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abstract

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Abdullah Mahrous, btisam Alshammari, Danah Almutiri, Ghada Aldosary

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Dosimetric Impact of Breast Expanders for MV Photon Breast Radiotherapy

Authors: Abdullah Mahrous[1], btisam Alshammari[2], Danah Almutiri[3], Ghada Aldosary[2,3]

Affiliation: [1]King Abdulaziz University, Jeddah, Saudi Arabia
[2]KASCH, Ministry of National Guard Hospital, Riyadh, Saudi Arabia
[3]Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia

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Introduction: Breast expanders are now commonly used in pre-radiotherapy (RT) breast-conserving surgeries. This study aims to evaluate the dosimetric impact of breast expanders in MV-photon breast plans.

Methodology: 3D-tangential breast RT plans from eleven patients with breast expander implants were retrospectively studied using the Monaco treatment planning system. For each case, three plans were created with different expander modeling strategies: with a standard CT-to-ED (sCT-to-ED) curve (EDrange = 0.200-1.695), with an extended CT-to-ED curve (eCT-to-ED) that models expander material accurately (ED range = 0.190 -5.200), and using a full water-equivalent planning-target-volume (PTV) override. Additionally, for each scenario, collapsed cone (CC) and Monte Carlo (MC) dose calculation algorithms were applied. Plan differences were evaluated based on dose-volume histograms (DVH) to evaluate PTV coverage and heart and lung doses.

Results: All plans applied 6, 10, or 15 MV beams. The average PTV volume was 866.0 ± 250.7 cc. Plans were prescribed using 40.05 Gy/15 fx or 42.56 Gy/16 fx. Generally, using a lower photon energy and/or having a smaller PTV volume caused more dosimetric perturbation (≤ 15% in PTV coverage). In all three scenarios, the PTV coverage decreased when MC was used (range= 0-15.4%, 0-14.4%, 0-10.0%, for PTV100%, PTV95%, and PTV90%, respectively). PTV107% (MC) increased by 13.3 ± 13.0 cc, 12.6 ± 17.8 cc, 11.4 ± 16.5 cc in situations when sCT-to-ED, eCT-to-ED or an override were used, respectively. Using MC, doses > 100% of the prescription were observed near metallic ports. Mean heart doses, mean lung, and lung-V16Gy were comparable throughout.

Conclusion: From DVH analysis, all plans using CC provided clinically acceptable coverage. MC revealed more dose heterogeneity around metallic ports. Overrides underestimated dose heterogeneity. Using the eCT-to-ED curve with MC provided the most accurate representation of the dose distribution in the presence of breast expanders and can be used to guide clinical decision

making.

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