Purpose: We developed an optical image guidance system to manage patient's inter-fractional set-up errors by tracking external markers at the specific positions (e.g., nose tip) behind a full facemask. However, a problem associated with the reproducibility of the marker positions during the entire course of treatments still remains. In order to remove this disadvantage, we applied the arbitrary-point-to-plane registration method to our existing system.

Methods: Infra-red (IR) reflecting markers were attached on arbitrary positions of the head phantom's face and then the phantom was immobilized by a full face thermoplastic mask. 3D coordinates of the IR markers behind the full facemask were reconstructed by the calibrated stereo camera system using the direct linear transform (DLT) algorithm. In order to match arbitrarily attached markers with a planning CT image, rough positions of three markers were manually defined (rough registration) and then the coordinates of all markers were determined through the point-to-plane registration using the contractive projection point (CPP) algorithm (fine registration). In addition, the marker registration error in 6 DOF was calculated. In order to validate accuracy of the system, the phantom was intentionally moved according to 10 sets of known translation parameters.

Results: A mean target registration error (TRE) determined by the experiments for arbitrarily attached markers was 1.24 ± 0.32 mm. The fine registration following the rough registration allowed fast and robust registrations.

Conclusions: The proposed solution for arbitrarily attached markers behind a full facemask enables us to avoid any daily errors in attaching the external markers at the specific positions.

Funding Support, Disclosures, and Conflict of Interest:

This work was supported in part by the SNU interdisciplinary project (2009-2010) and the SNU Brain Fusion project (2010-2011).