A Novel Image-Guided Rotating Gamma System for Intracranial Radiosurgery

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Objectives: A novel image-guided rotating gamma system has been developed for frame-based high-precision stereotactic radiosurgery (SRS) and frameless fractionated stereotactic radiotherapy (SRT). This work reports the dosimetric and treatment quality of this SRS/SRT system for intracranial SRS/SRT.

Methods: The Galaxy RTi system (Akesis, Concord, CA) consists of a rotating gantry, a focusing treatment head with 30 Co-60 sources, a kV cone-beam CT system and a 3D automated couch. It is a high-precision (0.5mm) SRS/SRT system with real-time and inline CBCT + kV/kV imaging. The gantry rotates at a speed up to 4 RPM delivering 30 non-coplanar, non-overlapping arcs simultaneously to form a spherical dose distribution with sharp penumbra. The compact source drawer combined with four collimators (4mm, 8mm, 14mm, 18mm) offers various possibilities to shape the dose distribution and to avoid critical structures. We investigated Galaxy's treatment quality by comparing treatment plans from previously treated Gamma Knife LGK 4C patients. Galaxy plans were generated using the Prowess TPS (Prowess, Concord, CA) with the same dose constraints and optimization parameters. Treatment quality metrics such as target coverage (%volume receiving the prescription dose), conformity index (CI), cone size, shots number, beam-on time were analyzed together with DVH curves and dose distributions.

Results: Ten intracranial patients were investigated in this work with the tumor volume ranging from 0.1 to 15.4 cc. The mean CI and dose coverage for Galaxy plans was 1.77±0.22 and 99.24±0.33% compared to 1.94±0.48 and 99.19±0.67% for LGK plans, respectively. The beam-on time for Galaxy delivery was 17.42±5.79 minutes compared to 21.34±7.35 minutes for LGK (both assuming dose rates at the initial installation). The dose fall-off is much faster for the Galaxy system, compared with LGK.

Conclusion(s): The Galaxy RTi system is a new SRS/SRT system with inline CBCT that can provide superior dose distributions similar to that of LGK with less beam-on time and faster dose fall-off. The system is also capable of real-time image guidance at the treatment position to ensure accurate dose delivery for SRS/SRT.