AbstractID: 13951 Title: Patient-Specific independent GammaPlan Quality Assurance for Gamma Knife Perfexion

Purpose: One of the most important aspects of Quality Assurance (QA) in radiation therapy is redundancy of patient treatment dose calculation. This work is focused on the patient-specific time and 3D dose treatment plan verification for stereotactic radiosurgery using Lexell Gamma Knife® Perfexion™ (LGK PFX).
Method and Materials: The virtual model of LGK PFX was built in Matlab™, based on the physical dimensions of this modality supplied by the manufacturer. However, in our model, the ring-specific linear attenuation coefficients (LAC) and output factors (OFs) reported by the manufacturer were replaced by the measurement-based collimator size-specific OFs and a single LAC=0.0065 mm^{-1}, as the manufacturer-supplied parameters resulted in 6-9% lower absolute dose in all cases. Depths for each LGK PFX shot was obtained by ray-tracing technique, and the dose calculation formalism was identical to the one used by GammaPlan treatment planning software. The architecture of the QA process was based on the in-house on-line database search code that retrieved the LGK PFX plan-specific information. A series of QA phantom plans was examined to verify geometric and dosimetric accuracy of our software. This was followed by calculation of a series of patient plans, which aimed at establishing action limits for our QA process.
Results: The shot time/focus point dose verification for each shot takes less than 1sec/shot with 3Disodose verification taking about 30sec/shot, database access time being less than 0.05sec. The geometric accuracy (location of the point of maximum dose) of the phantom and patient plan was dependant on the resolution of the original dose matrix and was of the order of 1-1.5pixel. Dosimetric accuracy of our calculated phantom and patient point dose was within 3-3.5% from the GammaPlan with the mean=2.3% and SD=1.1%.
Conclusion: The process for independent pre-treatment patient-specific Gamma Knife Perfexion time and dose verification was created and validated.