

**Purpose:** Geometric accuracy of single-isocenter Gamma Knife delivery has been well established to within 0.3 mm. The question frequently asked is the accuracy of the full-procedure Gamma Knife treatments, particularly important for large tumors requiring multiple isocenter deliveries. In this study, we performed direct measurements to determine such accuracy.

**Method and Materials:** An anthropomorphic head phantom with a central spherical target of 3.0 cm in diameter was employed for measurements. We placed the stereotactic frame on the phantom and followed identical imaging and treatment protocols for treatment planning and beam delivery. CT scans of varying slice thicknesses of 1 mm, 2 mm and 3 mm were acquired and used for treatment planning calculations. The phantom was irradiated using 16 isocenters delivered with Gamma Knife automatic patient positioning system (APS). Radiochromic films aligned with the center of the target were exposed. The isodose measurements were compared with the 3D dose calculations from the treatment planning system (Leksell GammaPlan Wizard 4C).

**Results:** The overall agreements were found to be approximately 2 mm between the measurements and dose calculations. The agreement was slightly better (approximately 1.5 mm) for the peripheral isodose line (e.g., 50% of the maximum dose) but deteriorated significantly (2-4 mm) for low (e.g., 30% of the maximum dose) or high isodose lines (e.g., 80% of the maximum dose). The 2-mm dose accuracy showed no dependence on the slice thickness of the CT studies. The 2mm overall accuracy is closely matched the dose grid box resolution of 1.8 mm that was needed to encompass the full target volume for calculations.

**Conclusion:** Overall accuracy of Gamma Knife irradiation of a large target was found to be approximately 2 mm, regardless the slice thickness of acquired images. The dose grid resolution was likely the dominant factor contributing to this result.