AbstractID: 3926 Title: Detecting Treatment Setup Errors for Head and Neck IMRT Patients with Multiple CT Scans

Purpose: Conventional methods determine treatment setup errors in patients undergoing intensity-modulated radiotherapy (IMRT) by using orthogonal portal images that only detect translational errors. This study utilizes image-guided radiotherapy to develop and test an algorithm for detecting both translational and rotational setup errors in head and neck patients with multiple CT scans.

Method and Materials: To confirm the accuracy of the proposed algorithm to detect translational shifts, it was tested using a constructed phantom with four embedded metal marks. Upon verification, ten head and neck patients with two temporally-independent CT scans were selected. For each patient, the translational and rotational errors were calculated by aligning selected bony landmarks from the two scans using matrix transformation with an incremental guess-check method. For comparison, the translational errors were also obtained by co-registering the two scans using the same landmarks with a commercial treatment planning system and comparing the isocenter of the second CT with that of the first CT. The contribution of the rotation to the translational error represents the difference between the translational shifts as computed by the algorithm and the conventional method.

Results: The results of this study showed that the average magnitude of the rotational errors about the transverse, anterior-posterior, and longitudinal axes were $2.3° \pm 2.2°$, $1.3° \pm 0.9°$, $2.1° \pm 1.6°$, respectively. The average contribution of this rotation to the translational error in the left-right, anterior-posterior, and longitudinal directions were 3.1 ± 3.2, 2.0 ± 4.4, 4.4 ± 7.3 mm, respectively. In general, the greater the rotational error in the setup, the greater the subsequent translational difference between the methods.

Conclusion: This study found that rotational errors do contribute significantly to the treatment setup error for head and neck IMRT patients. The proposed algorithm can detect these rotations and, consequently, more accurately determine the translations setup error.