Model for Pre-Surgical Intracerebral Hemorrhage Planning

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Overview

- Problem Statement
- Broader Impact
- Material Choice Update
- Material Design Matrix
- Mechanical Testing
- Updated Container
- Future Steps
- Acknowledgements
- References

Problem Statement

- Goal is to create a gel model to simulate interior of brain with various clots to image and validate the effectiveness of mapping techniques
- Improve material to better represent human brain tissue properties
- Improve gel container to cooperate better with scanner shape - minimize wave interference

Broader Impact

- A phantom brain is needed to acquire a range of stiffness measurements to be used in a database
- Design could lead to proper removal of clots
  - Drug treatment and suction vs suction alone
  - Save time in operating room
  - Save lives
- Prove accuracy of MRI modulus readings

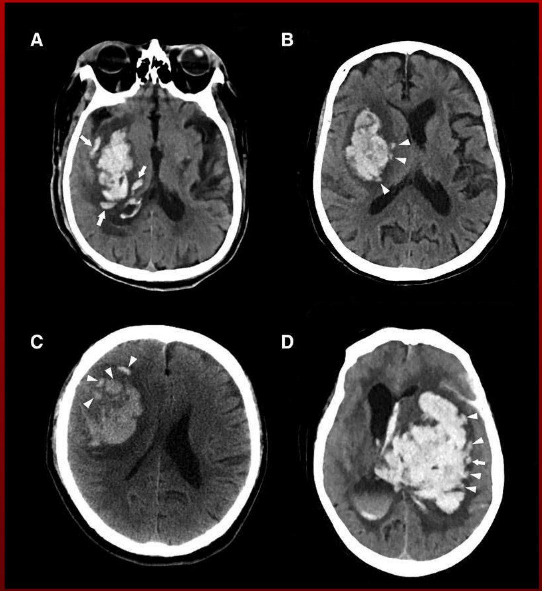

Figure 1. T1 scan of heterogeneous ICH clots

Material Design Matrix

Criteria	Polyacrylamide (PA)		Gelatin		Polydimethylsiloxane (PDMS)	
Ease of Fabrication (30)	4/5	24	3/5	18	4/5	24
Biomimicry (30)	5/5	30	2/5	12	4/5	24
Cost (15)	3/5	9	5/5	15	2/5	6
Safety (15)	4/5	12	5/5	15	3/5	9
Duration (10)	5/5	10	1/5	2	4/5	8
Total (100)	85		62		71	

Material Choice Update

- Using PA as an alternative to alginate
- Ideally will get us closer to the 1 kPa range in stiffness
    - Want to replicate mechanics of blood clots
- Polymerize at room temperature overnight to obtain less stiff samples

Mechanical Testing

- Want to obtain shear modulus for PA blood clot samples
    - More ideal measure for viscoelastic materials
- Brain is incompressible; measuring shear will be more realistic

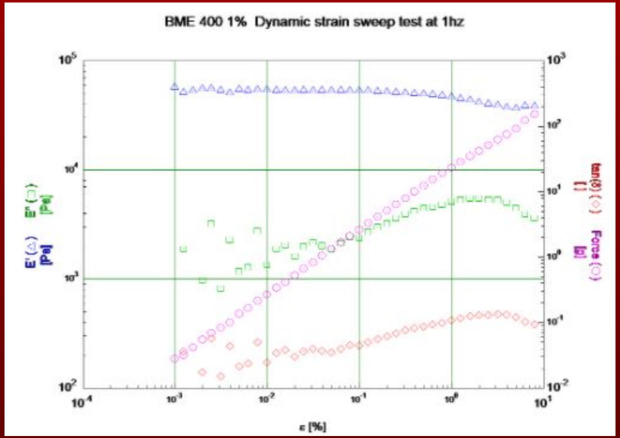

Figure 2. Previous DMA data of 1% alginate

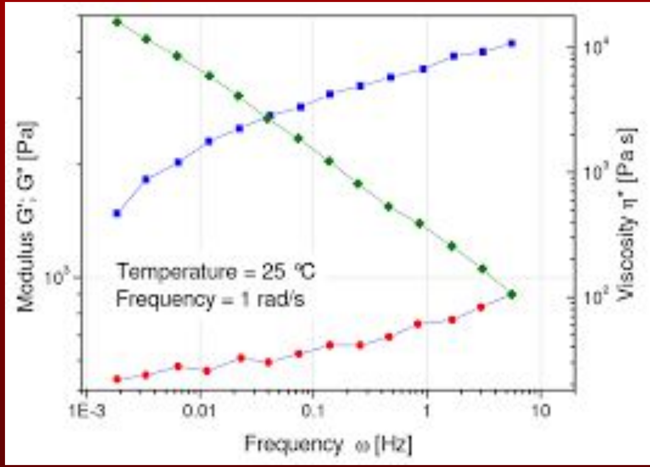

Figure 3. Sample expected rheometry data
http://www.tainstruments.com/pdf/literature/AAN016_V1_U_StructFluids.pdf

Updated Container

- Updated shape with CT scans provided of skull and neck via MeshMixer → 3D print
- Incorporate sinuses/fluids into model

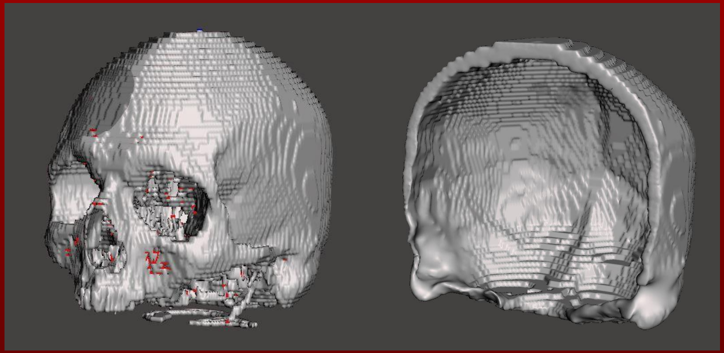

Figure 4. Container creation in MeshMexer

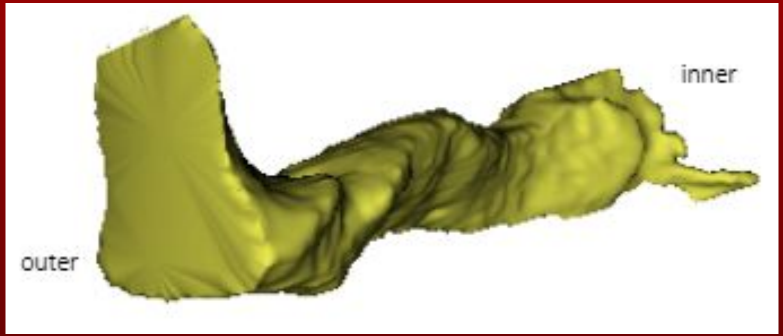

Figure 5. Isolated internal acoustic canal in 3DSlicer

Future Steps

Materials:

- Obtain polyacrylamide - hoping to work with Dr. Masters
- Find procedure to obtain ideal biomimicry
- Bring samples for rheometry testing
- Reiterate as needed

(Alex, Evan, Joe)

Container:

- Create new shape in MeshMixer with CT scans
- Use alginate until PA is available
- Work on phase issues
- Incorporate more advanced features

(Kurt, Payton)

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References

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