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JOINT AAPM | COMP MEETING

Dosimetric Variations In Gastrointestinal Radiotherapy Using End-Expiratory Breath Hold: A Comparative Assessment of Alignrt and Identify Surface-Tracking Systems

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ABSTRACT

Purpose: End-expiratory breath hold (EEBH) is commonly used in gastrointestinal (GI) radiotherapy to improve target dose coverage while reducing dose to adjacent organs at risk. This study compares the localization accuracy and residual dosimetric impact of two surface-guided radiation therapy systems, AlignRT (Vision RT) and Identify (Varian), during EEBH GI treatments.
Methods: Thirteen GI patients treated with EEBH using either AlignRT or Identify were retrospectively analyzed. System localization accuracy was evaluated using a human-shaped phantom with multiple region-of-interest (ROI) configurations. Residual translational displacements recorded during treatment were used to rigidly shift the planned dose distribution and recalculate planning target volume (PTV) D95%.
Results: With identical ROIs, AlignRT demonstrated 2.0% greater localization accuracy than Identify; however, Identify exceeded AlignRT by 1.5% when a larger ROI was used. Mean residual translational motion was smaller with AlignRT than Identify (0.74 mm vs. 2.87 mm). Correspondingly, PTV D95% decreased by only 0.3% with AlignRT (5135.08 to 5120.14 cGy) compared with 10.8% with Identify (5197.37 to 4632.02 cGy).
Conclusion: Both systems provided reliable EEBH motion management. AlignRT demonstrated greater ROI flexibility, smaller residual motion, and better preservation of PTV dose coverage than Identify.

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INTRODUCTION

EEBH is commonly employed in GI radiotherapy to enable dose escalation to the target while minimizing dose spillage to adjacent organs at risk(OARs). Surface-guided motion management systems are frequently used to support patient breath-hold stability. This study compares the residual dosimetric variations observed during EEBH GI treatments using two such systems: AlignRT(Vision RT, London, UK) and Identify(Varian Medical Systems, Palo Alto, CA).

To evaluate the commercial systems' performance on different settings is important to recommend localization methods for radiation treatments. This study investigates surface imaging systems on dosimetric effect on the GI EEBH patients.
GI EEBH treatments rely on surface guided system to reflect patient accurate breath hold positions to reproduce the simulation conditions. Correct ROI shapes and tolerance tables should refelct the sensitivity of the systems.

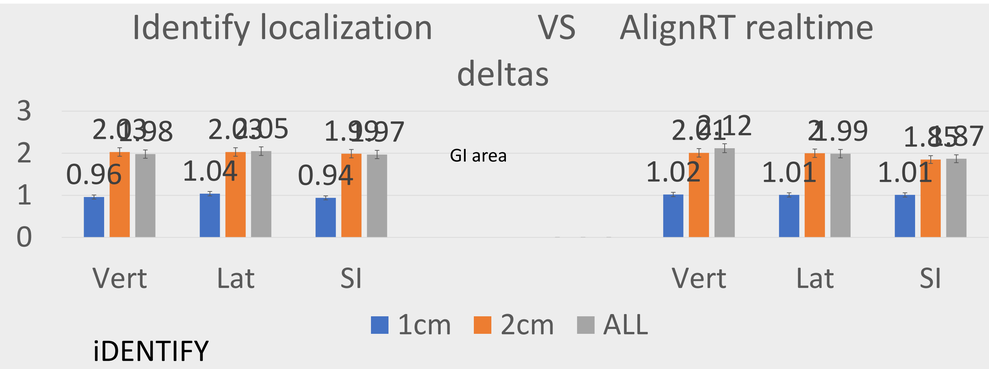
METHODS AND MATERIALS

Surface realtime data on 13 EEBH GI patients treated with either AlignRT on a c-arm based linac or Identify with an Ethos are analyzed retrospectively. First, we compared the systems' localization performance using a human-shaped phantom designed to mimic patient surface variations in the GI region. Both AlignRT and Identify were evaluated across multiple forms of region of interest (ROI). Second, we investigated the residual dose variations according to the system real time displacement readings on 3 translational directions. Using an average displacement at the breath-hold duration from AlignRT and Identify reports, the planning dose cloud is rigidly shifted according to the average residual displacements to compare the PTV coverages.

RESULTS

Note that during patient treatment, the AlignRT real-time delta tolerance was set to 3 mm/3° in all 6 DOFs. The Identify system, however, is limited to a 1-mm only at vertical direction.

During system performance testing, AlignRT demonstrated 2% higher accuracy in surface-displacement prediction than Identify when identical ROI shapes were used. However, when a larger ROI was applied, Identify's accuracy improved, exceeding AlignRT by 1.5%. AlignRT shows smaller averaging residual motion with 3 translational directions combined magnitude than Identify(0.74 mm vs. 2.87 mm.) The average resulting PTV D95% drops from 5197.37 to 4632.02cGy(10.8%) for Identify; AlignRT drops from 5135.08 to 5120.14cGy(0.3%.)



iDENTIFY

Inferior shift of plan iso: 0 mm 0.5 mm 1 mm

PTV (Editable)	P1	D 95.0 % ≥ 5000 cGy	5197.37 cGy	4998.31 cGy	4632.02 cGy	4118.68 cGy
	P1	D 90.0 % ≥ 5000 cGy	5317.08 cGy	5203.48 cGy	4934.53 cGy	4534.76 cGy
	P1	V 5000 cGy ≥ 95.0 %	98.78 %	94.97 %	88.63 %	81.55 %

vISIONrt

Inferior shift of plan iso: 0 mm 0.5 mm 1 mm

PTV (Editable)	P1	D 95.0 % ≥ 5000 cGy	5197.37 cGy	4998.31 cGy	4632.02 cGy	4118.68 cGy
	P1	D 90.0 % ≥ 5000 cGy	5317.08 cGy	5203.48 cGy	4934.53 cGy	4534.76 cGy
	P1	V 5000 cGy ≥ 95.0 %	98.78 %	94.97 %	88.63 %	81.55 %

DISCUSSION

Accurate end-expiratory breath-hold (EEBH) treatments for gastrointestinal (GI) cancers depend on surface-guided radiation therapy (SGRT) systems to reproduce the patient position established during simulation. Because SGRT uses external anatomy as a surrogate for internal target position, both ROI selection and motion tolerance settings influence the system's ability to detect clinically relevant breath-hold variations.
Our results suggest that ROI configuration affects localization accuracy and should be optimized for each SGRT system. An appropriately selected ROI can improve tracking robustness, whereas suboptimal ROIs may reduce sensitivity to respiratory motion. Likewise, motion tolerance settings should reflect the performance characteristics of the specific SGRT platform. The larger residual motion and greater loss of PTV coverage observed with Identify highlight the importance of commissioning system-specific tolerance tables rather than applying uniform thresholds across different platforms.
These findings demonstrate that careful optimization of ROI selection and tolerance settings is essential to improve breath-hold reproducibility and minimize residual dosimetric uncertainty during GI EEBH treatments.

CONCLUSIONS

Both systems show reliability at patient treatment sessions. AlignRT has better choices of ROI delineation than Identify while Identify shows larger residual dosimetric effect.

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