Abstract ID: 16019 Title: Modeling the Correlation between OAR Sparing and Patient's Anatomy in IMRT by A Machine Learning Method

Purpose: To summarize the knowledge of the dependence of organ-at-risk (OAR) dose-volume distribution on patient's anatomy by machine learning techniques from a database of previous expert plans.

Methods: 35 head-and-neck IMRT plans were studied retrospectively. The OAR-PTV geometry was modeled by the distance-to-target histogram (DTH). Principal Component Analysis (PCA) was applied to DVH and DTH to capture their salient features. The PCs of the DVH and DTH were then mapped to the parameter space of patient anatomy and dose distribution using correlation analysis. A polynomial model of the correlation between OAR DVH and patient anatomy was constructed and trained by a stepwise regression method. Two major OARs, the right/left parotids, were modeled in the regression analysis.

Results:
(1) PCA characterizes two salient features of the DTH and DVH, the first as the mean of the histogram, the second as the average gradient of the histogram within a range.
(2) The regression analysis shows that the main factors contributing to the first component of the principal component score (PC1) of OAR DVH are the PC1 of DTH and the fractional volume in the overlap region, and the main factor affecting the PC2 of OAR DVH is the PC2 of DTH.
(3) In terms of patient anatomy and dose-volume distribution parameters, these correlations indicate the influences of the mean and gradient of DTH on the mean and gradient of DVH by the patient plan. In addition, the fractional volume outside treatment field with co-planar beam setting also plays a role in determining OAR DVH. The determination coefficients by the polynomial models are: R²=0.89 and R²=0.47 for PC1 and PC2 of right parotid, respectively; R²=0.64 and R²=0.41 for PC1 and PC2 of left parotid, respectively.

Conclusions: The model learned from the database quantifies the influence of geometrical complexity on the OAR dose sparing.

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