Breast Tissue Expanders with Magnetic Ports: In Vitro Testing and Clinical Experience at 1.5-Tesla

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Target audience: Radiologists, MRI technologists, MRI safety officers, Breast surgeons

Background and Purpose: There is controversy regarding the safety of performing MRI examinations on patients with breast tissue expanders that have magnetic ports [1-3] (Fig 1-2). At our institution, abdomen-pelvis MRI/MRA is frequently requested in these patients to map perforator vessels supplying abdominal fat/skin to plan autologous breast reconstruction. Since the tissue expander will be removed at the time of breast reconstruction, surgeons performing these operations feel that the benefit of pre-operative MRA outweighs the risk of any migration or local tissue damage potentially caused by MRI. Accordingly the purpose of this investigation was to use *in vitro* and clinical experiences to assess if breast tissue expanders with magnetic ports are acceptable risk –benefit for patients undergoing MR imaging.

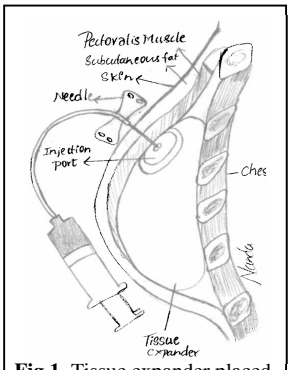

Fig 1. Tissue expander placed posterior to pectoralis muscle post mastectomy which is gradually expanded by adding saline via a magnetic port.

Methods: *In vitro* tests were performed using standardized techniques to assess magnetic field interactions, heating, and artifacts at 1.5-Tesla on a Mentor Siltex Medium Height Contour Profile Breast Tissue Expander (2, 4, 5). In addition, at the request of referring plastic surgeons, MRI/MRA of the abdomen and pelvis was performed in 16 patients with tissue expanders (Mentor, n=13), Natrelle 133sx (n=2), Natrelle 133mv (n=1)) with magnetic ports from July 2012 to November, 2012. After obtaining written consent, MRI of the abdomen/pelvis was performed at 1.5-T using axial, coronal and sagittal Single Shot Fast Spin Echo (SSFSE) T2-weighted and Gadolinium enhanced spoiled gradient echo (SPGR) sequences including a 5 minute high resolution 3D LAVA sequence. All cases were monitored by a radiologist with instructions to the patient to provide an alert upon any sign of discomfort, pain or burning.

Fig 2. A tissue expander before implantation

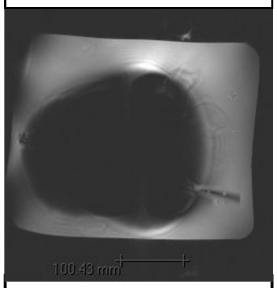

Fig 3. Tissue Expander Artifact.

Results: *In vitro* testing indicated that magnetic field interactions were acceptable (i.e., 43 degrees of deflection for the empty tissue expander and 29 degrees of deflection when half-filled with saline; torque was minor in each case). MRI related heating 1.5-T using whole body averaged SAR of 2.7 Watts/kg for 15 minutes indicated that heating was only 0.1˚C heating above the background temperature (i.e., without the implant present in the gelled-saline filled phantom). Artifacts were substantial (Fig 3) and may impair the diagnostic use of MRI Three of the 16 patients reported downward migration of the magnetic port before imaging, but no patient had implant apparent migration during imaging. At the time of tissue expander removal for breast reconstruction, the surgeons reported no visible evidence of heating or other significant findings in the surrounding subcutaneous tissues. Autologous breast reconstruction was successful in all patients with no surgical complications.

Discussion: Breast reconstruction post mastectomy helps women complete the healing process by mending the otherwise constant reminder of cancer diagnosis and treatment. Post mastectomy reconstruction with a tissue expander and implant involves a staged approach. A tissue expander is placed deep to the pectoralis major muscle to create a soft pocket to contain the permanent implant. Expanding that pocket takes several weeks or months of periodically adding saline to increase tissue expander volume. Many tissue expanders have an injection site for saline infusion containing permanent magnets for locating the injection port. Because of the internal magnet, these implants are considered unsafe for MRI and implant migration post tissue expander placement has been reported [1].

In this investigation, in vitro testing supports a relative lack of significant problems for a commonly used tissue expander with a magnetic port. Furthermore, findings revealed that 16 patients with tissue expanders with magnetic ports labeled “MR unsafe” safely underwent MRI at 1.5-Tesla without incident and no apparent damage to surrounding tissues noted at implant removal.

Conclusion: Our preliminary experience reveals that MRI of the abdomen and pelvis in patients with breast tissue expanders with magnetic ports can be performed safely under controlled conditions.

References

(1) Zegzula HD, Lee WP. Infusion port dislodgement of bilateral breast tissue expanders after MRI. Ann Plast Surg. 2001; 46:46-8

(2) Fagan LL, et al. Ex vivo evaluation of ferromagnetism, heating, and artifacts of breast tissue expanders exposed to a 1.5-T MR system. J Magn Reson Imaging 1995; 5:614–616.

(3) Nava MB, et al. Effects of the magnetic resonance field on breast tissue expanders. Aesth Plast Surg 2012;36:901–907

(4) Weiland JD, et al. Assessment of MRI issues for the Argus II retinal prosthesis. Magnetic Resonance Imaging 2012;30:382-389.

(5) Shellock FG, et al. Assessment of MRI issues for a 3-Tesla “immune” programmable CSF shunt valve. AJNR 2011;197:202-7