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PRESENTATION TITLE
Assessment of inter- and intrafraction displacement of individual axillary lymph nodes on MRI

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ABSTRACT
Assessment of inter- and intrafraction displacement of individual axillary lymph nodes on MRI

Purpose: Displacement of target volumes between treatment fractions or during irradiation may lead to decreased target coverage and increased dose to surrounding normal tissue. The goal of this study was to evaluate the inter- and intrafraction displacements of individual axillary lymph nodes (LN) on MRI in breast cancer patients and healthy volunteers to assess the potential impact on future MRI-guided (hypofractionated) RT.

Materials & Methods: MRI scans of five breast cancer patients were acquired on a 1.5T MRI scanner. Interfraction motion was simulated by repositioning the patient between repeated scan sets. Two to three 3D T₁-weighted spoiled gradient echo scans (T1) and two to three coronal-sagittal interleaved cine scans (0.6s per slice) were acquired per patient. Additionally, sagittal cine scans (0.3s per slice) of seven healthy volunteers were available. All cine scans were acquired during one minute of free breathing.

Individual LNs were identified and delineated in all T1 scans (Figure 1). To quantify displacement due to repositioning, i.e. interfraction displacement, T1 scans of each patient were rigidly registered. Registration was performed on two different regions: a) sternum and anterior chest wall region; b) axillary level I region. Subsequently, interfraction displacement for each LN in axillary levels I to IV was quantified as the difference in LN center-of-gravity.

Intrafraction LN displacement on the cine scans was investigated with an optical flow algorithm. With this method we applied a deformable registration of the cine scan frames to a reference frame of the same cine series. The mean displacement of pixels within one LN was calculated to determine LN displacement with respect to the reference frame. The maximum peak-to-peak difference in LN position was determined in left-right (LR), superior-inferior (SI), and anterior-posterior (AP) direction.
Results: In total 12 T1 scans of five patients and 14 cine scans acquired in five patients and seven volunteers were available for analysis. 127 individual LNs were identified in the T1 scans. Average LN interfraction displacements ranging from 1.4-2.5mm were observed in axillary levels I to IV. The LN displacements per level differed between the two registration regions, which showed deformation in anatomy, i.e. LNs in different axillary levels could move with respect to each other. In all cine scans, average maximum intrafraction LN displacement was 1.6mm (range: 1.2-2.0mm) in LR, 1.7mm (0.9-2.5mm) in SI, and 2.0mm (1.1-3.2mm) in AP direction. Displacements due to breathing motion and some small drifts in average position were observed (Figure 2).

Conclusions: Inter- and intrafraction displacements of individual LNs were small and within 3mm. With the current PTV margins (5-7mm) these displacements are not clinically relevant. However, management of LN displacements could become important in future MRI-guided RT, i.e. with smaller PTV margins. This would enable hypofractionated RT, e.g. in breast cancer patients with tumour-positive LNs, which could lead to less radiation-induced toxicity.
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*extreme LN positions. Left: anterior-posterior direction, and right: superior-inferior direction.*