AbstractID: 13657 Title: Deformable Registration Based Tool to Obtain Cumulative Doses from External Beam IMRT and HDR Interstitial Brachytherapy

Purpose: To obtain cumulative doses from external beam (EB) IMRT and HDR interstitial brachytherapy (BT) for prostate cancer.

Methods and Materials: A tool was developed for multimodality image manipulation and registration within our current treatment planning framework to obtain cumulative doses from BT and EB-IMRT. The HDR BT boost performed under transrectal ultrasound guidance is planned using Nucletron Oncentra prostate TPS. A total implant dose of 21 Gy is administered in two 10.5 Gy fractions. The daily external beam dose to the PTV was 2 Gy given in 23 fractions and planned with IMRT using Pinnacle TPS. US DICOM images, structures and 3-D dose matrix were pre-processed for import with in Pinnacle TPS. US and CT images were rigidly registered as a preliminiary step inside Pinnacle based on prostate contours on two imagesets and implanted visicoils markers. A linear-quadratic model is applied to calculate the total equivalent dose in 2Gy fractions (EQD2) with $\alpha/\beta=4$ for prostate. Tools were developed to perform deformable registration based on biomechanical model of human organs and the finite element analysis methods.

Result: A biomechanical model of US and CT prostate volume was generated on a clinical case using 5544 nodes (5240 subvolumes). The deformation vector field generated after deforming prostate contours was used to deform 3D US dose matrix on to CT grid. Using EQD2 of 50.4 Gy from brachytherapy and 46 Gy from IMRT, the cumulative D99 and D95 to CT prostate volume was 98.2 Gy and 100.4Gy.

Conclusion: There is a lack of availability of commercial TPS in which EBRT and BT plans can be fully integrated. The tool provides a robust and accurate means of obtaining cumulative doses from brachytherapy and EB- IMRT. It also has the potential to incorporate doses from brachytherapy during inverse planning adaptive optimization of external beam IMRT.