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Abstract

# Effect of Distortion to Radiosurgery Treatment Plans for Brain Metastases

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## Abstract

Objectives: Magnetic Resonance Imaging (MRI) is highly use to contour both target and critical volumes for intracranial stereotactic radiosurgery (SRS) treatments. Purpose of this study to evaluate the clinical impact of different type of MRI scanner distortions in SRS planning.

Methods: We performed retrospective analysis of 40 brain lesions(13 patient) treated in our department in 2017-2019. Same computed tomography was used for all patient scans. 20 lesions were scanned with 1.5 Tesla(T) MRI (Siemens Magnetom Avanto) and other 20 lesions were scanned with 3 T MRI (Siemens Magnetom Skayra). 10 lesions from both MRI scan were located center of magnetic field and other 10 lesions were 3 cm away. MRI distortion correction algorithm (Brainlab, Element) was used to correct MRI images. Same radiation oncologist was contour both uncorrected and corrected gross tumor volume(GTV). 1 mm margin was used to create a planning target volume (PTV). Uncorrected PTV volumes were used for SRS planning. Displacement vectors and PTV coverages were evaluated for all SRS plans. In addition, distortion phantom (StereoPhan, Sun Nuclear) was scanned in both MRI. Geometric displacement was determined and compared with real patient results.

Results: Around magnetic field center, mean displacement of the PTV due to gradient for 1.5 T and 3 T MRI were 0.46 mm (ranged 0.2 mm -0.6 mm) and 0.47 mm (ranged 0.2 mm- 0.7 mm), respectively. Minumum 3 cm away from magnetic center, mean displacement 1.5 T and 3 T MRI were 0.6 mm (ranged 0.5 mm-1.9 mm) and 1.1 mm (ranged 0.6 mm-2.1 mm), respectively. Mean covarage for both uncorrected and corrected SRS plans were 95.04% and 84.75%, respectively. In phantom measurement, for T1-weighted scans, mean displacement in the center of phantom and 3 cm away from the central axis were 0.14 mm and 1.5 mm for 1.5 T scan and 0.17 mm and 1.6 mm for 3 T scan, respectively. For T2-weighted scans, mean displacement in the center of phantom and 3 cm away from the central axis were 0.2 mm and 1.9 mm for 1.5 T scan and 0.2mm and 1.9 mm for 3 T scan, respectively.

Conclusions: Distortion from MRI scan could cause a geometric miss of intracranial targets. Distortion values varies within 3D brain MRI images.

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