AbstractID: 2576 Title: On the use of Optically Guided 3D-Ultrasound for daily in room target localization

Purpose: To describe the commissioning, quality assurance and clinical use of optically guided 3D-ultrasound guided patient positioning systems.

Method and Materials: To determine the absolute localization accuracy of an optically guided 3D-ultrasound guided patient positioning system an absolute coordinate system using optical-guidance was established and spherical targets at various depths were localized. In order to test the ability of this system to determine the magnitude of an internal organ shift with respect to the treatment isocenter, a phantom that closely mimics the typical human male pelvic anatomy was used. With the phantom on the treatment couch, optical guidance was used to determine the positions of each organ to within imaging uncertainty, and to align the phantom so the plan and treatment machine coordinates coincided. To simulate a clinical misalignment of the treatment target, the phantom was shifted by different precise offsets, and an experimenter blind to the offsets used ultrasound guidance to determine the magnitude of the shifts. In order to assess the inter-user variability of 3D-ultrasound image guidance, four experienced operators determined independently determined the daily organ shifts for the same 5 patients for 5 consecutive fractions. Moreover, in order to assess the extent of prostate motion during the time required to deliver a treatment, ultrasound localization was repeated at the end of treatment for 6 patients for a total of 29 fractions. For all patients treated at our institution for prostate cancer the prostate is immobilized using a rectal balloon.

Results: The accuracy of the system for localization of spherical targets imbedded in a phantom at depths ranging from 3 to 13 cm was determined to be (average ± standard deviation) AP = 0.2 ± 0.7 mm, Lat = 0.9 ± 0.6 mm, Ax = 0.6 ± 1.0 mm. For the phantom organ motion test the magnitude of the shifts could be determined on average to within 1.0 mm along each axis. The interuser variability was found to be small in comparison to the shifts indicated, showing that these shifts would have been worthwhile making in order to reduce the risk of geographical miss of the target. For the intrafraction prostate motion experiment the post-treatment ultrasound showed a mean prostate shift of 1.9 ± 1.0mm. The shift was within the imaging uncertainty of the system for 25 of the 29 fractions.

Conclusion: If users are adequately trained in the use of optically guided 3-D ultrasound target localization it can be a valuable tool for aligning patients and allow for the use of reduced margins and more aggressive fractionation schedules.

Learning Objectives:

1. Commissioning and quality assurance of optically guided 3D ultrasound patient positioning systems.
2. The clinical use of optically guided 3D ultrasound patient positioning systems.