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Abstract

Introduction of a Biometric, RFID and Surface Monitoring System Application on SRS/SBRT

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Objectives We present and evaluate a novel biometric authentication, RFID, and surface imaging technology for improving the safety and efficiency of patient setup and motion monitoring for SRS/SBRT treatments. Methods The study includes four basic function evaluations: biometric palm identification, presence of treatment accessory device with location/orientation verification, patient loading position orthopedic setup verification, and patient body surface monitoring during imaging and treatment. Patient-specific treatment accessory presence and their correct position/orientation on the treatment couch are verified via RFID and surface cameras. Duplication of initial patient position and orientation at loading position in treatment vault is accomplished by patient self-positioning according to augmented reality, color-coded video feedback agreement of real-time patient surface with a reference simulation-CT surface. Surface matching at treatment position can be done by matching current surface with simulation-CT body contour, or with captured reference surface. Intra-fractional patient motion can be monitored during IGRT imaging and treatment delivery. The tolerance of patient offset can be individually preset for both translation and rotation. A biometric, RFID and surface monitoring system is characterized and its application to SRS/SBRT treatments was evaluated on three prostate SBRT patients and one brain SRS on a Rando phantom. Results The system combines face photo and palm ID techniques, which was seen as an
improvement over the previous patient ID procedure of face photo and date of birth, especially for non-English speakers. The direct RFID verification of treatment accessory presence and position was regarded as superior to the previous process of assuming that the therapists had followed the setup instructions correctly, and was viewed as being capable of eliminating treatment accessory deviations. This feature is especially valuable for SRS/SBRT setup due to the extremely high delivered doses. Orthopedic patient setup verification directly matches patient orientation between CT simulation and treatment, helping duplicate the exact patient treatment posture as planned. Treating therapists reported a noticeable improvement in efficiency and accuracy of orientation from the patient being allowed to self-position. This efficient and accurate patient setup is extremely valuable for SRS/SBRT treatment. It is important to monitor patient intra-fractional motion during imaging and treatment for SRS/SBRT due to their small tumor margin and large fractional dose. Surface imaging has been shown to be an effective tool for patient motion monitoring. The intra-fractional motions recorded during treatment by studied system for three SBRT patients were within 3mm and 2

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degree within the pre-selected region of interest (ROI). The ROI included the pubic bone and a narrow band of the lower abdomen which has limited motion during respiration. The observed system accuracy for a mock non-coplanar arc SRS treatment on the Rando phantom was within 0.6mm and 0.6 degree. Conclusion The combination of biometric, RFID, and surface matching technologies was observed to be an effective process for enhancing safety and efficiency of the SRS/SBRT treatment.