the draft was due, as well as results and discussion, were added to the article. Edits were made based off of draft feedback, and appendices were updated.

The team will continue to edit the article prior to submission with other final deliverables.

**Conclusions/action items:**

**Team members will individually keep editing the journal article. The team must also prepare a final notebook for submission. The final advisor meeting will take place on Friday 05/05/23 to conclude the project.**



## 2023/05/03- Materials and Expenses Chart

Dana Stumpfoll - May 03, 2023, 11:51 AM CDT

**Title:** Final Materials and Expenses Table

**Date:** 05/03/2023

**Content by:** Dana

**Present:** Dana

**Goals:** Upload materials and expenses chart

**Content:**

### Expenses

Item	Description	Manufacturer	Part Number	Date	QTY	Cost Each	Total	Link
3D Printed Clip	Clip Design printed at the Makerspace	N/A	N/A	02/09/2023	4	1.03	4.13	N/A
3D Printed Clips	Different iterations of clips with smaller diameters	N/A	N/A	02/17/2023	12	1.75	20.94	N/A
Materials fee	Makerspace Materials Fee	N/A	N/A	02/17/2023	1	\$50	\$50	N/A
Griplok	TIDI Grip-Lok Small Securement Device — Pack of 10 — White — Flexible Material — Low-Profile Design for Comfort — Home Healthcare — Medical Supplies	TIDI	B07HJXQ8LH	3/8/2023	1	\$33.86	\$33.86	<a href="#">Griplok</a>

Hydrocolloid Dressing	Dimora Hydrocolloid Dressing 4" x 4" for Wound Care, 10 Pack Large Patch Bandages with Self-Adhesive for Bedsore, Burn, Blister, Acne Care, Super Absorbent for Fast Healing	Winner Medical Co.	B08F9Y9GBV	3/8/2023	2	\$15.00	\$30.00	<a href="#">Hydrocolloid Dressing</a>
Tattoo Practice Skin	Blank Tattoo Skin Practice - Rayyl 10Pieces Tattoo Practice Skin Silicone Soft 7.4x5.6" Thin Double Sides Eyebrow Tattoo Practice Skin for Tattoo Kit Beginner & Experienced Tattoo Artist	Rayyl	B09CMGL1D1	3/8/2023	1	\$13.99	\$13.99	<a href="#">Tattoo Practice Skin</a>
3D Printed Clips	Extra clips for testing	N/A	N/A	03/27/2023	2	0.96	1.92	N/A
Total							\$154.84	

**Conclusions/action items:**

Ensure Beki gets reimbursed for all expenses for the project.





## 2023/03/29- Bandage Fabrication

---

Dana Stumpfoll - Apr 19, 2023, 8:33 PM CDT

**Title:** Bandage Fabrication for Testing

**Date:** 3/29/2023

**Content by:** Beki

**Present:** Lauren, Beki, Oscar, Dana

**Goals:** Create clip bandage to use for wear testing

**Content:**

To begin the bandage fabrication, the hydrocolloid bandages were cut out using the Circuit machine in the Makerspace. The bases of the 3D printed clips were cut down from their original size to be  $1.9 \pm 0.1$  cm and can be seen in Figure 1 below. Once the clips were at the appropriate size, they were placed 0.75 cm from the edge of the bandage without the drain opening and centered horizontally. The clips were adhered to the hydrocolloid bandages by placing a waterproof adhesive on top of the clip and the hydrocolloid bandage and secured to them. To ensure the waterproof adhesive is attached, a thick piece of cardboard was used to get rid of any air bubbles that formed. Images of the fabricated bandages with the clip attached can be seen in Figure 2 and Figure 3.

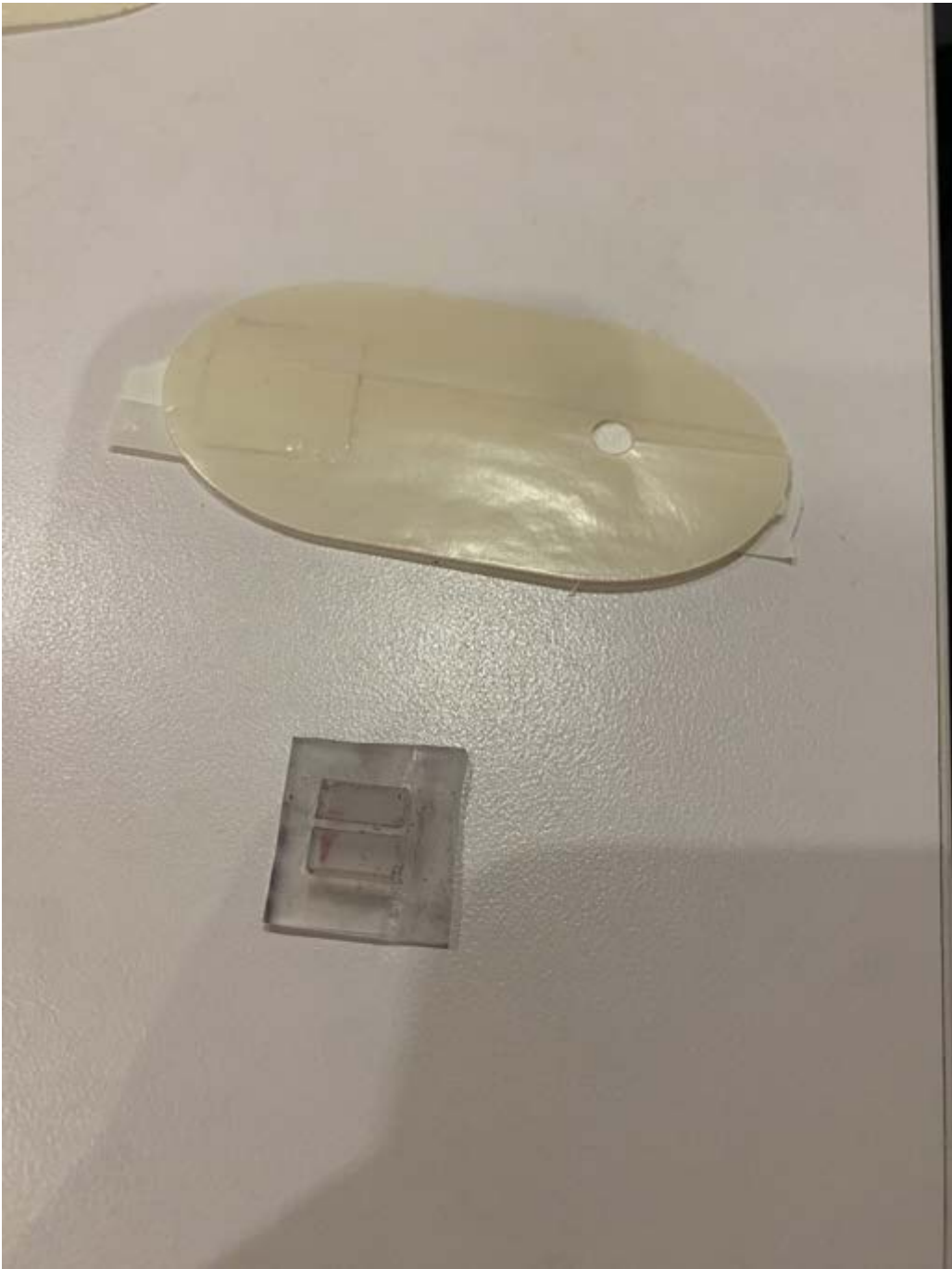


Figure 1: Hydrocolloid Bandage and Clip with the new base size



Figure 2



**Conclusions/action items:**

Attach the assembled bandages and griplok to the practice tattoo skin and begin water and sweat testing. The team also plans to begin adhesive testing next week using the MTS machine and ATSM standards.



## 2023/04/17- Final Bandage Fabrication Protocol

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Dana Stumpfoll - Apr 19, 2023, 8:34 PM CDT

**Title:** Final Bandage Fabrication Protocol

**Date:** 04/17/2023

**Content by:** Dana

**Present:** Lauren, Beki, Oscar, Dana, Abdoulahi

**Goals:** Finalize the fabrication protocol

**Content:**

- The first step for fabricating the bandage is placing the clip in the correct spot on the bandage.
    - The clip is approximately 1 cm from the edge of the bandage away from the hole. See Figure 1.
  - The next step is to trace the top part of the clip on the back of the water proof adhesive and cut out the square, leaving room for the adhesive to cover the base of the clip. See Figure 2.
  - The next step is to place the bandage with the clip on top on a surface, like cardboard, that you can cut on.
  - Then place the waterproof adhesive over the top of the clip (where the square is cut out) and hydrocolloid starting from the center of the hydrocolloid below the clip and moving outward. See Figure 3.
  - Once the waterproof adhesive is secured, the film on the waterproof adhesive can be removed. See Figure 4.
  - Then using a razor blade, the edge of the hydrocolloid can be traced to remove the excess waterproof adhesive and cut the waterproof adhesive out for the hole and slit. See Figure 5.
  - The bandage should then be fully fabricated.
-



Figure 1: Placement of the clip on the hydrocolloid.



Figure 2: Size of the clip cutout in the waterproof adhesive.



Figure 3: Waterproof adhesive laid over bandage with clip.





Figure 4: Film removed from the waterproof adhesive, now the bandage can be cut out.

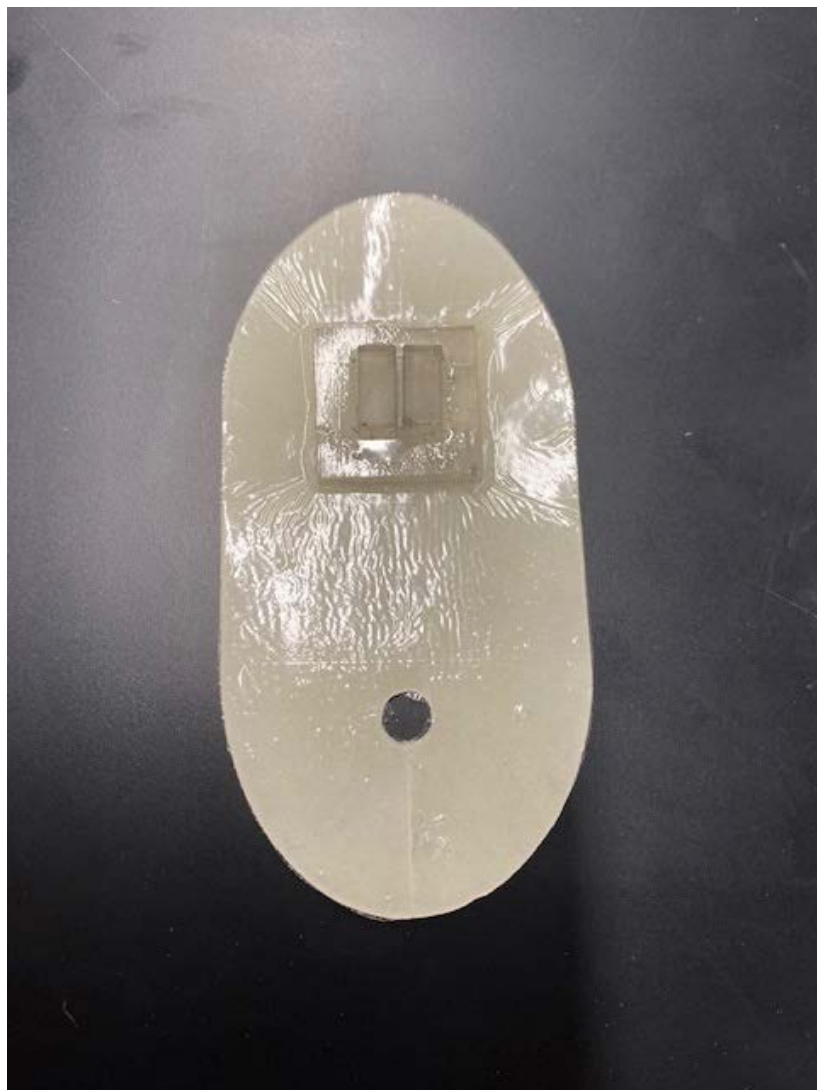


Figure 5: The final bandage design.

**Conclusions/action items:**

Now that we have finalized our fabrication protocol and made our final prototypes we can show them at the final poster presentation and have Dr. Wilke review our design.



## 2023/02/13 - Force Testing Protocol

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Oscar Zarneke - Mar 24, 2023, 9:45 AM CDT

**Title:** Force Testing Protocol

**Date:** 02/13/2023

**Content by:** Oscar

**Present:** Dana, Lauren, Abdoulahi, Beki

**Goals:** To record the protocol for force testing

**Content:**

1. Gather clips and Grip-Lok.
2. Gather uniform weights.
3. Adhere the clips and Grip-Lok to a clean vertical surface.
4. Secure the surgical drain tube to the attachment method vertically.
5. Draw a line on the surgical drain tube relative to the top edge of the mechanism holding it in place.
6. Attach the weight to the surgical drain tubing using tape.
  1. If no weights are available, fill the surgical bulb with 10 ml of water at a time by pipetting it into the opening of the bulb.
  2. If additional weights are needed 50 ml centrifuge tubes can be taped onto the bulb and 10 ml can be added at a time.
7. Release the weight and allow it to hang freely.
8. Repeat steps 3-7 using an increased amount of weight until failure (bandage falls, tube falls out of attachment device, or something tears/breaks) and record the weight of failure.
  1. Determine the weight added by using the density conversion of water.
    1.  $1 \text{ g/ ml} \times 10 \text{ ml} = 10 \text{ g}$  for every 10 ml added.
9. Repeat steps 3-8 using another attachment method.

**Conclusions/action items:**

Perform force testing on all the clip iterations



## 2023/02/20 - Flow Testing Protocol Draft

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LAUREN HELLER - Feb 28, 2023, 12:04 PM CST

**Title:** Flow Testing Protocol Draft

**Date:** 02/20/2023

**Content by:** Oscar

**Present:** Dana, Lauren, Abdoulahi, Beki

**Goals:** To record the protocol for flow testing

**Content:**

Flow test:

1. Use water and a viscous fluid to model blood/fluid with potential clots
2. Remove the bulb from the end of the surgical drain tubing
3. Attach to the vacuum in the biosafety cabinet.
4. Place the flat end of the drain that would be inserted into the patient in a beaker of water containing 100 mL of the fluid.
5. Start the vacuum and record the amount of time it takes for the fluid to flow through the tubing while it is inserted in the clip.

Creating the fluid:

- 3 parts corn syrup to 1 part water
- Can add a red dye to mimic blood
- Or glycerol mixed with water

**Conclusions/action items:**

Perform flow testing on all the clip iterations



## 2023/02/20 - Human Testing Protocol

Oscar Zarneke - Feb 20, 2023, 5:49 PM CST

### Title: Human Testing Protocol

**Date:** 02/20/2023

**Content by:** Oscar

**Present:** Dana, Lauren, Abdoulahi, Beki

**Goals:** To record the protocol for human testing

### Content:

#### Human Testing Plans - Comfort and Life Span

**Team Name:** Drain Pain

**Team Members:** Dana Stumpfull, Lauren Heller, Rebekah Makonnen, Oscar Zarneke, Abdoulahi Bah

**Project Name:** Improved Method for Securing Surgical Drains

### Testing Details

**Anticipated Findings:** Continuously monitor the condition of the fabricated design to observe adherence and mock patient comfort over time.

**Team Members:** Lauren Heller, Rebekah Makonnen, Oscar Zarneke, Abdoulahi Bah, Dana Stumpfull

**Evaluation Criteria:** Criteria will be evaluated daily based on the scales detailed below. Photos will also be taken at time of criteria evaluation. The criteria have been enumerated with detailed criteria, as there is not a standard quantitative measurement that can be taken.

#### Comfort:

1	Moderate skin irritation present and discomfort as the clip gets caught in clothing during daily activities.
2	Slight skin irritation and clip sometimes gets caught in clothing during daily activities.
3	Barely any skin irritation and clip rarely gets caught in clothing during daily activities.
4	No skin irritation and clip rarely gets caught in clothing during daily activities.
5	No skin irritation (cannot significantly feel the bandage on the skin), no sources of discomfort, and can complete daily activities without the clip getting caught in clothing.

#### Adherence:

1	Bandage has completely fallen off the body.
2	Obvious signs of wear and peeling on the bandage. Decreased functionality.
3	Moderate signs of wear and peeling on the bandage. Edge of the bandage begins to lift from the skin.

4	Small signs of wear and peeling on the bandage.
5	No signs of wear or peeling on the bandage. Bandage looks like it was just placed onto the skin.

**Detailed Steps of Testing:**

- 1.
2. Prep abdominal skin with alcohol wipe to clean the area. Shave hair as necessary.
3. Place fabricated bandage/clip design onto the abdomen of each participant in a uniform spot, meant to mimic the site of drain-skin connection following mastectomy.
4. Go about normal daily activities such as exercise and showering to ensure the bandage can last up to a week.
5. Take a picture of the bandage on the skin once a day before bed. Record observations twice daily (upon waking and before going to bed) of the comfort level based on the scales and criteria provided.
6. After one week has passed, remove the bandage if it is still on the skin.

**Conclusions/action items:**

Submit a proposal to the IRB to perform human testing, make protocol edits as necessary, and perform the testing.

---

LAUREN HELLER - Mar 21, 2023, 7:49 AM CDT

Team Update: This protocol will not be used due to issues obtaining IRB exemption. A new modified protocol can be found in the 03/20/2023 Protocol entry.



## 2023/02/28 - Flow Testing Protocol Final

LAUREN HELLER - Feb 28, 2023, 12:20 PM CST

**Title:** Fluid Flow Test Protocol

**Date:** 02/28/2023

**Content by:** Lauren Heller

**Present:** All team members present

**Goals:** Test fluid flow through drain tubing with clips of varying diameter to determine if tube impingement is impacting the fluid flow when compared to baseline control values.

**Content:**

### Testing Details

**Anticipated Findings:** Duration of time necessary to allow for bodily fluids to be drained in a controlled system. Determination of tube impingement caused by clip designs at various diameters. Compare the impact the diameter had on flow with the impact on how much weight each clip could support. Finalize clip design at the diameter that makes the most sense based on both factors.

**Evaluation Criteria:** Viscosity of artificial fluid will be held constant. Pressure of the vacuum used to pull fluid through the tube will be held constant. Baseline measurements will be obtained by pulling fluid volume through drain tubing with no clip attached. The duration will be measured from start to finish, and tube length will be recorded to allow for a standardized flow rate to be calculated. Data will be compared with trial runs on tubes secured in different tube diameters. Analysis will be conducted to determine statistical significance, as well as percent differences from baseline values.

### **Artificial Fluid Creation:**

1. 3 Parts Light Corn Syrup
2. 1 Part Tap Water
3. 3 Drops Red Food Coloring (easier to visualize fluid flow)

### **Detailed Steps of Water Testing:**

1. Measure 40mL of water into a small beaker.
2. Remove the bulb from the end of the surgical drain apparatus, placing the drainage end in the beaker and securing the open end to the vacuum pump in the biosafety cabinet.
3. Time duration needed to drain 30 mL of the beaker through the tube and into the vacuum.
4. Repeat steps 1-3 two more times to obtain three baseline readings.
5. Repeat steps 1-3 three times each for clips of 3mm, 3.25mm, 3.5mm, and 3.75mm diameters.
6. Analyze obtained data for statistical significance.

### **Detailed Steps of Artificial Fluid Testing:**

1. Remove existing contents of vacuum reservoir and add 80mL of artificial fluid into the vacuum reservoir.
2. Measure 40mL of fluid into a small beaker.
3. Remove the bulb from the end of the surgical drain apparatus, placing the drainage end in the beaker and securing the open end to the vacuum pump in the biosafety cabinet.
4. Time duration needed to drain 20 mL of the beaker through the tube and into the vacuum.
5. Repeat steps 2-4 two more times to obtain three baseline readings.
6. Repeat steps 1-5 for 4 clips of each diameter. (clips of 3mm, 3.25mm, 3.5mm, and 3.75mm diameters). 12 readings from each clip diameter should be obtained.
7. Analyze obtained data for statistical significance.

**Conclusions/action items:**

**The protocol was written and followed for flow testing to be conducted. Data was collected accordingly in a spreadsheet. This data will next be analyzed and the testing process/results will be added into the journal article.**





## 2023/03/20 - Mock Wear Test Protocol

LAUREN HELLER - Mar 21, 2023, 7:53 AM CDT

**Title:** Mock Wear Test Protocol

**Date:** 03/20/2023

**Content by:** Lauren Heller

**Present:** All team members were present.

**Goals:** Create a protocol for mock wear testing that is clear and reproducible.

**Content:**

### Testing Details

**Anticipated Findings:** From this testing we expect to find that the hydrocolloid bandage performs better than the GripLok. The bandage needs to be in place for up to one week.

**Evaluation Criteria:**

#### Adherence:

1	Bandage has completely fallen off.
2	Obvious signs of wear and peeling on the bandage. Decreased functionality.
3	Moderate signs of wear and peeling on the bandage. Edge of the bandage begins to lift.
4	Small signs of wear and peeling on the bandage.
5	No signs of wear or peeling on the bandage. Bandage looks like it was just placed.

### **Detailed Steps of Wear Testing:**

1. Create a sweat mimic using salt and water.
2. Adhere the different bandages to the imitation skin. Center the bandages on the long edge, distribute them on the short edge. Use 5 samples of each bandage.

Afternoon

3. Spray the salt water over the bandages 5 times.
4. Bend the surface in half along the long edge 5 times.
5. Rate the bandages according to the scale above after each salt water test.

Evening

6. Run water from a faucet over the bandages for 10 seconds. Pat dry.
7. Bend the surface in half along the long edge 5 times.
8. Rate the bandages according to the scale above after each water test.

1. Document how long the bandages stay adhered to the imitation skin (in days).

### **Conclusions/action items:**

We will begin testing following this protocol on 03/27/2023. Prior to this, we will be fabricating uniform bandages to obtain 5 consistent samples to test and collect data from. Testing will be conducted for approximately two weeks.





## 2023/04/14 - Adhesive Test Protocol

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Oscar Zarneke - Apr 14, 2023, 11:48 AM CDT

**Title:** Adhesive Test Protocol

**Date:** 03/20/2023

**Content by:** Oscar Zarneke

**Present:** All team members were present.

**Goals:** Create a protocol for adhesive testing that is clear and reproducible.

**Content:**

### Adhesive Test - Loop Tack

#### Testing Details

##### Detailed Steps of Testing:

1. Use 10 kN tensile load cell.
2. Make a loop with the bandage with the adhesive on the outside of the loop.
3. Place the loop in the top grip of the MTS.
4. Bring the loop into contact with a 5x2 cm sample of skin mimic (tattoo kit) attached to the bottom of the MTS.
5. Run the MTS as a tensile test, separating the grips at 150 mm/min while recording the force.
6. After the test, record the maximum force (in N).
7. Repeat with each bandage four times.

This test was modeled after ASTM standard D6195.

### Adhesive Test - Shear

#### Testing Details

##### Detailed Steps of Testing:

1. Use 10 kN tensile load cell.
2. Cut imitation skin in half. Secure the halves to the top and bottom of the MTS.
3. Bring the grips together so the halves are touching. Adhere a 3x5 cm bandage sample spanning the halves.
4. Separate the grips at a rate of 1 mm/s, recording the force.
5. Report the maximum force (in N).
6. Repeat with each bandage four times.

This test was modeled after ASTM standard D1002.



## 2023/04/20- Survey for Dr. Wilke

Dana Stumpfoll - May 03, 2023, 4:30 PM CDT

**Title:** Survey for Dr. Wilke

**Date:** 04/20/2023

**Content by:** Dana

**Present:** Dana, Abdoulahi, Oscar, Lauren, Rebekah

**Goals:** Create a survey for Dr. Wilke

**Content:**

- A google survey was created for Dr. Wilke to gather her input on our design.
- The final prototype will be delivered along with a QR code for her to scan to complete the survey.
- The questions included:

1. How comfortable do you think this device would be?

1 2 3 4 5

Painful      Unnoticeable

2. How do you think the device will perform during various daily activities? (physical therapy, showering, etc.)

1 2 3 4 5

Poor (peels, falls off)      Great (no problems)

3. How long do you think this device will last on a patient?

- 1-2 days
- 3-4 days
- 5-6 days
- 7-8 days
- 9+ days

...

4. How effective do you think the device would be at preventing tugging on the sutures?

- |                        |                       |                       |                       |                       |                       |                             |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------------|
|                        | 1                     | 2                     | 3                     | 4                     | 5                     |                             |
| Poor (extreme tugging) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Great (no pain, no tugging) |

o

5. How likely do you think the device will get caught on clothing?

- |            |                       |                       |                       |                       |                       |             |
|------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
|            | 1                     | 2                     | 3                     | 4                     | 5                     |             |
| Not likely | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very likely |

o

...

6. Would you recommend this device to your patients?

- Yes
- No

7. What do you like about this device?

Long answer text

8. What do you dislike about this device?

Long answer text

9. What changes would you make to the existing device to improve it? What features would you want changed and how?

Long answer text

o

**Conclusions/action items:**

Dana will drop off the survey and final prototype for Dr. Wilke. Hopefully she will distribute it to her colleagues so we can include the data on the poster.



## 2023/02/13 - Force Testing - 4.00 mm Diameter Clip

Oscar Zarneke - Mar 24, 2023, 9:08 AM CDT

**Title:** Force Testing - 4.00 mm Diameter Clip

**Date:** 02/13/2023

**Content by:** Oscar

**Present:** Dana, Abdoulahi, Oscar, Lauren, Rebekah

**Goals:** Record the results of force testing on the new clip

**Content:**

- The clip was secured to a flat, vertical surface while holding the surgical drain.
- Weight was added to the bulb of the drain until the clip no longer supported the drain.
- This was repeated for the 4 clip samples we printed.
- Average supported weight =  $391.81 \pm 35.08$  g
- This was less than anticipated, so more clip iterations will be printed with interior diameters of 3.75 mm, 3.50 mm, and 3.25 mm.

**Data**

4mm Diameter - Flexible	
Trial	Total Weight (g)
1	360.61
2	413.72
3	429.58
4	363.31
AVE	391.81
STD	35.08

**Conclusions/action items:**

Print new clip iterations and continue to perform force testing.



## 2023/02/20 - Force Testing - 3.25, 3.5, and 3.75 mm Clips

Oscar Zarneke - Mar 24, 2023, 9:10 AM CDT

### Title: Force Testing - 3.25, 3.5, and 3.75 mm Clips

**Date:** 02/20/2023

**Content by:** Oscar

**Present:** Dana, Oscar, Lauren, Rebekah

**Goals:** Record the results of force testing on the new clips

### Content:

- The clip was secured to a flat, vertical surface while holding the surgical drain.
- Weight was added to the bulb of the drain until the clip no longer supported the drain.
- This was repeated for the 4 clip samples of each diameter we printed.
- Average supported weight:
  - 3.25 mm =  $485.68 \pm 20.37$  g
  - 3.50 mm =  $441.22 \pm 22.01$  g
  - 3.75 mm =  $458.69 \pm 6.88$  g

### Data:

4mm Diameter - Flexible		3.75mm Diameter - Elastic	
Trial	Total Weight (g)	Trial	Total Weight (g)
1	360.61	1	451.36
2	413.72	2	456.8
3	429.58	3	467.89
4	363.31	4	
AVE	391.81	AVE	458.68
STD	35.08	STD	8.42
3.5mm Diameter - Elastic		3.25mm Diameter - Elastic	
Trial	Total Weight (g)	Trial	Total Weight (g)
1	433.32	1	484.98
2	418.53	2	452.96
3	435.38	3	496.21
4	477.63	4	507.54
AVE	441.22	AVE	485.42
STD	25.41	STD	23.52

### Conclusions/action items:

Complete flow testing.





Flow Velocity (m/s)	3 mm		3.25 mm		3.50 mm		3.75 mm		Control	
	Water	Corn Syrup	Water	Corn Syrup	Water	Corn Syrup	Water	Corn Syrup	Water	Corn Syrup
1	0.1207	0.0232	0.1023	0.0317	0.1086	0.0328	0.1147	0.0290	0.1216	0.0302
	0.1170	0.0267	0.1216	0.0322	0.1179	0.0319	0.1151	0.0329	0.1082	0.0407
	0.1191	0.0250	0.1210	0.0344	0.1205	0.0335	0.1170	0.0320	0.1118	0.0311
2	0.1123	0.0263	0.1086	0.0324	0.1224	0.0327	0.1120	0.0276	0.1120	0.0323
	0.1216	0.0256	0.1179	0.0309	0.1205	0.0325	0.1235	0.0314	0.1246	0.0309
	0.1145	0.0284	0.1216	0.0343	0.1268	0.0327	0.1170	0.0306	0.1175	0.0292
3	0.1172	0.0239	0.1243	0.0300	0.1102	0.0307	0.1115	0.0292	0.1175	0.0326
	0.1136	0.0239	0.1189	0.0316	0.1151	0.0326	0.1170	0.0326	0.1172	0.0324
	0.1216	0.0278	0.1153	0.0314	0.1210	0.0336	0.1248	0.0336	0.1143	0.0346
4	0.1120	0.0259	0.1153	0.0332	0.1241	0.0314	0.1153	0.0321	0.1162	0.0320
	0.1111	0.0269	0.1199	0.0306	0.1185	0.0336	0.1201	0.0326	0.1291	0.0324
	0.1252	0.0269	0.1175	0.0312	0.1181	0.0329	0.1275	0.0325	0.1220	0.0343
Average	0.1172	0.0259	0.1170	0.0320	0.1187	0.0326	0.1179	0.0313	0.1177	0.0327
Std Dev	0.0045	0.0016	0.0062	0.0014	0.0053	0.0009	0.0050	0.0019	0.0059	0.0029

**Conclusions/action items:**

Complete preliminary deliverables and move on to wear testing.



## 2023/03/29- Wear Testing Set-up

Rebekah Makonnen - Mar 31, 2023, 2:17 PM CDT

**Title:** Wear Testing Set-up

**Date:** 3/29/2023

**Content by:** Beki

**Present:** Lauren, Dana, Beki, Oscar

**Goals:** Set up the testing apparatus for wear testing and begin testing

**Content:**

To set up the testing samples, the team took the bandage with the clip adhered to it and attached it to tattoo practice skin. In order to determine how the design holds up compared to a market device, a Griplok was also attached to the tattoo skin, parallel to the hydrocolloid. Images of the experimental setup can be seen below. 4 of these samples were assembled and will be tested over 2 weeks. Following the wear test protocol that was created, a saltwater solution was sprayed onto each sample 5 times using a spray bottle in early afternoon and each sample is rinsed with tap water 4-5 hours later after the salt water has dried. After each sample was sprayed with salt water/tap water, the bandages and Griplok were rated 1-5 on how adhered they appeared.



**Conclusions/action items:**

Continue wear testing by spraying salt water in early afternoon and rinsing with tap water 4-5 hours later and rating the samples based on adherence.



## 2023/04/03 - Loop Tack Testing

Oscar Zarneke - Apr 10, 2023, 6:19 PM CDT

**Title:** Loop Tack Testing

**Date:** 04/03/2023

**Content by:** Oscar

**Present:** Lauren, Dana, Beki, Oscar, Abdoulahi

**Goals:** Record the results of loop tack testing

**Content:**

Loop tack testing was performed referencing ASTM standard D6195. Due to the size of our bandages, we could not follow the standard precisely. The size of the hydrocolloid was 6x10 cm, and the testing substrate was the skin mimic (tattoo kit skin) cut into a 2x5 cm strip as compared to the standard substrate of a 1-inch steel cube. The samples were brought into contact with the substrate and then separated at a rate of 150 mm/min as compared to the standard of 300 mm/min. This was done because of the reduced size of the substrate we used compared to the standard substrate, as 300 mm/min was too fast to record adequate data. The maximum force was recorded at the conclusion of the test (in N). All pictures can be seen in *2023/04/03 - Prep for Wear Test #2 and Loop Tack Testing*.

This testing was conducted to simulate pain upon bandage removal. Higher forces should represent greater pain. The hydrocolloid bandage was compared to duct tape and packing tape. Medical adhesive tapes of adequate size could not be acquired for the sake of testing. From anecdotal experience, duct tape is painful to remove while packing tape is less painful given a similar size of tape. However, duct tape remains adhesive far longer than packing tape. Given that the hydrocolloid is expected to stay on for a week or more, it is anticipated that the results of the hydrocolloid should be somewhere between packing tape and duct tape, but be closer to duct tape in value.

Results are shown below.

	Hydrocolloid	Duct Tape	Packing Tape
Test Number	Force (N)	Force (N)	Force (N)
1	1.193	2.333	0.274
2	1.453	1.746	0.397
3	1.807	1.846	0.316
4	2.279	2.087	0.243
AVG	1.683	2.003	0.308
STD	0.470	0.262	0.067

**Conclusions/action items:**

Continue testing (wear and adhesive shear).



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## 2023/04/07 - Shear Testing

Oscar Zarneke - Apr 10, 2023, 6:22 PM CDT

**Title:** Shear Testing

**Date:** 04/07/2023

**Content by:** Oscar

**Present:** Lauren, Dana, Beki, Oscar, Abdoulahi

**Goals:** Record the results of shear testing

**Content:**

Shear testing was performed referencing ASTM standard D1002. Because this standard is used for glue-like adhesives, we modified the testing to fit our purpose. The adhesive tapes/bandages were cut into 3x5 cm strips, and they were adhered to the skin mimic (tattoo kit skin). The skin mimic was cut with the halves being held by the MTS grips. The MTS was set with a 10 kN load cell and separated at a 1 mm/s rate. The maximum force was recorded at the conclusion of the test (in N). All pictures can be seen in *2023/04/07 - Shear Adhesive Testing*.

This testing was conducted to simulate pain upon bandage removal. Higher forces should represent greater pain. The hydrocolloid bandage was compared to duct tape and packing tape. Medical adhesive tapes of adequate size could not be acquired for the sake of testing. From anecdotal experience, duct tape is painful to remove while packing tape is less painful given a similar size of tape. However, duct tape remains adhesive far longer than packing tape. Given that the hydrocolloid is expected to stay on for a week or more, it is anticipated that the results of the hydrocolloid should be somewhere between packing tape and duct tape, but be closer to duct tape in value.

Results are shown below.

SHEAR	Hydrocolloid	Duct Tape	Packing Tape
Test Number	Force (N)	Force (N)	Force (N)
1	4.954	7.307	5.566
2	3.984	6.136	4.296
3	5.889	11.167	9.099
4	4.028	6.291	6.609
AVG	4.714	7.725	6.393
STD	0.902	2.353	2.037
AREA (cm <sup>2</sup> )	15		
AREA (m <sup>2</sup> )	0.0015		
SHEAR	Hydrocolloid	Duct Tape	Packing Tape
Test Number	Stress (Pa)	Stress (Pa)	Stress (Pa)
1	3302.667	4871.333	3710.667
2	2656.000	4090.667	2864.000
3	3926.000	7444.667	6066.000
4	2685.333	4194.000	4406.000

AVG	3142.500	5150.167	4261.667
STD	601.445	1568.361	1358.127

**Conclusions/action items:**

Continue wear testing and analyze results.



# 2023/04/20 - Wear Testing

Dana Stumpfoll - Apr 20, 2023, 3:22 PM CDT

**Title:** Wear Testing

**Date:** 04/20/2023

**Content by:** Oscar

**Present:** Lauren, Dana, Beki, Oscar, Abdoulahi

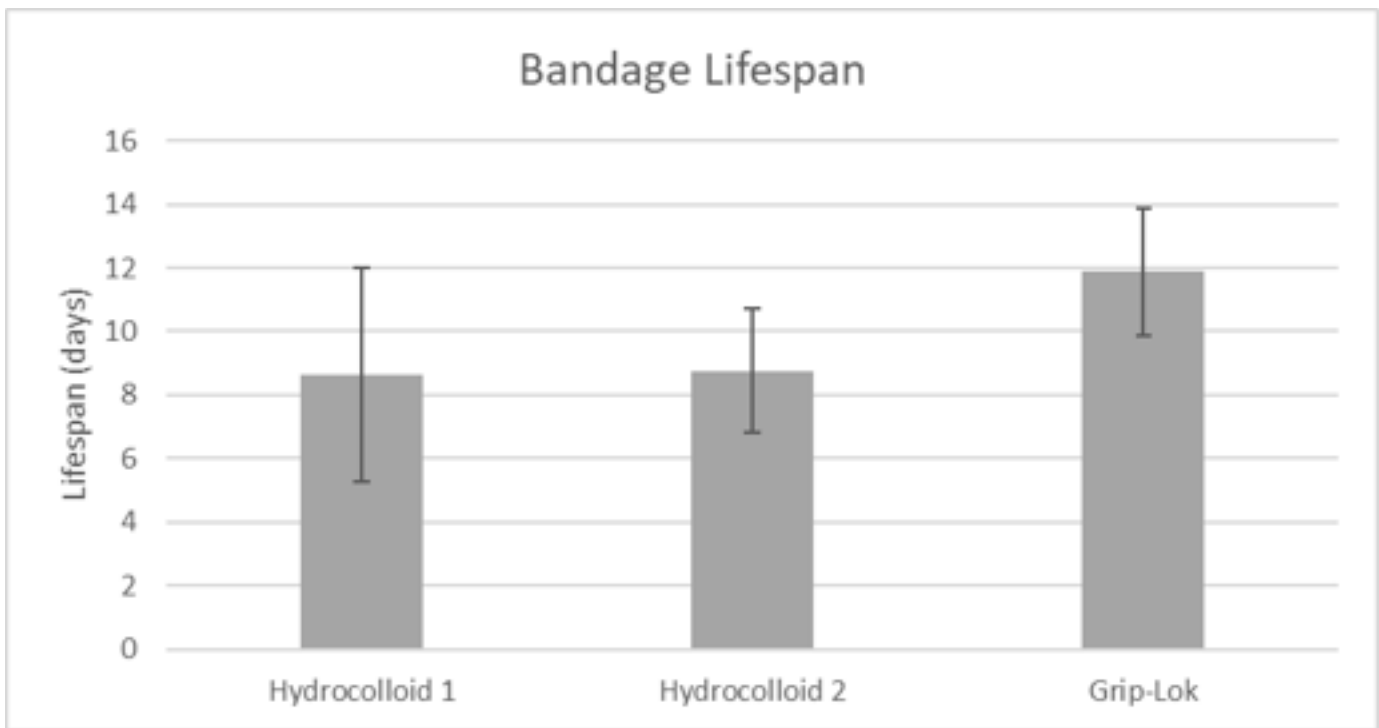
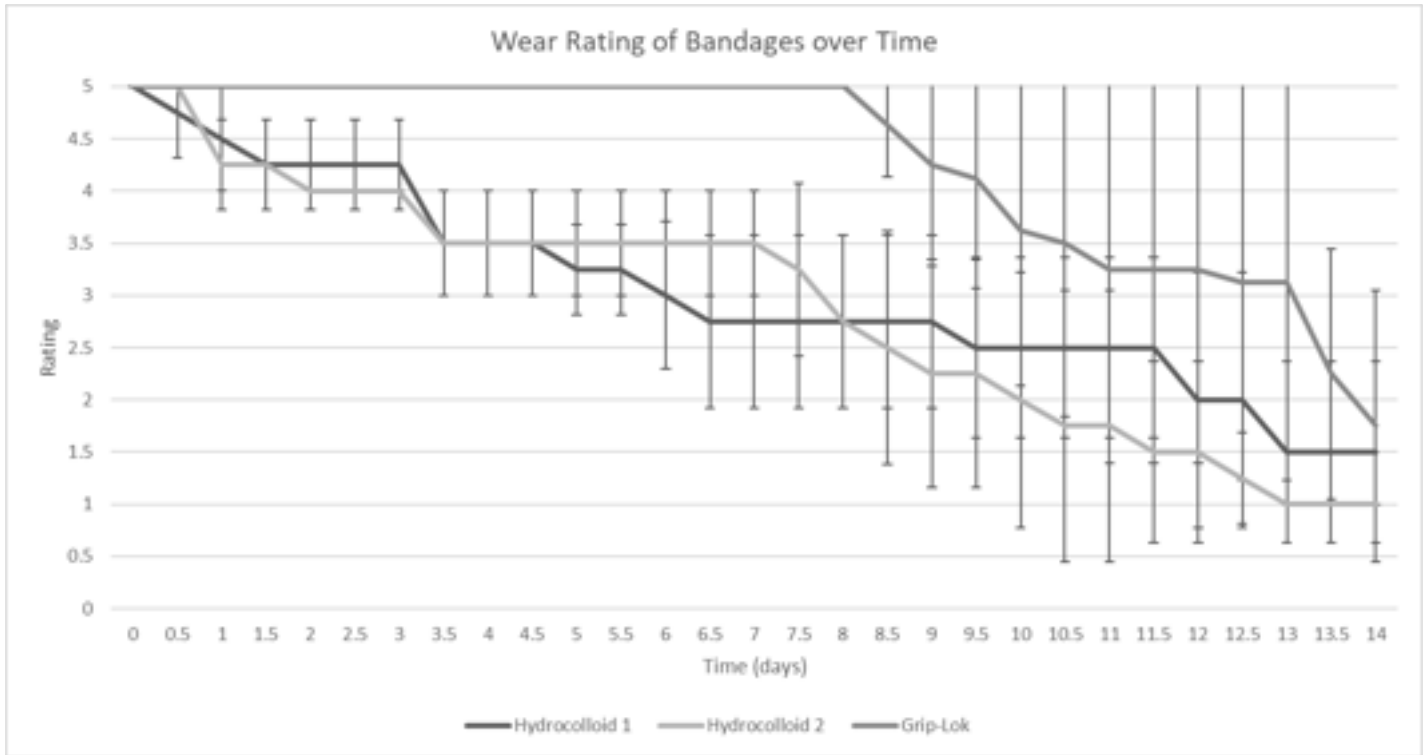
**Goals:** Record the results of wear testing

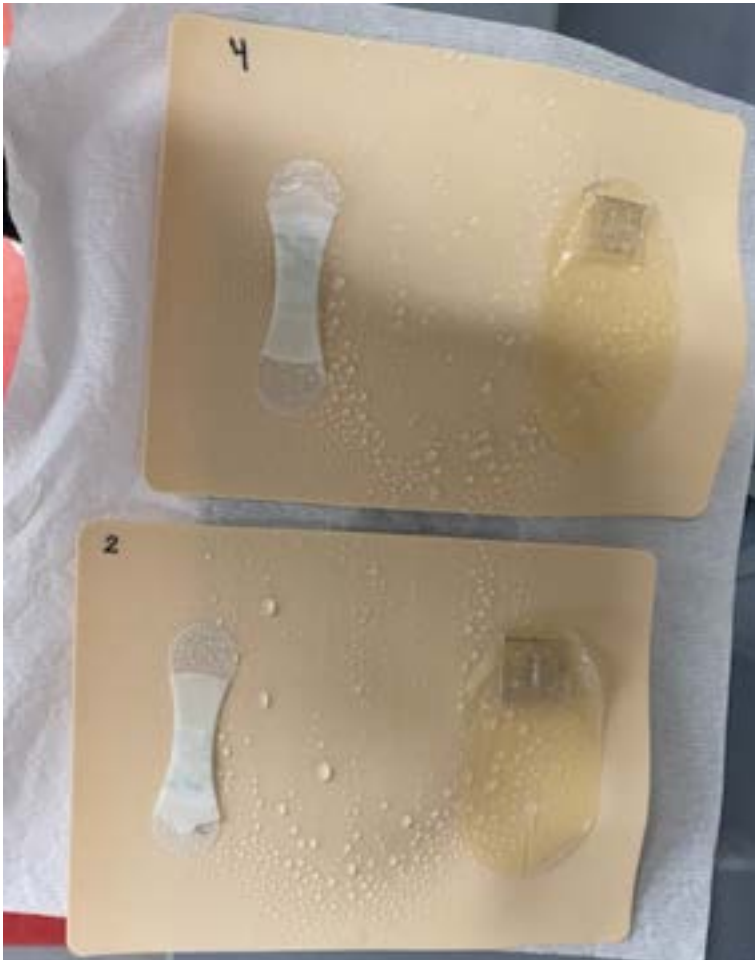
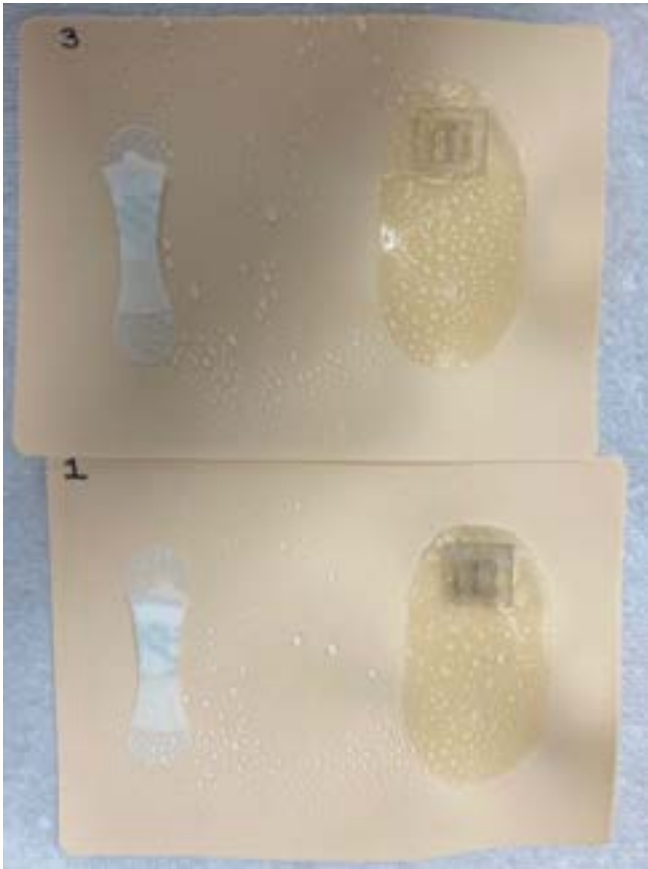
**Content:**

Wear testing was performed over the course of two weeks. Two sets of four samples were set up (Hydrocolloid 1 with Grip-Lok and Hydrocolloid 2 with Grip-Lok), resulting in 4 samples for each design fabrication method and 8 Grip-Lok samples. Wear test ratings were performed upon adherence and continued twice a day for 14 days after performing sweat and water protocols. The total results are shown below, with graphs indicating the trends over the 14 days as well as the average lifespan.

Days	Hydrocolloid 1				Hydrocolloid 2				Grip-Lok													
	Raw Data				Raw Data				Raw Data								Avg	Std				
0	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0
0.5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	0
1	4	4	5	5	4	5	4	4	4.25	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
1.5	4	4	4	5	4	5	4	4	4.25	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
2	4	4	4	5	4	4	4	4	4	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
2.5	4	4	4	5	4	4	4	4	4	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
3	4	4	4	5	4	4	4	4	4	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
3.5	3	3	4	4	3	4	4	3	3.5	0.5	5	5	5	5	5	5	5	5	5	5	5	0
4	3	3	4	4	3	4	4	3	3.5	0.5	5	5	5	5	5	5	5	5	5	5	5	0
4.5	3	3	4	4	3	4	4	3	3.5	0.5	5	5	5	5	5	5	5	5	5	5	5	0
5	3	3	3	4	3	4	4	3	3.5	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
5.5	3	3	3	4	3	4	4	3	3.5	0.4330127	5	5	5	5	5	5	5	5	5	5	5	0
6	2	3	3	4	3	4	4	3	3.5	0.70710678	5	5	5	5	5	5	5	5	5	5	5	0
6.5	2	2	3	4	3	4	4	3	3.5	0.8291562	5	5	5	5	5	5	5	5	5	5	5	0
7	2	2	3	4	3	4	4	3	3.5	0.8291562	5	5	5	5	5	5	5	5	5	5	5	0
7.5	2	2	3	4	3	4	4	2	3.25	0.8291562	5	5	5	5	5	5	5	5	5	5	5	0
8	2	2	3	4	2	3	4	2	2.75	0.8291562	5	5	5	5	5	5	5	5	5	5	5	0
8.5	2	2	3	4	1	3	4	2	2.5	0.8291562	5	5	5	5	4	5	4	4	4	4.625	0.48412292	
9	2	2	3	4	1	2	4	2	2.25	0.8291562	5	5	5	5	2	4	4	4	4.25	0.96824584		
9.5	2	2	2	4	1	2	4	2	2.25	0.8660254	5	5	5	5	2	3	4	4	4.125	1.05326872		
10	2	2	2	4	1	1	4	2	2	0.8660254	5	5	5	5	1	2	3	3	3.625	1.49478259		
10.5	2	2	2	4	1	1	4	1	1.75	0.8660254	5	5	5	5	1	1	3	3	3.5	1.6583124		
11	2	2	2	4	1	1	4	1	1.75	0.8660254	5	5	5	5	1	1	1	3	3.25	1.85404962		
11.5	2	2	2	4	1	1	3	1	1.5	0.8660254	5	5	5	5	1	1	1	3	3.25	1.85404962		

12	1	1	2	4	2	1.22474487	1	1	3	1	1.5	0.8660254	5	5	5	5	1	1	1	3	3.25	1.85404962
12.5	1	1	2	4	2	1.22474487	1	1	2	1	1.25	0.4330127	5	5	5	5	1	1	1	2	3.125	1.89983552
13	1	1	1	3	1.5	0.8660254	1	1	1	1	1	0	5	5	5	5	1	1	1	2	3.125	1.89983552
13.5	1	1	1	3	1.5	0.8660254	1	1	1	1	1	0	4	3	2	4	1	1	1	2	2.25	1.19895788
14	1	1	1	3	1.5	0.8660254	1	1	1	1	1	0	4	1	1	4	1	1	1	1	1.75	1.29903811
	5.5	6	9	14	8.625	3.37962646	7.5	8.5	12	7	8.75	1.95256242	14	13.5	13	14	8.5	9.5	10.5	12	11.875	1.99608993





**Conclusions/action items:**

Analyze the results.



## 2023/02/20 - Force Testing - Analysis

Oscar Zarneke - Mar 24, 2023, 9:20 AM CDT

### Title: Force Testing - Analysis

Date: 02/20/2023

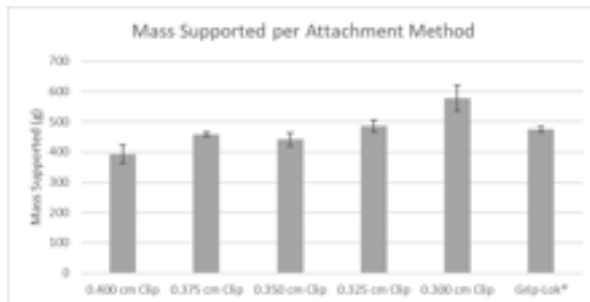
Content by: Oscar

Present: Dana, Oscar, Lauren, Rebekah

Goals: Record the analysis of force testing on the new clips

### Content:

- Average supported weight:
  - 4.00 mm =  $391.81 \pm 35.08$  g
  - 3.25 mm =  $485.68 \pm 20.37$  g
  - 3.50 mm =  $441.22 \pm 22.01$  g
  - 3.75 mm =  $458.69 \pm 6.88$  g
- Graph of results:



ANOVA was performed with a significant difference level of 0.05. If significance was found, multiple comparisons of means was performed using Tukey's honestly significant difference. All calculations were performed in MATLAB.

ANOVA revealed a significant difference between at least two of the groups ( $p < 0.001$ ,  $F = 14.92$ ,  $df = 5$ ). Multiple comparisons of means showed the 3 mm clip was significantly different than the 3.25 mm clip ( $p = 0.0095$ ), the 3.5 mm clip ( $p < 0.001$ ), the 3.75 mm clip ( $p = 0.0019$ ), the 4 mm clip ( $p < 0.001$ ), and Grip-Lok® ( $p = 0.0065$ ). The 4 mm clip was also significantly different from the 3.25 mm clip ( $p = 0.0043$ ) and Grip-Lok® ( $p = 0.0212$ ).

### Conclusions/action items:

The 3 mm clip performed the best, with the 3.25 mm clip performing better than the 4 mm clip. Complete flow testing to identify if the 3 or 3.25 mm clips compress the tubing.





## 2023/02/27 - Flow Testing - Analysis

Oscar Zarneke - Mar 24, 2023, 9:22 AM CDT

**Title:** Flow Testing - Analysis

**Date:** 02/27/2023

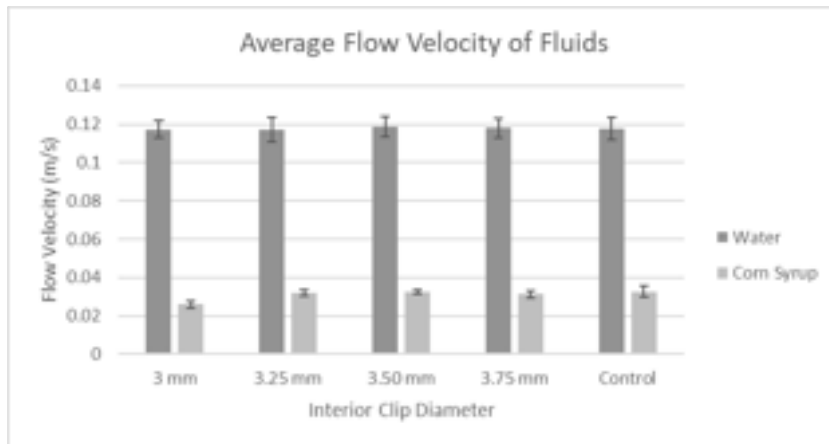
**Content by:** Oscar

**Present:** Dana, Oscar, Lauren, Rebekah

**Goals:** Record the analysis of flow testing on the clips

**Content:**

- Average flow velocities are shown in the figure below.



ANOVA was performed with a significant difference level of 0.05. If significance was found, multiple comparisons of means was performed using Tukey's honestly significant difference. All calculations were performed in MATLAB.

ANOVA showed no significant difference when water flowed through the drain ( $p=0.9502$ ,  $F=0.18$ ,  $df=4$ ), but a significant difference existed between at least two of the groups when the corn syrup-water mixture flowed through the drain ( $p<0.001$ ,  $F=28.25$ ,  $df=4$ ). Multiple comparisons of means revealed the 3 mm clip had a significantly different flow velocity than the 3.25 mm clip ( $p<0.001$ ), the 3.5 mm clip ( $p<0.001$ ), the 3.75 mm clip ( $p<0.001$ ), and the control ( $p<0.001$ ).

**Conclusions/action items:**

Because the 3 mm clip showed reduced flow with the corn syrup, we will move forward with the 3.25 mm clip as it performed best is force testing with no reduced flow. Complete preliminary deliverables and move on to wear testing.



## 2023/04/11 - Adhesive Testing - Analysis

Oscar Zarneke - Apr 11, 2023, 11:29 AM CDT

### Title: Adhesive Testing - Analysis

Date: 04/11/2023

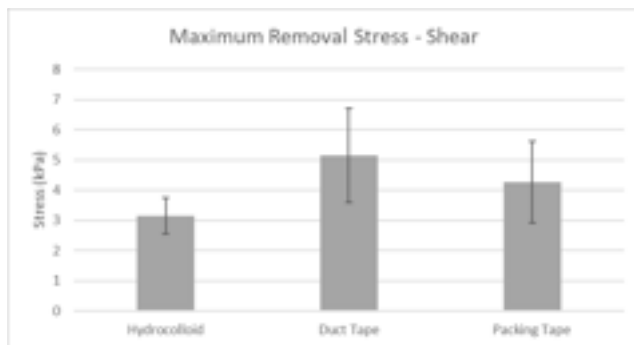
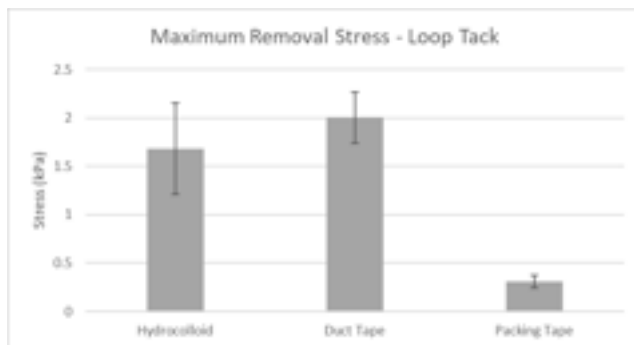
Content by: Oscar

Present: Dana, Oscar, Lauren, Rebekah, Abdoulahi

Goals: Record the analysis of adhesive testing

### Content:

- Average maximal removal stresses are shown in the figures below.



ANOVA was performed with a significant difference level of 0.05. If significance was found, multiple comparisons of means was performed using Tukey's honestly significant difference. All calculations were performed in MATLAB.

LOOP TACK: ANOVA showed a significant difference between at least two bandages/tapes ( $p=0.000071292$ ,  $F=33.0629$ ,  $df=2$ ). Multiple comparisons of means revealed the packing tape was significantly different from both the duct tape ( $p=0.000083576$ ) and the hydrocolloid ( $p=0.00041319$ ).

SHEAR: ANOVA showed no significant difference ( $p=0.1282$ ,  $F=2.6030$ ,  $df=2$ ).

### Conclusions/action items:

We can conclude the hydrocolloid bandage requires the same amount of stress to remove as duct tape in both removal scenarios (normal and shear). Therefore, we can predict the pain of removal to be approximately similar to duct tape. However, it was noticed during testing that the hydrocolloid experienced more strain (not statistically compared) than either other tape, so perhaps the extra "stretchiness" of the hydrocolloid influences the pain upon removal.





## 2023/04/20 - Wear Testing - Analysis

Oscar Zarneke - Apr 20, 2023, 11:43 AM CDT

### Title: Wear Testing - Analysis

**Date:** 04/20/2023

**Content by:** Oscar

**Present:** Dana, Oscar, Lauren, Rebekah, Abdoulahi

**Goals:** Record the analysis of wear testing

### Content:

ANOVA was performed with a significant difference level of 0.05. If significance was found, multiple comparisons of means was performed using Tukey's honestly significant difference. All calculations were performed in MATLAB.

WEAR RATING OVER TIME: ANOVA showed a significant difference from data points 3-20 (day 1-9.5) between at least two bandages (stats in Table 1). Multiple comparisons of means revealed the significant differences shown in Table 2.

Table 1

Day	p-value	F-statistic	df
1	0.0124	6.27	2
1.5	0.0026	9.75	2
2	0.0000208432	27.62	2
2.5	0.0000208432	27.62	2
3	0.0000208432	27.62	2
3.5	0.0000154043	29.25	2
4	0.0000154043	29.25	2
4.5	0.0000154043	29.25	2
5	0.0000029106	39.7	2
5.5	0.0000029106	39.7	2
6	0.0000208432	27.62	2
6.5	0.0000268291	26.33	2
7	0.0000268291	26.33	2
7.5	0.0001	19.5	2
8	0.0000438839	23.93	2
8.5	0.0017	10.89	2
9	0.0183	5.53	2
9.5	0.0269	4.84	2

Table 2

Day	p-value	Groups
1	0.0138	Hydro 2 and Grip-Lok

1.5	0.0084 0.0084	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
2	0.0006 0.0000	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
2.5	0.0006 0.0000	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
3	0.0006 0.0000	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
3.5	0.0001 0.0001	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
4	0.0001 0.0001	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
4.5	0.0001 0.0001	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
5	0.0000 0.0000	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
5.5	0.0000 0.0000	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
6	0.0000 0.0006	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
6.5	0.0000 0.0014	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
7	0.0000 0.0014	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
7.5	0.0002 0.0020	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
8	0.0002 0.0002	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
8.5	0.0091 0.0038	Hydro 1 and Grip-Lok Hydro 2 and Grip-Lok
9	0.0240	Hydro 2 and Grip-Lok
9.5	0.0443	Hydro 2 and Grip-Lok

LIFESPAN: ANOVA showed no significant difference ( $p=0.0942$ ,  $F=2.85$ ,  $df=2$ ).

#### Conclusions/action items:

We can conclude the Grip-Lok had better wear resistance over time, but the same lifespan. However, there were sources of error in testing: only 1 person rated the bandages at each data point and several people conducted the testing; a small force was applied to mimic tugging, but it was challenging to quantify the force and apply it the same way person to person; the samples remained in a locker when not being tested, not accurately representing the environment the bandages would experience while in use.



## 2023/05/03- Results from Survey for Dr.Wilke

Dana Stumpfoll - May 03, 2023, 4:38 PM CDT

### Title: Survey for Dr. Wilke Responses

Date: 05/03/2023

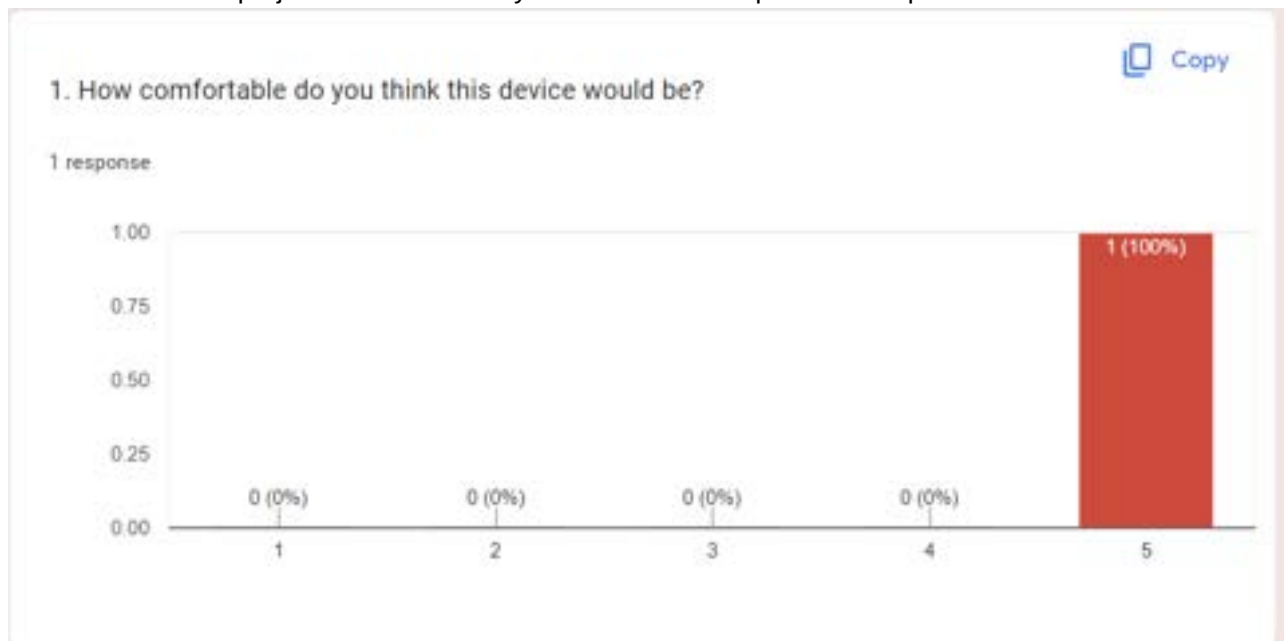
Content by: Dana

Present: Dana

Goals: Evaluate the results of the survey

### Content:

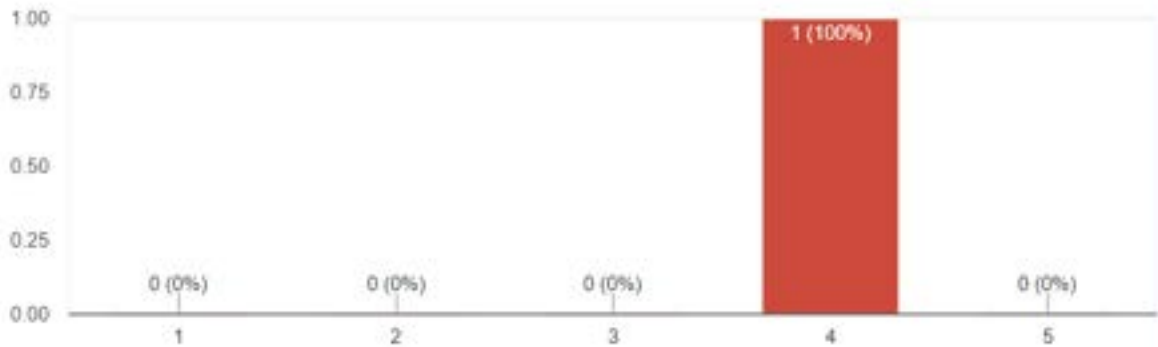
- A google survey was created for Dr. Wilke to gather her input on our design.
- The final prototype was delivered on 04/20/2023.
- Dr. Wilke responded to the survey, but no other doctors responded.
- We weren't able to incorporate the data because of this small sample size and time crunch for printing the poster.
- Based off her response to the questions it seems like she likes the device since it has a slit and hole for the wound site.
- She did not like that it is an adhesive and questioned how well it would hold up in the shower.
- She did say she would recommend it to her patients if it was on the market.
- If we continued this project we would modify the device to incorporate her input.



### 2. How do you think the device will perform during various daily activities? (physical therapy, showering, etc.)

[Copy](#)

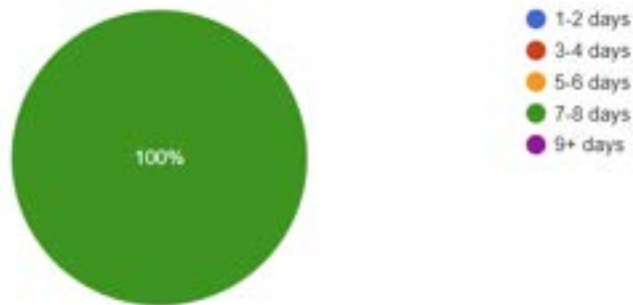
1 response



### 3. How long do you think this device will last on a patient?

[Copy](#)

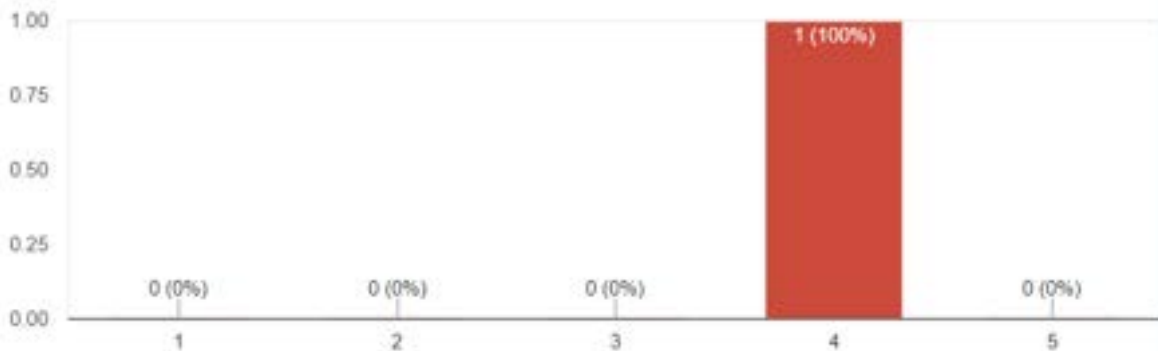
1 response



### 4. How effective do you think the device would be at preventing tugging on the sutures?

[Copy](#)

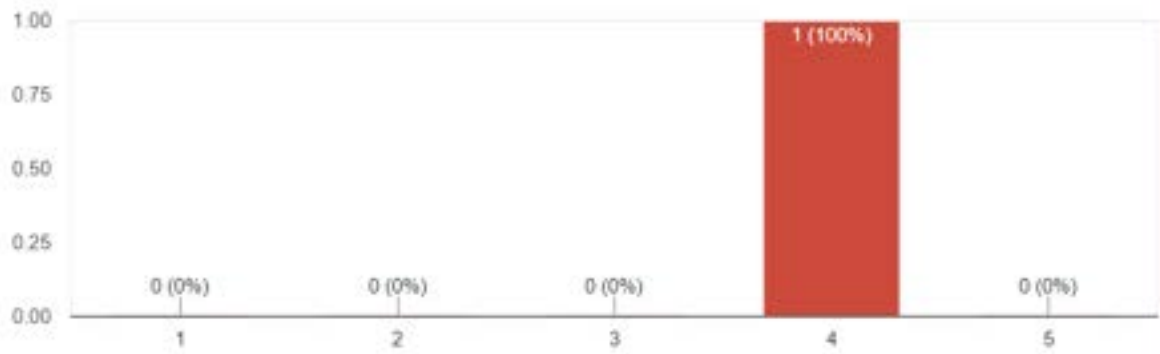
1 response



### 5. How likely do you think the device will get caught on clothing?

 Copy

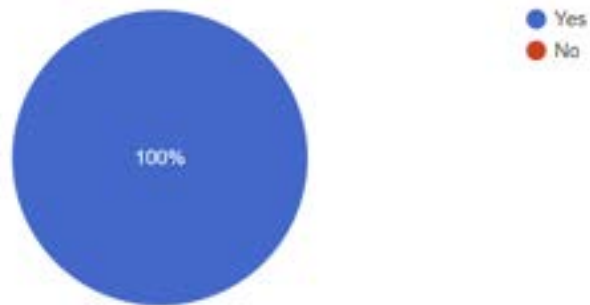
1 response



### 6. Would you recommend this device to your patients?

 Copy

1 response





7. What do you like about this device?

1 response

Tube holder and slit for drain exit

8. What do you dislike about this device?

1 response

May not be sticky enough to stay on skin during a shower

9. What changes would you make to the existing device to improve it? What features would you want changed and how?

1 response

Adhesive approach

•  
**Conclusions/action items:**

Overall this survey would have been more useful with a larger sample size. Dr. Wilke's opinion was a big help in validating our design as she places surgical drains for her patients.



## 2023/02/03 - Modified Clip Design

Dana Stumpvoll - Feb 03, 2023, 12:53 PM CST

### Title: Modified Clip Design

Date: 02/03/2023

Content by: Dana

Present: Dana, Abdoulahi, Oscar, Lauren, Beki

Goals: Modify the clip design to better fit the surgical drain tubing.

### Content:

- See attached SolidWorks file for new clip design.

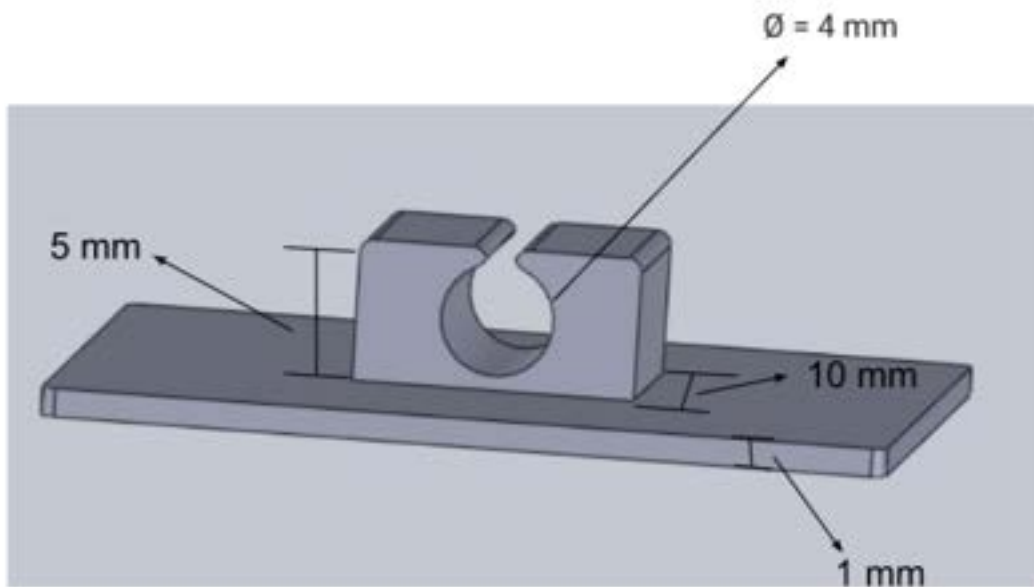


Figure 1: Modified clip design with dimensions.

- Dana modified the design to have a larger diameter for the hole for the surgical drain tubing.
  - Changed from 3 mm to 4 mm.
- Dana also modified the clip to be less bulky changing the height from 10 mm to 5 mm and the width from 20 mm to 10 mm.

### Conclusions/action items:

Dana will print the design and we will conduct weight testing again to ensure the new clip design holds the surgical drain tubing just as well. We will modify the design further as needed.



[Download](#)

**clip\_design\_4.SLDPRT (83.1 kB)** SolidWorks clip part file.



## 2023/02/17 - Clip designs with 0.25 cm increments

---

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST

**Title:** Clip designs with 0.25 cm increments

**Date:** 02/17/2023

**Content by:** Dana

**Present:** Dana

**Goals:** Create more iterations of clip designs for testing different diameters.

**Content:**

- See attached SolidWorks file for new clip designs.
- Dana created new clip designs with diameters varying by 0.025 cm.
- Using the same dimensions as the new clip design that is less bulky clips with diameters of 0.325, 0.350, and 0.375 cm were created.
- One of the clips broke after printing so we ended up with only 3, 0.375 cm clips.
- These clips were printed using the Elastic material.

**Conclusions/action items:**

We will now conduct weight testing again on these new clips to ensure the new clip design holds the surgical drain tubing just as well. We will finalize the design once we have completed testing.

---

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.25.SLDPRT (214 kB)** SolidWorks part files as well as STL files for 3D printing.

---

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.50.SLDPRT (217 kB)** SolidWorks part files as well as STL files for 3D printing.

---

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.75.SLDPRT (198 kB)** SolidWorks part files as well as STL files for 3D printing.

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.75\_1\_.STL (111 kB)** SolidWorks part files as well as STL files for 3D printing.

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.50\_1\_.STL (128 kB)** SolidWorks part files as well as STL files for 3D printing.

Dana Stumpfoll - Mar 01, 2023, 11:02 AM CST



[Download](#)

**clip\_design\_3.25\_1\_.STL (124 kB)** SolidWorks part files as well as STL files for 3D printing.





## 2023/04/17 - MATLAB Script

Oscar Zarneke - Apr 20, 2023, 11:44 AM CDT

**Title:** MATLAB Script

**Date:** 04/17/2023

**Content by:** Oscar

**Present:** Oscar

**Goals:** Record the most recent MATLAB script.

**Content:**

The MATLAB script can be seen below.

Oscar Zarneke - Apr 20, 2023, 11:44 AM CDT

Table of Contents	
Introduction	1
Class Notation Type: Matrix	2
Class Notation Type: Polynomial	3
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BME402-MATLAB\_Script-04\_17\_2023.pdf (852 kB)



## 2023/04/21 - MATLAB Script

Oscar Zarneke - Apr 21, 2023, 4:25 PM CDT

**Title:** MATLAB Script

**Date:** 04/21/2023

**Content by:** Oscar

**Present:** Oscar

**Goals:** Record the most recent MATLAB script.

**Content:**

The MATLAB script can be seen below.

Oscar Zarneke - Apr 21, 2023, 4:26 PM CDT

Table of Contents	
Introduction	1
Class Worksheet: Top: Recall	2
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BME402-MATLAB\_Script-04\_21\_2023.pdf (914 kB)







## 2023/05/03 - Final Poster Upload

Dana Stumpfoll - May 03, 2023, 4:43 PM CDT

**Title:** Final Poster Upload

**Date:** 05/03/2023

**Content by:** Dana

**Present:** Dana

**Goals:** Upload the poster to the notebook

**Content:**

The poster file can be seen below.

Dana Stumpfoll - May 03, 2023, 4:43 PM CDT



[Download](#)

Final\_Poster\_Drain\_Pain\_402.pptx\_1\_.pdf (1.53 MB)



**Title:** PDS

**Date:** 05/03/2023

**Content by:** Dana

**Present:** Dana

**Goals:** Upload PDS

**Content:**

The PDS document is attached and was edited to incorporate new aspects of the design as well as delete old criteria that were altered with the goals of this semester.



[Download](#)

PDS\_2\_.pdf (120 kB)



## 2023/02/09 - Chest Drain Fall-Out Rate Study

Dana Stumpfoll - Feb 16, 2023, 1:50 PM CST

**Title:** Chest Drain Fall-Out Rate

**Date:** 02/09/2023

**Content by:** Dana

**Present:** Individual Work

**Goals:** Research facts on the impact of our design.

**Content:**

- 
- Drains are a common device used after surgery where a space will be created that fluid can accumulate in.
- They are used to drain any fluid buildup to prevent infection.
- It has been estimated that 47.8 million drains were sold in 2020, and its projected to reach 59.7 million by 2030.
- This causes a demand for our device as more and more drains will be used and the comfortability and prevention of infection is important with the use of these surgical drains.
- Citation: "Surgical drains market statistics, Growth Drivers: Forecast- 2030," *Allied Market Research*. [Online]. Available: <https://www.alliedmarketresearch.com/wound-drainage-surgical-drains-market-A07517>.
  
- Some drains become displaced due to many factors such as tugging or sutures ripping out of the skin.
- Sutures are typically used to prevent drains from falling out but they do not always work.
- This study was done to analyze the suturing methods used to keep drains in place.
- Drain fallout was defined as the drain tip becoming dislodged from the patient before a medical practitioner could make the decision to remove it.
- A total of 369 drains were inserted into patients.
  - 106 were sutured
  - 263 were not sutured
- Results:
  - Of the sutured drains 7/106 fell out with a failure rate of 6.6% after 3.3 days
  - Of the not sutured drains 39/263 fell out with a failure rate of 14.8% after 2.7 days
- This allowed the researchers to conclude that suturing the drains leads to less fallout and displacement, although the method is not perfect
- Citation: R. Asciak *et al.*, "Chest drain fall-out rate according to suturing practices: A retrospective direct comparison," *Respiration*, vol. 96, no. 1, pp. 48–51, 2018.
  
- Ensuring the drains stay in is not the only benefit of suturing drains.
- This also helps with preventing the discomfort of reinserting drains and preventing infection.
- In a study it was found that risk of infection increases by 76.2% with each additional week past 21 days that the drain is in place.
- This means that if the drain has to be reinserted, the more likely it will have to stay in longer and the chance for infection will also increased.

- Citation: Chen CF, Lin SF, Hung CF, Chou P. Risk of infection is associated more with drain duration than daily drainage volume in prosthesis-based breast reconstruction: A cohort study. *Medicine (Baltimore)*. 2016 Dec;95(49):e5605. doi: 10.1097/MD.0000000000005605. PMID: 27930584; PMCID: PMC5266056.

**Conclusions/action items:**

Since the drains can still fall out even when they are sutured this shows another reason why our device is important and will impact peoples lives. Our device is intended to remove the force of tension away from the suture sight in hopes to make the drain more comfortable as well as keep the drain in place without the need for reinsertion. The longer the drain stays in place, the less time it will have to remain in and this will decrease the likelihood for infection to occur. Overall, our device will have a major impact on peoples lives.



## 2023/02/20 - Creating a viscous fluid similar to blood

---

Dana Stumpvoll - Mar 01, 2023, 11:27 AM CST

**Title:** Creating a viscous fluid similar to blood

**Date:** 02/20/2023

**Content by:** Dana

**Present:** Lauren, Beki, Oscar, Dana

**Goals:** Find a recipe using corn syrup to create a viscous fluid that mimics blood.

**Content:**

- In doing research we found that corn syrup and water can be mixed to create a blood mimetic for testing flow through our surgical drain tubing.
- We found a recipe that consists of 3 parts corn syrup - 1 part water.
- By creating this we can model a thicker fluid that might flow through the surgical drain tubing like blood or blood clots.
- This will help to determine if the smaller diameters have an actual affect on the fluid flow through the tubing when it comes to blood clots.
- Blood viscosity between 3.5 cP and 5.5 cP is considered to be normal by cardiologists [1].
- To create a similar viscosity it is recommended to mix 3 parts corn syrup with 1 part water, where corn syrups viscosity is between 2,000 - 3,000 cP and waters 0.69 cP [1].
- Once we created the mixture and added the food coloring, it looked and acted very similar to blood.

Citation: E. Reid, "Blood ViscoSpooky!," *Rheosense.com*. [Online]. Available: <https://blog.rheosense.com/halloween-fake-blood-viscosity>.

**Conclusions/action items:**

Now that we have a solution to mimic blood we will utilize it in flow testing.

**Title: Medical grade adhesive****Date:** 04/09/2023**Content by:** Dana**Present:** Individual Work**Goals:** Research different medical grade adhesives we could use.**Content:**

- Medical grade adhesive is used for a multitude of reasons such as bonding medical products and tube connections.
- AVENTK has lots of different options that are biocompatibility certified.
- The medical adhesive will not be touching the skin of the patient but it is important we ensure it is safe in case the patient does touch it or the bandage.
  - They have UV adhesive that cures with UV light.
  - This might not work for our design as we don't have UV light access.
- Another option is Loctite, which is a medical grade adhesive typically used for medical devices.
- This adhesive is suited for bonding metals, plastics, and elastomer.
- It is biocompatibility tested using ISO-10993.
- It binds porous and absorbent materials.
- This would be beneficial since it is like super glue, but for medical devices.



Figure 1: Image of the bottle of Loctite medical grade adhesive.

- Infinity bond is another well known medical grade adhesive.
- It is a cyanoacrylate super glue.
- This is similar to Loctite, but it costs \$220 for a case of 10.
- This product is interesting because you can choose what viscosity the glue will have.
  - 1-5 cps: similar to water
  - 100-200 cps: similar to tomato juice
  - 1500-2000 cps: similar to honey
  - 4000+: similar to mayonnaise
- It is also compatible with most sterilization methods.



Figure 2: Image of bottle of Infinity bond adhesive.

Material	Price	Link
Loctite	\$32.80	<a href="https://gokimco.com/products/loctite-142059-medical-grade-4011-instant-adhesive-20-grams?variant=31346749276212&amp;utm_source=google&amp;utm_medium=cpc&amp;utm_campaign=Google%20Shopping&amp;currency=USD&amp;gclid=Cj0KCQjw">https://gokimco.com/products/loctite-142059-medical-grade-4011-instant-adhesive-20-grams?variant=31346749276212&amp;utm_source=google&amp;utm_medium=cpc&amp;utm_campaign=Google%20Shopping&amp;currency=USD&amp;gclid=Cj0KCQjw</a>
Infinity Bond	\$220	<a href="https://www.infinitybond.com/products/infinity-bond-medical-device-cyanoacrylate-super-glue?_pos=1&amp;_sid=9e07504ce&amp;_ss=r&amp;variant=31f">https://www.infinitybond.com/products/infinity-bond-medical-device-cyanoacrylate-super-glue?_pos=1&amp;_sid=9e07504ce&amp;_ss=r&amp;variant=31f</a>

**Conclusions/action items:**

I will present the adhesives I have found during our team meeting and help Beki order one for our product. I will see if any of these are available on Amazor





## 2023/02/08 - Sterilization of Dressings

---

LAUREN HELLER - Feb 08, 2023, 1:35 PM CST

**Title:** Sterilization of Dressings**Date:** 02/08/2023**Content by:** Lauren Heller**Present:** Lauren Heller**Goals:** Research methods to sterilize final design to allow for use in medical settings.**Content:**

- Best method to sterilize dressings is through the use of an autoclave (apply moist heat). Needed exposure of at least 20 minutes at 121 degrees Celsius.
- The steam used should be dry, but at the phase boundary or liquid and vapor. It is important to ensure that air is removed from the autoclave chamber to make sure everything is sterilized properly.
- Packaging of the dressings is also important, and fabric-wrapped packaging was found to have less heat penetration than metal drums for packaging.
- Two methods of sterilization were tested in this article. These methods include the Double Vacuum Method and Downward Displacement Method. Both methods were tested and measurements were taken of the air in the chamber and air in the metal drums containing the dressings. It was found that there was no difference in the amount of air in the chamber between methods, but the double vacuum method was slightly better at removing air from the metal drums.
- Spore test papers were placed at varying layers within the drums. After 15 minutes of exposure at 20 psi, all spore tests were sterilized in both methods.
- Ultimately, the most important factors in autoclaving are the correct pressure/duration, followed by the removal of excess air in the chamber and packaging. This combination will ensure proper sterilization of the dressings.

**Conclusions/action items:**

Autoclaving is a good method to consider. It will be important to make sure that our clip design can be autoclaved without any change in shape or ability. Packaging material will likely need to also be sterilized, and then packaging can be done once both are sterile.

LAUREN HELLER - Feb 08, 2023, 12:46 PM CST

**IEEE:**

Alder VG, Gillespie WA, The Sterilization of Dressings, *Journal of Clinical Pathology* 1957;**10**:299-306.

J. Biol. Chem., 1923, 88, 245

### THE STERILIZATION OF DRESSINGS

BY  
T. H. ALLEN and W. A. LUDWIG,  
From the Department of Pathology, Johns Hopkins University

Received for publication June 1, 1923

The production of sterile dressings is an essential part of the aseptic method of surgery. In the early days of the development of this method the dressings were prepared in a room of the hospital where the operations were performed. In the early days of the development of this method the dressings were prepared in a room of the hospital where the operations were performed.

The effect of heat on the various materials used in the preparation of dressings has been studied by many investigators. It is well known that heat is effective in killing bacteria, and that the temperature and time of exposure are important factors in determining the degree of sterilization.

The aim of this study was to determine the effect of heat on the various materials used in the preparation of dressings. The results of this study are presented in the following tables. The first table shows the effect of heat on the various materials used in the preparation of dressings. The second table shows the effect of heat on the various materials used in the preparation of dressings.

and the effect of heat on the various materials used in the preparation of dressings. The results of this study are presented in the following tables. The first table shows the effect of heat on the various materials used in the preparation of dressings. The second table shows the effect of heat on the various materials used in the preparation of dressings.

The results of this study are presented in the following tables. The first table shows the effect of heat on the various materials used in the preparation of dressings. The second table shows the effect of heat on the various materials used in the preparation of dressings.

TABLE I AND II  
The effect of heat on the various materials used in the preparation of dressings. The results of this study are presented in the following tables.

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## 2023/04/12 - UV Biocompatible Adhesive

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LAUREN HELLER - Apr 12, 2023, 9:41 PM CDT

**Title:** Dymax Medical Device Adhesive

**Date:** 04/12/2023

**Content by:** Lauren Heller

**Present:** Lauren Heller

**Goals:** Research biocompatible adhesives to secure the clip to the bandage.

**Content:**

- Bonding materials by curing through exposure to UV or LED light. Works to bond glass, metal, and plastic components.
- Dymax offers a variety of adhesives for different needs. For the purpose of our product, the best options would likely either be the "Low Water Absorption Encapsulant, Coating and Bonding Adhesive for Wearable Medical Devices" or the "Moisture-Resistant Adhesive for Medical Wearables with Ultra-Red Fluorescing". Both are biocompatible in terms of wearable devices, and they are both either water resistant or low water absorption.
- Resin does degrade from UV exposure, however it is on long timescales (~6 months), which is outside the range that will be applicable to our design.
- Dymax products are largely acrylate or cyanoacrylate based, so they will perform similar to generic "super glue", but at a medical grade level.

**Conclusions/action items:**

**After fabrication of the prototypes for the wear test using a double-layer adhesive method, the team realized that there was pulling from the top layer causing the hydrocolloid to lift on the edges. We plan to utilize a medical grade cyanoacrylate to adhere the clip to minimize the lifting occurring. The switch from a double layer to a medical adhesive will be retested as necessary.**

LAUREN HELLER - Apr 12, 2023, 9:43 PM CDT

**IEEE Citation:**

Dymax, "Bonding," *Dymax*. [Online]. Available: <https://dymax.com/products/formulations/light-curable-materials/bonding>. [Accessed: 12-Apr-2023].



**Title:** Initial Journal Research

**Date:** 1/29/2023

**Content by:** Rebekah

**Present:** Rebekah

**Goals:** To have a list of journals that the team can potentially submit the final article to

**Content:**

The following journals were found by looking at the list of journals that are available through PMC (Pub Med Central). All journals that appear relevant will be included and the list will be narrowed down based on their impact score, which for the team's purpose will be around 3. Some possible journals include:

- **The Surgery Journal- 3.356**
  - looking further into this journal, it looks like the aim of this journal is to display information about general surgery procedures, clinical advances and major trends in the surgical field, so it would not be a good fit for this project
- **BMC Surgery- 1.95**
  - this journal focuses on surgical research training and practice, with specific focus in trauma, orthopedic, peripheral vascular, and head and neck surgery so it is not a good fit for this project
- **BMJ Surgery, Interventions, and Health Technology- 0.77**
  - this journal focuses on topics that involve surgery, surgical devices, and complex interventions, this journal could possibly be good- but the impact score is too low
- **Breast Care- 2.86**
  - Focuses on breast health, breast care, and breast ailments, including treatments of malignant and benign diseases of the breast, this journal seems to align with what the team is looking for and it has an impact factor in the desired range
- **The Breast Journal- 2.269**
  - This journal focuses on all aspects of research, diagnosis, and treatment of breast diseases, it seems like this journal aligns with what the team is looking for although the impact factor is a little lower than ideal

**Conclusions/action items:**

Bring these findings to the team in order to decide on which journal is the best fit for this project.



## 2023/02/02 - Searching for Potential Journals

Oscar Zarneke - Feb 02, 2023, 11:31 AM CST

### Title: Searching for Potential Journals

Date: 02/02/2023

Content by: Oscar

Present: Oscar

Goals: To further look at the journals brainstormed on 01/30 to find the best fit

### Content:

Following up on the journals identified on 01/30, I looked at a few articles to further identify what journal(s) would be a good fit for our project. I only looked at the journals with an impact score of less than 3.

- Advances in Skin and Wound Care
  - Lots of articles on how to care for wounds - new methods, technologies, etc.
  - A couple of articles on identifying wounds
  - Our project **might not completely fit** this journal - we are focused on comfort techniques, not wound care/identification
- BMJ Surgery, Interventions, and Health Technologies
  - The article topics are a little everywhere within the healthcare field - new technologies, care, techniques, investigations, etc.
  - Our project **fits this journal** with an advancement of patient care (comfort) through new technology
- Breast Care
  - Identification and treatment of breast cancers
  - ~~Our project does not fit this journal~~
  - After further looking at the scope and aims of the journal, **maybe this journal will work**
  - It encompasses identification and treatment, but also quality of life and supportive care
- Pain Research and Management
  - From their website:
    - Topics of interest include:
      - Chronic Pain
      - Neuropathic Pain
      - Headache
      - Anaesthesia
      - Dentistry
      - Oral Medicine
      - Rheumatology
      - - Drug Development

- I believe our project **will not fit** with this journal

### Conclusions/action items:

Bring this information to the team and finalize our journal selection.



## 2023/02/16 - Attaching Clip to Bandage

---

Oscar Zarneke - Mar 24, 2023, 10:17 AM CDT

**Title:** Attaching Clip to Bandage

**Date:** 02/16/2023

**Content by:** Oscar

**Present:** Oscar

**Goals:** Record notes from my conversation with someone from Molnlycke about attaching the clip to the bandage

**Content:**

- My contact is an upper salesperson at Molnlycke, a company that sells medical bandages
- One of their products is similar to a wound vacuum system
  - The vacuum attachment is placed over the primary bandage with another securing layer over it
  - I asked how this works, what is used, how it's manufactured, etc.
- Without giving me company information, I was told it is simply an IV film-type adhesive laying over the vacuum attachment
  - A similar IV film is offered by 3M
  - So, we could have the hydrocolloid, position the clip, then place the IV film over the top to secure it in place.

**Conclusions/action items:**

Bring this idea to the team. Work on fabricating a prototype using this method. Identify if the product we have (waterproof adhesive) would work rather than buying a new product.



## 2023/03/30 - Packaging of Wound Dressings

ABDOULAH BAH (anbah@wisc.edu) - Mar 30, 2023, 3:58 PM CDT

**Title:** Packaging of Wound Dressings

**Date:** 3/30/2022

**Content by:** Abdoulahi Bah

**Present:** Abdoulahi Bah

**Goals:** Have a better understanding on what is necessary for packaging a wound dressing

**Content:**

- **Search Terms:** N/A
- **Search Engine:** Google
- **Citation:** Butschli, J. (2017, June 5). Advanced wound care products and packaging needs. Healthcare Packaging. <https://www.healthcarepackaging.com/machinery-materials/package-design/article/13293295/advanced-wound-care-products-and-packaging-needs>
- **Things to consider:**
  - Customization - The team will need to determine how the packaging will look. The device has a kind of interesting geometry so we would need to determine how it would be packaged securely so it would not be damaged. Also we want to make sure the packaging is able to protect the device when being transported In addition, we would need to determine how many would we want to have in one package
  - Temperature/Humidity - The team is performing a wear and adhesive test which could give us some information about the required temperature and humidity. However, the team might need to do more research on the various materials in the device and their properties. This will help us determine what is the smallest the Temperature and Humidity can be so that the device still works.
  - User - We want to make sure that the packaging is user friendly
  - Cost - The device already has a certain cost, so we would want to make the packaging not as expensive.
  - Amount of Waste - This is an ethical factor, since we would need to take in consideration the environment. The team could also potentially use materials that degrade
- For our device there are some things that we would need to figure out before determining how to package the device

**Questions to Ask Team:**

How much will we want to spend on packaging so we are within budget?

Do we want the device to be in a separate package or multiple?

**Questions after reading:**

What materials are used in packaging?

What is a desiccant and why is it so important in packaging wound dressings?

What are some common ways sterile devices are packaged to maintain sterility?

**Conclusions/action items:** There are many things to consider when packaging a wound dressing. I found some factors that we could consider for packaging our design. However, there are many more factors to consider and things that need to be researched to package the device well. Some action items will be to find answers for the questions by addressing the questions to my team and doing additional research.

---

ABDOULAH BAH (anbah@wisc.edu) - Mar 30, 2023, 4:00 PM CDT



**Advanced\_Wound\_Care\_Products\_and\_Packaging\_Needs\_\_Healthcare\_Packaging\_1\_.pdf (686 kB)**





## 2023/04/2023 - Medical Device Packaging

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ABDOULAH BAH (anbah@wisc.edu) - Apr 28, 2023, 2:32 PM CDT

**Title:** Medical Device Packaging

**Date:** 4/04/2023

**Content by:** Abdoulahi Bah

**Present:** Abdoulahi Bah

**Goals:** Have a better understanding on what is necessary for packaging a wound dressing

**Content:**

- **Search Terms:** N/A
- **Search Engine:** Google
- **Citation:** [31] A. Bonner, Christian Brothers University, and USA, "Medical device packaging," Packcon.org, 23-Mar-2021. [Online]. Available: <http://packcon.org/index.php/en/articles/117-2021/291-medical-device-packaging>. [Accessed: 04-Apr-2023].
- Packaging of medical devices include a sterile barrier system and protective packaging. The sterile barrier system is the minimum amount of packaging that keeps the device sterilized. The protective packaging protects the sterile barrier
- The types of packaging:
  - Foil is very good in ultraviolet light, moisture and oxygen
  - Folded Cartons usually made from solid bleached sulfate, their shape is determined based on what will go into them - can be used to package sterile and non-sterile things
    - These are the two I chose from the article as they best apply to our prototype
- Test that can be performed on the packaging:
  - ISTA 3A used to simulate handling and transportation of parcel (drop test, dye penetration test, integrity test)

**Conclusions/action items:** The type of material is very dependent on the type of sterilization that will need to be used for the prototype. From there a material that can create a sterile barrier to keep the prototype sterilized. Some materials that could be looked into more are foil and folded SBA. There could be more research done on materials that can be used to create the packaging.



## 2023/04/16 - Education Packaging

---

ABDOULAH BAH (anbah@wisc.edu) - Apr 28, 2023, 2:32 PM CDT

**Title:** Education Packaging

**Date:** 4/16/2023

**Content by:** Abdoulahi Bah

**Present:** Abdoulahi Bah

**Goals:** Have a better understanding on what is necessary for packaging a wound dressing

**Content:**

- **Search Terms:** N/A
- **Search Engine:** Google
- **Citation:** [30] Medline.com. [Online]. Available: <https://www.medline.com/strategies/skin-health/1-2-3-educational-packaging-improves-patient-outcomes/>. [Accessed: 16-Apr-2023].
- Educational Packaging is a simple and clear way of showing users how the product is used and applied for
- There are four things that the article highlighted:
  - Large Print for important things (name and features of the product)
  - Color coding ( helps in differentiating between the various other products) - Make it stand out
  - Individual bandages or general things within in the package have the same instructions in case outer packaging goes missing
- The educational packaging helps the user follow their treatment plan due to clear instructions - overall easier to understand and use
- A study was done to see the effectiveness of educational packaging. Nurses were either given a dressing that had traditional packaging or educational packaging.
  - 0 nurses were successfully able to apply the traditional dressing correctly
  - 88% were able to apply the dressing correctly

**Conclusions/action items:** It is necessary that the wound care packaging not only protects and maintains the functionality of the prototype but also informs the user on how to use the product in a very clear manner. When the team is ready to do packaging it is important that the team uses more illustrations and more words to explain how the hydrocolloid bandage works and is applied.



## 2023/04/13 - Medical Grade Cyanoacrylate Adhesive

---

ABDOULAH BAH (anbah@wisc.edu) - Apr 13, 2023, 3:20 PM CDT

**Title:** Medical Grade Adhesive

**Date:** 04/13/2023

**Content by:** Abdoulahi Bah

**Present:** N/A

**Goals:** Determine a suitable cyanoacrylate that the team can use to attach the clip to the hydrocolloid bandage

**Content:**

- Medical grade cyanoacrylate super glue is very similar to regular super glue. The only difference is that the medical grade cyanoacrylate follows biocompatibility standards USP Class VI or ISO10993 standards.
- **Advantages:**
  - Can create super strong bonds with various rubbers, plastics, etc.
  - Resistant to many chemicals and solvents - NEED TO FACT CHECK
  - Easy to use and fast curing process once applied
- **Disadvantages based on Listed advantages from article:**
  - Fast curing process could make it difficult in accurately placing the clip in a specific position on the hydrocolloid
  - I have know super glue to be quite brittle and is not as flexible, so if the clip was to get on to something it would have to withstand a great amount of shear force
    - Could possibly test this if had the time to
- **Infinity Bond Medical Grade Cyanoacrylates** meet both ISO 10993 and USP Class VI standards and are compatible with many sterilization methods

**Conclusions/action items:** Did some general research on cyanoacrylates and how they are different from medical grade cyanoacrylates. The article listed some advantages that I would need to fact check further, but from that I thought of some disadvantages. If we were to use a cyanoacrylate we would need to determine a way to be consistent in the placement of the clip. Lastly, they provided a medical grade adhesive option that could be looked into further. Some action items would be to determine ways that we accurately place the clip to the hydrocolloid, do more research on medical grade cyanoacrylate, and find more options.



## 2023/04/06 - Simulated Temperature/Moisture Environment

ABDOULAHY BAH (anbah@wisc.edu) - Apr 06, 2023, 3:20 PM CDT

**Title:** Simulated Temperature/Moisture Environment

**Date:** 04/06/2023

**Content by:** Abdoulahi Bah

**Present:** N/A

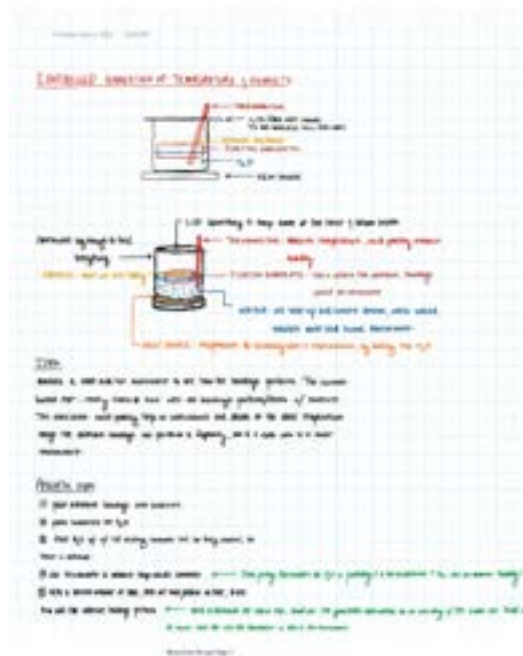
**Goals:** To determine a way to create a moist and hot environment that the adhesive bandage can be put in to test/understand more of the devices capabilities

**Content:**

- When doing preliminary research for packaging, one of the requirements to consider was temperature
- Looking at the tests we have done so far on the adhesive bandage don't really test on how well the adhesive bandage does in a hot and moist environment - this can be very important when it comes to packaging

**Conclusions/action items:** Do more analysis of this idea and weather it is feasible. There are still some things that need to be determined like (how to measure humidity, where to place the thermometer and how long would the adhesive bandage be in the container). Sharing this idea with the team might provide some idea on things that need to be figured out.

ABDOULAHY BAH (anbah@wisc.edu) - Apr 06, 2023, 2:57 PM CDT



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Simulation\_of\_Temperature\_and\_Humidity.pdf (2.58 MB)

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ABDOULAH BAH (anbah@wisc.edu) - Apr 10, 2023, 5:01 PM CDT

**Title: Simulated Temperature/Moisture Environment**

**Date:** 04/10/2023

**Content by:** Abdoulahi Bah

**Present:** N/A

**Goals:** To determine a way to create a moist and hot environment that the adhesive bandage can be put in to test/understand more of the devices capabilities

**Conclusions/action items:** Discussed and showed team the idea. They believe it is a very good idea and could be used with the fully assembled adhesive bandage with clip to gauge what part of the design fails first under heat. The temperature that causes failure in one of the components could possibly be used as the temperature the design would need to be below to still work. However, since we are so late into the semester we might not have a enough time to do this test.

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ABDOULAH BAH (anbah@wisc.edu) - May 03, 2023, 11:28 AM CDT

**Title: Simulated Temperature/Moisture Environment**

**Date:** 05/03/2023

**Content by:** Abdoulahi Bah

**Present:** N/A

**Goals:** To determine a way to create a moist and hot environment that the adhesive bandage can be put in to test/understand more of the devices capabilities

**Conclusions/action items:** Thinking about this more, the team could basically just use autoclave as a way to create this simulated environment. Especially with determining what kind of sterilization technique is best for the device, we could get two kinds of information: What threshold temperature and moisture level for the device and how would the device maintain functionality after being autoclaved.



## 2023/04/20 - Guide for Accurate Placement of Clip w/ Super Glue

ABDOULAH BAH (anbah@wisc.edu) - May 03, 2023, 11:24 AM CDT

**Title:** Guide for Accurate Placement of Clip w/ Super Glue

**Date:** 4/20/2023

**Content by:** Abdoulahi Bah

**Present:** N/A

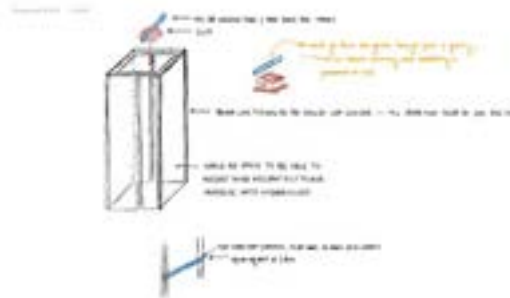
**Goals:** Brainstorm a way to accurately place the clip onto the bandage

**Content:**

- when I was doing research on medical grade cyanoacrylates one of the disadvantages is that these adhesives have a fast curing process. This can be tough if we wanted to have consistent placement of the clip onto the bandage
  - This would be very important if we were not using automated manufacturing in which they could A.I.
- So I brainstormed a guide in which the clip could be brought down to a specific position and there would be consistent and hopefully accurate placement of the clip
- However most likely if fabrication is streamlined we would not need this design. This was more for creating the prototypes.

**Conclusions/action items:** This was just a way the team could possibly place the clip easily onto the clip in a more accurate and consistent way. But it would not be as important since they are only prototype and with streamlining fabrication we would hopefully use machines.

ABDOULAH BAH (anbah@wisc.edu) - Apr 20, 2023, 1:49 PM CDT



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**Guide\_for\_Super\_Glue.pdf (2.01 MB)**



## 2014/11/03-Entry guidelines

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John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

**Title:** Descriptive title (i.e. Client Meeting)

**Date:** 9/5/2016

**Content by:** The one person who wrote the content

**Present:** Names of those present if more than just you (not necessary for individual work)

**Goals:** Establish clear goals for all text entries (meetings, individual work, etc.).

**Content:**

Contains clear and organized notes (also includes any references used)

**Conclusions/action items:**

Recap only the most significant findings and/or action items resulting from the entry.



**Title:**

**Date:**

**Content by:**

**Present:**

**Goals:**

**Content:**

**Conclusions/action items:**



