Purpose: To determine whether the reliability of calculated dose metrics in permanent implant prostate brachytherapy, performed on post-operative CT, can be improved though the use of a semi-automatic prostate model based on intra-operative ultrasound.

Methods: Intra-operative trans-rectal ultrasound (TRUS) data was collected from clinical subjects undergoing low dose rate prostate brachytherapy. Seed verification in TRUS data was acquired through seed cloud reconstruction in fluoroscopy data collected at the same time. A simplified 3-D prostate model was constructed from prostate boundary contours determined on TRUS images, and deformed to account for the effects of expected anatomical movement and deformation between data sets. Volume registration between the post-operative pelvic CT scan, obtained as part of routine QA procedures in which a seed implant plan reconstruction is performed, and TRUS data is determined through seed matching. The transformed and transposed prostate model is used to generate CT contours that inform the QA dose metrics D₉₀ and V₁₀₀ that determine implant quality.

Results: Preliminary results have shown that CT prostate contours generated using ultrasound-based models are within the expected variability of those drawn manually by experienced radiation oncologists, which is the current standard practice in prostate brachytherapy QA. Methods for improving the registration and model accuracy, and evaluating the performance, are currently in progress.

Conclusions: Prostate boundaries are notoriously difficult to discern on CT images due to poor soft tissue contrast. Dose metrics derived from CT contours are subject to considerable inter- and intra-observer variability, which affects the overall assessed treatment quality. We have found that an ultrasound-based semi-automatic prostate model can be registered to the CT and used to generate objective and reproducible CT contours. If applied in a clinical setting, this method could potentially improve treatment QA by setting a consistent definition of treatment volume.