AbstractID: 3176 Title: Independent Measurement of CyberKnife Synchrony Accuracy Using Optical Tracking

Purpose:
Synchrony provides respiratory motion compensation for CyberKnife by monitoring skin motion and dynamically steering the beam to follow the moving tumor. This study is designed to measure the accuracy and precision of the beam steering by recording the motions of both the linac and a ball-cube target using an independent optical tracker.

Method and Materials:
The target is a ball-cube phantom, which was CT scanned and planned for a 3000 cGy at 100% isodose line treatment using dynamic SRS (Synchrony). Respiratory motion was generated using a computer-controlled 3D motion simulator. We simulated regular respiratory motion as three sinusoids with the following extents: 10 mm SI, 10 mm AP, and 5 mm LR. The respiratory period was 5 seconds. All three axes were in phase. We used the Optotrak Certus (Northern Digital, Waterloo, Canada) optical tracking system for measurements in this study. Active LEDs were attached to the linac and the motion simulator to provide constant measurement of their position. Measurements were recorded at 30 Hz. We measured the tracking accuracy by computing the distance between the linac and the target. When Synchrony is active, the linac should follow the motion of the target exactly, so this distance should remain constant. We used the standard deviation of the linac-to-target distance during each beam as a measure of the beam steering accuracy.

Results:
We were able to track 61 of the 98 beams used during treatment. Other beams were not trackable because the linac or robot blocked the view of the Optotrak. Based on these beams, the standard deviation of the linac-to-target distance was 0.82 +/- 0.27 mm.

Conclusion:
These measurements provide independent, high-precision measurement of the tracking accuracy of CyberKnife with Synchrony. They demonstrate the system's capabilities for respiratory motion compensation.