AbstractID: 12030 Title: Digital Tomosynthesis for Target Localization

Any deviation between treated and planned volumes for 3-D conformal therapy, such as IMRT, may cause an adverse clinical outcome. It is therefore critical to minimize all potential deviations using an on-board (or real-time) imaging procedure immediately prior to radiation delivery. At present, conventional 2-D radiographic imaging and state-of-the-art 3-D cone-beam CT (CBCT) are typically employed for treatment verification. However, 2-D radiographic verification is mainly based on bony structures and/or implanted fiducials, and is sub-optimal for soft-tissue targets. While on-board CBCT can provide 3-D soft tissue information, it has three potential limitations: 1) The acquisition time is limited to a minimum of 60 seconds (≈15 breathing cycles) for on-board CBCT, making single breath-hold imaging impractical for organs which exhibit respiratory motion; 2) 360^o mechanical clearance for CBCT acquisition may limit the use of CBCT for large patients, those with tumors at peripheral locations (e.g. breast), or those with substantial immobilization or support devices; 3) A high radiation dose (2-9 cGy) is delivered to the imaged volume with current imaging techniques, which is undesirable for daily imaging and may be a particular problem for those who are at high risk of developing second malignancies. To overcome these limitations, innovative digital tomosynthesis (DTS) imaging technologies are being developed for 3-D and 4-D target localization.

Although DTS technology has been used for digital chest and mammography, its use in target localization is new. DTS only requires limited gantry rotation (e.g., a scan angle of 40^o or less) to reconstruct 3-D anatomic information. Thus, imaging time and dose are substantially reduced compared to CBCT, making breath-hold DTS a simple solution for daily imaging of moving organs. 4-D DTS can also be generated much faster than 4-D CBCT, which is desirable for on-board 4-D tomographic imaging. Further, the reduced mechanical clearance needed for DTS makes it more widely applicable than CBCT. At present, limited information has been published regarding the fundamentals of DTS for target localization, and/or preliminary clinical DTS localization results. The purpose of this presentation is to provide updated information about these topics, including the following objectives:

1. To understand the technical challenges and clinical potentials of using DTS technologies for target localization in radiation therapy
2. To understand the latest developments in DTS reconstruction and registration methods
3. To understand the clinical feasibility and efficacy of kV DTS compared to kV CBCT
4. To learn about the latest developments in MV DTS and brachytherapy DTS applications

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