Clinical use of a real-time surface image-guided positioning and tracking system in proton therapy

**Topic of interest:** Clinical applications of AlignRT$^{3c}$-cameras real-time surface image-guided positioning system (IGPS) for positioning patients to reduce the number of X-ray images and tracking intra-fractional movements in proton therapy.

**Methods:** The AlignRT$^{3c}$ system was configured near perpendicular to the gantry rotation for accommodating the X-ray IGPS. To evaluate positioning accuracy, more than 10 surfaces (Figure 1) of each patient for ten patients with intracranial tumors were acquired after patients positioned by X-ray IGPS. Displacements between acquired surfaces and the reference surface taken at 1st day of treatment were examined. Intra-fractional movements with respiratory was studied with gated surface that (Figure 2) allows setting the reference surface for patient at exhale during breathing. Intra-fractional movements due to respiratory were monitored on 10 sections of each patient for three patients with thoracic tumors.

**Results:** Accuracy of positioning patient (Figure 3) is 2.0mm at both anterior-posterior and lateral directions, and is 3.5mm in superior-inferior (SI) direction by aligning the surfaces of masks. Observed larger displacements along SI direction can be due to patient’s movements within the mask. Periodical displacements (Figure 4) within 5mm compared to its reference were seen for the three patients with thoracic tumors. However, 10 mm sharp displacements with a few seconds were observed when patient moved the body.

**Conclusions:** We have implemented the first AlignRT$^{3c}$ IGPS for proton therapy for positioning patients within 2mm, and successfully tracked intra-fractional respiratory motion during treatment after positioning patient.

**References:**