Output Factors and Dose Profiles for Gamma-Knife Collimators.

Because the spatial resolution of ionization chambers (primary dosimeters) is limited by their spatial dimensions, the accuracy of small field measurements (e.g. stereotactic radiosurgery fields) can be compromised by volume averaging. An example is the output factor for 4mm collimator of the Leksell Gamma-Knife. Based on radiochromic film measurements, Kellerman et al (Phys. Med. Biol. 43, 1998, p2251) reported that the recommended relative output factor for 4 mm collimator (OF for 4 mm/OF for 18mm =0.8) is found to be lower than their measured value. During the commissioning of our Leksell Gamma-Knife model B, we paid special attention to the 4mm collimator to resolve this controversy. Ionization chambers traceable to NIST, 1 mm^3 TLDs and Radiochromic film are used to measure the relative output factors as well as dose profiles. TG-21 calibration protocols were followed for ionization chamber measurements. Dose profiles and absolute doses were measured along X-axis. 6 MV photon beam is used for absolute calibration. Irradiated Radiochromic films were scanned in a He-Ne laser densitometer at 635 nm wave length. For output measurements of the small fields the ion chamber measurements are inaccurate. Both Radiochromic film measurements and 1mm TLD measurements showed good agreement with the Leksell GammaPlan treatment planning system within their experimental uncertainties. The relative output factors measured using radiochromic film were found to be closer to the manufacturer provided values than Kellermann et al.