

AbstractID: 12073 Title: Quality Assurance for the Leksell Gamma Knife
PerfexionTM

The Leksell Gamma Knife_Perfexion_ is the latest gamma stereotactic radiosurgery (GSR) unit manufactured by Elekta (Elekta Instrument, AB, Sweden). Introduced in 2006, it is substantially different in design and operation from previous Gamma Knife (GK) models. The major differences are in the collimation system, the configuration of the radioactive ⁶⁰Co sources, and in the patient positioning system. The Perfexion_ has one fixed tungsten collimator containing 576 different collimating channels, whereas older GK models have one primary collimator, located inside the unit, and 4 interchangeable secondary collimators that are mounted manually. In the Perfexion_, 192 ⁶⁰Co sources are situated on 8 moveable sectors (24 sources per sector), that slide over the collimator placing the sources over the planned collimating channels to deliver the desired radiation shot size. In older GK models, by contrast, 201 ⁶⁰Co sources are fixed in space and arranged in a pseudo-hemispherical configuration. Finally, for the PerfexionTM the treatment table, which moves with sub-millimeter accuracy in three orthogonal directions, is the patient positioning system. For older model GK units, patient positioning is accomplished by attaching the Leksell stereotactic frame to the secondary collimator via specialized hardware called trunnions or via the automatic-patient-positioner (APS).

The specific goals of quality assurance (QA) for gamma stereotactic radiosurgery include determining the dose rate for the largest available collimator, measuring the relative output factors and beam profiles for each collimator size and comparing the results to those used in or calculated by the treatment-planning program, and verifying that the radiation focal point coincides with the center of the patient positioning system. Although these QA tasks for GSR units have remained essentially unchanged over the years, new tools and protocols designed for linear accelerator QA have become available that can be applied to QA for GSR devices. With this in mind, a new AAPM Task Group (TG-178) has recently been formed and charged with updating QA procedures for older GSR devices that have static sources, creating new QA protocols for GSR devices that are characterized by moving sources, and suggesting a protocol for ionization chamber calibration specific to GSR devices.

This lecture will describe the operation of the Leksell Gamma Knife_Perfexion_ and the unique features of QA for GSR units, with emphasis on the Perfexion_. Some of the questions faced by TG-178 will be discussed, old QA procedures will be reviewed and possible new QA tests will be suggested.

Learning Objectives:

- 1) Review QA requirements for GSR units
- 2) Understand the design differences between older GK models and the Perfexion_ and the implications of these differences on routine QA
- 3) Become familiar with tools provided by the manufacturer to facilitate GK QA
- 4) Understand the difficulties associated with dosimetric calibration of GSR units
- 5) Review the use of radiochromic film for GK QA