Silicone Only Breast MRI using a Inversion Recovery TSE sequence with a B1-independent Spectral Selective Water Suppression Prepulse (SPAIR)

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Introduction: A growing number of women throughout the western world are having silicone breast implants, for breast reconstruction as well as cosmetic reasons. In the USA, approximately 2 million women have this type of implants [1]. From the literature, one can conclude that MRI is the best imaging modality to visualize possible rupture of breast implants. [2-5] To image this rupture full suppression of fluid and fat signal of the breast is needed. Most common used sequences are STIR-sequences combined with a water-presaturation pulse [5] or with multipoint Dixon technique [6].

Here we propose a new silicone only imaging technique based on a B1-independent water selective suppression prepulse (SPAIR) combined with an IR-TSE sequence. The sequence was developed to compare the in vitro dimensions of the silicone-gel filled prostheses to the in vivo dimensions of these prostheses in sub pectoral upright and recumbent position.

Materials and Methods: An IR-TSE-sequence (Turbo-STIR) sequence in which we apply a B1-independent spectral selective attenuated inversion prepulse (SPAIR) on the water frequency to suppress the water signal was implemented on a 1.5T Philips Intera MR scanner. The TI of the STIR-sequence is set such that during read-out the fat signal is completely nulled. The SPAIR-pulse is applied non-selective, thus the water signal in the whole volume is suppressed. By applying the SPAIR-pulse after the IR-pulse, the whole sequence is very time-efficient, i.e. there is no extra penalty for TR or TE. The SPAIR-pulse is implemented such that the user can define the inversion delay of the prepulse, thus allowing him to choose between full or partial water suppression.

Image parameters of the water suppressed IR-TSE sequence were: Multi-Slice IR-TSE, 40 slices of 3.5 mm, FOV 340 mm, Matrix 272x512, TR/TE/TI = 6253ms/70 ms/165ms, TSE factor 21, NSA 2, Scan Time 4'22". The inversion delay for full water suppression was set to 80 ms. All data were acquired with a standard four-element SENSE-Body coil in combination with a positioning device for prone imaging.

A specimen of the implant used in the volunteers was scanned in vitro. All scanned implants (in vivo and in vitro) were segmented and volume rendered on a ViewForum workstation (Philips Medical Systems, Best, The Netherlands) to compare in vivo and in vitro dimensions and shape of the implants.

Results: Six volunteers with different implants were scanned successfully. Both fat and water signal were suppressed in the both breasts, leaving only silicone with a high signal. No signal from small mammary arteries was seen on any of the acquired images. Two example slices in two different volunteers are shown in fig. 1.

The implants varied in size and shape and on the way they were surgically positioned in the breast. Volume renderings of in vivo and in vitro round and drop shape implants are shown in fig. 2. These volume renderings allowed the comparison of the in vivo and in vitro dimensions and shape of the implants.

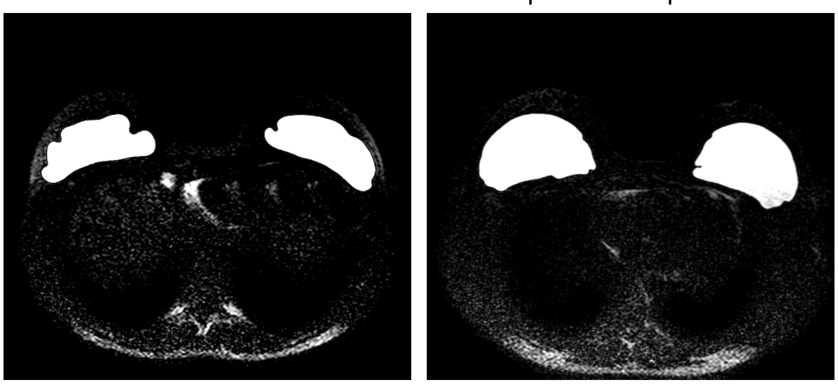

Fig. 1: Two slices of two volunteers with silicone implants with the SPAIR water suppressed IR-TSE sequence.

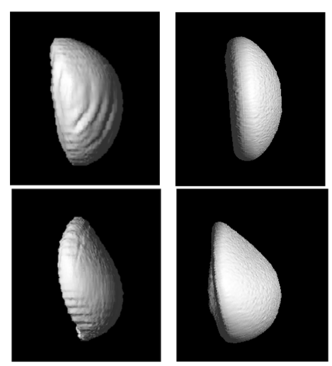

Fig. 2: Renderings of implants in vivo (left) and in vitro (right)

Conclusion: We have presented and successfully implemented a new technique for silicone only breast MRI. The sequence was applied for the detection and visualization of in vivo and in vitro imaging of breast implants of different shapes and different sizes. Because the sequence robustly suppresses both water and fat, a comparison between in vivo and in vitro dimensions and shape of these implants was made.

References: [1] Goscin CP et al. JMCC 8(5):399-406 (2001), [2] Pfleiderer B et al. MRM 29:656-659 (1993), [3] Mukundan Jr S et al. JMRI 3:713-717 (1993), [4] Schneider E et al. Radiology 187:89-93 (1993), [5] Ikeda DM et al. Plast Reconstr Surg 104:2054-2062 (1999), [6] Ma J et al. JMRI 19:298-302 (2004)