

Purpose:

As a part of a dose escalation total marrow irradiation (TMI) study, we have treated several patients using Tomotherapy. The purpose of this work is to critically review this new methodology in regards to conformality, uncertainty in dosimetric and treatment delivery, multi-modality imaging for enhancing conformal avoidance, future adaptive processes, and clinical concerns.

Method and Materials:

The kVCT, MVCT, PET, and SPECT images were applied in various stages of planning, treatment delivery, boost treatment delivery, and dose reconstructions, using Tomotherapy. Delivered dose was reconstructed using MVCT and kVCT images and compared with expected dose coverage to augment futures of adaptive process. To test the conformality, bone was contoured in four different regions. Clinical concerns about patient treatment and dosimetric uncertainties were also evaluated.

Results:

A statistical analysis of reconstructed dose showed that a very small fraction (0.2 %) of thoracic bone volume received 10 % less than the prescribed dose. Reconstructed PTV and lung delivered dose were the same as planned dose. SPECT imaging was able to detect skeletal metastasis in one patient while MR, CT, PET failed to detect all the bone metastases. In conjunction with CT images, SPECT image sets were used to explore conformal avoidance of the brain. Treatment procedures for entire bone marrow using Tomotherapy took 80 minutes whereas hemi body marrow irradiation took approximately an hour.

Conclusions:

Reconstructed dose matched planning dose with reasonable accuracy except in thoracic bone. Application of the appropriate imaging modalities enhances conformality to bone marrow as well as conformal avoidance of critical organs, and also helps in dose escalation. Without the proper margin determined for bone, one may underdose the target, although treatment planning can show good DVH. Current treatment procedures are long and require improvements for patient comfort and for accuracy of the treatment.