Purpose: Using a single isocenter significantly reduces delivery times in radiosurgery involving multiple targets. However, because not every target can be placed at isocenter with this type of treatment, a conventional Winston-Lutz test cannot be used. We describe a novel Winston-Lutz like multtarget test (MTT) for verifying accurate positioning.

Methods: A target phantom, comprised of an acrylic plate with recesses for three 3/4” spheres was constructed and a high-resolution (0.5x0.5x0.8 mm) CT scan obtained with PTFE spheres placed in the recesses. The scan was imported into a commercial treatment planning system and multiple beams were prepared, having their isocenter at the centroid of the arrangement of spheres. Every beam incorporated three MLC-defined rectangular apertures that circumscribed the spheres. Custom software selected setup parameters (table, gantry and collimator angle, MLC openings) such that the spheres were centered as precisely as possible within their respective MLC fields, considering the discrete width of collimator leaves.

The phantom, with the PTFE replaced by steel spheres, was placed on the treatment couch and imaged using stereoscopic x-ray beams. A 6 degree-of-freedom robotic couch applied translations and rotations to reproduce the CT position. A MV EPID rendered images of the spheres within their respective apertures, allowing identification of sphere and aperture centers. Any error upstream would manifest itself as inaccurate centering of a sphere.

Results: Eight beams with table angle 0 and two beams each with table angles 49.7, 89.8, 272.3, and 310.1 were selected. The maximum calculated distance between any sphere and the respective aperture center was 0.07 mm. The median difference measured from the MV images ranged from 0.1 mm to 1.4 mm with a median of 0.8 mm.

Conclusions: The MTT is a practical end-to-end test for quality assurance of the entire positioning process in multitarget radiosurgery, from CT scanning to beam delivery.