UW BME Design

VetMed: Cat Cystocentesis

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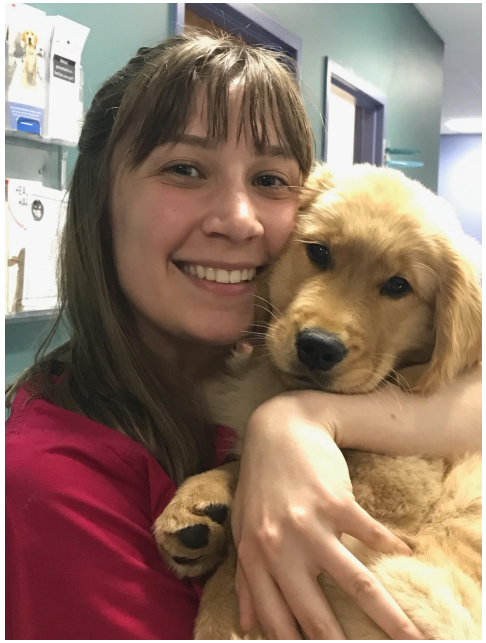


Client:
Melissa Shear
UW-Madison Vet Student

Advisor:
Dr. Edward Bersu
Professor Emeritus

Accessory Client: Dr. Jessica Pritchard, UW-Madison Vet School Faculty

Outline-

- **Define the Problem**
  - What is the problem?
  - Why is it important that we find a solution?
- **Background Information**
- **Summary of Product Design Specification**
- **Design Alternatives**
  - Discussion of top three design alternatives
  - Design Matrix - Steps taken to determine which design alternative best meets the client and design requirements
- **Future Work**
- **Reference/Acknowledgements**

Problem Statement

- Delicate procedure that requires precision and accuracy
- Vet students lack confidence needed for performing procedures like these [1[

Our Goal:

- Develop a teaching model that allows veterinary students to practice Cystocentesis to assist in the learning of proper techniques that can be used when working with live animals

Importance of the Device:

- At the University of Wisconsin-Madison Veterinary School, there is currently no way for students to practice this procedure except on live animals or cadavers

Background

- **Quick procedure**
  - Collect sterile urine samples for testing
  - Relieve distended bladders
- **Cat position: held on side, back, or standing up**
- **Full procedure**
  - Palpate bladder
  - Visualize an “x” between last four nipples
  - Insert a needle with a syringe attached at 45 degree angle in center of the “x”
  - Aspirate urine
  - Release bladder and withdraw syringe

Teaching model at Universidad de Buenos Aires

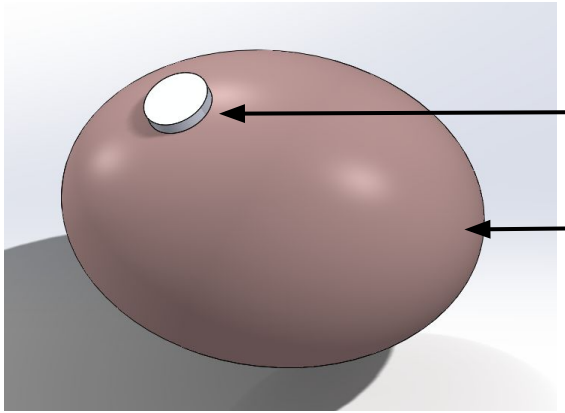
Summary of PDS

1. **Size and Weight:**
    a. Mimic average cat, 18 inches and 8 pounds [2], [3]
    b. Mimic the anatomical size of a feline bladder (~125 mL, 7 cm long / 5 cm diameter) [4], [5]
2. **Life in Service:**
    a. Goal: 500 punctures/structure
3. **Materials:**
    a. Mimic mechanical properties of the tissue of a cat

Bladder Design- No Diaper Needed

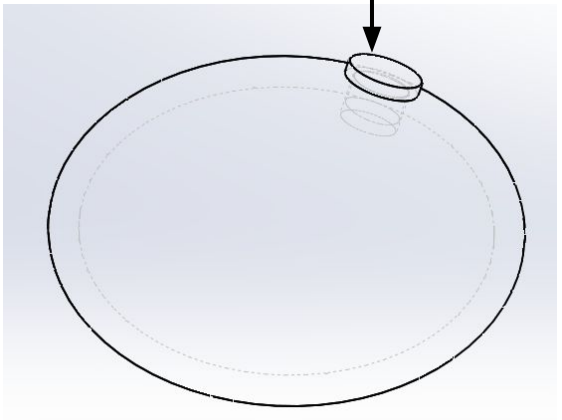
- Self-Sealing
- Refill Only
- Disadvantages:
  - Needle must remain
  - Coat inside with a place to refill
  - Outside sealant has tricky application
  - Additional layers

[6], [7]



Hole / Plug

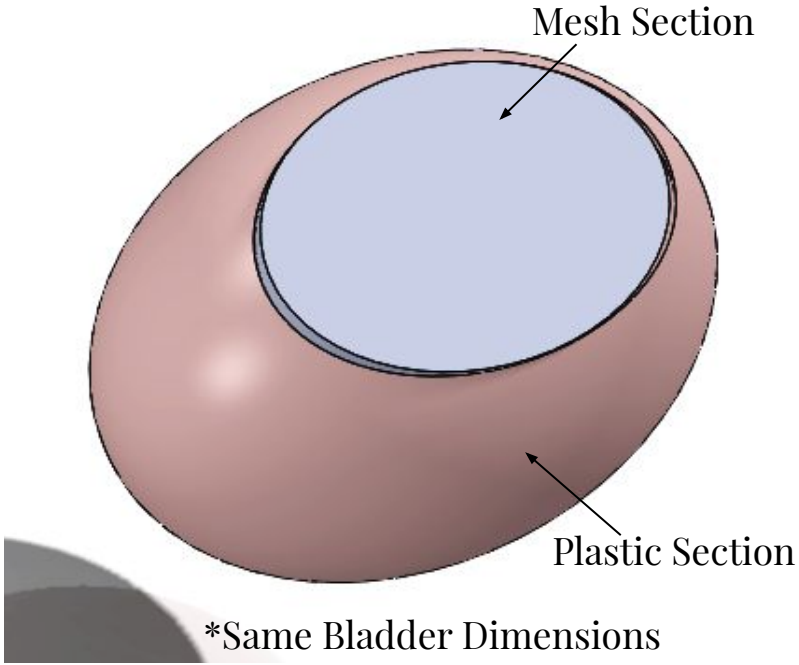
Resealable Outer Layer



Dimensions-

- Long Axis:
  - Outer: 7.71 cm
  - Inner: 7.21
- Short Axis:
  - Outer: 5.50 cm
  - Inner: 5.00 cm

Bladder Design- Frankenbladder

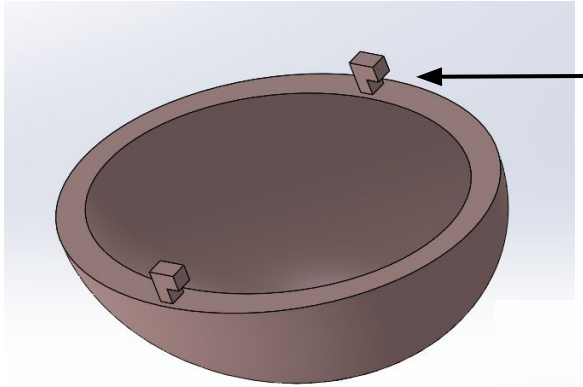


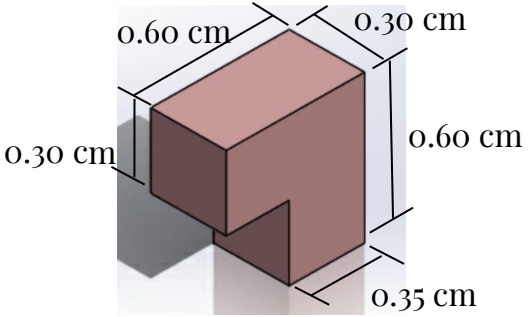
*Same Bladder Dimensions

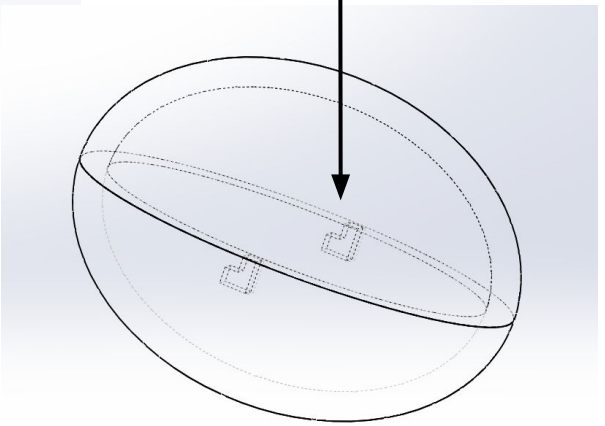
- Plastic Section: Holds Liquid
- Mesh Section: Punctionable
- Structural / Shape Integrity
- Disadvantages:
  - Only accessible from top
  - Hard to refill
  - Unsure connection viability

Bladder Design- Puzzle Pee-ces

- Two Separate Halves
  - Tissue mechanical properties
  - Do not hold liquid
  - Interlock
- Enclose water balloon
- Disadvantages:
  - Replace semi-regularly
  - Replace balloon every time
  - Interlocking mechanism



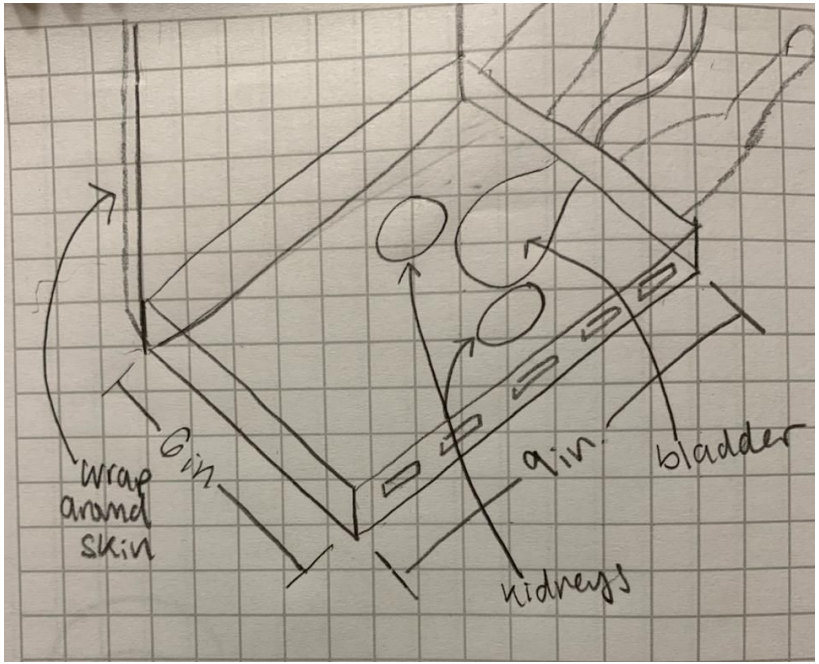




*Same Bladder Dimensions

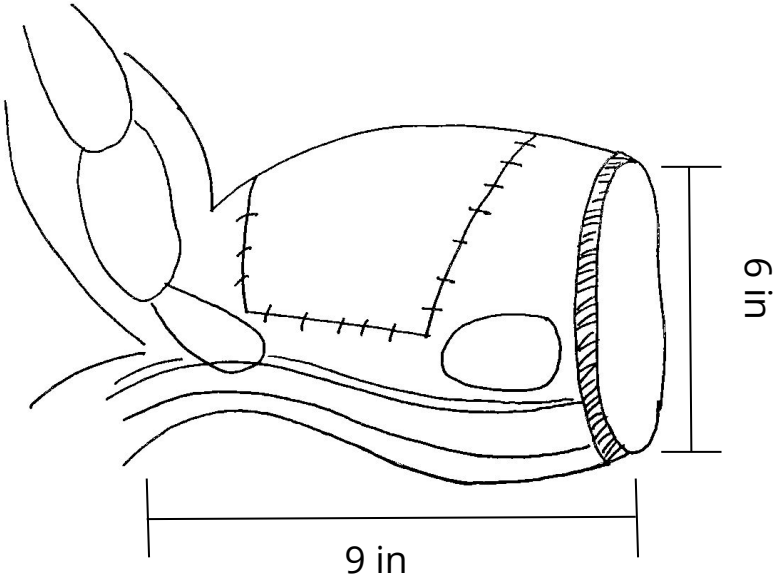
Structural Design - Wrap Around

- Easy to Store
- Customer Friendly
- Straightforward Fabrication
- Similar Internal Anatomy
- Disadvantages
  - Outer shape not similar to a cat body
  - Not able to turn the device on its side



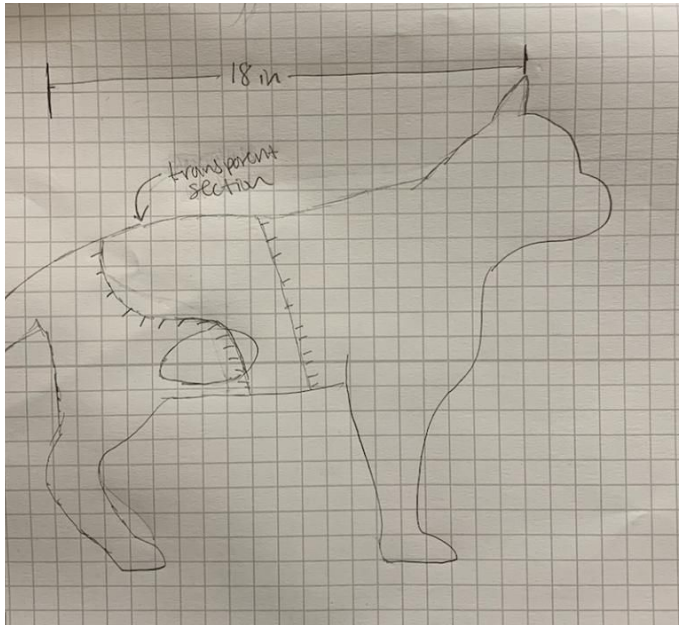
Structural Design - Kittens Get Stitches

- Realistic Shape and Movement
- Comparable Mechanical Properties
- Practice Side and Stomach Procedure
- Disadvantages
    - Complicated Fabrication
    - Difficulty in Storage



Structural Design - The Vision

- Option to View Procedure
- Realistic shape and size
- Low Production Cost
- Disadvantages
    - Complicated design
    - Difficult to store
    - Clear is not comparable to procedure



Bladder Design Matrix

Criteria (Weight)	Puzzle Pee-ces		Frankenbladder		No Diaper Needed	
Realism (25)	5	25	4	20	5	25
Ease of Use / Simplicity (20)	4	16	3	12	3	12
Easy to Store (15)	5	15	3	9	2	6
Ease of Fabrication (15)	3	9	1	3	1	3
Durability (15)	4	12	3	9	5	15
Cost (10)	4	8	4	8	2	4
Total Score (/100)	85		61		65	

Structural Design Matrix

Criteria (Weight)	Wrap Around		The Vision		Kittens Get Stitches	
Realism (25)	2	10	5	25	5	25
Ease of Use / Simplicity (20)	4	16	4	16	4	16
Easy to Store (15)	3	9	3	9	4	12
Ease of Fabrication (15)	4	12	1	3	3	9
Durability (15)	4	12	2	6	4	12
Cost (10)	3	6	5	10	4	8
Total Score (/100)	65		69		82	

Future Work

- Creating a “skin”
  - Ecoflex
  - Other plastics
- Puncturable balloons or materials
  - (Water) balloons
  - Vacuette caps
  - Sealant
- Bones and structural elements
  - CT scans
    - 3D printing
- Practicing the procedure
  - Vet School
    - Practice lab experience

References & Acknowledgements

[1] L. E. Williams, J. A. Nettifee-Osborne, and J. L. Johnson, “A Model for Improving Student Confidence and Experience in Diagnostic Sample Collection and Interpretation,” *Journal of Veterinary Medical Education*, vol. 33, no. 1, pp. 132–139, 2006.

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[3] Sashin, D. (2019). *A Healthy Weight for Your Cat*. [Online] WebMD. Available at: https://pets.webmd.com/cats/guide/healthy-weight-for-your-cat#1 [Accessed 21 Sep. 2019].

[4] Healthline. (2015). *Bladder Anatomy, FUnction & Diagram | Body Maps.* [Online]. Available at: https://www.healthline.com/human-body-maps/bladder#1 [Accessed 3 Oct. 2019].

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[6] “Duraseal Technology Helps Keep Trucks Up and Running,” *Duraseal Technology Helps Keep Trucks Up and Running*. The Goodyear Tire and Rubber Company, 2008.

[7] The Christian Science Monitor. (2019). *Why tire sealant may not be the solution*. [online] Available at: https://www.csmonitor.com/Business/Saving-Money/2016/0804/Why-tire-sealant-may-not-be-the-solution [Accessed 3 Oct. 2019].

Special thank you to our client Melissa and advisor Ed!

QUESTIONS?