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Imaging for Radiation Therapy (ACR Guidelines/AAPM TG 142)

Image-guided patient positioning has rapidly been accepted as a method of accurate target localization in the treatment room for radiation therapy. Radiographic imaging systems commonly integrated with medical accelerators include megavoltage (MV) planar imaging, kilovoltage (kV) planar imaging, and MV or kV computed tomographic imaging (both serial and cone beam). Clinical in-room use of kV imaging devices is being systematically summarized in TG 104. The fundamental goals for kV imaging in radiation oncology target localization are different from those in diagnostic imaging. In radiation oncology there is greater emphasis on the localization accuracy, which requires precise reconciliation of coordinate systems for imaging and radiation delivery systems. The localization accuracy is also dependent on the visibility of the anatomic structures to be localized. Better image quality generally comes at the cost of higher imaging dose. It is conceivable that the localization accuracy of some treatment sites (such as breast portals) may be less sensitive to image quality than others (such as head and neck). Therefore, it is critical to carefully balance the desire of image quality and imaging dose with careful consideration of the localization accuracy. A variety of kV imaging systems was recently introduced. Applications of these kV imaging systems include 2-D radiographic imaging, 2-D fluoroscopic imaging, 3-D tomographic imaging as well as 4-D imaging to study organ motions. Acceptance testing and commissioning procedures for each imaging system should be carefully established. These acceptance testing criteria should include parameters related to safety, image quality, imaging dose, and localization accuracy for both hardware and software. The baseline data established during these procedures should be used for the QA criteria for subsequent testing. AAPM TG-142 provides extensive QA recommendations for in-room x-ray imaging systems.

This lecture will provide an overview of the radiological imaging technologies currently used in Linac based radiation therapy, including recommendation for quality assurance requirements in clinical practice and clinical trials.

Educational Objectives:

1. Understand the radiological imaging technologies in the linac-based treatment room
2. Understand the requirement of quality assurance of using imaging devices in clinical IGRT practice
3. Understand the standard of practice proposed by ACR and basic requirement for IGRT credentialing in clinical trials