AbstractID: 4008 Title: II: Advanced topics in IMRT treatment planning

IMRT treatment planning is fundamentally different from previous methods of computerized radiotherapy treatment planning, because (1) the user is asked to initially specify characteristics of the desired solution, and (2) the treatment plan is computer-derived using multivariable optimization techniques. Hence, the method is sometimes called 'inverse treatment planning.' However, this process is typically hindered by the need to guess which parameters will lead to an acceptably good plan. Typically the 'right parameters' to lead to an acceptably good plan are unknowable and this fact leads to a series of iterations in which the human user refines the input data guesses given to the planning system. The difficulty is related to the common commercial use of linearly weighted sums of objective function terms. It is routine, therefore, for dose hot spots and cold spots to shift, even between different structures, in an uncontrolled manner. A related paradox of the typical planning process is that normal tissue weights in the objective function should be small (so as not to negatively impact target dose characteristics) but not too small (so that dose to the structure will be reduced). Finding this range, which may not exist to satisfaction, is a trial and error process. Another difficulty is that DVH-outcome data collected using one type of treatment planning (say, 3-D conformal) probably applies less well to dose distributions which minimize just those stated metrics (as done in IMRT treatment planning). Other sources of planning error include: the relationship between DVH dose target goals and their impact on outcome, doubts about which beams should be selected, and the impact of dose algorithm accuracy on optimized target coverage. This review course session will focus on advanced IMRT treatment planning topics, including: (1) the effect of dose calculation approximations on IMRT solution characteristics, (2) beam selection techniques, (3) methods to deal with uncontrolled tradeoffs between different dosimetric objectives (e.g., prostate DVH vs. rectal DVH), including *ad hoc* methods and emerging alternatives to standard optimization methods (such as prioritized optimization), (4) radiobiological input data (e.g., DVH constraints) relevant for prostate and head and neck planning, and (5) emerging planning techniques based on radiobiological outcomes models (e.g., EUD, TCP, and NTCP). *Ad hoc* methods to control tradeoffs in current systems include multi-step approaches in which the target is optimized first, followed by adding the next most important normal tissue structure while holding the target DVH as a constraint, followed by adding other normal tissue structures, and so on. These issues will be discussed in the context of current commercial systems as well as emerging approaches.

Educational objectives:

1. Review of methods for selecting number and orientations of beams.
2. Discussion of the effect of simplified dose calculation algorithms on treatment plan quality.
3. Review of radiobiological data, including dose volume constraints, commonly used for IMRT planning of head and neck and prostate plans.
4. Discussion of practical, as well as emerging, methods to control dosimetric tradeoffs in IMRT planning.
5. Discussion of radiobiological optimization vs. dosimetric optimization.