

Purpose:

Intensity modulated radiation therapy (IMRT) planning using pre-treatment megavoltage computed tomography (MVCT) provides a viable solution to adaptive radiotherapy. A strategy was developed to assess the impact of MVCT image quality on treatment plans using Helical TomoTherapy.

Methods:

The Octavius phantom (PTW) was scanned with a Philips CT-scanner and the Helical TomoTherapy unit for kilovoltage CT (kVCT) and MVCT, respectively. MVCT images were acquired with three modes (slice thickness): coarse (6-mm), normal (4-mm) and fine (2-mm). Contours from existing head-and-neck plans were transferred from the Pinnacle treatment planning system to phantom images and IMRT plans were generated using the TomoTherapy planning station. Comparison between the kVCT-based plan (benchmark plan) and MVCT-based plans were conducted to evaluate dosimetric variations. Dose volume histograms (DVH) were examined for plan quality. Plans using MVCTs acquired with three modes were also evaluated for dosimetric differences. Additional plan evaluations were performed with retrospective dose reconstruction based on the delivered leaf sequences.

Results:

Isodose distributions of four plans are comparable despite the intrinsic difference between MVCT and kVCT images. No significant variations on the target coverage were found from DVHs. However, plan using coarse MVCT images gave largest dose deviations ($> 50\%$) for critical structures from that of benchmark plan while the best agreement was observed between fine MVCT and kVCT. Plan parameters were found to be consistent among four plans. Comparisons between planning doses and reconstructed treatment doses revealed high fidelity delivery.

Conclusions:

IMRT planning using MVCTs proved to be equivalent with that using standard kVCT when fine imaging mode was selected. Target coverage on MVCT plans is comparable to that on the standard kVCT plan. MVCT thicknesses were shown to have impact on plan quality. Caution is needed when performing treatment planning with MVCTs.