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Abstract

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Characterization of Geometric Distortion in MRI T1-Weighted Images Used for Stereotactic Radiosurgery Treatment Planning

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Abstract

Objectives:

Brain stereotactic radiosurgery (SRS) is a high dose, high precision treatment technique typically utilizing 0 – 1 mm planning target volume (PTV) margins for setup uncertainties. Typically, a planning MRI is acquired for target definition. The purpose of this study was to characterize the geometric distortion on 3D T1-weighted sequences observed on the MRI scanners used for brain SRS.

Methods:

Twelve MRI closed bore systems from multiple manufacturers, models, and field strengths were characterized for geometric distortion on the brain SRS-specific T1-weighted imaging sequence. A standard ACR phantom was imaged with the brain protocol used to acquire images on each scanner with the appropriate head coil, and the images were imported into the treatment planning system. The diameter of the ACR phantom was measured in the superior-inferior, right-to-left, lower-to-upper diagonal and upper-to-lower diagonal directions. The deviation between the measured diameter and the true diameter was recorded as geometric distortion.

Results:

An overall average of 0.65 ± 0.0.60 mm (0.0 - 1.9 mm) of geometric distortion was detected across the twelve scanners for our brain SRS MRI sequence. One scanner was identified with >1mm average distortion (1.15 ± 0.31 mm). In this case, measurements in the left-to-right and both diagonals measured >1.0 mm. All other scanners demonstrated average geometric distortion < 1mm (0.60 ± 0.38 mm).

Conclusion(s):

It should be noted that geometric deviation from MRI scanners is non-zero even when the distortion correction feature is applied. To limit the overall uncertainty in SRS treatment planning and delivery, the MRI scanner identified with >1mm geometric deviation was deemed unsuitable for use in SRS treatment planning.