AbstractID: 9529 Title: Increasing the efficiency and radiobiological relevance of IMRT treatment planning: replacing dose-volume thresholds with generalized equivalent uniform dose or mean-tail-dose metrics

Purpose: Our goal is to validate treatment planning metrics that are computationally efficient yet have inherent radiobiological meaning, either directly or by correlating highly with more explicitly biological metrics. We show how mean-tail-dose and the generalized equivalent uniform dose (gEUD) metrics could be used to replace dose-volume metrics in IMRT treatment planning.

Method and Materials: gEUD and MOH/MOC*x* (mean of the hottest/coldest *x*% of a structure) are candidates for dose-volume metric replacements due both to their averaging-nature (closer to the expected radiobiology), as well as their convexity (and the linearity of MOH/MOC*x*), which allows for optimal solutions and faster optimization. We used datasets from both 3DCRT planning (219 lung/pneumonitis; 263 lung/esophagitis; 491 prostate) and IMRT (40 prostate; 398 head and neck). We calculated the Spearman's rank-correlation coefficient between typical clinical dose-volume metrics and these quasi-radiobiological metrics with a range of values for the variable parameter (*a* for gEUD; *x* for MOH/MOC*x*). We also calculated the sensitivity and specificity values resulting from using the quasi-radiobiological metrics to 'predict' violation of a clinical dose-volume threshold.

Results: We found high correlations between the proposed quasi-radiobiological metrics and clinical dose-volume metrics. Twenty-seven out of thirty correlations tested had a Spearman correlation coefficient above 0.90 with highly significant p-values. We also found, for many of the dose-volume metrics, the associated quasi-radiobiological metric was an excellent classifier.

Conclusion: There is evidence from large datasets including both 3DCRT and IMRT patients that the biological metrics of gEUD and MOH/MOC*x* are highly correlated to traditional dose-volume metrics and are fairly accurate for classifying acceptable from non-acceptable plans. Many of the gEUD or MOH/MOC*x* metrics could be substituted for traditional dose-volume constraints with a sensitivity and specificity well above 0.80.

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