

AbstractID: 12347 Title: An analysis of CyberKnife prediction accuracy

Purpose: To evaluate the prediction model used by the CyberKnife radiation therapy system in marginal terms. **Method and Materials:** The CyberKnife uses an online prediction model to improve radiation delivery. Modeler points indicate the tracked position of the tumor and Predictor points predict the position ≈ 115 ms in the future. The discrepancy between Predictor points and their corresponding Modeler points was investigated. For 100 data sets from 23 de-identified lung patients, margins were determined in each anatomic direction about the Predictor points so as to minimally increase coverage to an arbitrary percentage of Modeler points. Each data set had about 30 minutes of motion data, of which about 10 minutes constituted treatment time; only these 10 minutes were used in the analysis. The frequencies of margin sizes were analyzed and truncated Gaussian normal functions were fit to each direction's distribution. The standard deviation of each Gaussian distribution was then used to describe the necessary margin expansions in each signed dimension in order to achieve the desired coverage. In this study 95% coverage was compared to 99% coverage. **Results:** Considering the magnitude of 2σ from the mean of the Gaussian in each signed dimension, the margin expansions needed for 95% coverage were 1.2 mm in the lateral directions and 1.7 mm in the AP directions. For the SI directions the fit was poor; but empirically, the expansions were 3.5 mm. For 99% coverage, the AP margin was 3.6 mm and the lateral margin was 2.9 mm. The SI margins for 99% coverage were highly variable. **Conclusion:** The Predictor points follow the Modeler points closely. Margins were found in each clinical direction that would provide 95% coverage for 95% of the fractions reviewed in this study. Similar margins were found in two clinical directions for 99% coverage in 95% of fractions.