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Expanded visual guidance of breath-hold for CBCT-guided online adaptive radiotherapy (ART) in a closed-bore configuration

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INTRODUCTION

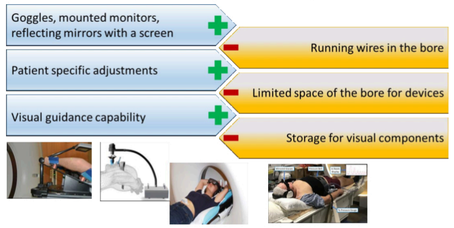
- High quality CBCT images with reduced motion artifact are critical for CBCT-guided online ART.
- Although visual guidance is beneficial for respiratory motion management in imaging and radiotherapy, there are cumbersome issues with conventional approaches in closed bore-type systems such as space limitation, collisions, hygiene, storage and cable-related safety.

AIM

- To investigate an expanded visual guidance system to aid breath-hold CBCT scans for an online ART system coupled with a closed-bore ring gantry LINAC.

METHOD

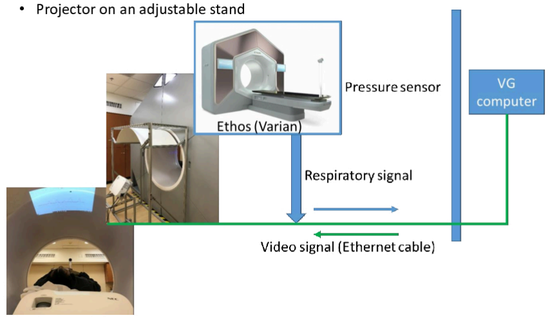
Conventional visual guidance in closed bore-type RT



Expanded visual guidance in a closed-bore configuration

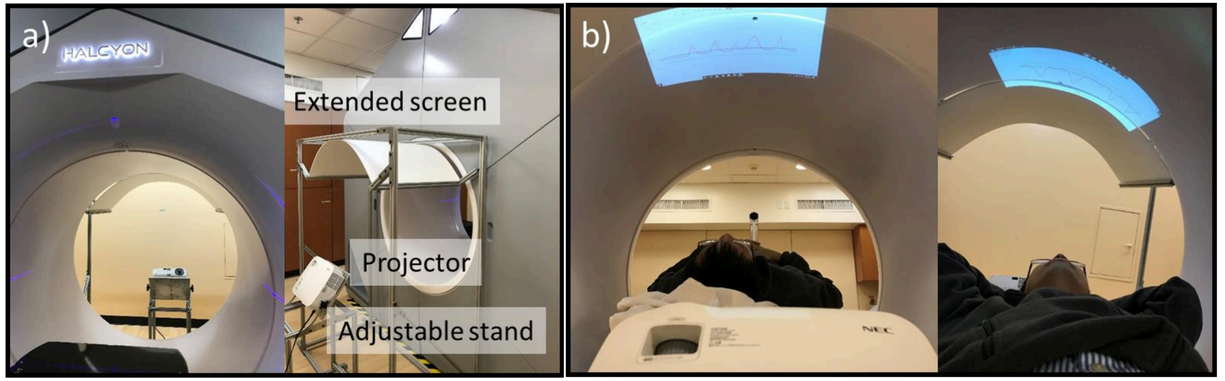
a) Respiratory motion detection:
- Pressure sensor

b) Visual guidance:
- Extended screen
- Projector on an adjustable stand

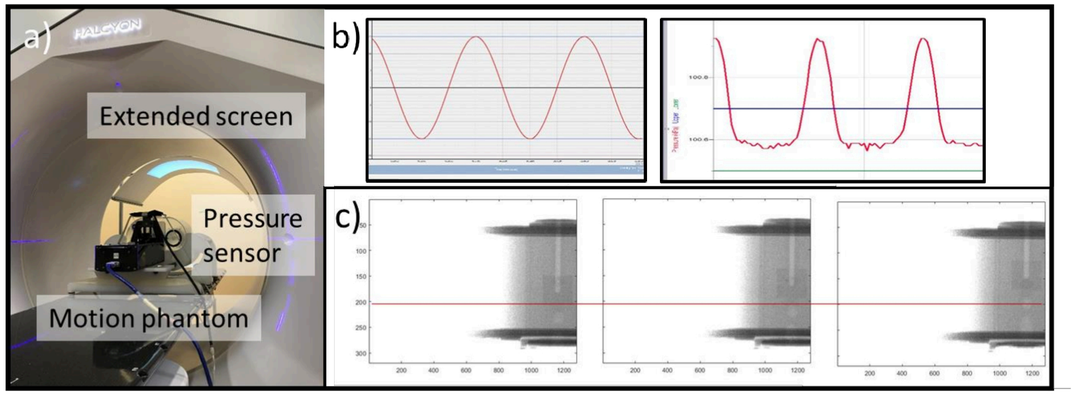


RESULTS

- The feasibility of installation, clinical workflow and system performance was tested on the investigators. In addition, CBCT and 2D kV fluoroscopic and planar images of a motion phantom were acquired with the full system installed.



Feasibility of the system (a) installation and (b) performance. (a) An extended screen and a projector on an adjustable stand. (b) The respiratory motion guidance on the extended screen was presented to an investigator.



CBCT and kV planar images of a motion phantom were acquired with the full system installed. (a) A pressure sensor was attached on the surrogate plate of a motion phantom (MRI4D version of the QUASAR motion phantom). Visual guidance was shown on the extended screen and the motion of the insert was captured using kV planar imaging on Ethos. (b) Phantom motion control (left) and corresponding visual guidance (right) during imaging. (c) Positions of a shifted cuboid were presented based on the reference red line.

CONCLUSIONS

- The proposed method removes all issues with conventional visual guidance approaches.
- The system can be incorporated with any motion management system and can be a universal solution for closed bore-type systems such as CT and MRI.
- The feasibility study of breath-hold control on fast CBCT in X-ray-based radiotherapy with 8 abdominal cancer patients is ongoing.

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