AbstractID: 5761 Title: A Scientific Comparison of Inverse Treatment Plan Quality Using a Convex Non-Linear Programming Model as a Function of Beam Quality and Beam Number

Purpose: Recent advances in large scale fluence map optimizations for IMRT allow the use of large beam numbers that conform to the target to generate the desired target coverage while at the same time maintaining dose to critical organs below tolerance limits. Additionally, IMRT has effectively removed the need for high energy accelerator beams due to the excellent plan quality achievable with low beam quality. We investigate the diminishing returns in plan quality with increasing beam numbers and compare IMRT treatment planning of 6MV and ^{60}Co therapy dose models.

Method and Materials: A convex non-linear model was used to compare the plan quality, from dose volume histograms and fluence maps, for three treatment sites (H & N, CNS and prostate) for a 6MV and ^{60}Co dose model. Plans were calculated for 5, 7, 9, 11, 17, 35 and 71 equidistant beam angles and quality assessed on target coverage ($R_{95\%} > R_{Rx}$) and organ sparing for each case.

Results: Similar target coverage was achieved for ^{60}Co as with 6MV and equivalent organ sparing was also observed for all three sites. Increasing the number of beams provided some improvement in organ sparing while maintaining target coverage conditions. Dose calculation times increased linearly with beam number and FMO calculations increased by up to 900% between 5 and 71 beams.

Conclusion: We have demonstrated that IMRT plan quality using a ^{60}Co dose model produces similar dose distributions to 6MV. We also show that plan quality does not show considerable improvement above 11 beams for IMRT and significant increases in the treatment planning times are observed extending the number of treatment beams to 71 beams.

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