

Abstract ID: 9841 Title : Quality Assurance for Image-Guided Radiation Therapy

Image-guided radiation treatment (IGRT) is now widely available and implemented for routine clinical use in many clinics, allowing unprecedented level of precision and accuracy in treatment delivery. These systems bring about substantial change in clinical practice for all the disciplines involved in radiation medicine. One can now correct patient position immediately prior to administration of radiotherapy by registering IGRT images to the reference planning CT scan. IGRT information displays not only two-dimensional bony anatomy and airways, like portal imaging, but also three-dimensional datasets representing the internal anatomy of the patient, implanted markers, soft tissue, and sometimes the target to be irradiated. Growing experience with IGRT has demonstrated the ability to verify, on a daily basis, the position of internal anatomical structures, such as the tumor or its surrogates, the spinal cord, and other organs at risk with respect to the treatment beam geometry for several anatomical sites. It is therefore logical to use IGRT daily for on-line correction of patient translations and rotations, and to compare successive IGRT images to monitor changes of internal anatomy through the course of therapy. Nevertheless, introducing IGRT within busy radiation therapy clinics requires thoughtful commissioning and quality assurance (QA) protocols, and judicious modification of existing radiation therapy processes and protocols. While the modes of use of these systems will continue to evolve in the distant future, their performance needs to be of the highest level, as they will be depended upon in the treatment process; in deed, increasing the precision of radiotherapy delivery may lead to reduced margins and therefore allow further dose escalation.

There are two key features of IGRT systems that require particular attention: geometric accuracy and image quality. First, the chosen IGRT system often does not share common central axes with the megavoltage treatment beam; therefore, the geometric relationship of the IGRT dataset to the megavoltage treatment beam must be assessed and monitored to ensure adequate localization, scaling, and geometric accuracy. Second, image quality metrics define the ability of the IGRT system to consistently produce an image of sufficient quality to localize the structures of interest, through either manual or automatic registration of IGRT images to the reference planning CT scan. A well-planned QA program integrates closely the IGRT system procedures with clinical procedures described in accepted QA standards such as the report of the AAPM task group 40.

This lecture will present a brief review of IGRT systems, including kilovoltage and megavoltage cone-beam CT, ultrasound, CT on rails, Tomotherapy, and projection radiography. The emphasis will be on QA issues germane to these systems and the clinical processes relating to their use. QA procedures and phantoms will be suggested, and some QA metrics, with their associated tolerance levels based on clinical experience will be presented. Successful strategies for clinical implementation of IGRT will also be discussed.

Educational objectives:

1. Understand the technical issues related to IGRT systems
2. Understand the impact of IGRT on clinical processes
3. Present a QA program for IGRT systems focusing on geometric accuracy and image quality.