

Helical tomotherapy IMRT technology has been implemented in the Hi-Art system developed by Tomotherapy, Inc. The Hi-Art system uses a linear accelerator mounted on a rotating CT gantry and a fan beam of 6 MV photons to deliver radiation along a helical path, obtained by continuous concurrent gantry rotation and couch/patient travel. Beam delivery during rotation of the gantry is subdivided into 51 distinct gantry segments of approximately 7° each. For each of the 51 projections, the beam intensity is modulated with a 64-leaf binary multileaf collimator (MLC), resulting in 3,264 possible beamlets for each helical rotation. The optimum MLC sequence is created using inverse treatment planning with a gradient search algorithm. Compared to conventional IMRT techniques, this greater number of degrees of freedom can potentially produce superior dose distributions, e.g. more uniform dose to the target and lower doses to normal tissues.

The treatment planning system utilizes convolution/superpositional algorithms to compute the delivered dose from the Hi-Art system. Users have the ability to select delivery parameters including jaw width, pitch and the degree of modulation (modulation factor) prior to plan optimization. Optimization may be performed utilizing differential calculation techniques which may change the time for plan completion. Dose calculation is also affected by the choice of planning CT size and resolution, as well as the selected dose grid size.

Due to the increased complexity of Tomotherapy plans, well-designed quality assurance (QA) tests are needed to validate treatment plans for individual patients. In addition to phantom QA measurements, a technique has been developed for independently calculating dose to a point in a helical Tomotherapy treatment plan. This technique utilizes the planned treatment sinogram, along with dosimetry functions commonly used in standard MU calculations, obtained from a gantry-static Tomotherapy beams. A comparison of this technique with phantom and patient treatment plans will be shown in this talk.

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Educational Objectives

1. To understand the principles of helical tomotherapy
2. To get an overview of the calculation technique employed by the Hi-Art treatment planning system
3. To understand the effect of different user-selectable parameters on the treatment plan optimization process
4. To understand the calculation technique used in an independent dose calculation technique for helical tomotherapy