INTRODUCTION: Precise co-registration of brain tissue and medical imaging is critical for validation of novel imaging biomarkers meant to detect infiltrative brain cancer. Brain tissue distortion during fixation, and brain slicing in sub-optimal orientation can complicate co-registration. METHODS: Three high-grade glioma patients undergoing brain only autopsies were included in this analysis. A clinically acquired MRI was used to render 3D computer assisted drafting (CAD) models. To generate a fixation cage for preventing tissue distortion, a high-resolution 3D-T1-weighted MRI scan was used to generate a solidified mesh with approximately 500 holes to allow formalin exposure. The left and right hemispheric meshes were then 3D printed in plastic using a MakerBot Replicator2X. The brains were fixed in formalin for approximately 14 days within the plastic meshes. To generate a slicing mold for one patient, the shell from the 3D-T1-weighted scan was combined with the slice profile of 6.5mm thicker-cut images. A slicing mold was then designed and 3D-printed with slots oriented vertically with the brain lying on its side within the mold. To assess consistency, the thickness of each slice was measured. To assess the co-registration with the patient’s clinical MRI, gyri and sulci from each MRI slice were identified and compared to the corresponding tissue slice. RESULTS: The 3D-printed brain cages took approximately 16hrs per hemisphere to print using approximately 1.6lbs of plastic (~$35/brain). The custom brain-slicing mold took approximately 22hrs to print totaling about 1.2lbs of plastic (~$26). The average tissue slice thickness was 6.9mm compared to the 6.5mm MRI slices. Of the 188 gyri and sulci identified on in tissue slices 73% co-localized precisely with those seen in corresponding MRI slices. CONCLUSION: 3D printed brain cages and slicing molds provide affordable means for preventing tissue distortion and precisely slicing brain tissue for co-registration with imaging acquired prior to death.