AbstractID: 7363 Title: Experimental evaluation and verification of the deliverability aspects of IMRT beams optimized with adaptive diffusion smoothing

Purpose: To experimentally determine the impact of adaptive diffusion smoothing (ADS) on the delivery accuracy and efficiency of IMRT fields.

Method and Materials: IMRT optimization was performed on several cases with and without the use of an ADS penalty applied within the objective function. The ADS penalty is based on diffusion principles and promotes smoothing in beam areas that are not essential to meeting the cost function objectives. Previous studies have shown that the use of the ADS penalty results in IMRT plans that are dosimetrically equivalent, less complex, and require fewer MU to deliver compared to standard IMRT. All plans were sequenced and delivered via step-and-shoot delivery. Film and ion-chamber dosimetry were performed, and the total MU, delivery time, and differences between convolution/superposition calculations and film measurements for standard and ADS IMRT beams were evaluated.

Results: Measurements verified that IMRT plans optimized using the ADS penalty were less likely to exhibit small regions of disagreement due to factors such as tongue-and-groove compared to standard IMRT plans. In particular, the in-field agreement between calculations and measurements for the ADS plans was superior to the more modulated standard IMRT plans. The use of ADS resulted in the area outside a +/- 5 cGy criteria between calculations and film measurements decreasing from 3.7 to 1.8 % in a head/neck example and from 10.8 to 6.7 % in a prostate example. In addition, the total MU for SMLC delivery was reduced by 20 to 45 % in all cases with no loss in plan quality according to the DVHs and dose metrics.

Conclusion: The use of the ADS penalty inside an inverse IMRT plan objective function reduces beam complexity without sacrificing dosimetric quality and results in significantly more efficient and accurate delivery of IMRT fields.

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