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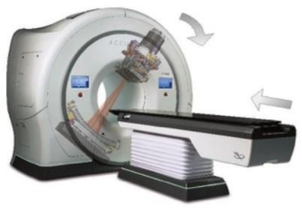
On the dosimetric effect of virtual bolus for superficial tumors treated using helical TomoTherapy



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Background: This study assesses the dosimetric impact of using virtual bolus (VB) to aid photon fluence optimization in superficial tumors.

Materials & Methods: A left breast Ca patient treated with a prescription dose of 40.05Gy in the PTV delivered in 15 fractions was used as a test case (Figure 1). Four helical TomoTherapy (Accuray Inc.) treatment plans were developed, either without or with VB of 3, 5 and 10mm thickness. Dose calculations were performed using the Collapsed Cone based MBDCA of the Precision (Accuray Inc.) treatment planning system (TPS). The treatment plans were exported to an independent Monte Carlo (MC) based dose calculation system (Prosoma Core, MedCom GmbH). MC simulations were performed for each case accounting for or ignoring the presence of the VB region. The impact of the VB in the patient's skin dose was assessed by comparing dose calculations with and without the VB.

Results: TPS and MC dosimetry calculations agreed within 1% as shown in Figure 2, indicating a mean skin dose >95% of the prescription (range: 93% - 102%). This implies that the MBDCA of Precision TPS correctly accounts for the build-up region at skin and enhances the photon fluence to increase the dose locally. This cancels out the skin sparing effect of the classical 3D radiation therapy technique using two oblique opposed fields and could potentially lead to skin detrimental skin burns. On the contrary, the use of VB during treatment planning, effectively controlled photon fluence optimization in the proximity of skin for all studied thicknesses. The build-up region was determined to be 6-8mm thick. Using the 3mm thick VB led to an 8% reduction in skin dose which reached 11% for both 5mm and 10mm VB thicknesses.

Conclusion: Utilizing a 3mm thickness VB ensures prevention of skin overexposures in tumors that extend into the build-up area.

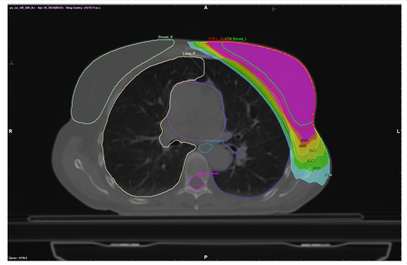

Figure 1: Dose distribution without the use of VB (Precision)

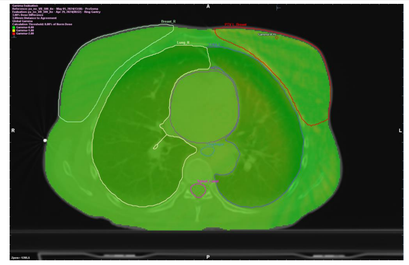

Figure 2: Gamma evaluation (3%/3mm) (MC Vs Precision) without the use of VB

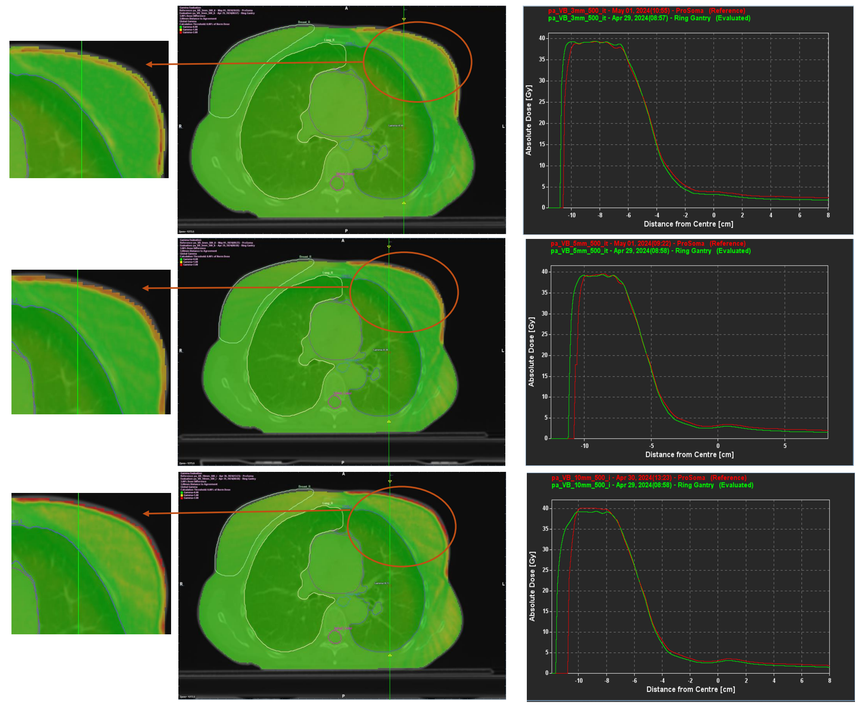

Figure 3: Gamma index maps (left) and vertical dose profiles (right) from the comparison of MC (without VB) and TPS [with 3mm (upper),5mm (middle) & 10mm (lower) VB] dose calculations