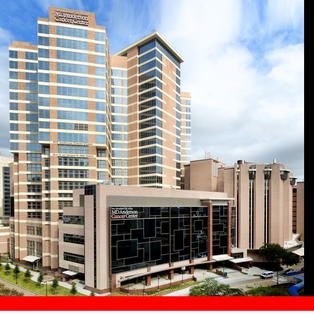

3D MRI Data Curation for Deep Learning-based Brain Shift Simulation during Tumor Resection

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Introduction

During tumor resection, the brain shifts. This negatively impacts the location of vital structures and the original tumor location. This poses as an implication to the original surgical plans that neurosurgeons designed.

Aim

During this internship, 35 patients' 3D MRI data were curated for deep learning- based brain shift simulation during tumor surgery to take into account brain tissue variation and a variety of tumor surgery scenario.

Method

During this internship, a combination of preoperative, intraoperative, and postoperative images after partial tumor resection were retrospectively collected from 35 patients.

- 15 patients were collected from the MD Anderson intraoperative data (MDACC Brain Suite)
- 14 patients were collected from BITE
- Four patients' T1 data were retrieved from the NAMIC Brain Modality data.

For each patient, the following steps were taken to measure the brain shift amplitude.

Brain tissue segmentation

- **Brain tissue segmentation** is also known as contouring segments of the brain. The brain tissues were contoured in a radiation therapy treatment planning system (Raystation v10) The preoperative tumor was contoured on preoperative Magnetic Resonance (pMR) T2. The cerebellum and the brainstem were also contoured.
- The **brain segmentation** was then reviewed for accuracy by a neuroradiologist. The brainstem, cerebellum, and dura were manually contoured on both the pMR and intraoperative Magnetic Resonance(iMR)T1 images.

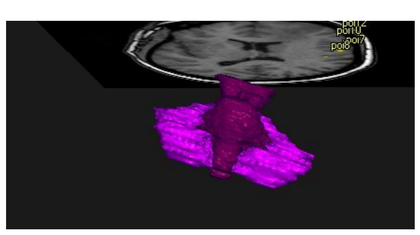

Figure 1: Above is a 3D image with the cerebellum and the brainstem that has been contoured.

Method (cont.)

Landmark Placements

- The landmarks between the preoperative (pMR) and intraoperative (iMR) images were strategically placed on the sulci close to the tumor. To do this, the landmarks were placed on the T1A iMR.
- Screenshots were taken of the T1A iMR to estimate where the exact locations of the landmarks placed shifted on the T1B iMR (image taken after opening the skull). The landmarks were then placed on the T1B iMR. This was done to measure the brain shift amplitude.

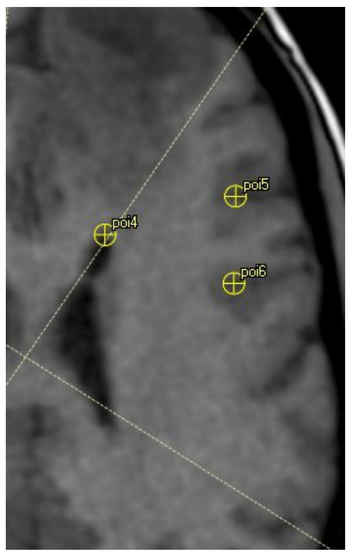

Figure 1: Above is an image with the land marks placed on a T1A iMR.

Skull stripping

Skull stripping serves to extract all of the extrameningial tissues and delineates the brain boundaries. Having extrameningeal tissues like the dura and the eyes can complicate co-registration of iMR images such as T1A and T1B.

- The skull strip was completed by using both the Putty and command-line softwares.

Results

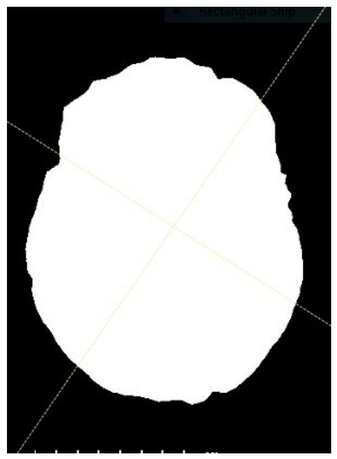

Figure 1: Above is a skull strip from a patient made from using Putty and command line scripting.

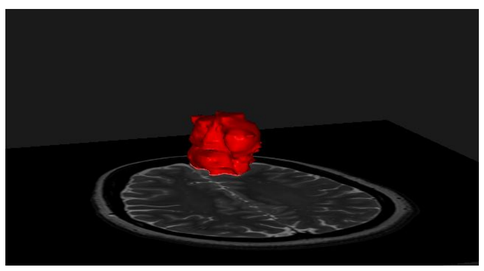

Figure 2: Above is the image of a tumor that has been contoured in 3D resolution on a T2 iMR.

Tumor Type	Volume of Tumor
Astrocytomas	37.22cm^3
Oligodendroglioma	64.73 cm^3
Glioma	75.83 cm^3
Glioblastoma	53.47 cm^3
Glioma	11.04 cm^3

Table 1: In the table above, the tumor scenario (measured from brain segmentation) that a patient has and its volume is portrayed.

Conclusion

Data curation to generate a deep learning based brain shift simulation algorithm consists of gathering a significant amount of 3D MRI patient data, segmenting brain tissues and measuring brain shift. 35 patients have been curated so far. The objective for the project is to curate 200 patients to take in account brain tissue variation and a variety of tumor surgery scenario.

Acknowledgements

This research work was supported by the Partnership for Careers in Cancer Science and Medicine Summer Program (PCCSM), The Department of Imaging Physics Research Program at the University of Texas MD Anderson Cancer Center, and the Department of Neuroradiology and the University of Texas MD Anderson Cancer Center. I would also like to thank Dr. Melissa Chen for extensively double checking my tumor contours. I would like to thank Dr. Lesage for being my research mentor this summer. Thank you Yulun He for helping me with technical issues. I would like to thank Dr. Brock, for allowing me of this opportunity.

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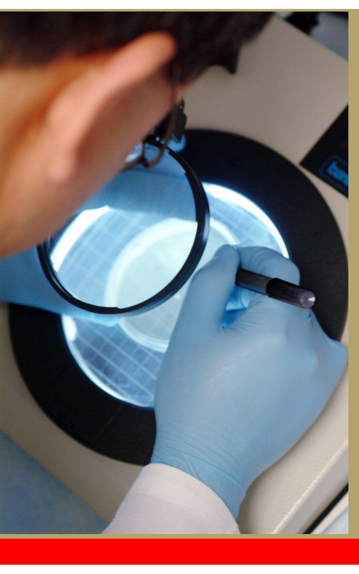

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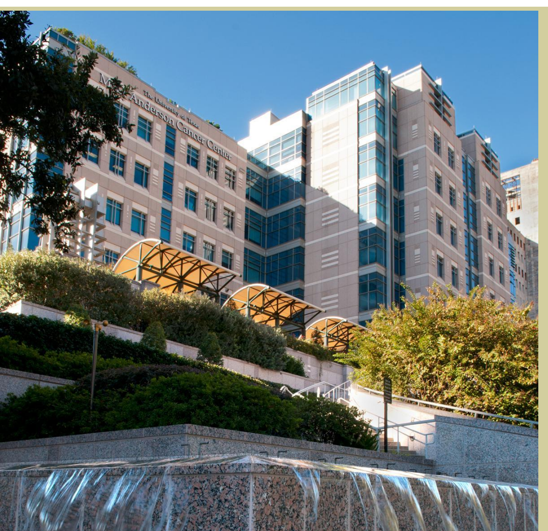

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