Endoscopic Spine Training Simulator

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BME Design

Overview

- Problem statement

- Background

- Product Design specifications
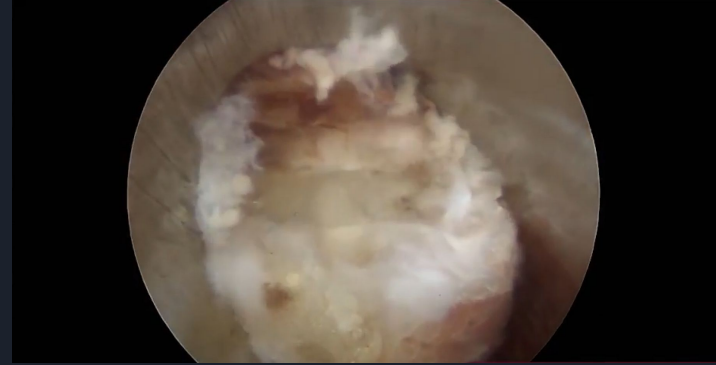
- Designs and MAtrix

- Future Work

Problem Statement

- Spine surgery becoming more commonplace
  - Discrepancies between standard procedure and client's

- Current Methods
  - smaller incisions than standard surgery
  - operation microscope and X-rays

- Problems
  - Low acuity in simulation environment
  - Accommodate surgeons' needs
  - Accessible as an open source platform

BME Design

Background

- Existing products ("SPINE MENTOR")
  - Extremely expensive
- Cannula placement (Yue)
  - The spinal needle test (Milad)

https://youtu.be/G-hbwVYg6z0 (3:00-3:30)

https://simbionix.com/simulators/spine-mentor/

BME
Design

Product Design Specifications

- Must be safe
- Box size = 8in x 8in x 12in
- No 3D printing - must be low tech
- Focus on surgical tasks not the anatomy
- Mimic 3 Tasks:
  - 1. Targeting with the angled lens of endoscope
  - 2. Sweeping away tissue
  - 3. Poking holes through membranes
- BONUS: Lens extension off of cell phone

Base Design

Boxes:

- Boxes made of plywood
- 8"x8"x12" for both boxes
- Comprehensive box may be longer

Tools:

- Cannula
- Bevel
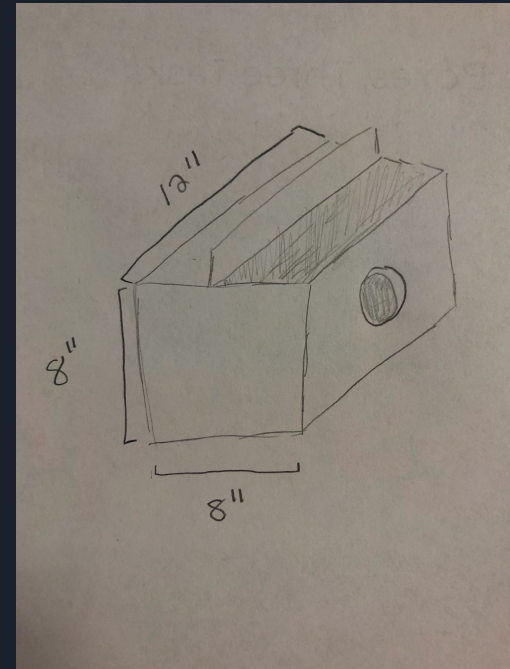- Endoscope
- Surgical Grabber/Grasper

Design 1 -
One Box, Three Interchangeable Tasks

What's different:

- Interchangeable insides
- Singular box
- One entry point for endoscope

Benefits:

- Easy build
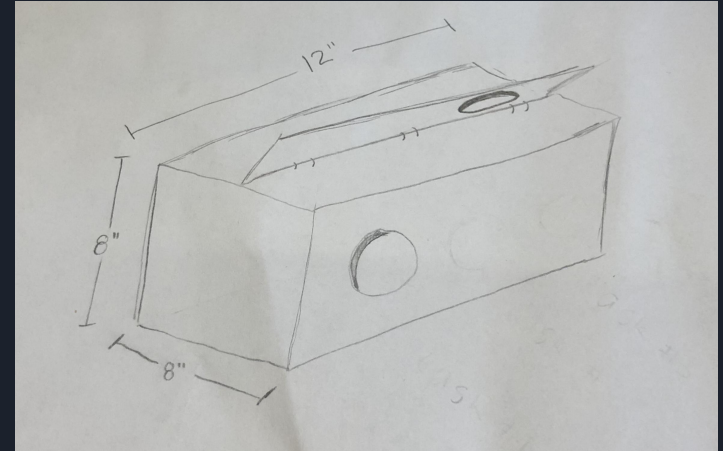- Specificity
- Cut down on cost

Design 2 -
One Box, Comprehensive Tasks

What's Different:

- Each opening allows all three tasks
- Hinged lid, used for easy access
- Surgeon has freedom of task choice

Benefits:

- All in one box
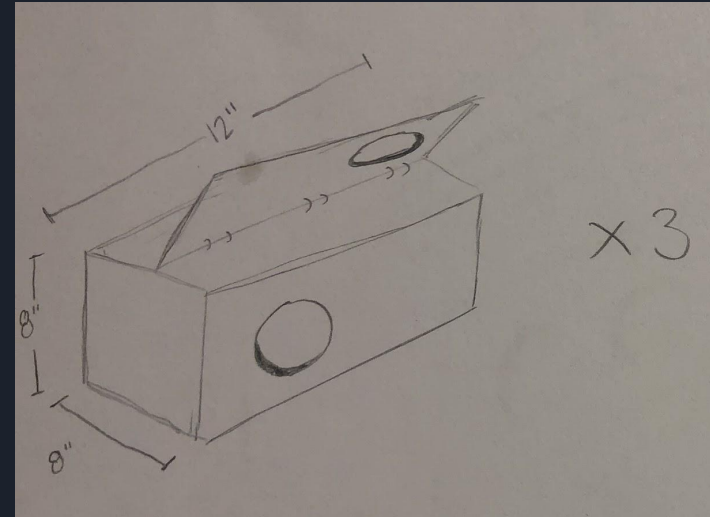- Allows practice of a full surgery

Design 3 -
Three Boxes, Separate Tasks

What's Different:

- Each box is specific to one task
- Two different entry points per box

Benefits:

- Box is customizable to surgeon needs
- Simple design, easy to replicate
- Allows focused practice

Design Matrix

	Design	Interchangeable	Comprehensive	Seperate
Criteria (weight)				
Degree of Accuracy (30)		18	27	20
Ease of Construction (20)		17	12	18
Translatability (20)		13	10	15
Ease of Use (10)		7	9	9
Materials (10)		8	8	8
Time (10)		7	6	8
Total (100)		70	72	78

Future Work

- Confirm our chosen design

- Formulate a design plan

- Begin initial fabrication

- Evaluate quality of product through testing

- Analyze prototype and possible improvements

- Implement reasonable enhancements

Acknowledgements

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- UW Health University Hospital

- UW Madison BME Department

References

Yue, James J., and William Long. "Full Endoscopic Spinal Surgery Techniques: Advancements, Indications, and Outcomes." *Current Neurology and Neuroscience Reports*., U.S. National Library of Medicine, 2015, www.ncbi.nlm.nih.gov/pmc/articles/PMC4480053/.

Uniyal, Priyank, et al. "A New Progression Towards a Safer Anterior Percutaneous Endoscopic Cervical Discectomy: A Technical Report." *OMICS International*, OMICS International, 10 Aug. 2016, www.omicsonline.org/open-access/a-new-progression-towards-a-safer-anterior-percutaneous-endoscopic-cervical-discectomy-a-technical-report-2165-7939-1000329.php?aid=78246.

Milad, M P, and M F Terkildsen. "The Spinal Needle Test Effectively Measures Abdominal Wall Thickness before Cannula Placement at Laparoscopy." *Current Neurology and Neuroscience Reports*., U.S. National Library of Medicine, Nov. 2002, www.ncbi.nlm.nih.gov/pubmed/12386366.

"SPINE MENTOR™." *Simbionix*, simbionix.com/simulators/spine-mentor/.