AbstractID: 7211 Title: Commissioning of a CyberKnife G4 system at Stanford University Medical Center

Objective: A CyberKnife G4 system was installed at SUMC in September 2006. Unique challenges involved in the commissioning process of this system such as determination of k_Q for absolute calibration, direct TPR measurement, output factor measurements for small collimators, and radiation dose verification are discussed. Comparisons are made between this newer G4 system and the older G3 system at SUMC which was also recently recommissioned as part of an upgrade.

Methods: An anthropomorphic head phantom was used for testing four different available tracking modes. All beam data acquisition and measurement were performed with either an Accuray small solid water phantom or a Wellhofer water phantom. A minor modification of the TG-51 protocol was implemented in order to determine the beam quality factor k_Q. A PTW Farmer's ion chamber TN30013 was used for absolute calibration and dose verification. Scanditronix SFD and RFD diodes as well as a PTW 60008 diode were used for all relative dose measurements.

Results: All subsystem functionalities were verified to agree with the manufacturer's specifications. The system targeting accuracy was less than 0.4 mm for 6D skull, spinal skeleton, 6D fiducial, and Synchrony tracking. The beam quality factor k_Q was determined to be 0.9917. Radiation leakage at 1.5 cm depth and 80 cm SAD measured at 0.16 cGy/min when the CyberKnife robot was in transit or standby. Radiation dose delivery at the center of the target was within 1% as planned. The output factor for 5 mm collimator was 0.710 at 80 cm SAD. Directed TPR measurements, field width, flatness, symmetry, and penumbra agreed with composite data collected by Accuray.

Conclusions: The performance of the CyberKnife G4 system satisfied the manufacturer's specifications. This sophisticated combination of robotics and near-real-time imaging guidance allows frameless stereotactic radiosurgery for both intracranial and extracranial lesions to be delivered with submillimeter accuracy.