Purpose: On-board optical 3D imaging enables measuring daily setup patient uncertainties without involving any additional imaging-induced radiation dose to critical structures. We hypothesize that the tumor and normal organ deformation caused by routine patient head and neck misalignments can be determined by coupling a quantitative patient-specific biomechanical model with quantitative skin surface 3D imaging.

Methods: A set of 3D cameras are used to track the patient anatomy externally. One of the cameras employed a marker less face recognition and tracking for delineating the region of the patient's face. The location of the face was then shared among the camera controllers in real-time and the anatomical contour that closely matches the face region is selected and integrated to form a single 3D anatomical representation. Patient surface aligning was performed between the patient's external surface obtained from a reference 3D anatomy (simulation CT, MRI, patient surface map from previous fraction) and the above-mentioned camera system to quantify the daily patient setup variations. For each of the 3D patient surface, a point feature histogram (PFH) was first generated. Once the PFH descriptors were generated, a non-rigid iterative closest point registration algorithm that minimizes the difference in the PFH descriptor aligns the patient surface to the reference 3D anatomy.

Results: The proposed tracking system was able to track both the patient surface setup uncertainty and the internal anatomy when coupled with a patient specific biomechanical head and neck model.

Conclusions: A 3D head and neck tracking system that monitors the interfraction patient setup uncertainties in the head and neck cancer patient is presented. The aligning process was shown to perform for cases with and without the head immobilization system. The external patient surface manifold and the motion vectors will be coupled to align the biomechanical model using model-guided techniques.