UTILIZING 3D PRINTED ANATOMICAL MODELS TO IMPROVE PATIENT EDUCATION IN A NORMAL PRESSURE HYDROCEPHALUS CLINIC

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Background and Aim

- Reviewing radiographic findings with patients without a background in healthcare can impede patient understanding of their condition

- Physical models have previously been shown to improve patient satisfaction during clinical encounters

- Use 3D printed anatomic models to improve patient understanding and consultation experience

Source Imaging
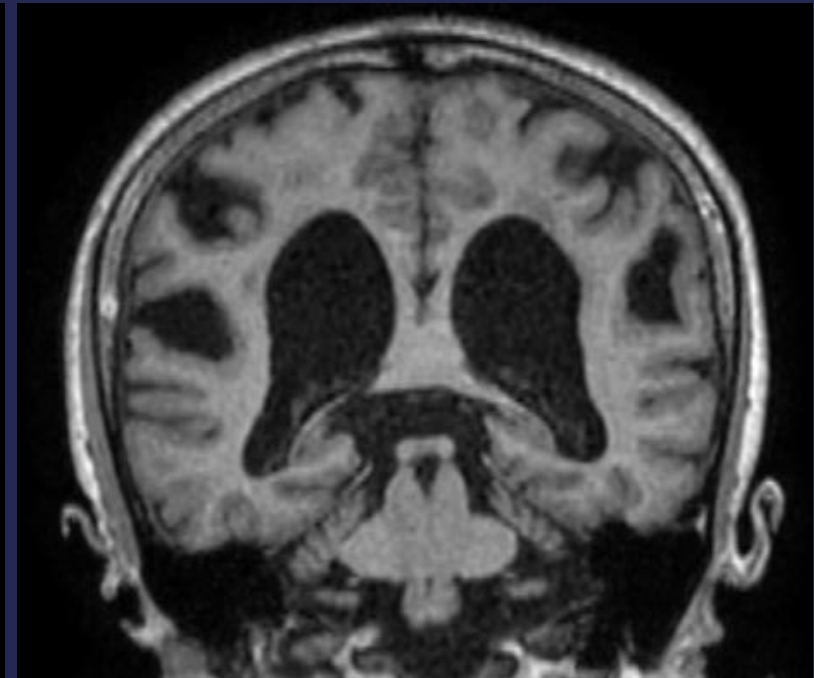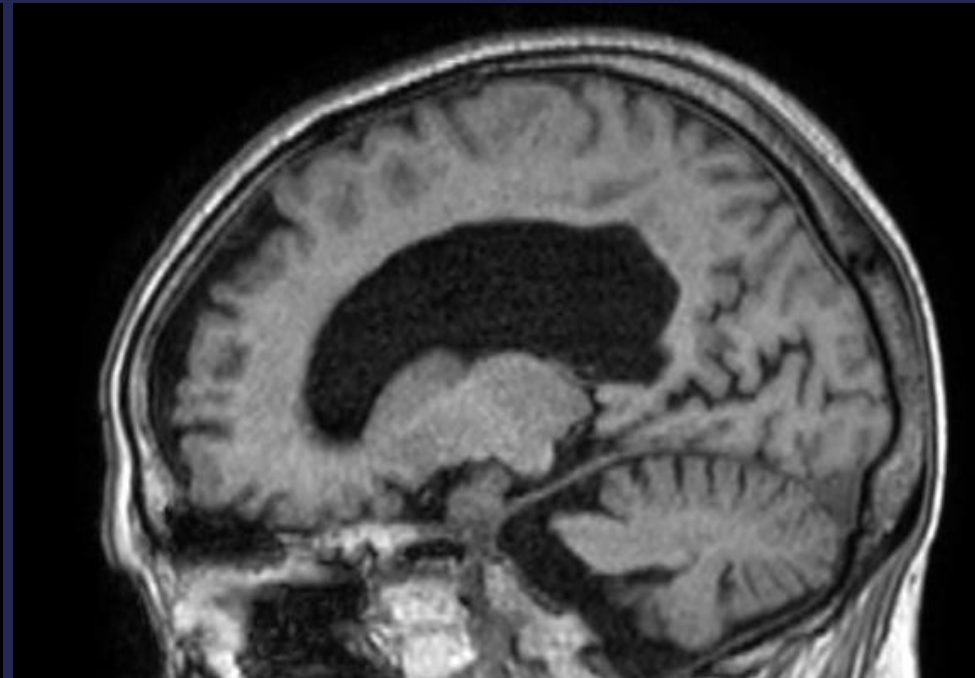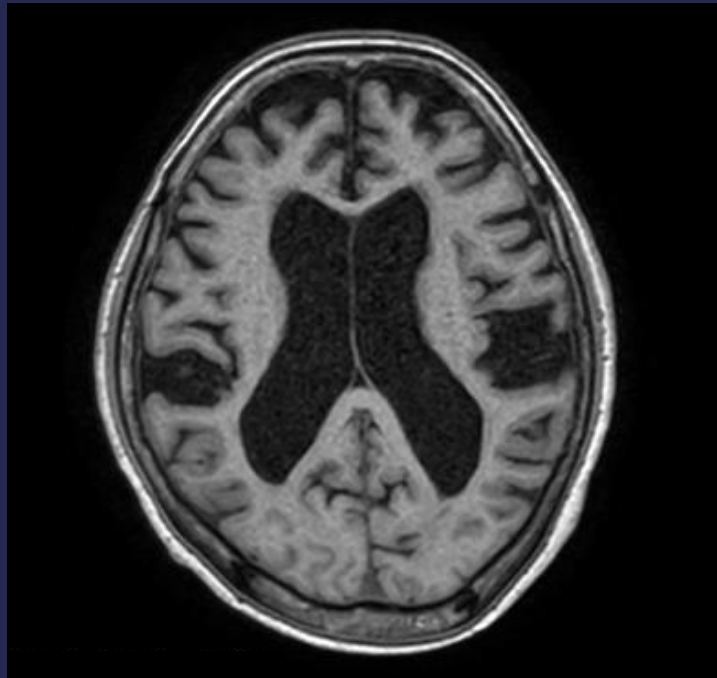
Model Construction
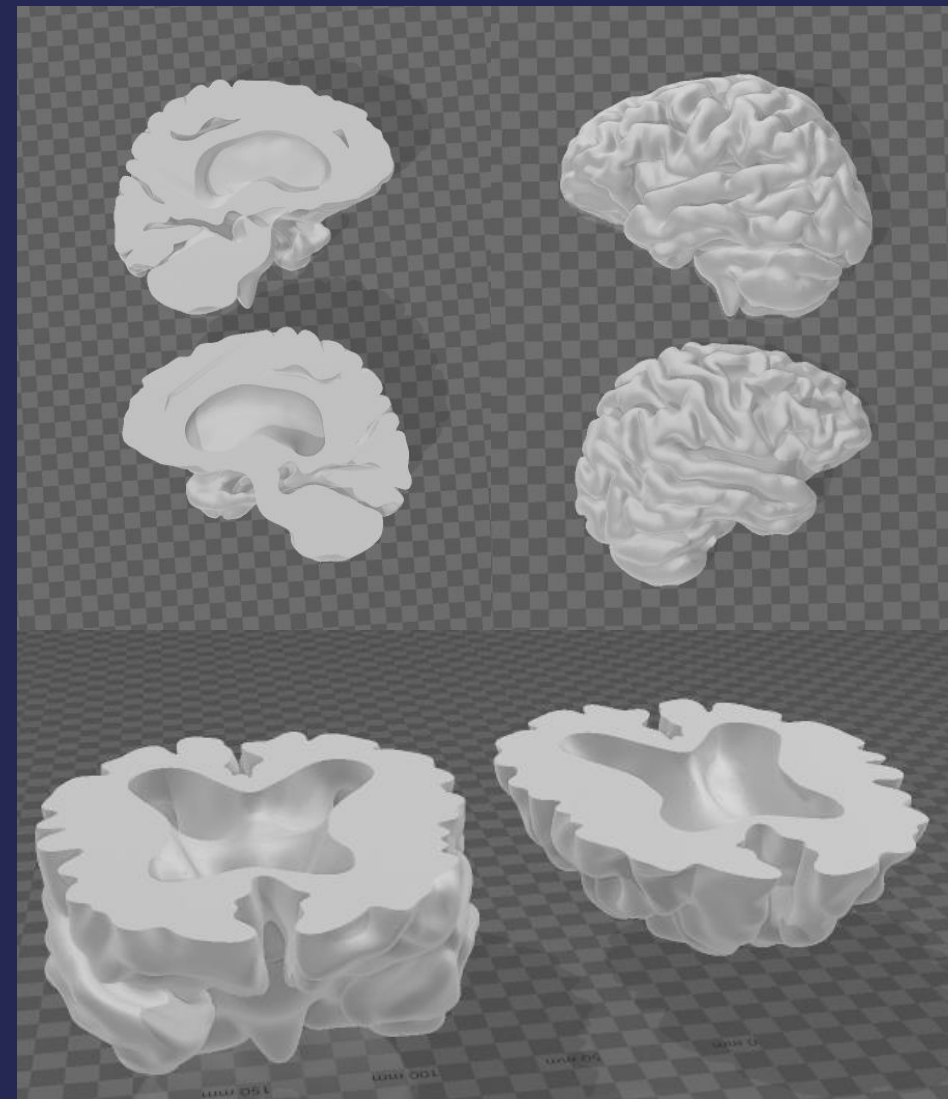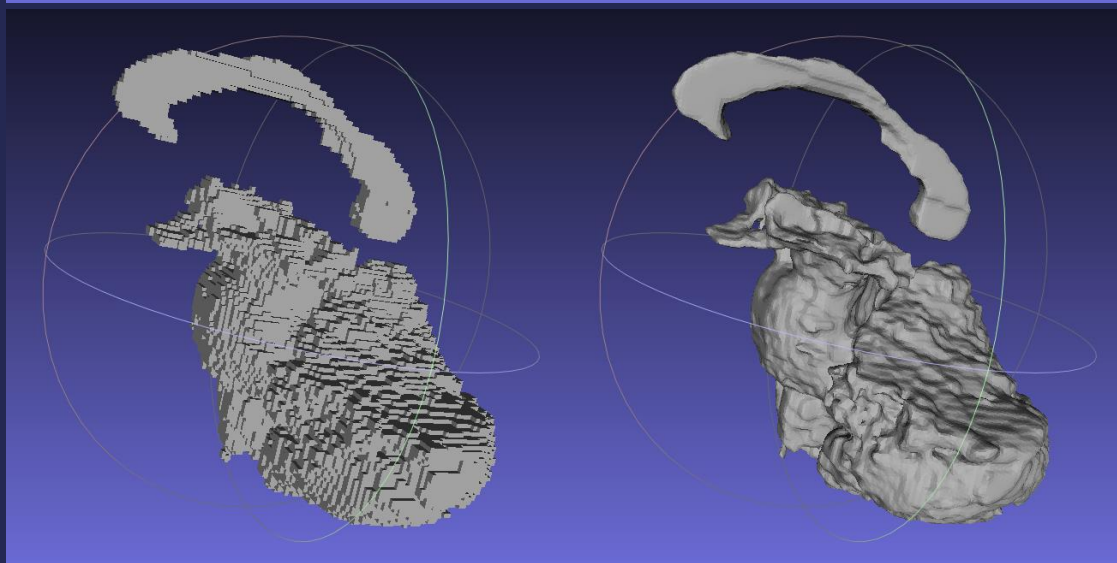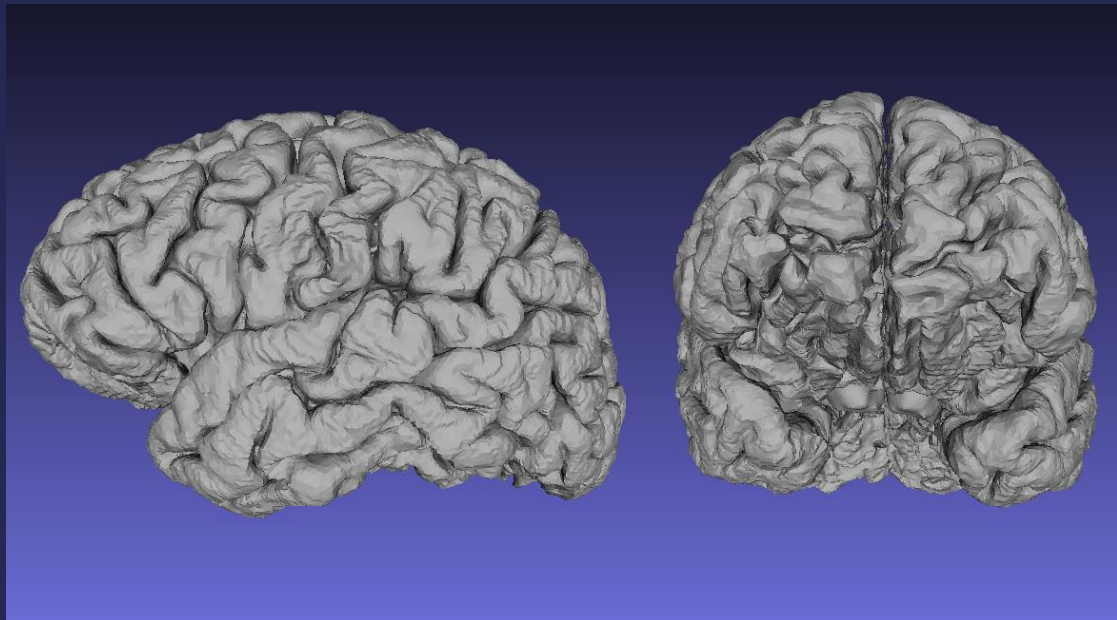
3D Printing and Fabrication Process

- Sagittal- and axial-split models were printed using a Formlabs Form 3 SLA Resin printer.
- Models were printed to 40% actual scale
- Total resin volume for all models was approximately 700 mL (~70$)
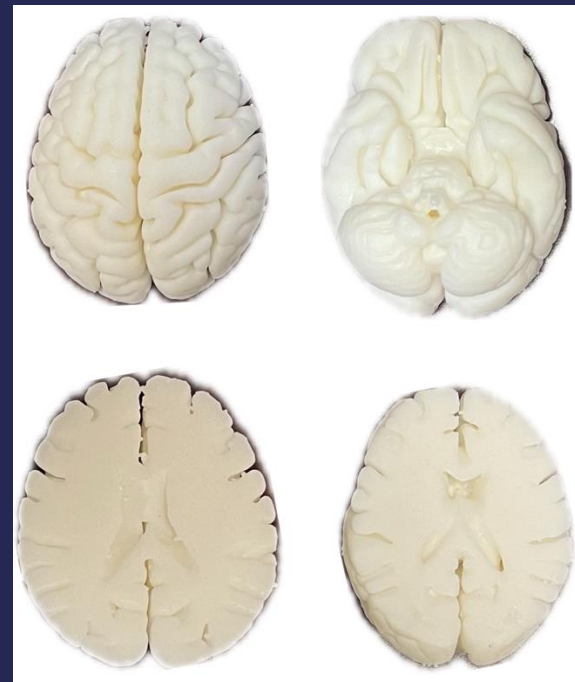
Patient Selection and Data Collection

- 30 patients were randomized into control and educational intervention groups
- In the educational intervention group, patients received physician education that utilized 3D printed models of a NPH and control brain in addition to MRI imaging
- Exclusion criteria included patients working in healthcare, requiring the use of a translator, and/or with a MoCA score < 21
- The impact of the educational intervention was assessed using a standardized two-part patient questionnaire

Normal Pressure Hydrocephalus Questionnaire

<u>**Preliminary Questions:**</u>

Are you currently, or have you ever, worked in a clinical healthcare setting?
    YES   NO

Have you ever visited the hydrocephalus association website or another hydrocephalus education resource?
    YES   NO

Has any prior provider spent time educating you on normal pressure hydrocephalus before today?
    YES   NO

What is your highest level of educational attainment?
_____

<u>**Experience Survey:**</u>

Was a 3D model of the brain used at your appointment today?
    YES   NO
    If so, please rate how useful you felt the 3D model was to your education today:
        (least useful)   1   2   3   4   5   *(most useful)*

<u>Please rate the following on a scale of 1 to 5:</u>
    the overall helpfulness of the education you received today on hydrocephalus:
        (least helpful)   1   2   3   4   5   *(most helpful)*
    how comfortable you feel now with your understanding of hydrocephalus:
        (least comfortable)   1   2   3   4   5   *(most comfortable)*
    your level of stress and/or anxiety surrounding your condition <u>**BEFORE**</u> your appointment today:
        (least stressed)   1   2   3   4   5   *(most stressed)*
    your level of stress and/or anxiety surrounding your condition <u>**AFTER**</u> your appointment today:
        (least stressed)   1   2   3   4   5   *(most stressed)*

<u>**Knowledge Survey:**</u> *If you don't know the answer, that's okay! Just circle "I don't know".*

What is contained within the brain's ventricles?
    a) Water
    b) Cerebrospinal fluid (CSF)
    c) Blood
    d) I don't know

Where are the brain's ventricles located?
    a) in the middle of the brain
    b) on the outside of the brain
    c) between the skull and the brain
    d) I don't know

What is the major cause of symptoms in normal pressure hydrocephalus?
    a) infection of the brain's ventricles
    b) inflammation of the brain's ventricles
    c) compression of the brain by the brain's ventricles
    d) I don't know

Which symptom of hydrocephalus is the most likely to improve after shunt placement?
    a) trouble with walking
    b) memory problems
    c) urinary incontinence
    d) I don't know

After a shunt is placed, it will drain fluid from:
    a) the brain tissue
    b) the brain's ventricles
    c) the brain's blood vessels
    d) I don't know

After a shunt is placed, it will drain into:
    a) the chest cavity
    b) the brain's ventricles
    c) the abdominal cavity
    d) I don't know

For the majority of cases of normal pressure hydrocephalus, the cause is not known.
    TRUE   FALSE

Results

Metric	Educational Intervention Group	Control Group	p - value
Mean Correct Knowledge Answers	5.7 +/- 0.3	4.9 +/- 0.4	0.05
Number "I don't know" Responses	8	17	0.05
Mean Change in Stress Score	-0.9 +/- 0.4	-1.1 +/- 0.4	0.36
Mean Helpfulness Score	4.7 +/- 0.1	4.7 +/- 0.1	0.50
Mean Comfort Score	4.5 +/-0.2	4.6 +/- 0.2	0.30

Conclusion and Considerations

- 3D Printed Models have the potential to improve patient understanding of their diagnosis and treatment options
- Both patients and providers find value in physical aids during clinical encounters
- Models are cost effective with production turn-around <48 hours
- Challenges of incorporating pathology into modelling software
- Unclear whether individualized models provide any additional benefit
- Changes in cognitive function can impair education