Veterinary bone marrow aspirate models

Date: 11/7/2024

Client: Dr. McLean Gunderson

Advisor: Prof. Randy Bartels

Team:

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- 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

Last Friday the team participated in the Show and Tell presentations with our peers. We got some great feedback on our current design and advice for transitioning our 3D scan .stl files into workable CAD files. We've used this experience to continue purchasing materials and work on the CAD model.

Difficulties / advice requests

The team is still deciding on a method of attachment for the pseudo muscle and skin that will allow the replaceable component of the bone to be easily accessible. The CAD model of the 3D scanned bones is also proving difficult to work with due to its complexity.

Major team goals for the next week

- Order remaining materials for testing and fabrication.
- Continue work on the CAD models.
- 3D print further iterations of the bones for testing.

Next week's individual goals

- Avery
    - Continue working on the CAD model of the bones.
    - 3D print test bones from CAD.
    - Finalize base and method of attaching the skin and muscle.
- Helene
    - Determine how to attach skin/muscle to the model.
    - Look into testing methods for what prototype materials we have so far.
- Anya
    - Help with the CAD model of the bones.
    - Figure out an attachment method for the shoulder joint.
    - Test the new U-joint out for the shoulder to determine if it will be the best fit possible for the project.
- Ella
    - Go over advice given from the show-and-tell presentation about muscle and skin attachments
    - Determine the material for muscle
- Ellie
    - Look into methods of attachment for the muscle, and the edited portion
    - Work on Autocad skills and how to carve out the removable portion

Timeline

Task	Sept				Oct				Nov					Dec	
	6	13	19	27	4	11	18	25	1	8	15	22	29	6	11
Project R&D															
Empathize	X	X													
Background…		X	X	X	X	X									
Prototyping						X	X	X	X						
Testings									X						
Deliverables															
Progress Reports	X	X	X	X	X	X	X	X	X						
PDS			X												
Prelim presentation					X										

Prelim Report						X									
Final Poster															
Final Report/Notebook															
Meetings															
Client		X		X											
Advisor	X	X	X			X									
Website															
Update	X	X	X	X	X	X	X	X	X						

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

Current design

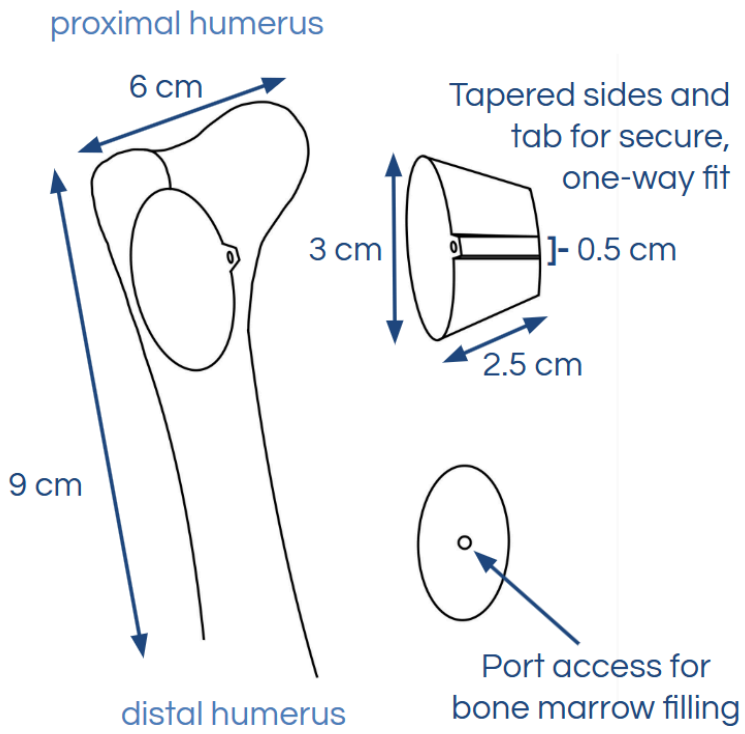

Figure 1: Drawing of the Slide Method of attachment

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 week's goals and accomplishments

- Team
    - Presented initial 3D print, pitch, and call to action at the Show and Tell.
    - Began implementing strategies suggested by peers at the Show and Tell.
    - Purchased silicone for muscle.
    - Began fabricating the model.
- Avery
    - Continued to work on the CAD model with team/individually.
    - 3D printed test piece for the humerus.
    - Further researched converting .stl into workable CAD files.
- Helene
    - Worked on editing the SW model for prototyping and testing.
    - Drafted protocols for prototyping and testing.
- Anya
    - Worked on CAD model to create removable piece and edit parts to incorporate joint
    - Purchased shoulder joint.
- Ella
    - Continued to learn Solidworks.
    - Continued to research materials for muscle fabrication.
- Ellie
    - Worked on solidworks skills
    - Purchased materials (silicone) and recorded pricing.

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Avery Schuda	11/6/24	-Show and Tell with team -Worked on CAD models in Fusion and SolidWorks -Further researched converting .stl into CAD	6	6	54

Ellie Kothbauer	11/7/24	-Show and tell with team; relayed feedback - Researched and purchased some needed material	3	3	36
Anya Bergman	11/7/24	-Show and tell with team -Tested 3D scans by 3D printing the STL files that we got from them -Purchased shoulder joint	3	3	35
Helene Schroeder	11/7/24	- Show and Tell with the team; received great and insightful feedback. - Created a testing protocol draft for the replaceable component.	3	3	33
Ella Cain	11/7/24	-Did the Show-and-Tell with the group -Continued to work with SolidWorks -Created ideas for muscle sleeve	3	3	39

Materials and expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Category 1										
Material test strips	We printed out strips of PLA, ABS, and PETG at different densities to see with materials work the as a bone replication	Makerspace 3d printers	.	UW madison Makerspace		9/26/2024	3	$0.17	$0.51	

Right Humerus PLA print	We printed out a Right Humerus out of Bambu Labs PLA Matte		7747593925	Makerspace Design Building		10/31/2024	1	$1.38	$1.38	
4 Red silicone rubber sheets	4 1ft by 1ft sheets of Red silicone sheets were ordered for muscle replica	Tlence Store via Amazon		Vendor		11/7/2024	1	$23.99	$23.99	
Universal joint (for shoulder joint)	1 ⅜ in long, overall large, chrome	Westword	54PR13	Grainger		11/5/2024	1	$17.08	$0.00	
								TOTAL:	**$25.88**	