AbstractID: 4403 Title: Accurate dosimetry in narrow stereotactic photon fields

Dosimetric measurements for stereotactic radiosurgery or radiotherapy fields typically include determination of relative output factors, tissue maximum ratios and off-axis beam profiles. Accurate measurements of each of these quantities are made more difficult when the measured field sizes are either comparable to the detector size, or less than the distance required for lateral electronic equilibrium. These difficulties are present when measuring either single, static-field cone or micro-MLC linac-based delivery systems, or simultaneous multiple-field Gamma Knife delivery systems.

Several detector characteristics should be considered when choosing a measurement system. The detector size in the radial direction will determine the extent of the beam profile integrated in the reading. Typically solid-state detectors or film (radiographic or radiochromic) have been used to reduce this volume-averaging effect. Several other detection systems have also been used, including pin-point ionization chambers, thermoluminescence dosimetry, and diamond and scintillation detectors. Techniques exist to correct for finite detector volume, including the extrapolation of measured results to zero-volume, and deconvolution of measured data with the detector response function.

The detector energy response also should be considered due to the variation in the number of low energy scattered photons with field size and depth. Additionally, for field sizes below lateral electronic equilibrium, variations in the stopping power ratios affect the conversion of ionization to dose, particularly for higher-energy measurements. Both of these effects increase with beam energy and depth.

This lecture will provide an overview of the measurement techniques used to determine dosimetric quantities for stereotactic fields. Recommendations for measurement systems will be made, and limitations to each system will be discussed. Estimations of error will be provided, both for individual measurements and in the overall planned dose. When available, comparisons will be made with results predicted by theoretical Monte Carlo calculations.

Educational Objectives:

1. Understand the basic principles and practical aspects of clinical dosimetry for stereotactic radiosurgery.
2. Understand the limitations and applicability of various detector types and sizes for small field measurements.
3. Understand current techniques available to correct data measurements in small fields.