

Purpose: Long volume sarcomas are usually treated with a two-isocenter technique. Due to the sharp dose gradients at the field edges, 3 mm setup uncertainties can cause up to 30% dose variations in the overlap region, potentially increasing dose to the bone and risking subsequent fracture. This dose variation is conventionally reduced by using junction shifts. We have developed a two-isocenter IMRT technique to spare bone and simultaneously control the junction dose. The technique uses extended dose gradients throughout a junction region to improve the tolerance to setup uncertainties and inverse planning to develop complimentary dose gradients.

Methods: An initial dose gradient across a 4-6 cm junction region is induced either with segmented inferior parallel-opposed beams or using variable dose target junction volumes. Superior IMRT fields, which overlap the junction region, are put and optimize doses superiorly and establish a complementary dose gradient to the initial gradient. Then, segments beams are removed and replaced by inferior isocenter fields to complete dose coverage in the junction region and inferior target.

Results: Four lower extremity sarcoma cases have been planned with this technique in Pinnacle 7.6c, demonstrating the following advantages over the conventional technique: **Improvement in junction dose uniformity:** $\pm 5\%$ target dose heterogeneity for the segments-induced method and $\pm 3\%$ for the variable-dose-volumes method vs. 7% for the conventional moving junction techniques; **Improvement in potential error control:** for 3 mm setup uncertainties, a) $\pm 5\%$ junction target dose shifts vs. up to $\pm 10\%$ hot or cold spots in the conventional treatment; b) Maintained bone sparing dose in junction vs. risk of increased bone dose.

Conclusion: A technique has been developed to permit the application of IMRT to long limb sarcomas with both critical structure sparing and stable junctioning. This technique has applications to other sites where abutting fields offer treatment or efficiency advantages.