

Gantry mounted kilovoltage cone-beam computed tomography (kV-CBCT) systems are quickly gaining popularity for use in image-guided radiation therapy. These systems are capable of acquiring high resolution volumetric images of the patient at the time of treatment which can then be registered with the planning CT dataset to confirm proper alignment of the patient on the treatment table. To date, two such systems are commercially available, the X-ray Volumetric Imager (XVI, Elekta Oncology Systems, Crawley, UK) and the On-Board Imager (OBI, Varian Medical Systems, Palo Alto, CA).

While kV- CBCT is a very useful tool for positioning the patient prior to treatment, daily use in a high fraction therapy regimen results in an associated imaging radiation dose. In order to quantify the radiation dose associated with CBCT imaging, an in-house anthropomorphic phantom representing a 50th percentile adult male (J Appl Clin Med Phys 2009;10(3):195 -204) and a fiber-optic coupled (FOC) dosimetry system (Med Phys 2009;36(5):1711-16) were used to directly measure organ doses incurred during clinical protocols for the head, chest, and pelvis. For completeness, the dose delivered using factory installed protocols from both the XVI (v4.0) and the OBI (v1.4.13.0) were investigated. While these measurements provided a direct measure of organ doses, a practical method for estimating organ doses that could be performed with phantoms and dosimeters currently available at most clinics was also desired. To accomplish this goal, a 100 mm pencil ion chamber was used along with standard CT dose index (CTDI) acrylic phantoms to measure the cone-beam dose index (CBDI). A weighted CBDI (CBDI_w), similar to the weighted CT dose index (CTDI_w), was calculated to represent the average dose in the acrylic phantom. Organ dose conversion coefficients were then developed by comparing CBDI_w to the previously measured organ doses. These conversion coefficients allow specific organ doses to be estimated quickly and easily using readily available clinical equipment.

This lecture will provide an overview of the methodology used to perform organ dose measurements in the anthropomorphic phantom as well as a summary of the results. The measured CBDI values will also be presented along with the organ dose conversion coefficients.

Educational Objectives:

1. Understand the doses associated with popular kV-CBCT imaging protocols.
2. Understand the methodology used to perform organ dose measurements in an anthropomorphic phantom.
3. Understand how to apply organ dose conversion coefficients to CBDI measurements in order to estimate CBCT organ doses.