

AbstractID: 8496 Title: Management of image-guidance dose in radiotherapy treatment planning

Purpose

Recent studies demonstrate that imaging procedures in radiotherapy for patient setup may add significantly to the doses to the normal tissues of the radiotherapy patient, especially using MV and kV cone-beam CT (CBCT). These imaging procedures add the dose to an already high level of therapeutic radiation to organs. Accounting for image-guidance dose is becoming increasingly important for radiation oncologists with regards to the total dose limit for normal tissues. This study is to accurately model and quantitate the additional dose from image-guidance procedures, especially kV CBCT, as part of radiotherapy dose in the patient treatment planning.

Method and Materials

Unlike megavoltage photon beam in which the dose calculations mainly depend on the electron density of the media, the dose calculations of kilovoltage x-ray depend on atomic number of the medium due to the photo-electric effect. Therefore, kVx -ray dose calculation is not available in current radiotherapy treatment planning systems. The Monte Carlo code BEAMnrc was used to generate kV CBCT beams and DOSXYZnrc was used to calculate dose to the patient using volumetric CBCT images. The dose-volume-histograms (DVHs) for organs were evaluated.

Results

For a representative head-and-neck cancer patient treated with 33 fractions of IMRT, if the kV-CBCT procedure was used in each treatment fraction, the accumulative imaging dose can total 230 cGy to 95% of the eye volume, a minimum of 132 cGy to 90% of the soft tissues within the imaged volume, and 528 cGy to 90% of the cervical vertebral volume.

Conclusion

The DVH analyses show significant doses to radiosensitive organs from repeated CBCT procedures. Hence, the management of imaging dose during radiotherapy is important to reduce the risk of complications. Total therapeutic dose limits in the treatment planning process may need to include the additional x-ray dose to radiosensitive organs from image-guidance procedures.