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Effect of interfractional shoulder motion on low neck nodal targets for patients treated using volume modulated arc therapy (VMAT)

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Abstract

Purpose: To quantify the dosimetric impact of interfractional shoulder motion on targets in the low neck for head and neck patients treated with volume modulated arc therapy (VMAT).

Methods: Three patients with head and neck cancer were selected. All three required treatment to nodal regions in the low neck in addition to the primary tumor site. The patients were immobilized during simulation and treatment with a custom thermoplastic mask covering the head and shoulders. One VMAT plan was created for each patient utilizing two full 360° arcs and a second plan was created consisting of two superior VMAT arcs matched to an inferior static AP supraclavicular field. A CT-on-rails alignment verification was performed weekly during each patient's treatment course. The weekly CT images were registered to the simulation CT and the target contours were deformed and applied to the weekly CT. The two VMAT plans were copied to the weekly CT datasets and recalculated to obtain the dose to the deformed low neck contours.

Results: The average observed shoulder position shift in any single dimension relative to simulation was 2.5 mm. The maximum shoulder shift observed in a single dimension was 25.7 mm. Low neck target mean doses, normalized to simulation and averaged across all weekly recalculations were 0.996, 0.991, and 1.033 (Full VMAT plan) and 0.986, 0.995, and 0.990 (Half-Beam VMAT plan) for the three patients, respectively. The maximum observed deviation in target mean dose for any individual weekly recalculation was 6.5%, occurring with the Full VMAT plan for Patient 3.

Conclusion: Interfractional variation in dose to low neck nodal regions was quantified for three head and neck patients treated with VMAT. Mean dose was 3.3% higher than planned for one patient using a Full VMAT plan. A Half-Beam technique is likely a safer choice when treating the supraclavicular region with VMAT.

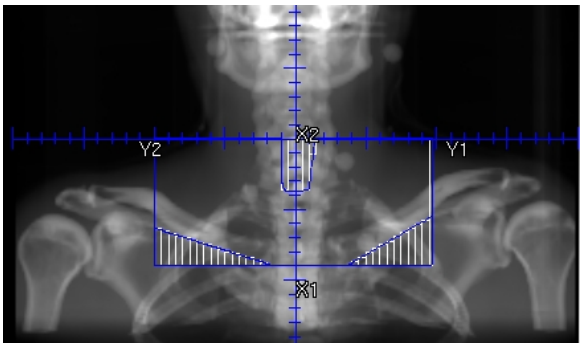

FIG 1: Example AP supraclavicular field. The superior border would be matched to VMAT arcs targeting the primary CTV in the head.

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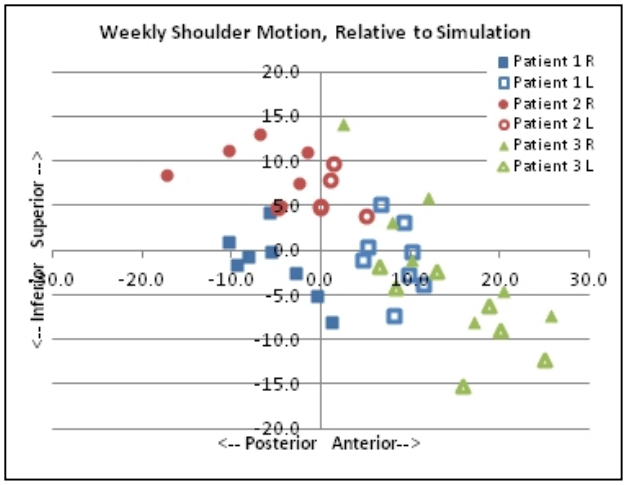

FIG. 2: Weekly shoulder motion relative to position at simulation for all three patients.

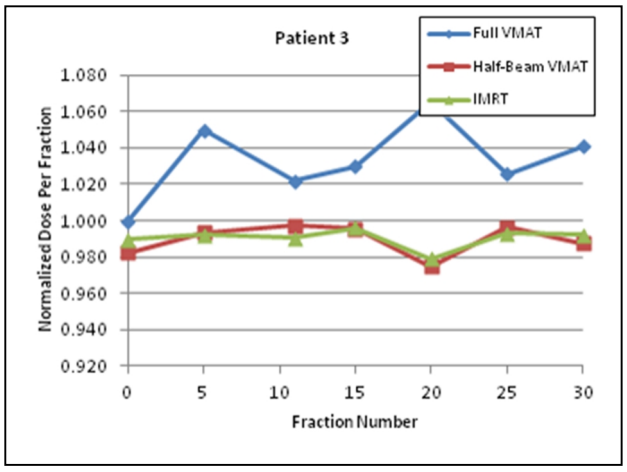

FIG. 3: Mean dose per fraction for the supraclavicular CTV for Patient 3. Normalized to the mean dose calculated on the planning CT scan.

FIG. 4: The CT-on-rails system at our institution.

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