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Three-Dimensional MRI and Cone-Beam CT Matching for Localization of Prostate Cancer Treatment

PURPOSES: There is a growing interest using MRI only for prostate cancer treatment planning. This study is aimed to investigate clinical feasibility of matching 3D planning MRI to on-board cone-beam CT (CBCT) images for target localization.

MATERIAL AND METHODS: Five patients treated with prostate cancer were analyzed in this retrospective study. In addition to conventional treatment planning CT, planning MRI images were acquired for each of these patients for better soft tissue delineation. The MRI images were fused to the planning CT during the clinical planning process. Nine sets of on-board CBCT images were acquired prior to treatment from these patients. On-board patient position correction was performed using planning CT-CBCT matching for all the treatments. In this study, both CT-CBCT matching and MRI-CBCT matching were performed to localize the treatment isocenter. The couch shifts for isocenter placement from each matching were recorded to evaluate localization accuracy. The relative differences of the couch shifts between the MRI-CBCT matching and CT-CBCT matching were analyzed to assess the accuracy of the MRI-CBCT matching relative to the CT-CBCT matching.

RESULTS: The couch shifts in lateral, longitudinal and vertical directions based on the MRI-CBCT matching are 0.18 ± 0.12 cm, 0.18 ± 0.16 cm, and 0.38 ± 0.12 cm, respectively. The differences of the couch shifts between the MRI-CBCT matching and CT-CBCT matching are 0.23 ± 0.10 cm, 0.29 ± 0.19 cm, and 0.30 ± 0.21 cm along the lateral, longitudinal and vertical directions, respectively.

CONCLUSIONS: Target localization based on matching between 3D planning MRI and on-board CBCT is feasible for the radiation treatment of prostate cancer.