Veterinary bone marrow aspirate models

Date: 11/28/2024-12/5/2024

Client: Dr. McLean Gunderson

Advisor: Prof. Randy Bartels

Team:

Avery Schuda - Co-Leader - aschuda@wisc.edu

- Helene Schroeder Co-Leader, BSAC hschroeder4@wisc.edu
- Anya Bergman Communicator ambergman2@wisc.edu
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Problem Statement

Veterinary professionals commonly collect bone marrow aspirates from three main sites in dogs and cats: the iliac crest, the trochanteric fossa, and, mostly commonly, the proximal humerus. Currently no veterinary bone aspiration models exist for students to practice on, requiring the use of cadaver dogs. Cadavers can only be used for about 5-10 insertions of the Illinois bone marrow biopsy needle per site, but does not contain live bone marrow that can be collected. This project aims to create a low-cost 3D anatomically correct model of the humerus with relevant soft tissue structures, mimics the consistency and structure of the bones, and allows for insertion of "bone marrow" for collection, allowing veterinary students to practice the skill of bone marrow aspiration.

Brief Status Update

The team had a productive two weeks, meeting several times to finalize fabrication of the model, test, and complete the poster ahead of the poster session on Friday. We updated the design of the scapula and humerus connections to accommodate the ball and socket instead of the U-joint to achieve rotation of the shoulder. The design of the replaceable component was also updated to add a tab to provide a one-way fit, and increase the thickness of the aspiration site as suggested by the instructors during testing.

Difficulties / advice requests

We will need to send the final CAD/3D printing files to Dr. Gunderson, currently we are planning to use Dropbox, but let us know if there is another file sharing method that works better for you.

Major team goals for the next week

- Present at the poster session on Friday 12/6.
- Complete the final report and deliverables.
- Give the final model and files to Dr. Gunderson.

Next week's individual goals

- Avery
 - Present final model at poster session on Friday.
 - o Finish final report, documentation, and other deliverables.
 - Send final CAD and 3D printing files to the client.
- Helene
 - Present at poster presentations on Friday.
 - o Finish final report, notebook, other deliverables.
- Anya
 - Present Poster during Presentation on Friday.
 - Finish all key deliverables.
- Ella
 - o Finish final deliverables and post them to the project's website.
 - Submit final deliverables to canvas course.
 - o To present the poster on Friday.
- Ellie
 - Present final model at the poster session on Friday
 - Finish the final report

Timeline

Task	Sept			Oct			Nov					Dec			
lask		13	19	27	4	11	18	25	1	8	15	22	29	6	11
Project R&D															
Empathize	Χ	Χ													
Background		Χ	Х	Х	Х	Х									
Prototyping						Χ	Χ	Χ	Χ	Х	Χ	Χ	Х		
Testings									Χ	Х	Х	Χ	Х		
Deliverables															
Progress Reports	Χ	Χ	Х	Х	Х	Х	Х	Χ	Х	Х	Х	Х		Х	
PDS			Χ												
Prelim presentation					Х										
Prelim Report						Х	·						·		
Final Poster														Χ	

Final Report/Notebook															
Meetings															
Client		Х		Х										Х	
Advisor	Х	Х	Х			Х				Х		Х		Х	
Website															
Update	Х	Х	Х	Χ	Х	Х	Х	Х	Χ	Х	Х	Х	Х	Х	

Filled boxes = projected timeline **X** = task was worked on or completed

Current design

Tapered sides and tab for secure, one-way fit 9 cm Port access for bone marrow filling

Figure 1: Drawing of the Slide Method of attachment

The proposed final design features the Slide Method of attachment for the design of the replaceable component. The oval section will be hollow to allow the client to fill the simulated bone marrow fluid into the port in the base of the design. The tab allows the user to easily orient the removable section correctly and slide it into place. Both the replaceable component and the rest of the bony structures (scapula, humerus, and fixed elbow) will be 3D printed using PLA. Surrounding the bones will be relevant musculature made from soft silicone which will further help the replaceable component remain in place when the needle enters and exits. The simulated skin, fabricated by the client out of neoprene and pourable silicone, will be affixed over top and will help to hold the musculature and bones in an anatomical position.

Previous two weeks' goals and accomplishments

Team

- Ordered remaining materials for testing and fabrication.
- Continued work on the CAD models.
- o 3D printed further iterations of the bones for testing.
- Finish fabrication before leaving for Thanksgiving break.
- Finalized testing plans.
- Began working on final deliverables.

Avery

- Continued working on design deliverables.
- Continued to work on CAD model and fabrication.
- Worked on assembly, documentation, and methods for testing data
- Continued working on CAD models based on team and client feedback.
- Continued 3D printing final iterations of the design.

Helene

- Continued working on fabrication of final deliverables.
- Worked on the poster presentation and the final report.
- Looked ahead to testing by working on testing protocols.

Anya

- o Finished joint connection in CAD between scapula and humerus
- Continued 3D printing models to find the best one
- Worked on inside of the replaceable segment.
- Worked on final deliverables.

Ella

- Helped with the assembly and fabrication of the final design.
- Worked on the final design deliverables
- o Finalized fabrication of the model.
- Completed poster segment
- Brought materials to test for client

Ellie

- Helped with assembly and fabrication
- Worked on final poster and other deliverables
- Finalized fabrication of the model
- Helped with testing of the model's components
- Completed the poster to present on Friday

Activities (11/28 - 12/5)

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Avery Schuda	11/28/24 - 12/5/24	-Worked on several final iterations of CAD models -3D printed final iterations of the model -Met with team to finish fabrication -Worked on and printed final poster -Worked on documentation and design deliverables	35	35	106
Ellie Kothbauer	12/5/24	-Met with the team and worked on the poster presentation -Met with the team to finish fabrication of the model -Started to work on deliverables	10	10	55
Anya Bergman	12/5/24	- 3D printed final components for the model. - Met with team to work on poster presentation and finish fabrication. - Started work on final deliverables.	18	18	62
Helene Schroeder	12/5/24	-3D printed final components for the model -Met with team to work on Presentation, and finish fabricationWorked on editing the poster and the final report.	10	0	62
Ella Cain	12/5/24	-Printed components for testing and fabrication at the Makerspace Met with team on Monday, Wednesday, and Thursday to finalize fabrication and complete the poster -Went with Anya to the School of Veterinary Medicine to present testing components to client and staff	12	12	60

Materials and expenses

Item	Description	Manufact urer	Mft Pt#	Vendor	Vendor Cat#	Date	Q T Y	Cost Each	Total	Link
Category 1							<u> </u>			
	We printed out									
	strips of PLA, ABS,									
	and PETG at									
	different densities			UW						
	to see with			madiso						
	materials work the	Makerspa		n						
Material	as a bone	ce 3d		Makers		9/26/			\$0.5	
test strips	replication	printers		pace		2024	3	\$0.17	1	
				Makers						
	We printed out a			pace						
Right	Right Humerus out			Design						
Humerus	of Bambu Labs PLA		774759	Buildin		10/31			\$1.3	
PLA print	Matte		3925	g		/2024	1	\$1.38	8	
				Makers						
				pace						
	We printed out			Design						
Right Leg	forelimb, humerus	Makerspa		Buildin					\$4.1	
Full Print	and Scapula	ce		g		11/14	1	\$4.18	8	
	4 1ft by 1ft sheets									
4 Red	of Red silicone									
silicone	sheets were									
rubber	ordered for muscle	Tlence		Amazo		11/7/		\$23.9	\$23.	
sheets	replica	Store		n		2024	1	9	99	
Universal										
joint (for										
shoulder	1 % in long, overall		54PR1	Grainge		11/5/		\$17.0	\$0.0	
joint)	large, chrome	Westword	3	r		2024	1	8	0	
Alecpea	Glue specifically for	Alecpea		Amazo		11/18	1	\$9.99		

Special	silicone			n	/2024				
Glue									
				Makers					
				pace					
				Design					
	¼ thick, 12 in x 36	Makerspa		Buildin	11/20			\$3.2	
Masonite	in	ce		g	/2024	1	\$3.25	5	
Black									
Stainless									
Steel	10 x 0.79", 10 x			Amazo	11/18			\$5.9	
L-brackets	1.57", 60 x screw	YAMASO		n	/2024	1	\$0.30	9	
Picture									
frame	Package of 100 to								
turn	fasten replaceable								
button	component to			Amazo	11/18			\$6.9	
fasteners	humerus	Hoedia		n	/2024	1	\$0.07	8	
	50 6 x 2 mm			Amazo	11/18			\$3.9	
Magnets	magnets	Nuiknow		n	/2024	1	\$0.08	9	
Door		Prime-Lin		Amazo	11/18			\$9.9	
Panel Clip	8 pack, clear acrylic	e	T 8733	n	/2024	1	\$1.25	9	
Non slip	16 pcs with stainless								
rubber	steel wash screws, 2			Amazo	11/18			\$5.8	
feet	sizes	Quadafy		n	/2024	1	\$0.37	9	
							TOTA	\$25.	
							L:	88	