Purpose: The goals of stereotactic radiotherapy (SRT) are the ablation of target tissue and sparing of critical normal tissue. We evaluate the effect of maximum dose escalation on conformity and gradient to intracranial targets representing brain metastases of varying size with helical tomothearpy SRT (TomoTherapy Inc., Madison, WI).
Methods: Spherical targets were generated in the center of a head phantom at the central axis of delivery. The target diameters were 10, 13, 15, 20, 25, 30, 35, and 40 mm. The prescription (Rx) was for a 7 Gy fraction and with maximum dose to Rx dose ratios (MDPD) of 1.025, 1.05, 1.075, 1.1, 1.15, 1.2, 1.25, and 1.3. Plans were run using a consistent approach with a goal of 95% of the target receiving Rx and 90% Rx minimum dose. Conformity of the Rx to the target is evaluated using a ratio of over and under coverage of the target. Dose falloff is analyzed using CGIg: the difference of effective radii of spheres equal to half and full Rx volumes.
Results: Plans were developed for each target and MDPD combination expect for the 10 and 13 mm targets with a minimum MDPD of 1.064 and 1.039, respectively. Conformity improved with increased target size, but was mostly consistent for a specific target volume. Improvement in dose falloff increased with MDPD for all targets. The overall difference in effective dose gradient is 0.9, 2.8, 1.9, 1.8, 2.8, 2.6, 2.2, and 2.5 mm corresponding to a relative CGIg improvement of 11.7%, 50.2%, 34.9%, 34.9%, 72.8%, 91.5%, 84.4%, and 156.7% for 10, 13, 15, 20, 25, 30, 35, and 40 mm targets, respectively.
Conclusion: Escalation of MDPD improves dose falloff without degradation of conformity. Optimal Rx isodoses should be tailored to the tradeoff between tumor dose heterogeneity and dose falloff with helical tomotherapy SRT.