AbstractID: 7281 Title: Image Guided Neutron Therapy: A Six Degree Correction Method Using Implanted Fiducial Markers

Purpose: To develop and assess the accuracy of a novel repositioning scheme based on implanted gold markers and orthogonal films to reduce the treatment margins in fast neutron radiotherapy. This repositioning scheme corrects for both translational and rotational deviations due to set up error and/or patient organ movement.

Method and Materials: The proposed repositioning scheme involves five gold markers that are implanted into the structure to be localized. Geometric errors are estimated based on relative differences in the positions of the gold markers between the CT locations and 3D coordinates reconstructed from two orthogonal films. An in-house developed computer software automatically calculates the six correction parameters (three translation and three rotation) using a PointSet-to-PointSet co-registration algorithm that iteratively finds the optimal solution. All gold marker coordinates and shifts are referenced to the isocenter. The accuracy of the repositioning scheme was evaluated using phantom experiments. A phantom containing five gold markers was moved and rotated to 23 different positions and the repositioning scheme was applied to each case. These positions include translational and rotational movements in different directions with magnitude ranging from 1-15 mm and 2-10 degrees for translation and rotation, respectively. The calculated correction parameters were compared to the known movements to assess the accuracy of the repositioning method.

Results: In all 23 cases, the repositioning scheme was able to very accurately correct the induced geometric errors. The mean correction error, defined as the difference between the calculated correction values and known movements, was 0.37 mm for translation and 0.74 degrees for rotation.

Conclusion: The proposed repositioning scheme and software corrects for both translational and rotational geometric errors and achieved very high accuracy in the phantom experiment. Its application in clinical fast neutron radiotherapy will serve to reduce the irradiated volume and associated normal tissue complications.