Purpose:
This study demonstrates two novel MRI techniques for imaging near metals, and compares their artifact correction abilities, ease of use, acquisition time, and SNR. Future directions for imaging near metals are derived from this comparison.

Methods:
A water phantom containing an ASTM F75 Cobalt-Chromium-Molybdenum alloy hip prosthesis encased in a Lego structure was imaged using a 1.5T Siemens Avanto MRI scanner. For the 3D-PLACE technique, two 3D turbo spin echo (TSE) complex datasets were acquired with 12x5mm slices, TR=300ms, TE=11ms, and variable frequency encoding gradients. Differing gradients allowed computation of a displacement field from the complex image phase difference for mapping pixels to their undistorted locations. Further post-processing addressed fractional pixel shift. For the GS-bSSFP technique, four 3D balanced steady state free precession (bSSFP) complex datasets were acquired with 52x3mm slices, flip angle=41 degrees, TR=4.2ms, TE=2.1ms, and phase cycling = 0, 90, 180, and 270 degrees respectively. For each pixel, the four phase cycled image values were plotted in the complex plane to locate the demodulated solution at the intersection of lines connecting alternating phase cycles. SNR was improved through a second pass solution. Comparisons were made through observations and parameter calculations.

Results:
Relative to 3D-PLACE, GS-bSSFP yielded ~60% of the signal void, reduced signal pile-up, and almost as accurate distortion correction. Strikingly, GS-bSSFP achieved more than twice the SNR in 28% of the scan time of 3D-PLACE, with no pulse sequence programming requirements.

Conclusions:
This study indicates that GS-bSSFP shows potential for expeditious high signal clinical imaging near metals. Currently the technique is being revised to use less than four acquisitions; combined with limitations on the number of slices and subsampling techniques, this technique should become fast enough to be employed intraoperatively. Remnant distortion artifacts in GS-SSFP images can be eliminated by combining the technique with 3D-PLACE.