AbstractID: 3359 Title: Inter and Intra-fractional Patient Motion for a Set of Immobilization Devices

Purpose: We assessed the magnitude of inter- and intra-fractional patient motion for a broad set of immobilization devices.

Method and Materials: In our practice for proton radiotherapy, we verify patient setup prior to each treatment field by means of digital imaging. Deviations from the “expected” patient position (with 6 degrees of freedom on our patient positioner) are stored in a database and were retrospectively analyzed for patient setup accuracy. Data was analyzed for each ordinal direction and for the combined spatial displacement. Immobilization devices were separated into “rigid” and “non-rigid” devices depending on their connection to the patient positioner.

Results: Systematic offsets in intra-fractional motion are small for all immobilization devices, and less than 0.2mm for translations and less than 0.1 degrees for any rotational axis. Although the mean translation per ordinal direction is often smaller than 1mm, the mean spatial displacement for intra-fractional motion for rigid devices is 1.3mm compared to 1.9mm for non-rigid devices. The modified Gill-Thomas-Cosman frame controlled intra-fractional patient motion best, with a 95% probability (v95) of observing less than 1.8mm of motion. For the widely used IC-mask, the v95 value is below 3mm. All other immobilization devices have a v95 greater than 3.0mm for intra-fractional patient motion, while the mean spatial inter-fractional displacement (rigid devices only) was at least 3mm with a v95 of at least 6mm.

Conclusion: Intra-fractional patient motion is generally smaller than inter-fractional patient motion, which indicates that immobilization devices are better at maintaining a certain patient position than at reproducing this position between fractions. Immobilization devices that rigidly connect to the patient positioner ensure better immobility than those that do not. However, none of the immobilization devices achieved sub-millimeter immobility. Patient position verification remains necessary to achieve high setup accuracy.

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