AbstractID: 11421 Title: A novel image guided Stereotactic Radiosurgery strategy employing Virtual Frame preplanning and frame based treatment

Purpose: This study investigates a novel image-guided cranial SRS strategy consisting of an invasive frame for rigid-immobilization coupled with cone-beam-CT (CBCT) and a six-degree-of-freedom (6DOF) couch. A preplanning process was developed based on a virtual frame (VF) system which allows avoiding treatment through the invasive frame.

Method and Materials: A head phantom with a 9/16″ diameter steel-ball target inside was used to test the proposed strategy. A CT-simulation of the head phantom was performed followed by a treatment planning in Pinnacle with non-coplanar beams. The VF toolkit consisting of a 3D-surface mesh representation of invasive frame was used to optimize frame location to avoid beam-frame interference. The real frame was then placed on the phantom guided by the VF frame-skull measurements and CBCT-guided alignment was performed with a 6DOF couch. A MV portal image was taken for each beam with a 24x24mm^2 open-field exposure. The displacement vector between the centers of the square and the ball on portal image was used to quantify delivery accuracy. Two different invasive frames (Leksell&BrainLab) were tested and the end-to-end delivery accuracy was obtained.

Results: VF system can effectively guide frame placement to avoid treatment beams. The frame itself does not introduce serious artifacts on CBCT images. With 6DOF couch the positioning error can be reduced to sub-millimeter level. The end-to-end tests for two invasive frames both achieved the delivery accuracy within 1.5 mm.

Conclusion: A new strategy of using VF based preplanning and invasive frame based immobilization for image-guided single-fraction SRS was demonstrated in a phantom study. VF system based simulation enables the preplanning prior the treatment day limiting the time required to plan on the day-of-the procedure. The image-guided treatment using invasive frame keeps high accuracy of patient positioning and radiation delivery. The strategy also eliminates the necessity of frequent intra-fraction motion monitoring.