# Preplanning Resection of a Glioma with DTI Tractography and Virtual Reality

Ochsner Health System

Henry Sanicola MA, Caleb Stewart BS, Stephen Fletcher MS, Marcus Ware MD, PhD, Korak Sarkar MD

## Introduction

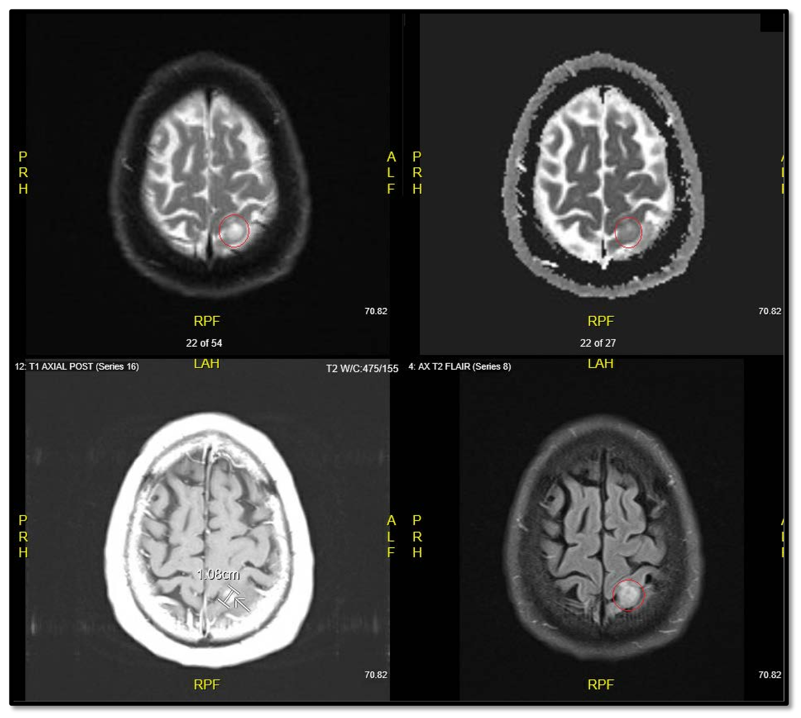
Lesions near eloquent brain structures require robust preoperative planning to maximize the benefit of resection and preserve function. In this case, the patient was followed by a multidisciplinary team of physicians using serial MRI scans. The latest MRI and MRI Spectroscopy suggested acute progression from low grade glioma into a higher grade. To establish a definitive diagnosis, we recommended a biopsy. The patient received a special MRI sequence with diffusion tensor imaging (DTI). We were able to demarcate the motor cortex to allow the surgeon to avoid injury to this area. A parietal craniotomy for partial resection/open biopsy of the tumor was performed.

DTI enables noninvasive, *in vivo*, visualization of white matter tracts of the nervous system by measuring the diffusion of water molecules. It consists of quantitative (i.e. DTI-indices) and qualitative (tractography) data to evaluate regions-of-interest. Immersive technology leverages the latest advancements in computing capabilities and headset technology to generate interactive experiences in virtual reality. This branch of technology has promising applications in medical education, preoperative planning, and intraoperative navigation.

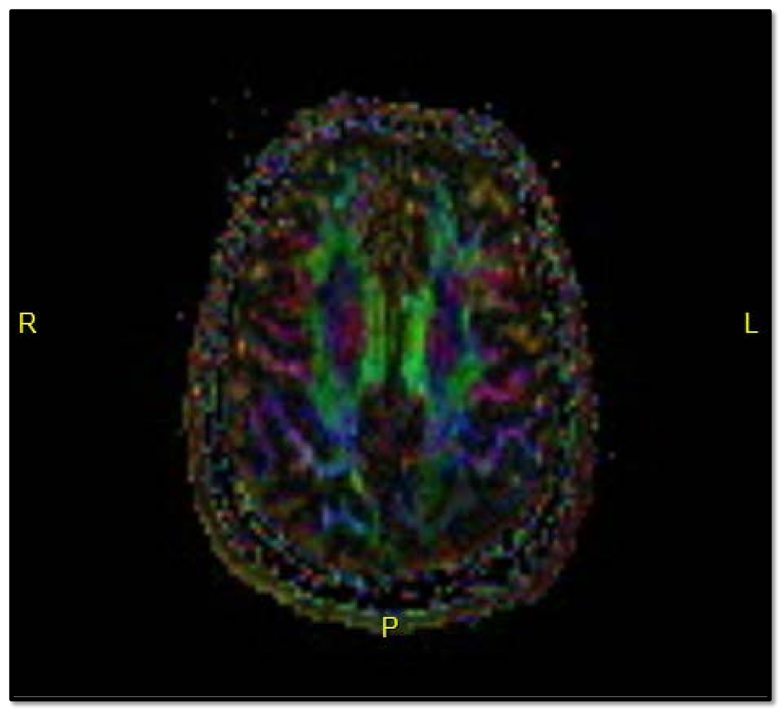
## Methods

Computer tomography (CT) data were acquired with the desired slice thickness between .6 and 1 mm. The DTI protocol was also acquired and the anatomical protocol included a T1-weighted 3D magnetization-prepared rapid acquisition gradient echo sequence (MP-RAGE). *3D Slicer* (Brigham and Women's Hospital, USA) was used to process the images to produce the anatomical structures and white matter tractography (WMT). Files were exported and uploaded into our proprietary VR software.

## MRI and DTI Imaging

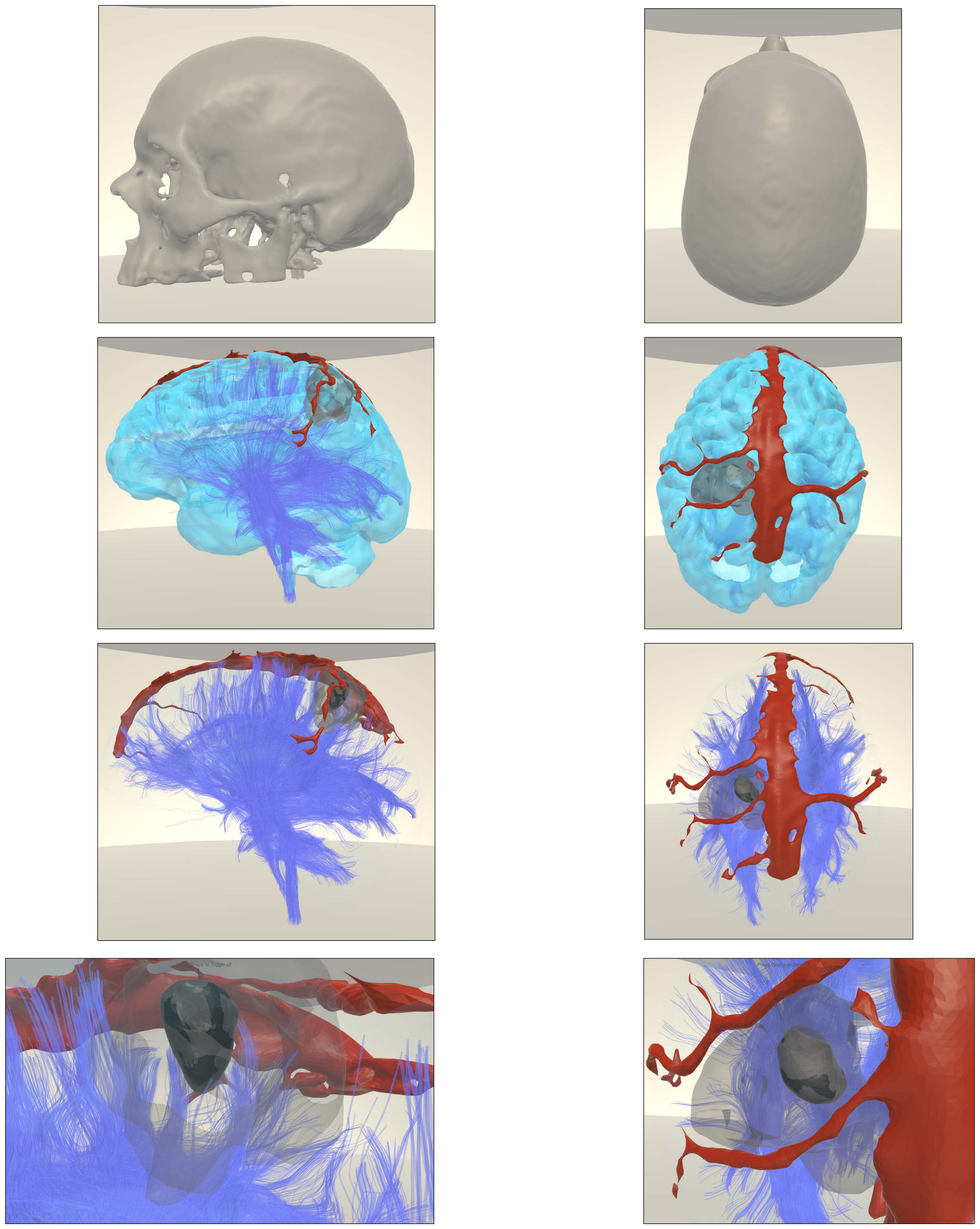


MRI W/WO Contrast: Cortical/subcortical T2/FLAIR hyperintense infiltrative lesion in the left superior parietal lobule.




MRI Brain Synaptive Stealth W/WO Contrast: Lesion measures 1.6 by 1.0 cm in maximal coronal dimension.

## Ochsner VR Models



## Discussion

This report presents a novel application of 3D modeling incorporating whole brain tractography in low-grade glioma.[1,2,3] Tractography is a highly valuable technique for demarcating neuronal tracts that can be used to guide surgery. WMT-based surgery is recognized as a valuable tool for balancing the trade-off between preserving function and maximizing resection of gliomas. Understanding the white matter configuration using tractography is particularly useful given the unpredictable interaction between fibers and gliomas. Tracts can display several alterations including anatomical distortion (mass effect), tumor infiltration, edema, complete disruption, and functional reorganization.[4] When we put our model into VR, the surgeon could visualize the relationships between the tumor and normal structures including: bone, vasculature, brain parenchyma, and white matter. Engaging with these anatomical features provides the surgeon with the spatial information to plan their procedures step-wise from craniotomy to specific regions of tumor resection.

## Conclusions

Understanding spatial relationships and tract position relative to the tumor is fundamental to neuro-oncological intervention. Virtual reality may improve operative planning while reduce operating time and surgical complications.[5,6] This technology has considerable potential in complex neurosurgical procedures.

## References

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