AbstractID: 10796 Title: Imaging Guided Frameless Stereotactic RadioSurgery using CBCT 6D Image Registration and 6D Couch on Novalis Tx™ System

Purpose: To investigate localization accuracy for image-guided frameless stereotactic-radiosurgery (IG-SRS) using CBCT 6D image registration and 6D-couch on Novalis Tx system.

Method and Materials: Novalis Tx system is a powerful radiosurgery system featuring BrainLAB 6D-couch and Varian CBCT. In this work, we performed phantom and patient studies to investigate IG-SRS with CBCT 6D guidance. In phantom studies, a head phantom was positioned on couch, scanned with CBCT, and matched with planning CT using 6D image registration. Matching results were used to test accuracy of CBCT 6D/6D match for correcting translational and rotational setup errors. In patient studies, 10 intracranial SRS cases were randomly selected. Patients were initially positioned with BrainLAB mask system with target-positioning-overlays (TAPO). Patients were then scanned with CBCT, and positions were adjusted based on CBCT. Discrepancies between CBCT 3D/3D match and 6D/6D match were quantitatively analyzed.

Results: Phantom experiments showed that translational discrepancies in root-mean-square (RMS) were 0.39, 0.23, and 0.36mm along lateral, longitudinal, and vertical directions. Rotational discrepancies in RMS were 0.38^o, 0.19^o, and 0.22^o in pitch, roll, yaw, respectively. In retrospective patient studies, setup displacements measured in RMS between BrainLAB TAPO and CBCT 6D/6D match were upto 2.5mm translationally and 1.0^o rotationally. If positioning was corrected using CBCT 3D/3D match, translational discrepancies in RMS were <0.5mm except 0.71mm in vertical, and rotational displacements in RMS were 0.67^o, 0.88^o and 0.22^o in pitch, roll, yaw, as compared with CBCT 6D/6D match. CBCT guided 6D correction was performed in two cases to achieve necessary positioning accuracy. After 6D adjustments, translational and rotational displacements of upto 4mm and 0.9^o were measured in CBCT 6D/6D match were fully corrected using 6D-couch.

Conclusion: CBCT 6D/6D match offers unprecedented view to verify patient positioning in both translations and rotations. Combined with 6D-couch, translational and rotational setup errors can be effectively minimized.