AbstractID: 6820 Title: Accuracy assessment of an optic-guided target localization system for non-invasive intra-cranial SRS using CBCT-based 3D/3D match

Purpose: To assess the total accuracy of an optic-guided target localization system for non-invasive stereotactic radiosurgery(SRS) of intra-cranial lesions using a 3D/3D match based on an on-board imager(OBI) CBCT.

Methods and Materials: A head phantom with 5 gold markers and data from 32 SRS/IMRS patients with intracranial lesions were used to validate the localization accuracy of Varian Trilogy frameless SRS system. For all the cases, a Varian stereotactic mask system was used for immobilization and planning CT was acquired with a slice thickness of 1.25mm. The target was first localized under the guidance of the optical positioning system through monitoring the reference fiducials on the phantom or on a custom biteblock fixed on the maxillary dentition for real patients. kV-OBI images and CBCT with a slice thickness of 1.0mm were then acquired. 2D/2D registration between kV-OBI images and DRRs and 3D/3D registration between CBCT and planning CT were performed. For real treatments, the online setup was adjusted based on the 3D/3D registration. Offline analysis of the total accuracy of optic-guided positioning system and kV image-based 2D/2D match was evaluated with the CBCT-based 3D/3D match as benchmark.

Results: The optical positioning system provided a target localization accuracy of 0.9±0.4mm for the phantom study and 1.3±0.4mm for the clinical investigation. The errors encountered mainly consist of the camera calibration inaccuracy, the biteblock repositioning reproducibility and the fiducial registration inaccuracy. With the aid of the kV image-based 2D/2D match, the target localization accuracy improved to 0.5±0.3mm for clinical cases.

Conclusions: The non-invasive frameless SRS can provide a target localization accuracy of about 1.3mm with the aid of optical positioning system. If combined with kV images or CBCT, the system has the capability of delivering similar accuracy as that of a frame-based invasive system(~0.5mm), providing an excellent tool for fractionated treatment without patients' discomfort.