Dose Reconstruction in Tomotherapy

Dose reconstruction may not be possible in general radiotherapy but is effective for quality assurance of tomotherapy treatments involving steep dose gradients. This process can be accomplished by calculation, measurement, or a mixture of the two. We utilize a hybrid method in which the incident energy fluence emitted from the NOMOS MIMiC multileaf collimator (MLC) is found using measured data and the dose is then computed using convolution/superposition.

The procedure has been applied to three different treatments involving phantoms. It was found that the process is a sensitive measure of the following:

-correct positioning of the phantom
-accelerator variations and corresponding normalization
-sampling of the measured data with respect to the number of beam angles
-leakage and transmission through the jaws and MLC
-mechanical behavior of the leaves.

The method is most sensitive to the positioning of the phantom, normalization of accelerator output, and leaf behavior. Problems with positioning cause systematic errors related to the magnitude of the positional changes. It is therefore essential that a CT at the time of treatment be used for dose reconstruction. Possible accelerator output variations cause delivery errors dependent upon the extent of the variations. As this method utilizes measured data, a normalization system must be chosen judiciously. Finally, mechanical aspects of the leaves such as leaf latency are problematic since they are variable in the NOMOS MIMiC. The ability to reveal such delivery errors makes dose reconstruction a very attractive tool for radiotherapeutic verification.