AbstractID: 10544 Title: A method to overlay biological optimization on traditional dose-volume constrained Intensity Modulated Radiotherapy (IMRT) optimization

Purpose: Biological optimization for IMRT planning is typically not clinically utilized, perhaps due to uncertainties associated with normal tissue complication models. Clinically, IMRT planning still relies heavily on dose-volume constraints. We propose a method that can overlay biological optimization onto a clinically satisfactory dose-volume optimized plan.

Methods and Materials: Following dose-volume optimization, we compute the incremental fluence adjustments required to reduce the biological equivalent uniform dose (EUD) while approximately maintaining the dose-volume optimized constraints. The incremental fluence adjustment vector is added to the fluences. The process of computing and adding the incremental fluence adjustment vector is iterated, until the original dose-volume optimized constraints are exceeded by some tolerance value. At this point, a fluence correction vector is applied to bring the constraints back within tolerance. Following the correction, the EUD reduction iteration is continued. This process of EUD reduction followed by dose-volume constraint correction is repeated until no further EUD reduction is possible. The methodology is demonstrated in the context of a prostate cancer case and olfactory neuroblastoma case.

Results: For both cases, it is shown that EUD reduction after dose-volume optimization can additionally reduce doses, especially high doses, to normal organs. Dose-volume constraints were maintained within tolerance limits of 2%. In the prostate cancer case, highest doses to both rectum and bladder were reduced by an additional 5%. In the olfactory neuroblastoma case, the target was closely surrounded by the eyes, optic nerves, chiasm and brainstem. Despite this proximity, EUD optimization further reduced the highest doses to left eye, left optic nerve, right eye, right optic nerve, and chiasm by upto 15%, 5%, 12%, 6% and 1%, respectively.

Conclusions: The method developed here can further reduce biological metrics after dose-volume optimization, without compromising dose-volume optimized constraints. Thus, biological optimization can be accommodated within the framework of current clinical expectations.