Paracervical Block Training Model (PBTM), BME 200/300

Date: 11/6/2025

Client: Dr. Jessica Dalby
Advisor: Professor Randolph Ashton
Team:
Renee Sobania (Co-Team Leader)
Evelyn Ojard (Co-Team Leader)
Ellinore Letts (Communicator)
Abigayle Chapman (BSAC)
Nora Lorentz (BWIG)
Cadence Seymour (BPAG)

Problem Statement

A paracervical block (PCB) is a medical procedure which consists of injecting the tissue where the vaginal wall meets the outer part of the cervix, the cervicovaginal junction, with lidocaine in four locations; 2, 4, 8, and 10 o'clock. This procedure is done to reduce pain during intrauterine device (IUD) insertion and other gynecological procedures. Many women have to endure the procedure without the help of a PCB, or only have access to other less effective methods because of limited provider training and lack of realistic affordable models to practice on. Current task trainers that are used to practice IUD insertions typically do not have a cervicovaginal junction, which is making these models less realistic as you are unable to practice a paracervical block. This results in fewer providers learning proper PCB technique and thus more patients who are unable to have access to this procedure.

Our team is tasked with creating a realistic, reproducible, and low cost model that includes a realistic cervicovaginal junction to simulate PCB injections to train healthcare professionals to make this procedure more accessible. Creating an anatomically accurate model with materials that better simulate the mechanical properties of the female reproductive tissues by having a needle insertion resistance of 1.09N, and elasticity of 1.94 kPa/mm. This will allow providers to practice needle placement, injection, and IUD insertion in a supervised safe learning environment. Ultimately, our goal is to improve provider access to learning the PCB procedure and expand patient access to pain management in women's healthcare.

Brief Status Update

During week 9 of our design project, the team worked testing the Ecoflex 00-20 for its mechanical properties using the MTS machine. The dogbone and cylinder molds were printed off in the Maker Space and were filled with Ecoflex. The team performed mechanical testing for tension on the dogbone molds. The team also worked on making improvements based on Dr. Dalby's feedback from the Friday meeting. The cervical piece was adjusted to have vaginal

walls, the connector piece was adjusted to fix the dimensions of the tube, the uterus was printed in a clear material and the vaginal mold was printed off and filled.

Weekly/Ongoing Difficulties

The team has no current concerns with completing the background research for the project. However, there are logistical project questions that will need to be addressed in upcoming client meetings and team meetings.

Summary of Weekly Team Member Design Accomplishments

- Team
    - The team performed MTS testing of Ecoflex 00-20.
    - The team filled the dogbone and cylinder molds with Ecoflex 00-20.
    - The team thought of new design ideas for the cervical plate.
    - The team printed off the vaginal mold and filled it with Ecoflex
    - The team modified the connector plate to fit the dimensions of the tube.
    - The team made modifications to the cervical mold.
    - The team printed the uterus in a clear filament.
- Renee Sobania
    - Worked on planning out the next two weeks so we can have 4 working models for Dr. Dalby to test on and get feedback on.
    - Worked on new sketches for the cervical component.
    - Printed off the dogbone and cylinder molds for the MTS testing.
    - Filled the molds with Ecoflex 00-20 for MTS testing.
    - Performed mechanical testing on the dogbone pieces.
- Evelyn Ojard
    - Met with Dr. Dalby to review current prototypes and create a plan to make changes based on her comments
    - Worked on new sketches for the cervical component
    - Performed mechanical testing on dogbone pieces
- Ellinore Letts
    - Filled MTS molds.
    - Created modified cervix design.
    - Performed MTS compression and tensile testing on ecoflex samples.
- Abigayle Chapman
    - Created cervix sketch
    - Researched size of vaginal opening as well as surrounding skin width
    - Printed vaginal opening pieces with altered measurements according to researched values
    - Filled molds with Ecoflex for MTS testing
    - MTS tested the Ecoflex 00-20
- Nora Lorentz
    - Created a rough cervix sketch to meet updated requests

    - Printed a clear cervix
    - Filled molds with Ecoflex prior to MTS testing
    - MTS tested the Ecoflex 00-20
- Cadence Seymour
    - Designed in Onshape the new connecting piece
    - Drew out some designs for old cervix problems
    - MTS tested the ecoflex with team
    - Filled molds with Ecoflex prior to MTS testing
    - I went and bought wood for the team

Upcoming Team and Individual Goals

- Team
    - Show the model to the client to get feedback
- Renee Sobania
    - Bring a finished model to the client for feedback so we can finish the 4 models.
    - Print off a new cervical mold, fill it with Ecoflex and see how it performs.
    - Assemble a full model.
    - Finish mechanical testing on the Ecoflex for compression.
- Evelyn Ojard
    - Bring a finished model to the client for feedback so we can finish the 4 models.
    - Make SolidWorks drawing of new cervical mold
    - Print mold and cast with Ecoflex to see how it performs
    - Assemble first prototype and present to client.
    - Finish compression testing of material.
- Ellinore Letts
    - Analyze MTS results, determine desired material changes.
    - Create a base and complete a full model.
- Abigayle Chapman
    - Continue working towards creating the full model for client feedback
    - Finish MTS testing, consider results
- Nora Lorentz
    - Continue working on fabrication process
    - Have 4 model finished soon to show client
- Cadence Seymour
    - I want to fabricate the rest of the cervix molds with my group once the materials come
    - I also want to work with my group to perform MTS testing on our ecoflex
    - I also want to do some research on how we might incorporate an aspect of the design to pull the uterus from the cervix.

Previous Weeks Team and Individual Goals

- Team
    - Continue working on a mold for the vaginal opening and uterus mold insert.
    - Modify Cervical mold and connector plate in Solidworks.

    - Begin MTS testing on Ecoflex if material arrives in time.
    - Form Ecoflex into Dog bone shape for testing.
- Renee Sobania
    - Make Ecoflex into a dogbone shape for MTS testing.
    - Modify the cervical mold to improve the cervicovaginal junction based on client feedback.
    - Complete MTS Testing
    - Work on Uterus Solidworks design
- Evelyn Ojard
    - Cast the Ecoflex in the mold to begin MTS testing
    - Modify the cervix mold based on feedback from our client after our meeting this Friday
    - Complete MTS Testing
    - Research dimensions of uterus to better understand how to do the SolidWorks drawing
- Ellinore Letts
    - MTS test.
    - Generate material results to design further prototypes.
- Abigayle Chapman
    - Assist with Exoflex dog bone/cervical mold modification
    - Continue research on how our model could signal procedural errors to a user
- Nora Lorentz
    - Continue working with the team to print and cast more components of our design
    - Further MTS testing progress on the materials
    - Sketch additionally needed parts in SolidWorks or perform any needed modifications
- Cadence Seymour
    - I want to work with my group to continue solving the problem of our previous designs on the cervix
    - I want to print out the new connecting piece for the group.

Activities

Name	**Date**	**Activity**	**Time (h)**	**Week Total (h)**	**Sem. Total (h)**
Renee Sobania	10/28	Filled the Dogbone and cylinder mold with Ecoflex 00-20 MTS testing for tension	1 2.5	3.5	35.5
Evelyn Ojard	11/3	Created cervix sketch	0.5	4.0	34.5

	11/5 11/5	Made initial solidworks design for updated cervix Completed tensile testing	1.5 2		
Ellinore Letts	10/28 11/05	Filled molds, created secondary design sketches. MTS ecoflex.	3.5	3.5	34
Abigayle Chapman	10/28 11/3 11/3 11/04 11/05	Filled Dogbone and cylinder mold with ecoflex 00-20 Created cervix sketch Researched vaginal opening and surrounding skin measurements Printed vaginal pieces MTS tested the Ecoflex 00-20	1 .5 1 .5 2	6	39
Nora Lorentz	11/3 11/4 11/5	Filled molds with ecoflex Sketched cervix and printed clear uterus MTS testing	1 1 2	4	34.5
Cadence Seymour	11/3 11/4 11/5 11/6	Filled molds with ecoflex Sketched the cervix design Redesigned the connecting piece MTS testing Researching	1 1 1.5 2 1	6.5	34

Project Timeline

PROJECT TITLE	Paracervical Block Training Model	TEAM NAME	PCBTM Team
DATE UPDATED	9/18		

					PHASE 1 - Prototype			PHASE 2 - Testing										PHASE 3 - Final Design	
TASK TITLE	TASK OWNER	START DATE	DUE DATE	PERCENT OF TASK COMPLETE	9/7 - 9/13	9/14 - 9/20	9/21-9/27	9/28-10/4	10/5 - 10/11	10/12 - 10/18	10/19-10/25	10/26-11/1	11/2-11/8	11/9-11/15	11/16-11/22	11/23-11/26	Thanksgiving Break	12/1-12/6	12/7-12/12
Materials and Research																			
Conduct Initial Background Research	Everyone	9/7	9/17	100%															
Product Design Specifications	Everyone	9/10	9/18	100%															
Design Matrix Criteria and Design Ideas	Everyone	9/19	9/24	100%															
Fabrication																			
Design in SolidWorks	Everyone	9/19	9/26	100%															
Start Fabrication Process	Everyone	9/22	10/3	100%															
Complete First Iteration	Everyone	10/3	10/31	50%															
Preliminary Presentation	Everyone	9/28	10/3	100%															
Show-and-Tell	Everyone	10/27	10/31	0%															
Testing																			
Tensile Testing	Everyone	11/1	11/8	0%															
Compression Testing	Everyone	11/9	11/15	0%															
Data Collection and Revisions	Everyone	11/16	11/22	0%															
Client testing	Everyone	11/16	11/22	0%															
Final Product																			
Final Product Client Testing	Everyone	11/23	11/29	0%															
Final Data Collection	Everyone	11/23	11/29	0%															
Final Report Draft	Everyone	11/23	11/29	0%															
Final Team Meeting	Everyone	11/23	11/29	0%															
Deliver Final Product to Client	Everyone	11/23	11/29	0%															
Final Documents																			
Final Notebook	Everyone	11/30	12/5	0%															
Write final report	Everyone	11/30	12/5	0%															
Prepare poster	Everyone	11/30	12/5	0%															
Review all final documents	Everyone	11/30	12/5	0%															
Final Poster Session	Everyone	11/30	12/5	0%															
Final peer and self evaluation		11/30	12/12	0%															

Gantt Chart

Materials and Expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
3D Printed Prototype	Preliminary prototype of mold for cervix	Makerspace	PLA basic	N/A	N/A	10/16/2025	1	$8.39	$8.39	
3D Printed Prototype	Preliminary prototype of mold for the uterus and connecting ring	Makerspace	PLA basic	N/A	N/A	10/16/2025	1	$5.10	$5.10	
Category 2										
Tubing	Charlotte pipe coupling 1.5” x 2” PVC DWV Hub x	N/a	PVC00102060 0HD	Homedepot	472476	10/23/2025	10	$1.59	$15.90	https://www.homedepot.com/p/Charlotte-Pipe-1-1-2-in-x-2-in-PVC-DWV-Hub-x-Hub-Increaser-Reducer-

										Coupling-PVC001020600HD/203391373
Tubing	Hub increaser/reducer PVC pipe 1.5-inch diameter x 6-inch length	N/a	PVC07112060 0	Homedepot	193844	10/23/2025	1	$7.32	$7.32	https://www.homedepot.com/p/Charlotte-Pipe-1-1-2-in-x-10-ft-PVC-Schedule-40-DWV-Pipe-PVC07112060 0/100348474?MERCH=REC-_-pipsem-_-100581718-_-0-_-n/a-_-n/a-_-n/a-_-n/a-_-n/a
Ecoflex	Ecoflex 00-20	N/a	N/a	Smooth-On	N/a	10/23/2025	3	$32.43	$64.86	https://shop.smooth-on.com/ecoflex-00-20
Tubing	PVC DWV All Hub Sanitary Reducing Tee 2 x 2 x 1.5 inches	N/a	PVC02400645 0HD	Homedepot	74323400	10/23/2025	10	$6.28	$62.80	https://www.homedepot.com/p/Charlotte-Pipe-2-in-x-2-in-x-1-1-2-in-PVC-Sch-40-Tee-PVC024006450HD/203821695
Adhesive	Gorilla construction adhesive – 1 tube	N/a	801000300	Homedepot	1001378150 00	10/23/2025	1	$9.98	$9.98	https://www.homedepot.com/p/Gorilla-9-oz-Heavy-Duty-Construction-Adhesive-8010003/206063265
Adhesive	Hook and loop tape with adhesive	N/a	90277B	Homedepot	23953600	10/23/2025	1	$20.93	$20.93	https://www.homedepot.c

	- white, ¾ inch, approximately 5” per task trainer									om/p/VELCRO-15-ft-x-3-4-in-White-Sticky-Back-Tape-90277B/202261924?g_store=4909&source=shoppingads&locale=en-US