

AbstractID: 2458 Title: Statistical Analysis of IMRT Treatment Verification Films

Purpose: To compare the delivery of an intensity modulated radiation therapy (IMRT) treatment with the computer generated plan and to quantify this comparison using statistical techniques.

Method and Materials: Comprehensive quality assurance is performed for every patient who undergoes an IMRT treatment. Part of this treatment planning and delivery check involves irradiating a set of Gafchromic® EBT and/or Kodak EDR2 radiographic films. These images are converted to absolute dose and compared with the computer predicted dose maps. Two different implementations of principal component analysis (PCA) are employed for these comparisons. One system consists of creating a scatter plot of lexicographical representations of the irradiated film and the planar dose map (PDM) predicted by the treatment planning system, and the other utilizes the eigenvectors of the covariance matrix of the PDM and film for computing the PCA.

Results: The results and merits of the mathematical PCA and geometrical variance techniques are compared with the pure image subtraction and distance-to-agreement (DTA) methods. The two statistical methods provide a more complete representation of potential radiation intensity delivery errors than the two latter ones. For some cases, small streaks of high-level radiation that appeared in the films but not on the plans were more pronounced in the statistically produced images. On other cases, the fact that the subtraction and the PCA methods both indicated the same unplanned hot spots provided more assurance on the verification quality.

Conclusion: All these approaches to IMRT image evaluations -namely the two statistical, image subtraction, and DTA methods- are sufficiently robust to decipher most treatment delivery errors. However, since each method performs the image analysis differently, combining all these techniques is more powerful in detecting discrepancies in treatment delivery versus the IMRT plans and guarantees discovering any anomalies in radiation delivery in almost all the cases.