Automatic Couch Position Determination for Qfix Couch System using ESAPI

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INTRODUCTION

Acquiring treatment couch position at initial patient setup as the reference for multiple-fraction radiotherapy potentially has failure modes including inaccurate R&V system transcription, wrong indexing of the patient, and incorrect setup of immobilization devices.

AIM

To automatically determine the couch position at treatment from the planning CT. This will provide reference couch position for patient setup in multiple-fraction treatment delivery.

METHOD

- The Qfix couch system (kVue and DoseMax) has a fixed couch position correspondence between at CT simulation and radiation delivery based on the H to F indexes on the couch top (Figure.1).

- These couches have embedded marker BBs on the top indicating the indexes and couch center.

- With Varian Eclipse system, a C# script using the Eclipse Scripting Application Programming Interface (ESAPI) was programmed to automatically localize the couch and its marker BBs on the planning CT, and derive the couch position at irradiation.

- The script first searched the couch top plane vertically on simulation CT, then located the BBs in the CT plane based on their CT contrast and marker sizes, finally, determined the H-F indexes according to the in-line distances and orders of the markers.

- The script was used to extract couch positions for SBRT plans with DoseMax and conventional EBRT with kVue couch for various treatment sites. The computed vertical, lateral and longitudinal positions were compared with the couch positions acquired on film-only or first-treatment fraction.

RESULTS

- The script-computed positions of the markers were compared with Eclipse-displaying positions after manual selection of the markers on planning CT images. For 55 plans, the medians (min, max) of the differences are 0 (-0.2, 0.2), 0 (-0.3, 0.1) and 0 (-0.2, 0.2) cm in x, y and z orientations for Kvue and DoseMax couches, respectively

- In 11 SBRT plans using the DoseMax couch, the median (5% and 95% percentiles) differences between computed and acquired couch positions are 0.2(-0.2 and 0.6), 0.0 (-0.2 and 0.4) and 0.4 (0 and 0.6) cm for vertical, longitudinal and lateral positions, respectively. For the 44 plans using kVue couch, the median differences are 0.1 (-0.2 and 1.0), 0.5 (-0.7 and 1.6) and 0.2 (-0.4 and 1.2) (Figure.2)

Figure.1 Left: Qfix kVue and DoseMax couch and corresponding CT images; Right: Searching couch top plane along the Posterior-Anterior direction in CT axial slice
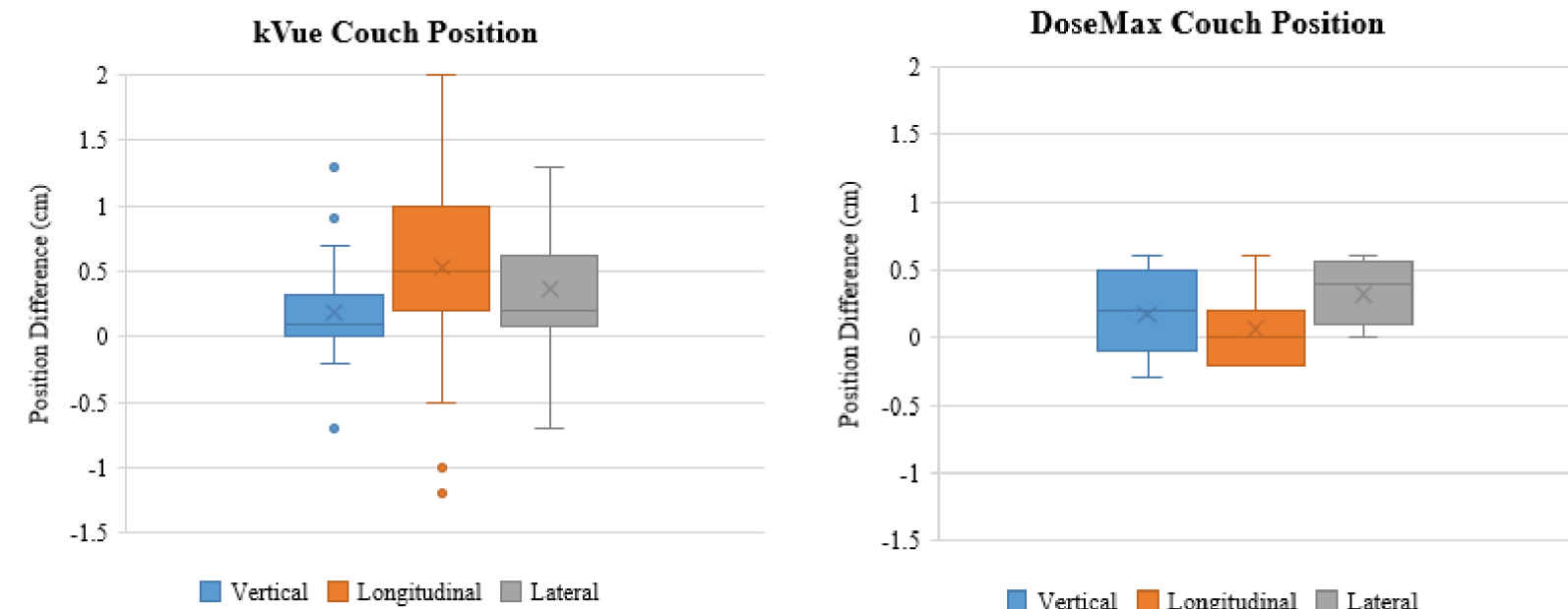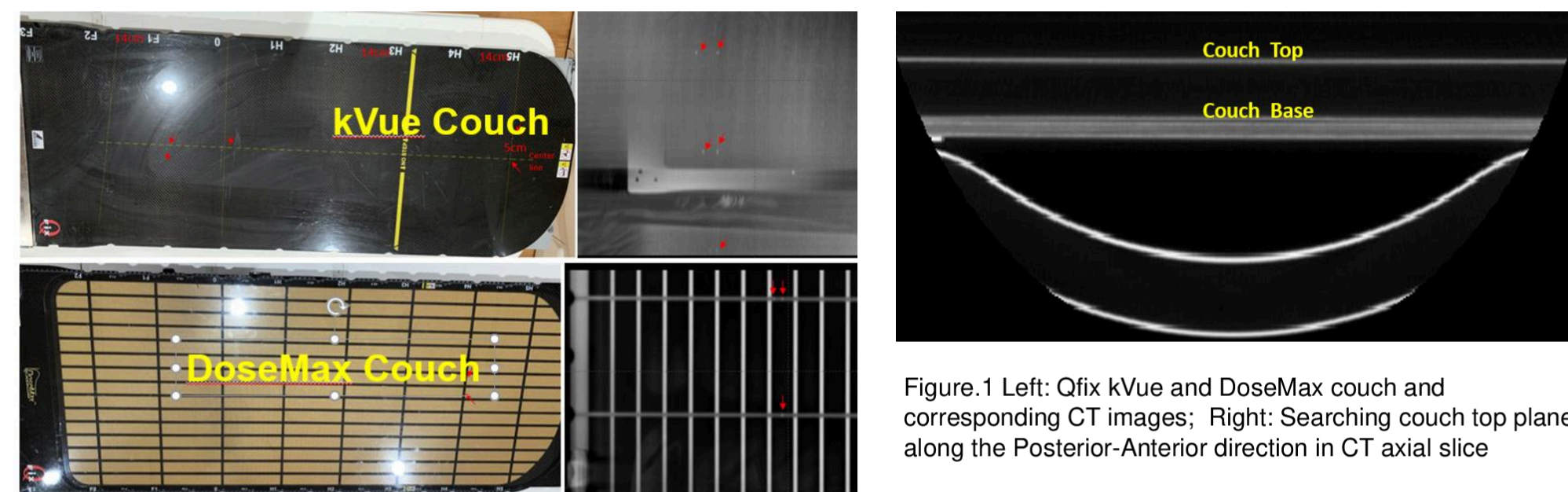

Figure.2 Boxplots of the differences between computed and treatment acquired couch positions for the plans using kVue (left) and DoseMax (right) couches.

Figure.3 Comparisons between couch position at each fraction, mean couch position, acquired and computed couch positions.

- Substantial variations exist in fractional couch positions for multiple-fraction radiation therapy with 6DOF couch. The automatically computed couch positions are valid choices as the reference of treatment couch position (Figure.3).
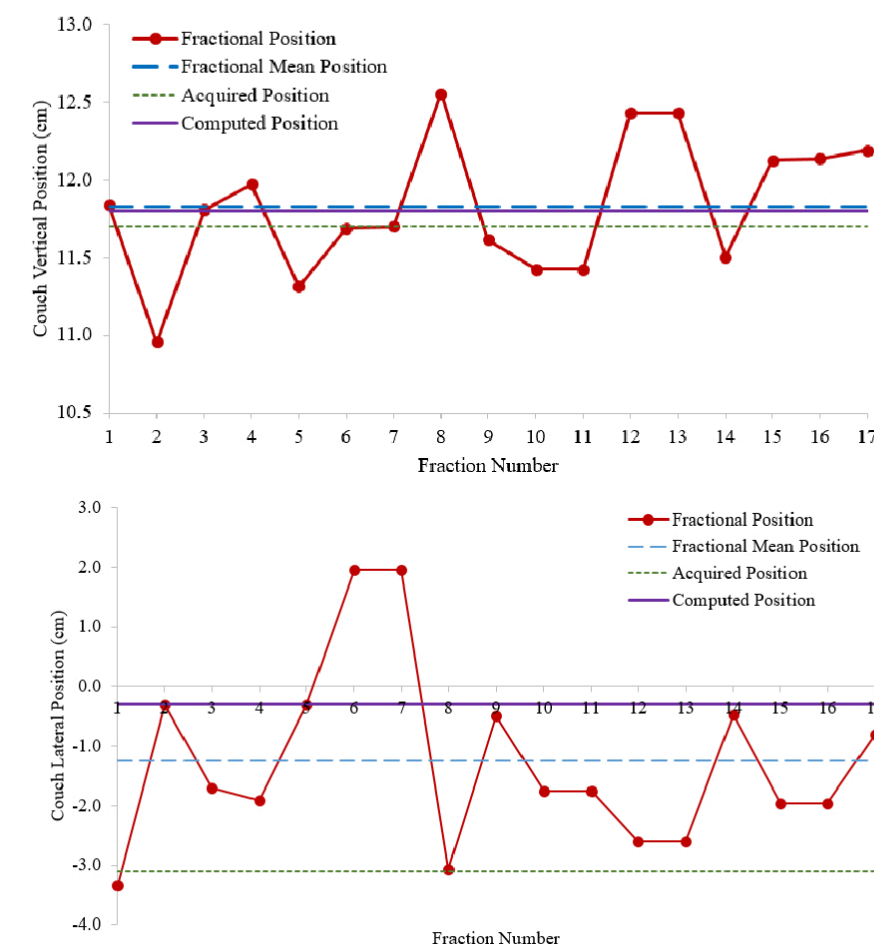
CONCLUSIONS

- We have developed a method automatically deriving treatment couch position from simulation CT for the Qfix couch system.

- This automated process could increase the efficiency of patient setup and reduce plan modifications when inconsistencies are discovered at the time of patient mode up.

CONTACT INFORMATION

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