

Validation of the ExacTrac Implanted Marker Workflow Using Synthetic CT for MR-Only Prostate Radiotherapy Planning: A Phantom Study

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Purpose

To support MR-only prostate radiotherapy planning, a synthetic CT (sCT) dataset was generated from prostate MRI acquired on the Siemens MAGNETOM Vida 3T MRI simulator at Princess Alexandra Hospital. As the ExacTrac implanted marker workflow is the preferred image-guidance approach for stereotactic prostate treatments at our institution, this study evaluated the feasibility of using ExacTrac version 2.0.2 with an in-house prostate MRI phantom.

Materials and Methods

The sCT dataset was reconstructed from a large-field-of-view (LFOV) T1 VIBE Dixon sequence. The sCT images were resampled to meet the ExacTrac image resolution requirement (512×512 pixels) while accounting for the increased matrix size resulting from couch insertion. Known 4-mm translational offsets in the vertical, lateral, and longitudinal directions were introduced to assess beam-hold functionality of the ExacTrac implanted marker workflow.

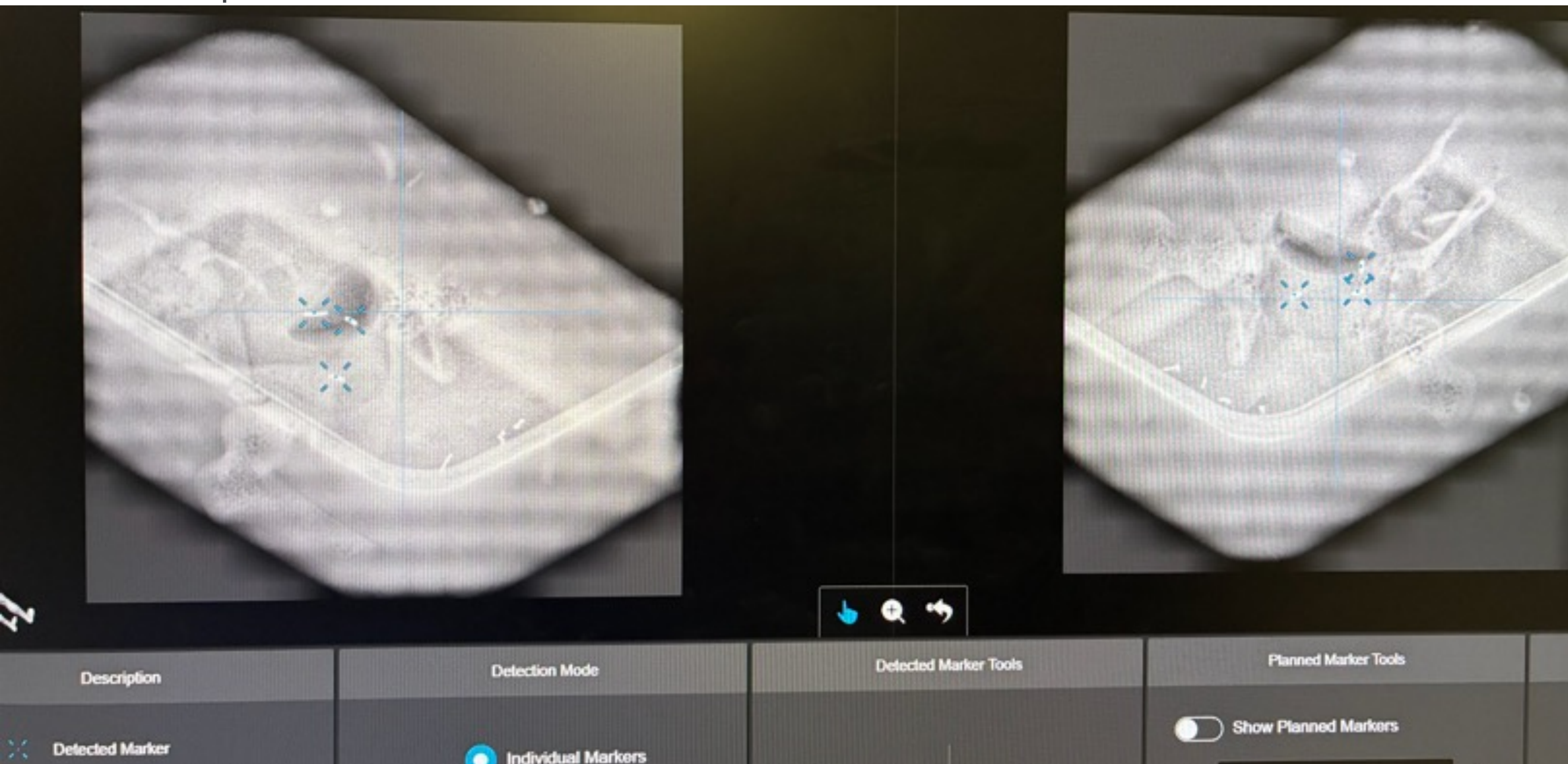


Figure 1. ExacTrac successfully detected the fiducial marker centres for the VMAT plan using the sCT dataset.

Results

As fiducial markers are not modelled in the sCT dataset, they were not visible on the reconstructed sCT images. Registration therefore relied on fiducial marker contours generated on the T1-weighted MRI and propagated to the sCT dataset. Using paired kV X-ray images, ExacTrac successfully identified the fiducial marker centres for a VMAT plan using the sCT dataset. All introduced 4-mm translational offsets were detected, with a maximum difference of 0.2 mm in the lateral direction. Surface deviations detected by ExacTrac were also consistent with those observed on the paired kV X-ray images.

Conclusion

This phantom study demonstrated the technical feasibility of using the ExacTrac implanted marker workflow with the sCT dataset for MR-only prostate radiotherapy planning. Clinical implementation of the ExacTrac implanted marker workflow using sCT remains subject to vendor approval.

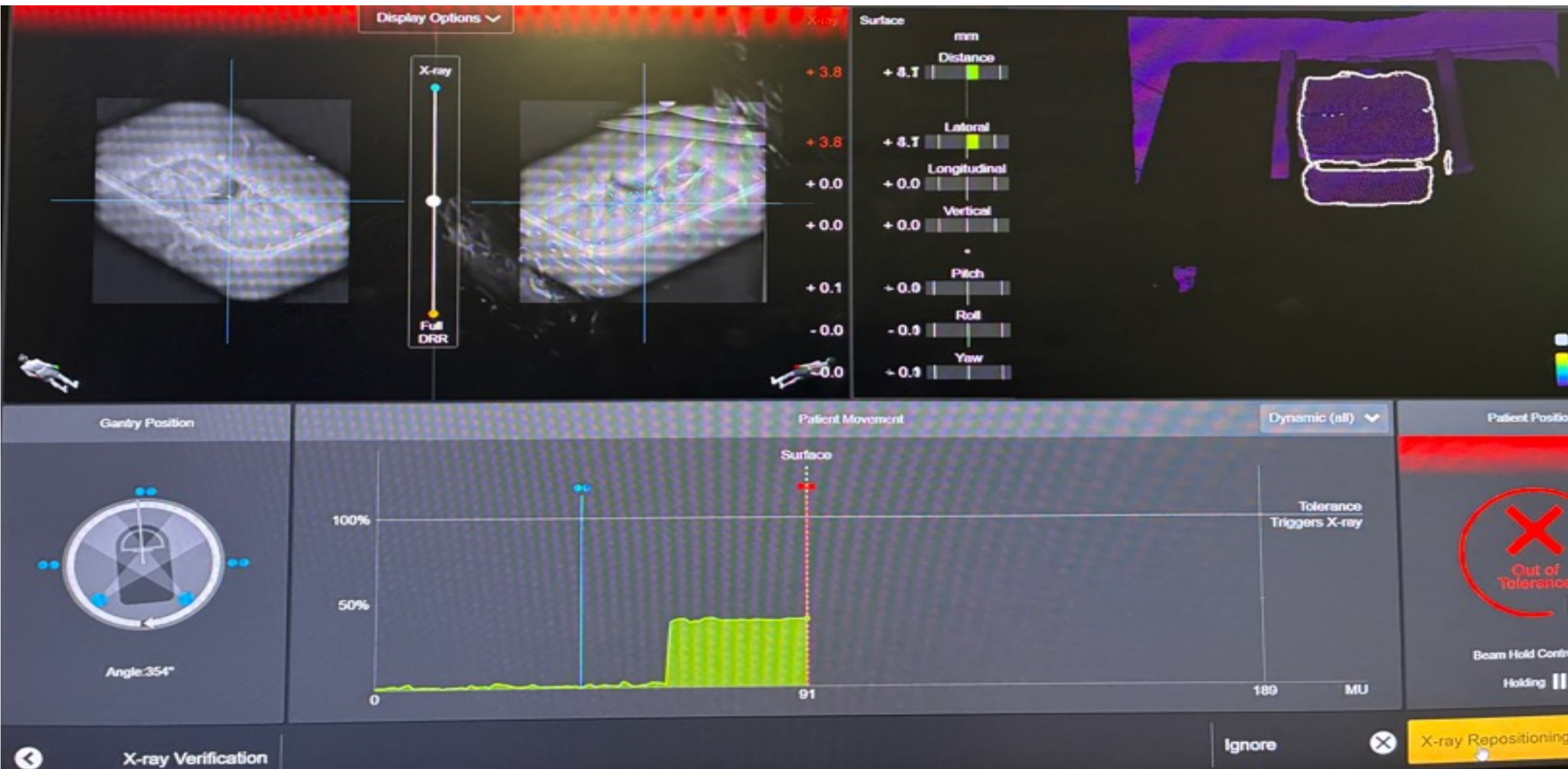


Figure 2. ExacTrac detected the introduced 4-mm lateral offset.