

Purpose: To describe the commissioning and quality assurance for helical tomotherapy machines.

Method and Materials: Helical tomotherapy is a volumetric image guided, fully dynamic, IMRT delivery system. It was been developed at the University of Wisconsin and is now commercially manufactured as the 'Hi-Art'. At the core of this fully dynamic IMRT Delivery system lies a short gantry-mounted linac that is used both for treatment and per-treatment MVCT imaging. Aside from the primary collimator and the jaws, which set the width of the beam, it is also collimated by a binary multileaf collimator generating a fan beam of intensity-modulated radiation. Modulation varies with gantry angle. Hence, the Hi-Art allows for the acquisition of a helical pre-treatment MVCT scan that is used for online image guidance and allows for precise interfraction positioning of the patient while in the actual treatment position just prior to the start of treatment. Due to its unique design the Hi-Art system, allows highly conformal dose-distributions to be delivered to patients in a helical fashion. Patients are treated lying on a couch that is translated through the bore of the machine as the gantry rotates, therefore the Hi-Art is the therapy equivalent of helical CT. Since this approach to therapy is fully dynamic it requires synchrony of gantry rotation, couch translation, linac pulsing and the opening and closing of the leaves of the binary multileaf collimator used for beam modulation.

Results: Over the course of the clinical implementation of the HiArt we have developed a quality assurance (QA) system that covers machine specific QA. The machine specific QA system is similar to that recommended for conventional linear accelerator QA by AAPM Task Group 40; however since the Hi-Art design and operation differs from that of conventional medical linear accelerators, the tomotherapy QA system contains also novel components, such as QA checks for synchrony of gantry rotation, couch translation, linac pulsing and the opening and closing of the leaves of the binary multileaf collimator.

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Conclusion: In the first part of the presentation the design and dosimetric characteristics of Hi-Art machines are summarized and the QA system is described along with experimental details of its implementation, while in the second part the pre-treatment patient-specific delivery QA for helical tomotherapy is discussed.

Learning Objectives:

- 1) The audience will understand the rationale for the proposed machine specific QA for Tomotherapy machines and how to carry out the various tests in a systematic and controlled fashion
- 2) The rationale for the proposed patient specific pre-treatment QA and how to carry it out in a systematic and controlled fashion will be understood.