AbstractID: 7205 Title: Evaluating the impact of probe depression on prostate displacement in ultrasound-guided prostate IMRT treatment

Purpose: The prostate displacement under the mechanical pressure of abdominal ultrasound probe may compromise the accuracy of ultrasound-guided prostate IMRT treatment. The purpose of this study is to investigate the impact of ultrasound probe depression on the prostate displacement by finite element method (FEM).

Method and Materials: An ultrasound system (Restitu^{TM}, Resonant Medical System, Montreal, Canada) integrated with a CT-Sim was used to acquire a full set of 3-D ultrasound (US)-CT images for a typical prostate cancer patient. The patient's structures, such as body, bone, bladder, and prostate, were contoured on the CT images. These structures were utilized to generate a 3D finite element model. The mechanical properties of the patient's tissues and ultrasound probe, including elastic module (E) and Poisson's ratio (v), were set as: body (E=25kPa, v=0.45), bone (E=10GPa, v=0.45), bladder (E=10kPa, v=0.45), prostate (E=100kPa, v=0.45), and probe (E=3GPa, v=0.35), respectively. The corresponding displacement of prostate centroid during ultrasound localization was calculated by a FEM software (Ansys).

Results: When the depression of ultrasound probe increased from 10mm to 50mm with an increment of 10mm on the patient's abdomen at an angle of 45 degree to horizontal plane, the displacement of prostate centroid was increased from 0.5mm to 4.9mm in the inferior direction and 0.4mm to 3.6mm in the posterior direction. There was no significant left-right displacement of the prostate. The 3D vector displacement of prostate centroid is increased from 0.6mm to 6.1mm based on FEM calculation.

Conclusion: The displacement of prostate was non-negligible when the depression of ultrasound probe was more than 20mm on the patient's abdomen. This displacement should be considered in the 3-D US–CT image-registration and US-guided radiation therapy.