Purpose: To assure high accuracy in radiation delivery during linear accelerator based stereotactic radiosurgery procedures, a Winston-Lutz test is typically performed to measure the effective isocenter wander over the wide range of gantry and couch angles employed. Ideally, this deviation is lower than 1-1.5 mm depending on institutional tolerances. Automation of this test with portal imaging allows a large amount of data to be taken and processed. This study explores the effect of various collimation techniques on beam-center stability, and addresses one technique of repositioning in response.

Methods: Winston-Lutz shots were obtained using a Trilogy linear accelerator, BrainLab Winston-Lutz pointer, and electronic portal imaging from a full range of gantry and couch angles. The test was repeated using MLCs, a 10mm stereotactic cone from BrainLab, and jaws for beam collimation. All images were processed using an in-house MATLAB-based program which calculates the distance between the tungsten ball and aperture center with accuracy within ~0.1mm. Ideal shifts were calculated by minimizing this variation from gantry rotation alone, and performed manually.

Results: The in-plane gantry sag was found to be on the order of ~0.8mm, independent of collimation technique or setup. The MLC carriage had a ~0.3mm cross-plane displacement to the inferior from the cone center, negated by a 90 degree collimator rotation. The total gantry misalignment was greatest near gantry 180 (~1.5mm), varying by collimation method. Optimizing to minimize gantry error reduced errors to less than 0.7mm but increased the effect of couch rotation.

Conclusions: Isocenter evaluation is dependent on collimation method used, and should be conducted with the same technique as delivery. It may be useful to consider the varying delivery accuracy from different couch/gantry angles during treatment planning. Repositioning methods after couch rotation may affect ideal laser positions.