Standard treatment planning process typically starts with CT-image acquisition, followed by contour drawing, beam definition, dose calculation, and plan evaluation. For intensity-modulated radiation therapy (IMRT), two additional steps, optimization and delivery, are needed. Moreover, other considerations specific to IMRT such as QA and radiation protection also need to be addressed.

Optimization is the process by which optimal intensity distribution is determined that would produce the dose distribution closest match the user's desire. The user typically specifies the prescription dose (or range of doses) to the target, dose constraints (or dose/volume constraints) to critical organs, and other optimization parameters. A special problem encountered in certain cases (e.g., breast and neck nodes) is the 'skin-flash' problem. The intensity profile determined by optimization does not extend beyond the skin, where the target ends. This may cause the target to be underdosed due to motion or setup uncertainties. Possible solutions to this problem will be discussed.

Once the intensity distribution is determined, it can be delivered through the use of a physical compensator; a special device such as MIMiC; or a conventional multileaf collimator (MLC), either in dynamic or in step-and-shoot mode. For clinical implementations, it is convenient to use MIMiC or MLC. In these approaches, the entire intensity profile is not delivered all at once, but made up of many segments, each covering only a portion of the treatment volume. If the treatment volume moves (e.g. breathing) during a fraction, it moves in and out of these segments, resulting in doses delivered to deviate from those expected. The effects on such deviation can be calculated if the pattern of motion is known. Another restriction on conventional MLC is the maximum field width. If the field width exceeds this limit, the intensity-modulated field must be split into two. Various ways of splitting will be described.

Quality assurance includes those that are normally done for conventional treatment and those that are particular to IMRT. The latter includes record-and-verify (R&V), flat-phantom dosimetry, and independent MU calculation. R&V system verifies all leaf positions before the first and after the last segment. Flat-phantom dosimetry compares calculated versus measured data, obtained with chamber and/or film. The independent MU program calculates the absolute dose from leaf sequence, including effects of extended source, rounded leaf-ends and transmission through the leaves.

Another consideration specific to IMRT is the increased total-body dose and room shielding requirement. This is caused by the longer beam-on-time typically required by IMRT than conventional treatments. These issues are examined based on treatment sites and delivery techniques.

IMRT is still an evolving technology. While it produces superior dose distributions than conventional treatment, it also requires additional efforts to ensure its proper use. The issues addressed here are only part of what have been encountered so far. There is no doubt new problems will emerge. As with any other new technique, IMRT must be used with care.

Education objectives:

- To provide general understanding of IMRT methodologies and procedures.
- To address special issues associated with IMRT.