Metal Artifact and the Application of Metal Artifact Reduction Sequence in Neuroimaging

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Purpose
To illustrate the imaging appearance of artifact arising from metal hardware in neuroimaging and demonstrate the improvement of image quality with the technique of metal artifact reduction sequence (MARS).

Materials & Methods
MR imaging studies for 39 cases containing metal artifacts were performed on GE Signa or Siemens Sonata 1.5 T MR systems. They were 12 of brain cases, 15 of head and neck cases, and 12 of spine cases. Both T1- and T2-weighted imaging with axial, sagittal, or coronal sections were performed in different study cases. The MARS was optimized by using the following parameters: fast spin-echo T1-weighted imaging with 3 of echo train length, 400-600/5-8/3-4 (TR/TE/NEX), 62.5 kHz of frequency bandwidth, 256 x 224 matrix and 240-280 mm field of view; fast spin-echo T2-weighted imaging with equivalent condition except 17 of echo train length and 3200-5000/80-90/3-4 (TR/TE/NEX). For the test phantom, T1- and T2-weighted MR images were obtained through the metal phantom (metallic surgical clips, fixation plate, amalgam and metallic stent) immersed in water. Artifact volume was compared between the images obtained by the conventional and the modified (MARS) T1- and T2-weighted sequences.

Results
Artifact arising from metal hardware remains a significant problem in brain, spine, head and neck MR imaging. The metal artifact reduction sequence (MARS) reduces the size and intensity of susceptibility artifacts from magnetic field distortion. This technique significantly improves the visualization of brain tissue and skull vault adjacent to the surgical wire or clipping in patients who have undergone craniotomy and the artifacts from the artificial denture or amalgam filling in teeth. In the oral cavity, the MARS technique improves the visualization of tongue and buccogingival soft tissue structures adjacent to implanted amalgam. In neck stenting cases, this technique allows the visualization of peri-stenting soft-tissue structure and vessels. In patients with spinal fixation hardware, the MARS technique frequently allows the visualization of vertebral bodies and spinal canal contents. The effect of artifact reduction is variable for various
test phantoms.

**Conclusion**
Our clinical experiences indicated that image quality in the presence of metal could be improved significantly by the application of the MARS technique in a variety of neural imaging settings.

**References**