Purpose: To explore additional application of the new Aquarius external laser alignment verification Phantom by LAP (Aq-LAP Phantom) examining geometric accuracy of magnetic resonance images (MRI) commonly used for planning intracranial stereotactic radiation surgery (ICSRS) cases.

Methods: Newly designed external patient alignment lasers were first aligned by the Aq-LAP Phantom at a Siemens Magneton Vario 3T MR unit. The scans were then performed with the T1 Axial 3D MPRAGE protocols with 0.9 mm temporal resolution, which may be used for ICSRS. They also include FLAIR, T2 BLADE and Diffusion Axial TRACE imaging acquisitions with 1 mm temporal resolution. The MRI will be fused to 1 mm cut computerized tomography (CT) images acquired by a Siemens Somatom Sensation Open©. The geometric distortions (GD) were measured against the CT in all axial, sagittal, and coronal directions at different levels.

Results: MR images of the Aquarius Phantom indicate a distinct similarity between the nonlinear GD along the z-axis crosshair and typical magnetic field gradient nonlinearity. There is linear correlation between MR divergence datasets of distorted crosshairs (p-values from 0.57 to 0.00), and nonlinear correlation between MR divergence datasets of the distorted crosshair with the CT divergence datasets of the cross plane (p-values from 8.45x10^-4 to 1.38x10^-46). The margin of error exceeded no more than 0.29 mm. GDs up to about 2 mm are observed at the distal regions of the longitudinal axis in the SRS treatment planning MR images.

Conclusions: Using the Aquarius Phantom, one is able to detect GD in ICSRS planning MRI acquisitions, and align the external LAP patient alignment lasers by following the LAP QA. Based on the results, one may recommend using the Aquarius Phantom to determine if margins should be included for SRS treatment planning.

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The Aquarius Phantom, used for laser alignment and geometric distortion detection, was provided by LAP of America.