AbstractID: 8844 Title: The Impact of Probe Angle and Tissue Elastic Module in Ultrasound-Guided Prostate IMRT

Purpose: An integrated ultrasound and CT-Sim system can be used to assist the daily setup of prostate IMRT patient. The purpose of this study is to investigate the influence of probe angle and the tissue elastic module on the displacement of prostate during ultrasound localization using Finite Element Method (FEM).

Method and Materials: An ultrasound localization system (Resonant Medical System, Montreal, Canada) integrated with a CT-Sim was used to obtain a full set of 3-D ultrasound (US)-CT images. The patients' anatomical structures, such bone, bladder, and prostate, were contoured on the CT images by radiation oncologists. The ultrasound probe was positioned at 1cm inferior to bladder superior boundary. A 3D finite element model was generated for each of the patient. The corresponding displacement of prostate during ultrasound localization was calculated by FEM software (Ansys).

Results: Under normal tissue elastic module (body (E=15kPa), bone (E=10GPa), bladder wall (E=300kPa), prostate (E=100kPa), and probe (E=3GPa)), when the angle of ultrasound probe increased from 10 to 60 degree to vertical plane with 2cm compression of ultrasound probe, the total displacement of prostate was 0.46~0.6mm (0.43~0.54mm inferior, 0.15~0.25mm posterior). When the elastic module of bladder wall changed from 50kPa to 1MPa with the probe angle of 45 degree, the total displacement of prostate was increased from 0.26mm to 0.76mm (0.23 to 0.68mm inferior, 0.1 to 0.32mm posterior). There was almost no left and right displacement during compression.

Conclusion: For the displacement of prostate, there was no significant dependent on the probe angle and limited dependent on the tissue elastic module. With proper controlled compression, the total prostate displacement can be limited within 2mm. This displacement can be corrected by FEM calculation.