Model for Pre-Surgical Intracerebral Hemorrhage Planning

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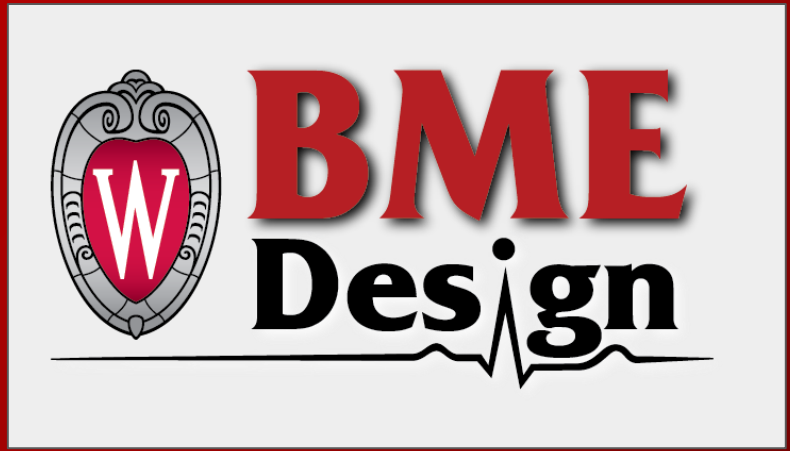
Overview

- Problem Statement
- Background and Prior Work
- PDS
- Design Alternatives
- Design Matrix
- Future Work: Stages 1-4
- References
- Acknowledgements



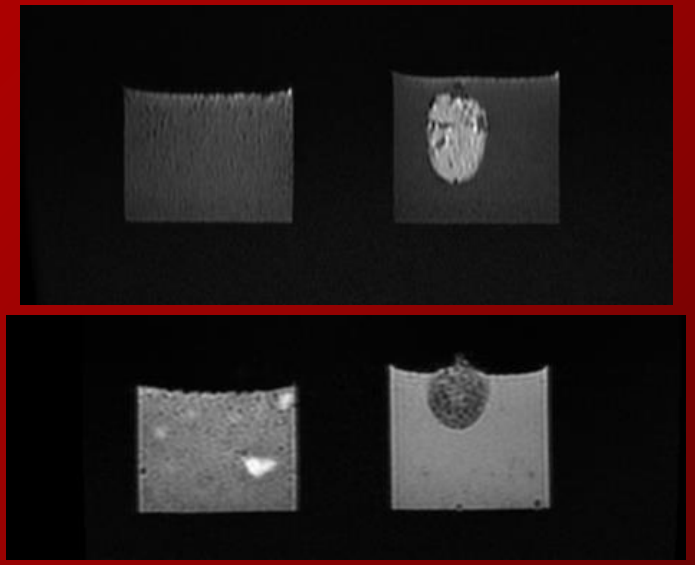
Problem Statement

- In the past, very little could be done for patients with intracerebral hemorrhaging
- Recent efforts being made to remove as much clot as possible to prevent damage
- Characteristics of different clots vary - differences in rigidity affect removal approach
- Research being done to map rigidity of clots before operation

Goal is to create a gel model to simulate interior of brain with various clots to image and validate the effectiveness of mapping techniques

Background / Prior Work

- Recently two methods to remove cerebral clots have been developed
- The method used is dependent upon the stiffness of the clots
  - Suction
  - Drug treatment then suction
- A phantom brain is needed to acquire a range of stiffness measurements to be used in a database
- The phantom will also be used to test MRI Resolution
- Last semester
  - Gel making protocol
  - Proof of concept completed

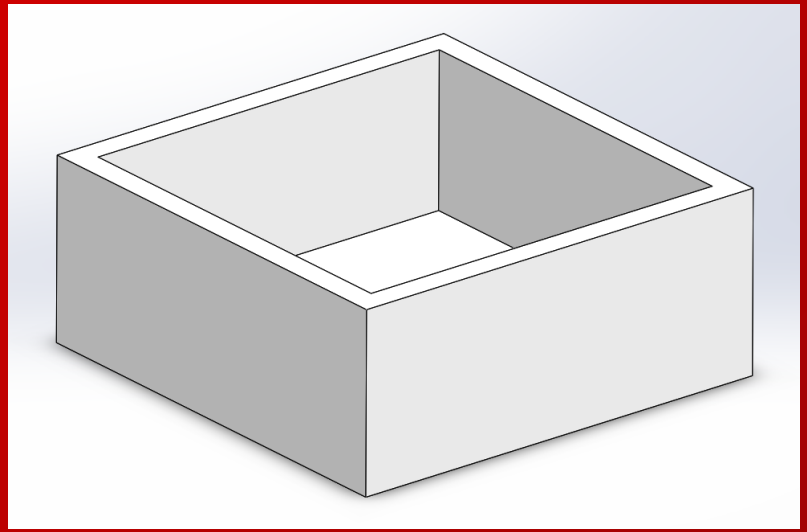


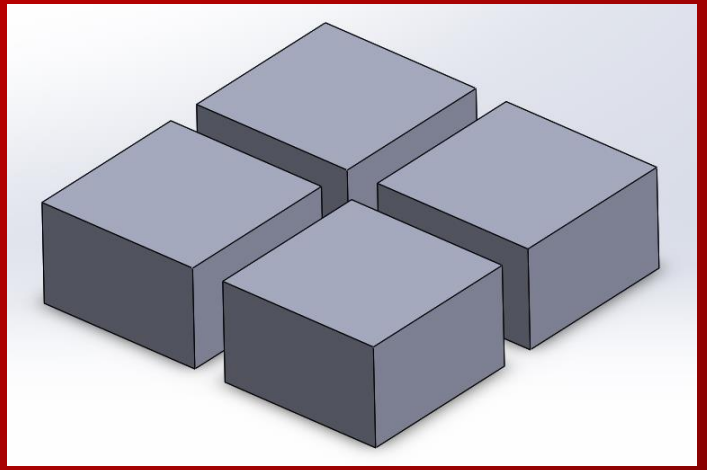
T1 and T2 imaging results from last semester

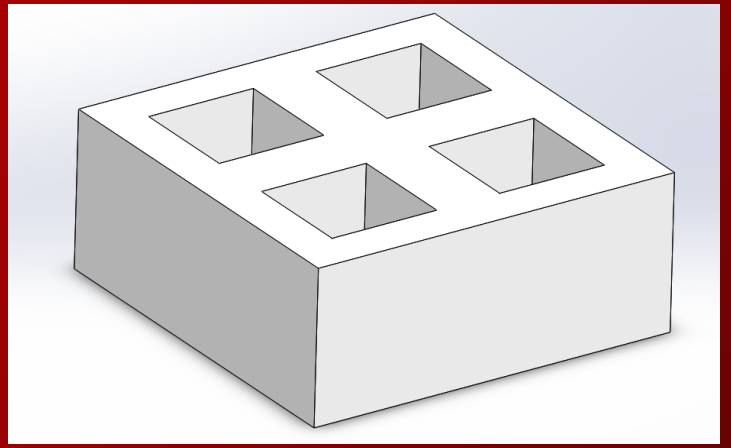
PDS

- Final stiffness should be comparable to brain matter
- Size of “Clots” must test the accuracy of MRI
- Must be resilient to handling and transport
- The phantom must be able to handle powerful magnetic fields (no metal)
- Must be sharp contrast between stiffnesses

Updated Design







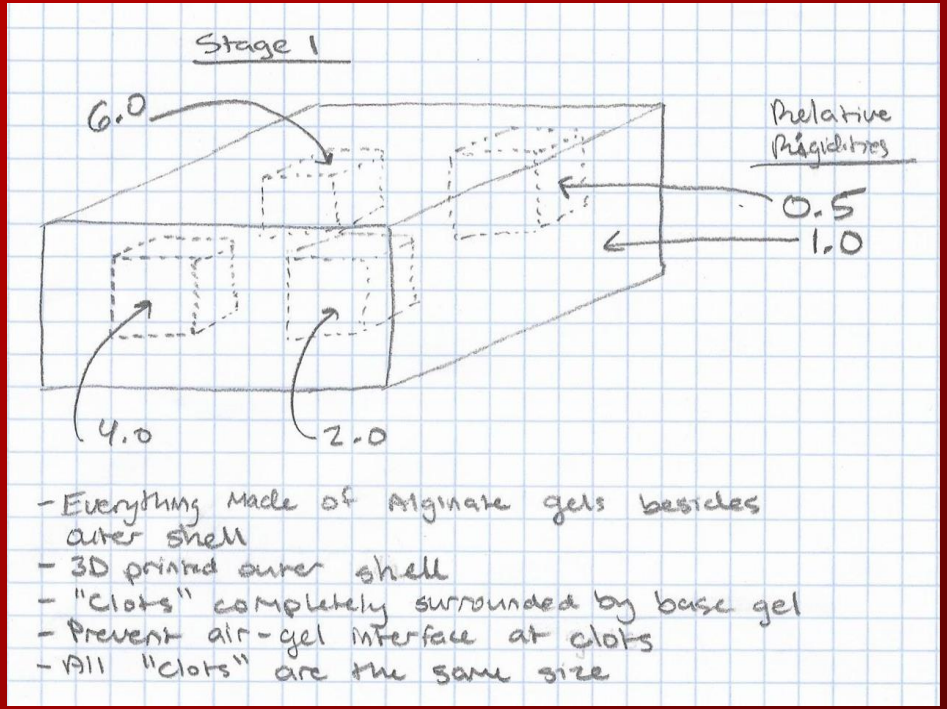
Gel Fabrication Protocol

Protocol:

1. Dissolve alginate in warm water
2. Add $CaCO_3$ and Glucono-δ-lactone
3. Mix gel thoroughly
4. Before the gel sets, scoop it into the finger-tip of a latex glove
5. Tie the top of the latex glove off, ensuring no air gets in the glove
6. Allow the clot gel to set in a fridge
7. Repeat steps 1-4 for gel iterations
8. Suspend the clot using a wooden stick in the cavity of the container
9. Pour the base gel into the cavity and allow the gel to set in the fridge

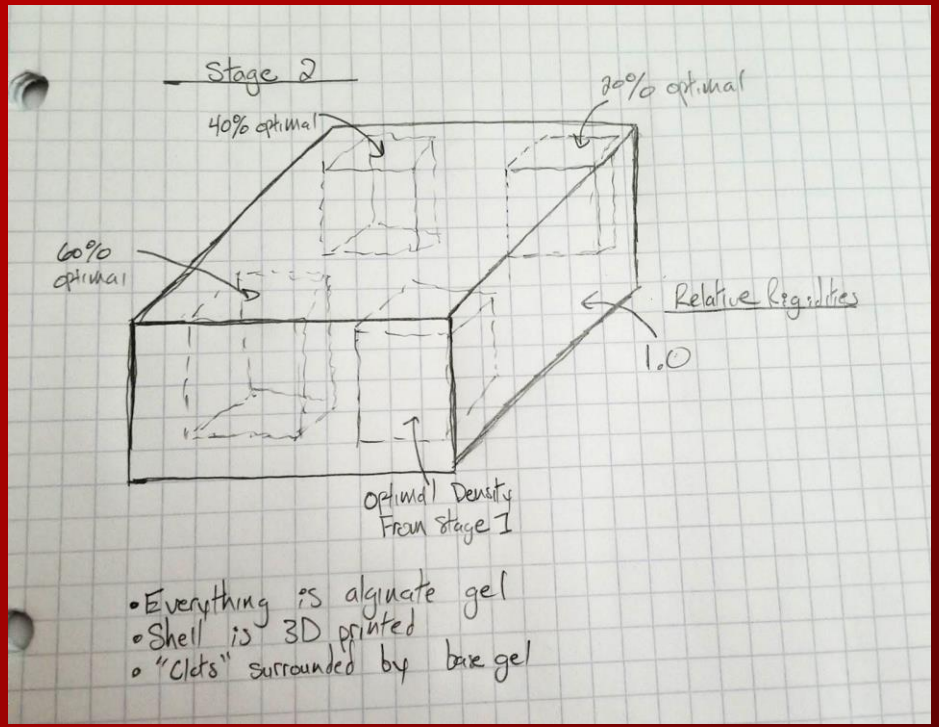
Future Work - Stage One

- All alginate gel besides outer plastic shell
- “Brain” base gel
- “Clot” gels of varying rigidity
- Prevent air-gel interface with “clots”
- Same size “clots”



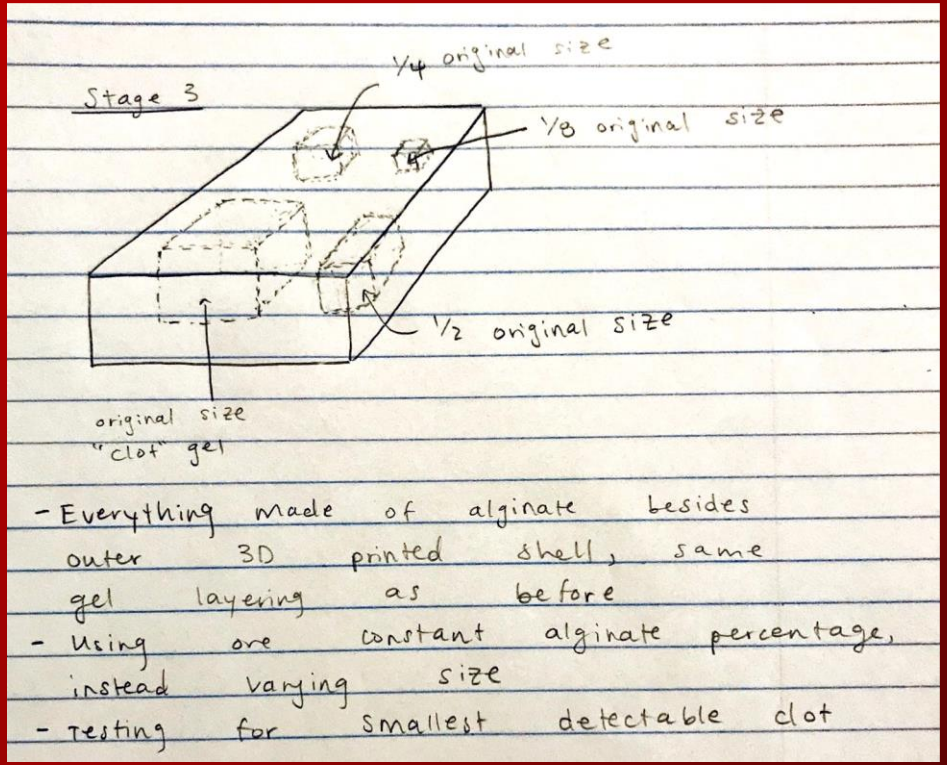
Future Work - Stage Two

- Same setup as stage two
- Refined range of varying “clot” rigidity
- Goal is to find imaging threshold



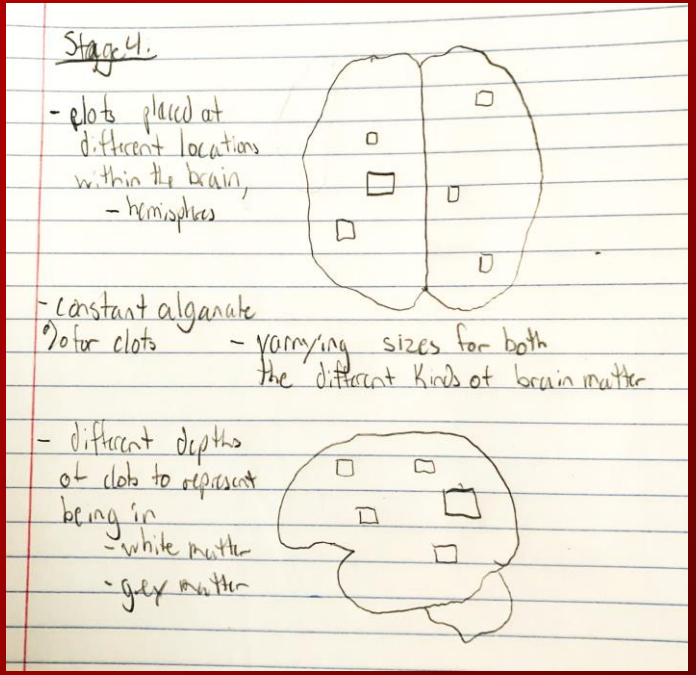
Future Work - Stage Three

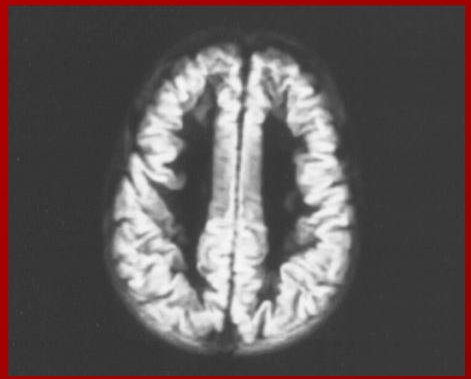
- Same setup as previous stages
- One “clot” rigidity - whatever was found to be threshold in stage two
- “Clots” of varying sizes
- Testing for smallest detectable “clot”



Future Work - Stage Four

- New sample holder - brain model
- Same constant threshold “clot” rigidity
- Different “brain” gels to model gray and white matter
  - Different depths of clots
  - Different sizes of clots





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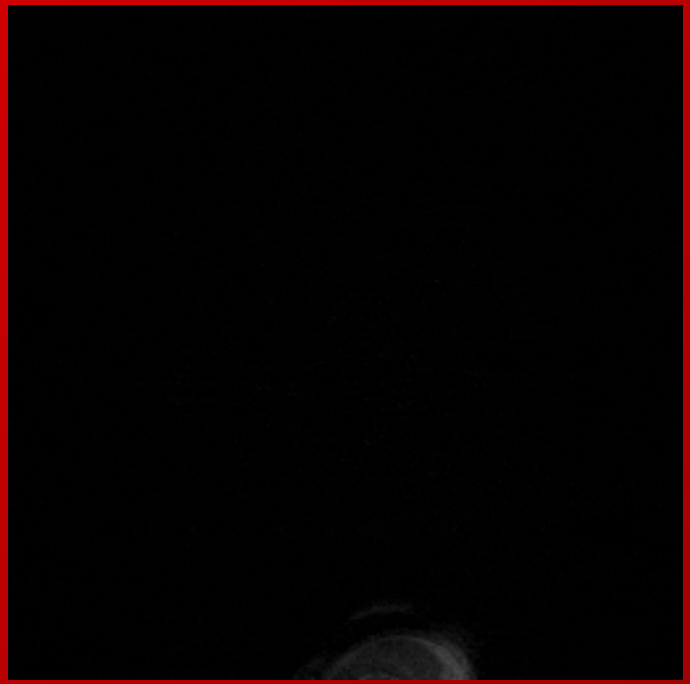
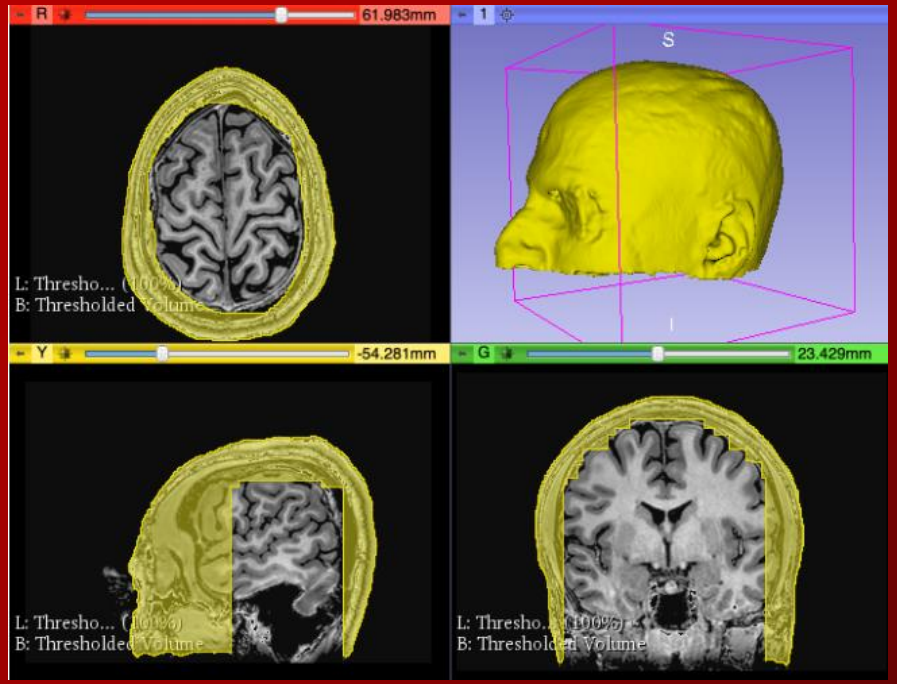
Future Work - Stage Four





Thank you to Dr. Block and Dr. Hai!

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