MRI Compatibility of SelectSilver® Based Wound Dressings

J. Kevin Bailey, MD[1], Steffen Sammet, MD, PhD[2], Jason Overocker, PA-C[3], Beretta Craft-Coffman, PA-C[4], Cristina M. Acevedo, PhD[5], Martin E. Cowan, PhD[5], and Heather M. Powell, PhD[6]

[1]Department of Surgery, Wexner Medical Center, The Ohio State University, [2]Department of Radiology, University of Chicago Medical Center, [3]Department of General Surgery, Saint Alphonsus Medical Group, [4]Burn and Reconstructive Centers of America, LLC. [5]Milliken Healthcare Products LLC, [6]Department of Materials Science and Engineering, Department of Biomedical Engineering, The Ohio State University, Columbus, Ohio.

BACKGROUND

As silver dressings gain more widespread use, it is more likely that patients with silver-based dressings will also undergo magnetic resonance imaging (MRI). In current practice, these dressings are removed prior to imaging due to concerns over heating and image distortion. As dressing changes can be painful, the need to remove dressings simply for MR imaging may increase pain and contribute to opioid dependency.

GOAL

To examine MRI compatibility of a collection of SelectSilver based wound dressings.

METHODS

- Materials:
  - SelectSilver-based: TRITEC™ Silver, ULTRA Silver, ASSIST Silver, and ASSIST Silver Absorbent; Milliken Healthcare Products, LLC
  - InterDry®; Coloplast Corporation
  - Non-silver containing control dressings: ULTRA and ASSIST Absorbent; Milliken Healthcare Products,LLC; and Kerlix™ gauze; Covidien Ltd.,
- Clinical high field 3T MRI scanner (Philips Healthcare, Best)
- American Society for Testing of Materials (ASTM) Standards F2052-15 and F2213-06 (Figure 1) were utilized to examine deflection and torque of the dressings within the MRI unit
- Adult porcine hind limb with full-thickness wound was dressed with silver-based and control dressings in the dry and wet state and scanned consecutively in six MRI sequences
- Survey, T^1-weighted SE, T^1-weighted IR TSE, T^2-weighted TSE, DUAL TSE, and FLAIR
- Images from each set of scans were graded individually on a 0 to 4 scale, in which a 0 rating corresponded to an image without any distortion present and a 4 signified that the image was unusable
- Temperature probes (Luxtron 790 Fluoroptic Thermometer; Luxtron Corp.) were placed at the periphery of the wound and within the subcutaneous fat in the center of the wound to quantify possible heating during MR scanning

RESULTS

- Deflection and torsion were not detected in control or silver-based dressings (Table 1)
- For all combinations of dressings and MRI scans, average heating was between 0-0.2 °C (Figure 2)
- Dressings, in dry and hydrated forms, caused no image distortion in any MRI scan performed (Figure 3 & 4)

Table 1. Average delection and torque of non-silver and silver based wound dressings. A material with a delfection angle less than 45° was considered MRI safe. A torque less than the material's longest axis multipled by its mass was considered MRI safe.

Material/Test	Deflection (Degrees)	Torque (N*m)	MRI Safe
ASSIST Absorbent	0 ± 0	0 ± 0	Yes
ASSIST Silver Absorbent	0 ± 0	0 ± 0	Yes
ASSIST Silver	0 ± 0	0 ± 0	Yes
InterDry®	0 ± 0	0 ± 0	Yes
TRITEC™ Silver	0 ± 0	0 ± 0	Yes
ULTRA	0 ± 0	0 ± 0	Yes
ULTRA Silver	0 ± 0	0 ± 0	Yes
Kerlix™	0 ± 0	0 ± 0	Yes
Metal Control	90 ± 0	0.47 ± 0.01	No

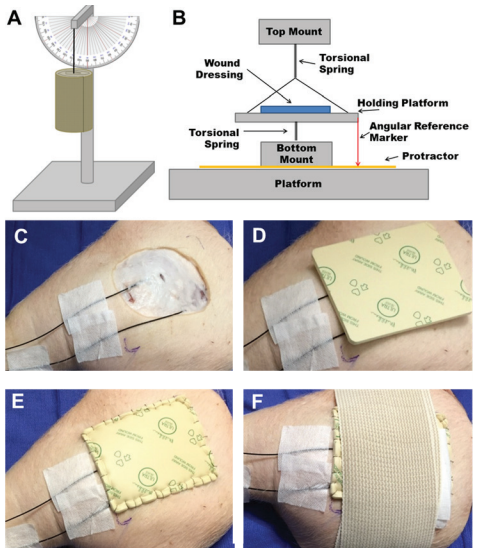

Figure 1. Schematic of the non-magnetic test fixtures to examine deflection (A) and torsion (B) following ASTM guidelines. Photographs of the porcine hind limb model used to examine heating and image distortion beneath wound dressings. C) Temperature probes were placed at the periphery of the wound and at the center of the wound beneath the thin layer of remaining dermal tissue. D) Dressings were placed over the wound in a dry or hydrated state for MR imaging. To mimic the complete assembly of dressings often used, wound dressings were also stapled to the periphery of the wound (E) and covered by absorbent gauze followed by elastic bandaging (F).

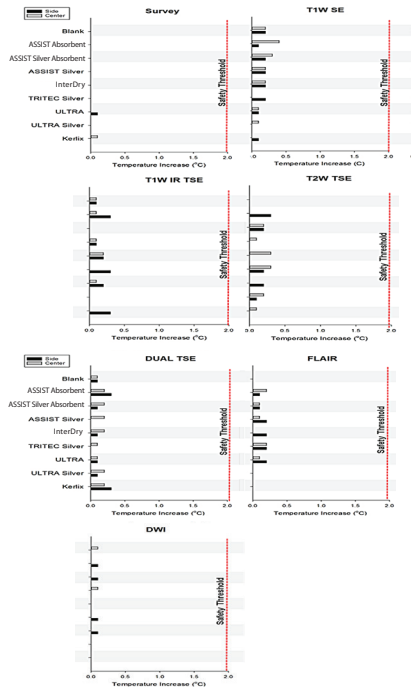

Figure 2. Magnetically induced heating of porcine tissue under dry wound dressings after MR scanning using a series of 7 standard clinical MRI sequences. A wound dressing was considered MRI safe if the increase in temperature was less than 2 degrees C.

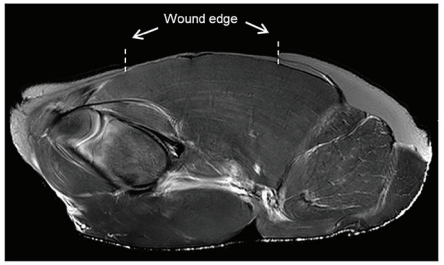

Figure 3. A T^2-weighted TSE image of a porcine hind limb with wound borders indicated with white dashed line). Scan was performed with no wound dressing.

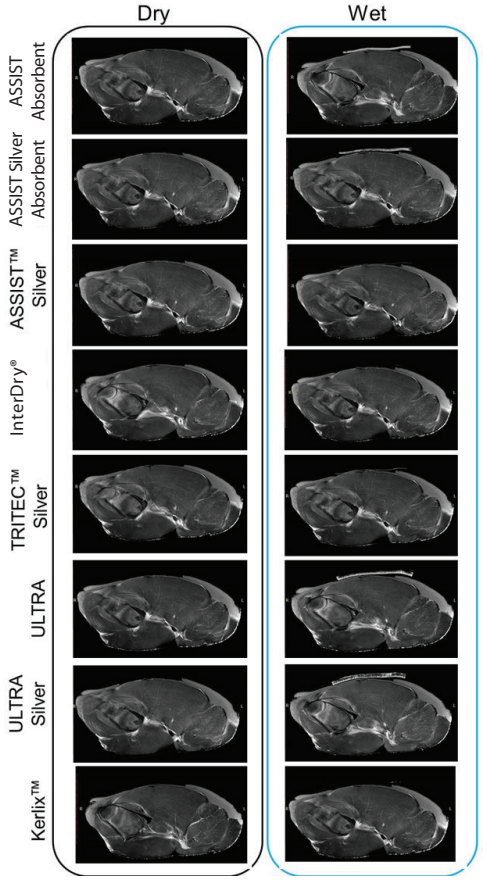

Figure 4. MR images of a porcine hind limb with wound dressings covering a full- thickness cutaneous injury (outer boundaries of wound indicated with white dashed line). Wound dressings were imaged in their dry and hydrated forms using seven standard, clinical MRI sequences (T^2-weighted TSE MRI sequence shown as examples). No image distortion was observed in this study.

CONCLUSIONS

Evaluation of MRI safety and compatibility revealed no concerns for safety or image distortion in any of the silver-containing wound dressings tested thus it would be acceptable to leave these dressings intact during MR imaging. The ability to leave dressings in place during imaging will provide a significant benefit to patient care by reducing pain associated with dressing removal.

MRISafeStudyR01