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"Evaluation of patient setup uncertainties and effect of IGRT shift tolerance"

This study quantified population setup error for head and neck (HN) patients using daily shift data. Results were compared to published data and evaluated to determine effects of an image-guided radiotherapy (IGRT) shift tolerance. Translational shifts from daily Tomotherapy MVCT registrations were retrospectively analyzed for 32 HN patients to characterize population systematic and random errors. At our clinic, a physicist and physician must review the image registration and setup for all patient shifts greater than 10mm. The effect of this IGRT tolerance on patient setup was evaluated by calculating population setup statistics and number of failed fractions (shifts outside 10mm) for patients before (n=22/fractions=606) and after (n=10/fractions=267) IGRT policy. Group mean and population systematic errors are 0.3±1.7mm(lateral), -1.1±2.1mm(longitudinal) and 4.9±2.0mm(vertical). Random errors are in the range of 1.8-2.5mm. Results are similar to published data for HN with ranges of 0.0-3.8mm in magnitude, with the exception of the vertical direction due to treatment couch sag from virtual to treatment isocenter and thermoplastic mask shrinkage between simulation and treatment. After IGRT policy implementation, population setup statistics for the group mean are similar, however systematic and random errors decreased to 0.1-1.5 mm. With a 10mm tolerance, 27/606(4.5%) fractions failed before and 2/267(0.8%) after policy implementation. This difference was statistically significant (χ^2-p=0.005). Based on the magnitude of setup errors for HN patients, a stricter policy of 5mm tolerance may be warranted. The systematic shift of ~5mm in the vertical direction may require a 1cm tolerance for the z-direction or systematic correction after the first fraction. The number of failed fractions for a 5mm tolerance is 161/606(26%) before and 15/267(5.6%) after policy implementation (χ^2-p<0.0001). This analysis indicates that our patient setup data is consistent with published studies for HN and use of an IGRT tolerance can improve setup further, particularly for random setup errors.