Feasibility of using Surface Guided Deep Inspiration Breath Hold (DIBH) in conjunction with CBCT for target localization for pancreas, mediastinum and liver treatment

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Introduction

The use of surface guided DIBH for left breast radiation therapy has been well established in the last decade, with the on-board MV imaging panel used to verify target alignment via planar imaging. Tumors of the abdominal area may sometimes demonstrate large intrafrational motion on the order of 1-2 cm due to breathing. For these cases, the size of the PTV may be significantly reduced through the application of DIBH. CBCT is a commonly-used IGRT technique for abdominal radiation therapy. In this study, the feasibility of using DIBH in conjunction with CBCT for pancreas, mediastinum, and liver treatments was evaluated.

Clinical Experience

Five patients undergoing radiation therapy were investigated in this study. Table 1 lists the specifics for each patient. The simulation-CT was acquired with the patients DIBH. The patient surface contour generated from treatment planning system was set as reference for surface guidance. On each treatment day, surface guided DIBH (tolerance of ±3mm and 3^0) was used for patient setup, and during CBCT acquisition.

Table 1. Patient information

Patient #	Site	Fractions	3CBCT	2CBCT	1CBCT
1	Pancreas	6	1	1	4
2	Pancreas	16	2	6	8
3	Mediastinum	16	0	1	15
4	Mediastinum	18	0	0	18
	total	56	3 (5.4%)	8 (14.3%)	45 (80.3%)
5	Liver	10	Treated free breathing		

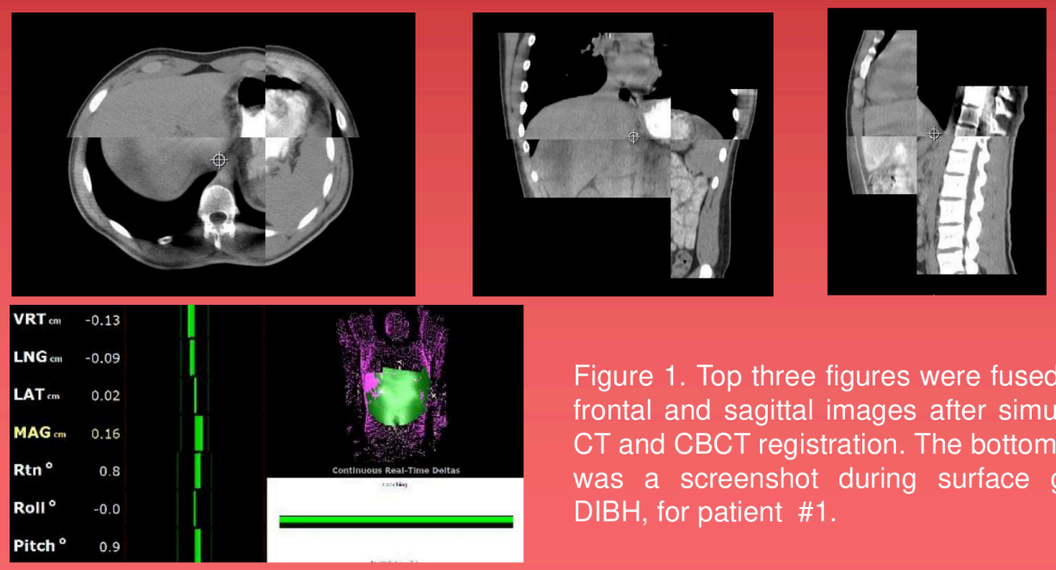
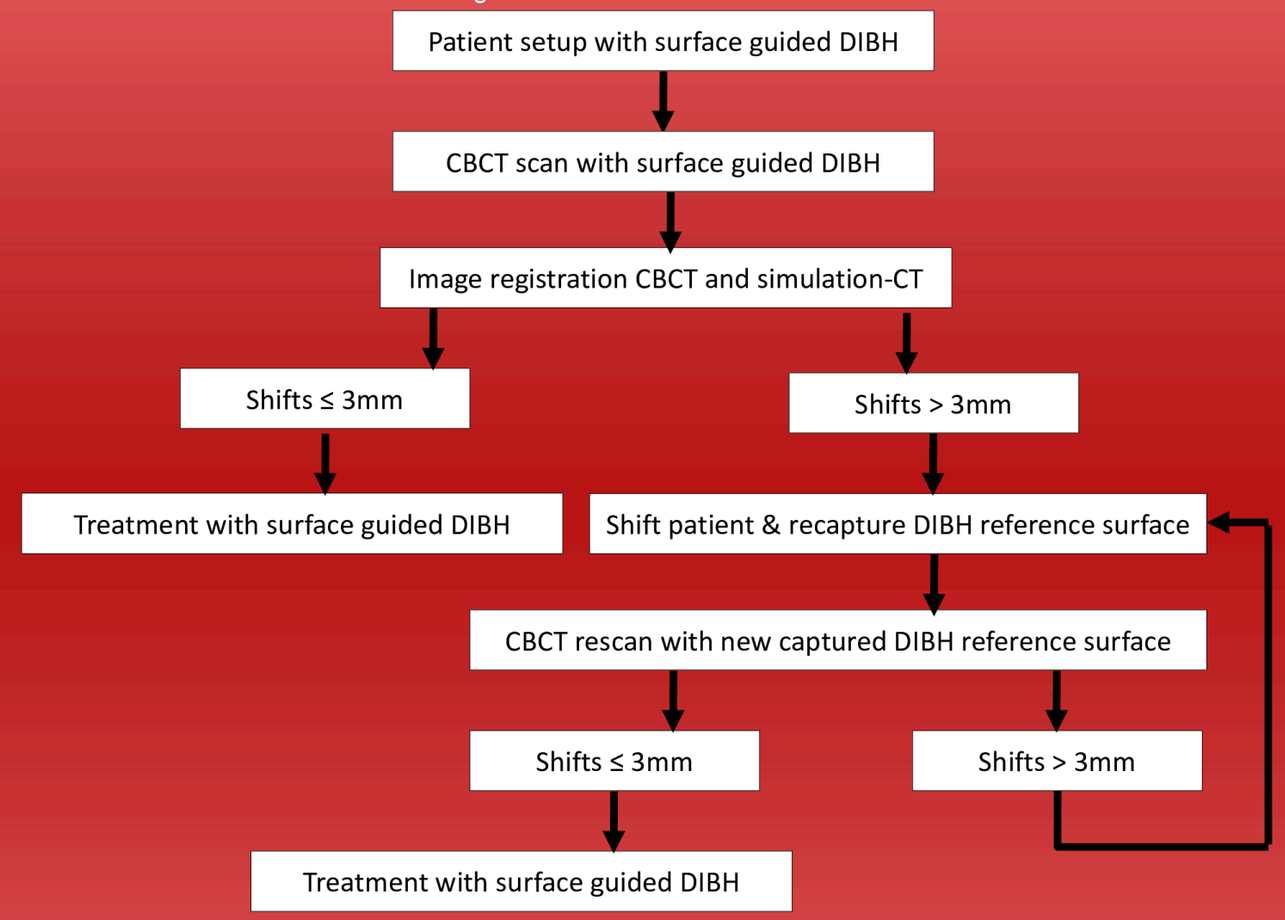


Figure 1. Top three figures were fused axial, frontal and sagittal images after simulation-CT and CBCT registration. The bottom figure was a screenshot during surface guided DIBH, for patient #1.

Workflow

Surface guided DIBH with CBCT workflow



Four out of five patients (treated for pancreatic and mediastinal lesions) in this study were successfully treated using surface guided DIBH in conjunction with CBCT for target localization.

There were total 56 treatment fractions. For eight fractions (14.3%), 2 CBCTs were acquired due to shifts greater than 3mm; for three fractions (5.4%), 3 CBCTs were acquired due to a second set of shifts needed; for 45 fractions (80.3%), only 1 CBCT was scanned. One liver patient showed inconsistency and uncorrelated CBCT shifts relative to surface imaging shifts during DIBH based on three CBCTs acquired during the first treatment day. Due to the lack of correlation between CBCT and surface imaging, the DIBH treatment was aborted, and the patient was treated free breathing.

Conclusion

To summarize, for most patients in this study, it is feasible to use surface guided DIBH with CBCT for target localization. For one patient, surface shifts were uncorrelated with 3D imaging and the patient was treated without DIBH.