# A 3D Probabilistic *Glioblastoma Multiforme* Location Atlas

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**Abstract**: A 3D probabilistic *glioblastoma multiforme* (GBM) location atlas was developed from a population of 136 de-novo GBM patient cases. The atlas displays an asymmetric and nonuniform tumor distribution across brain lobes.

**Methods:** Anonymized MRI data from brain tumor patients presenting with initial diagnosis of GBM were selected from UCLA's Neuro-Oncology Database in March 2003. One hundred thirty six (136) patients were identified based on the availability of good quality, double-echo MR scans obtained at an early stage in the treatment. All studies used the same echo and repetition times to assure consistent computation of parametric T2 values using the mono-exponential approximation. Parametric T2 and apparent Proton Density (PD) maps were calculated from the PD- and T2-weighted multislice images and registered using a 12-affine algorithm to a 'target' brain volume developed from a normal brain atlas.

Parametric T2 maps were used to identify volumes of tumor and necrotic tissue from normal and edematous tissues. In cases where a resection cavity was present, it was assumed that the cavity was originally composed entirely of tumor tissue. Thresholding of the parametric T2 images was use to map tumor/necrosis tissue and CSF into one category, and then CSF located outside of the resection cavities was manually removed from the maps on a case-by-case basis. The resulting tumor volume maps from each case were then used to create a tumor location atlas shown in Figure 1.

**Results:** Figure 1 demonstrates a spatially nonuniform pattern of GBM distribution. There is a greater incidence of tumor growth in the right temporal and left frontal lobes compared to other brain areas. This may be the result some yet to be understood fundamental aspect of GBM developmental biology. There is also the possibility of selection bias. Many of the cases included in the atlas were imaged after being referred to our center for neurosurgical consultation. Therefore the atlas may have a bias for tumor locations that can be safely resected.

**Conclusions:** The study has demonstrated that a large scale probabilistic GBM location atlas can be developed from clinically acquired parametric T2 MRI data. The results suggest that GBMs do not develop uniformly throughout the brain. To our knowledge this nonuniformity in GBM development has not been demonstrated previously. Atlases of GBM location may provide insight into the fundamental biology of glioma development, provided that selection bias can be eliminated.

Tumor Incidence as Percent

N = 136

11%

5%

0%

R

R