The use of three-dimensional conformal radiotherapy (3DCRT) has now become common practice in radiation oncology departments around the world. Typical applications of 3DCRT involve a number of fixed beams entering the patient from directions which are hand-selected with the aid of beams' eye viewing to avoid the traversal of sensitive normal tissues to the maximal extent possible, even if those directions are out of the axial plane. Plan optimization is accomplished iteratively until a satisfactorily uniform dose to the target is achieved without exceeding the dose tolerance of neighboring sensitive tissues.

There remain situations for which conventional 3DCRT cannot produce a satisfactory treatment plan due to limitations of the method along with the geometry of the problem. Intensity modulated radiotherapy (IMRT) uses modifications in the intensity of the beams across the irradiated field as an additional degree of freedom to enhance the capability of conforming dose distributions in three dimensions. There are a number of different methods of producing these intensity-modulated dose distributions, some of which are relatively simple and others quite elegant and complex

Simple IMRT methods are those which can be planned and iteratively optimized with existing "forward" 3D treatment planning systems. These IMRT plans include fields made up of two or more subfields, shaped with a multileaf collimator (MLC), at least one of which is designed to reduce dose to overlying normal tissues. This planning scheme replaces noncoplanar methods that avoid normal tissue irradiation by complex angle selection alone.

General IMRT methods are those that require the use of inverse treatment planning programs with computerized optimization. These treatments can be accomplished by static "stop and shoot" MLC delivery methods or by dynamic sliding window methods. A significant advantage of the static IMRT method is that each MLC segment is a separate field that can be verified with the accelerator R/V system and that portal verification methods can still be used.

For dynamic MLC methods of intensity modulation the gantry is fixed and the leaves are moving across the field while the beam is on. With this approach, any number of intensity levels can be delivered without a significant increase in treatment time using special DMLC accelerator control software. For DMLC methods, verification of the shape and location of the intensity pattern at the time of treatment is either difficult or impossible.

Dosimetric verification of inverse treatment plans requires the use of phantoms with both multiple point and multiple plane dose capabilities. The dosimetric differences of the treatment delivery methods and the MLC designs will be addressed. The resources required to mount an IMRT program and methods of identifying patients with the most potential gain will be discussed.

Educational Objectives:

1. Understand the concept of intensity modulation
2. Learn how to predict the most useful application of IMRT
3. Understand the different methods of delivering IMRT with conventional MLCs
4. Understand planning methodologies
5. Learn about different verification methods
6. Understand dosimetric consequences of MLC design and treatment method
7. Understand the required resources for launching IMRT capabilities