

**Purpose:** To quantify interobserver variations in the delineation of high-grade gliomas for magnetic resonance imaging (MRI) with gadolinium (Gd) contrast and positron emission tomography (PET) with 3,4-dihydroxy-6-<sup>18</sup>F-fluoro-L-phenylalanine (<sup>18</sup>F-FDOPA) imaging modalities.

**Methods:** Twenty patients with histologically confirmed high-grade gliomas underwent radiotherapy treatment planning with computed tomography, Gd-enhanced MRI and <sup>18</sup>F-FDOPA PET. The images were fused and two trained observers delineated the Gd enhancement and <sup>18</sup>F-FDOPA uptake. The MRI-based gross tumor volume (GTV) was defined as the volume of Gd enhancement excluding the surgical cavity. The PET-based GTV was defined as the union of the <sup>18</sup>F-FDOPA uptake and Gd enhancement excluding the surgical cavity. For each GTV, a clinical target volume (CTV) was defined as the union of the GTV and the surgical cavity, plus a 2-cm three dimensional (3D) margin. A planning target volume (PTV) was defined as a 0.5-cm 3D margin on the CTV. Interobserver and intermodality variability of the GTV, CTV and PTV were quantified by differences in the volume and percent volume overlap (PVO) of the structures.

**Results:** The MRI-based and PET-based GTV volumes delineated by the second observer were on average 0.65 and 0.98 times the volumes delineated by the first observer. The root mean square error (RMSE) of the linear regression of the interobserver volumes was 10.7 cm<sup>3</sup> and 16.0 cm<sup>3</sup> for MRI-based and PET-based volumes. The interobserver GTV PVO for MRI-based and PET-based delineations was similar (49.6% vs. 59.1%, p=0.132). PET-based GTV volumes were 1.6 times larger than MRI-based volumes, with a RMSE of 27.6 cm<sup>3</sup>. The mean intermodality GTV PVO was 41.6%.

**Conclusions:** There was less interobserver variability for GTV volumes delineated with combined MRI and <sup>18</sup>F-FDOPA PET compared to volumes delineated with MRI only. GTV volumes delineated with both MRI and PET were 1.6 times larger than volumes delineated using only MRI.