MR relaxometry of silicone breast implants at 3.0T
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INTRODUCTION: The U.S. Food and Drug Administration currently recommends that women with silicone-gel breast implants (SBI) get screenings for silent ruptures three years after implant and every two years after that (1). Early detection of SBI rupture is essential for avoiding pain, deformity, and disease (2). MRI is thought to be the most sensitive imaging modality to detect flaws in breast implants in vivo (3). Modern MRI pulse-sequences have been optimized for silicone imaging at 1.5 Tesla (4). With the increasing use of 3T MRI systems, there is a need to characterize the relaxation properties of SBI and to optimize pulse sequences for 3T. Additionally, the introduction of collesal gel implants makes it important to understand if the protocols that have been developed on 1.5T systems for the conventional SBI need to be modified for the collesal-SBI to obtain optimal image contrast.

METHODS: Three SBI were imaged on a 3T Siemens Trio system. For T1 measurement, an IR-prepared single shot sequence with inversion times of 50, 300, 500, 600, 650, 700, 750, 800, 900, 1000, and 1200 ms was acquired for a single slice. Scan parameters were as follows: 136x256 acquisition matrix, $TE = 11$ ms, flip angle = $180^\circ$, $TR = 5$ s, field of view (FOV) = 89x150 mm, slice-thickness = 5 mm, 8-channel receive-only head coil. For T2 measurement, a multi-echo spin echo sequence was acquired with echo times $TE = 15$ to 480 ms at 15 ms increments, pixel bandwidth = 130 Hz, 96x128 acquisition matrix, $FOV = 150 \times 150$ mm, and $TR = 2$ s. A hand drawn region-of-interest (ROI) within the implant was selected for $T1$ and $T2$ calculations on a voxel-wise basis. A phantom containing all three SBI samples from various vendors was used for the experiments. In order to optimize the pulse sequences for contrast to noise of silicone relative to fat and water a multi-compartment phantom containing lard, egg-white, and silicone was utilized to measure relaxation times.

DISCUSSION: Known $T1$ and $T2$ values of silicone-gel breast implants will assist pulse-sequence development for silicone gel implants to assess implant integrity. Along with the lack of experience at 3T and the utilization of MRI for screening asymptomatic women (as opposed to a diagnostic tool), there is a need for improved diagnostic specificity and hence better image quality. To date, the relaxation times of SBI have not been reported in the literature. One limitation of the reported relaxation times of other phantom making materials is the multispectral nature of these materials reported as aggregate $T1$ and $T2$.

Alongside existing $T1$ and $T2$ information for breast tissue (5), the information about the $T1$ and $T2$ of SBI provided in this abstract is necessary for improved MRI sequences that enhance the sensitivity and specificity of the diagnosis of breast implant damage or degradation. These results indicate that the $T1$ and $T2$ rates are quite similar for the three different types of SBI and therefore it is not necessary for the patient or the technologist to understand the kind of implant to tailor the 3T MRI study.

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