Evaluation of dosimetric impact of catheter-position uncertainty in balloon high dose rate brachytherapy of breast cancer

In balloon high dose rate (HDR) brachytherapy, the delivered dose distribution can be different from the intended dose distribution of the treatment plan. Primarily, this discrepancy results from the position uncertainty of $^{192}\text{Ir}$ source during CT image-based treatment planning as well as system uncertainty for delivery of radiation. Hence, AAPM task group 56 recommends the positioning accuracy of $^{192}\text{Ir}$ source to be within ±2 mm (1). In clinical practice, catheter length measurement is required prior to each delivery of radiation to verify the dwell positions of $^{192}\text{Ir}$ source within ±2 mm tolerance compared with those in the treatment plan. This study evaluated dosimetric impact of catheter-position uncertainty in balloon HDR brachytherapy for 30 breast patients.

Figure 1. Box graphs show the dosimetric variation of PTV_EVAL V90 and breast tissue V200 values. Ref is the clinical treatment plan and 8 shifted plans are noted as positive sign (+) for distal shift and negative sign (-) for proximal shift of catheters, respectively. In box graph, each parallel bar represents 25, 50 and 75 percentile value. The whisker shows 1.5 inter-quartile ranges and open circles represent outliers.

Figure 2. Average change (left panel) and modulus of average change (right panel) of dosimetry data of 8 shifted plans compared to those of clinical plan (Ref) for 30 HDR breast patients. Eight shifted plans are noted as positive sign (+) for distal shift and negative sign (-) for proximal shift of catheters.

References: