Supporting Document

Isocenter measurements with an electronic Winston-Lutz test: impact on treatment planning

In-plane misalignment (mm) by delivery angle. Independent of collimator or ball placement, there was an approximate 0.8mm discrepancy between gantry 0 and gantry 180 of the relative in-plane alignment of the field due to gantry sag. The lasers can be placed such that the gantry 0 will match the field light cross-hairs, as in the above, or set to reduce the maximum deviation by splitting the extrema.

Cross-plane misalignment (mm) by delivery angle. A perfectly circular gantry rotation and fixed collimator would produce a sinusoidal distribution determined by ball misalignment and misalignment of the beam axis from the radius. The cone closely follows this pattern, but the MLC carriage appears to shift based on the gantry angle. Rotating the collimator to 90 (not depicted) nearly eliminates this effect.

Total misalignment of field and ball before (left) and after (right) realignment of ball using a 1cm x 1cm MLC aperture. The radial graphs represent the total displacement, in mm (radius) over the full range of gantry rotations (angle). Because of the findings on the left, we typically avoid the arc range posteriorly between 150 and 230 degrees for high-sensitivity treatments (keeping the couch 0 misalignment to within 1.3mm). In attempting to reduce the gantry-induced misalignment we can shift the setup (graph on right) so that the couch 0 misalignment stays within 0.7mm, but it is apparent that it retains sensitivity to couch rotation. This can be accommodated by patient repositioning after couch rotations using either lasers or imaging if so desired, which has its own precision to consider. The authors suggest that stereotactic QA be designed with the treatment parameters in mind, and that treatment parameters should be sensitive to QA results.