

Purpose:

Collimator angle is a degree of freedom that has seldom been explored in IMRT inverse planning. This work investigates the impact of multi-leaf collimator rotation (IMLCR) on a dosimetric scoring function and lays the groundwork for optimal collimator angle selection in IMRT planning.

Method and Materials:

The scoring function models the maximum deliverable dose at an arbitrary beam orientation and is calculated using a sampling method. To calculate the scoring function, the beam portal is divided into a grid of beamlets based on collimator movement constraints. The intensity of each beamlet is set at the maximum intensity that does not violate the tolerance of any structure intersected by that beamlet. The score is calculated from the fraction of the dose prescription deliverable by each beamlet. The IMLCR is measured as the increase in the scoring function over all collimator angles.

Results:

- 1) For large tumors (not fully coverable by the beam portal), the mean IMLCR is 22.2%. Collimator rotation enables more exposure of the tumor to the beam, and thus increases the irradiation of the tumor.
- 2) For small tumors (fully coverable by the beam portal) with nearby critical structures, the mean IMLCR is 9.3%. Collimator rotation allows critical structures to be better isolated from tumor irradiation. When the tolerance of the nearby structures is high relative to the tumor's prescription, collimator rotation has little impact for small tumors.

Conclusion:

The variation observed in the dosimetric scoring function indicates that collimator rotation can significantly raise the maximum deliverable dose at a given gantry angle. When the tumor is large and/or has nearby critical structures (tolerance $\leq 50\%$ of the tumor's prescription), collimator rotation has the greatest impact and is worth considering. Collimator angle selection could play an important role in improving the quality of IMRT treatment plans.