

Computed tomography (CT) simulator combines functionality of a conventional simulator with features and image processing and display tools of a three-dimensional radiation therapy treatment planning (3D RTTP) system. Due to this ability, CT-simulators have become the primary imaging modality for treatment planning in radiotherapy. Another development in CT has been the rapid replacement of single slice scanners with multislice CT in diagnostic radiology departments. This process is also beginning in radiation therapy where multislice CT scanners also offer several advantages. This presentation: 1) describes multi-slice CT technology; 2) describes potential advantages of multi-slice CT in radiation oncology; and 3) describes CT-simulation process with multi-slice CT scanners.

One of the greatest limitations in the CT-simulation process has been the heat storage capacity of x-ray tubes in single slice CT scanners used for patient imaging. Radiotherapy treatment planning scans demand large number of images of high quality. Large number of images and very good image quality are needed for tumor volume and critical structure delineation and for verification of accuracy of patient treatments. Single slice scanners were often unable to acquire large number of high quality images efficiently. This resulted in a perpetual compromise between number of images and image quality used for radiotherapy treatment planning.

Multi-slice CT is typically not associated with x-ray tube heat storage problems and virtually unlimited numbers of high quality images can be acquired. This improvement in number of images and image quality has a potential to affect several aspects of radiotherapy treatment planning process. Better image quality allows improved tumor and normal structure delineation. The ability to acquire increased number of images also allows acquiring thinner slice thicknesses than with the single slice scanners. Thinner CT images greatly improve quality of digitally reconstructed radiographs (DRRs) and ability to verify patient positioning for treatment planning. In addition to better DRRs, CT data sets acquired on multislice scanners can have isotropic resolution enabling multiplanar contouring and more accurate definition of anatomical structures.

Multi-slice CT also acquires images much faster than single slice scanners. The faster scan capability has spun development of new image acquisition techniques

generally referred to as dynamic-CT, 4D-CT, or 5D-CT. Dynamic CT acquisition enables capturing of tumor motion as a function of patient breathing. This information can then be used in the treatment planning process for improved targeting of tumor volumes and sparing of critical structures.

Multislice CT has resulted in a situation where CT technology has surpassed the capabilities of treatment planning system. CT scanners can produce much more information than treatment planning systems and current treatment planning processes can manage efficiently. Presently, implementation of multislice technology and exploitation of its benefits in radiotherapy requires a balance between the volume of collected data and the ability of treatment planning systems to process this data.

EDUCATIONAL OBJECTIVES:

- 1) to describe multi-slice CT technology;
- 2) to describe potential advantages of multi-slice CT in radiation oncology; and
- 3) to describe CT-simulation process with multi-slice CT scanners.