Purpose: Evaluate the effectiveness of the roll correction feature of the TomoTherapy Hi-ART system.

Methods: A roll-sensitive plan was designed and delivered to a cylindrical solid water phantom to test the accuracy and utility of roll corrections. Cylindrical target structures containing coaxial inner avoidance structures were placed adjacent to the plane bisecting the phantom and 7cm laterally off central axis. The phantom was positioned at isocenter with the target-plane parallel to the couch surface. Varying degrees of phantom roll were induced and dose to the targets and inner avoidance structures was measured using Kodak EDR2 films placed in the target-plane. Normalized point doses were compared with baseline (no roll) data to determine the sensitivity of the test and the effectiveness of the roll correction feature. Gamma analysis between baseline, roll-corrected and uncorrected films was performed using RIT software.

Results: On average, significant deviations from baseline point dose measurements (±3 standard deviations) are observed beyond 0.4° of uncorrected phantom roll. Conversely, all point dose measurements with roll correction applied are indistinguishable from baseline (<3 standard deviations) up to our maximum tested roll of 5°. For measurements in the rolled phantom without roll correction, gamma pass rates drop below 90% starting at an average of 0.25°. Gamma pass rates for all measurements with roll correction applied were greater than 97%.

Conclusion: Using our rigid phantom and roll-sensitive test plan, rotational misalignment greater than 0.25° can be detected and results in observable differences between planned and delivered dose. Utilizing the roll correction feature accurately corrects for the effects of such misalignment. Further work is required to evaluate the efficacy of roll correction in clinical circumstances where deformation accompanies rotation and to assess the clinical impact of using rotational and translational corrections compared to translational corrections alone.