This study evaluated the efficacy of the VAT technique in reducing metal artifacts when compared to conventional 2D imaging in a 3T MR system, using commercial total knee prostheses made of Oxinium and Cobalt-Chromium materials.

**BACKGROUND**

- Magnetic resonance imaging (MRI) provides enhanced soft tissue contrast and is the preferred choice for evaluating orthopedic conditions. A major limitation of this imaging modality, however, is metal-induced artifacts, which obscure important anatomic structures near embedded metal implants. These artifacts limit the clinical utility of MRI.

- MRI depends on a homogenous local magnetic field (Bo). Metal implants produce local field inhomogeneities that create dephasing and frequency shifts of nearby spins; this results in both loss and distortion of signal. Further, metal-induced artifacts are uniquely influenced by the composition, size, shape, and orientation of the implant.

- Several strategies are used to mitigate artifacts caused by metal implants. One such strategy depends on unique metal artifact reduction sequences (MARS). View angle tilting (VAT), in particular, is an FDA approved sequence. VAT applies an extra gradient in the slice selected direction during the readout phase and is able to correct in-plane spatial distortion (1). In combination with other techniques, such as placing the implant parallel to Bo and increasing read-out bandwidth, significant artifact reduction is attainable.

**OBJECTIVES**

- This study evaluated the efficacy of the VAT technique in reducing metal artifacts when compared to conventional 2D imaging in a 3T MR system, using commercial total knee prostheses made of Oxinium and Cobalt-Chromium materials.

- Two knee prostheses, Oxinium and Cobalt-Chromium, were suspended separately in a 1.3-gallon agarose phantoms. Imaging was performed in a 3T MR system using a four-channel body coil.

- T1-weighted images (T1WI) and STIR images in both the sagittal and coronal planes were acquired using VAT and conventional techniques. The areas of metal artifacts in the mid-sagittal plane and mid-coronal plane were measured using a dedicated off-line workstation.

- The area of image artifact was defined and calculated as the total area minus the area representing normal background signal (class area).

- VAT’s capacity to reduce metal artifact when compared to conventional technique was represented as a percent artifact reduction.

**RESULTS**

- On average, Cobalt-Chromium prosthesis produced more artifact than Oxinium prosthesis by 3.28% and 3.97% for T1WI and STIR, respectively.

- The VAT technique reduced artifact when compared to conventional 2D imaging. When VAT was implemented, the areas of metal artifacts were reduced by 17.9% in T1WI and 19.0% in STIR images for Oxinium implants.

- VAT reduced artifacts by 35.6% in T1WI images and 28.2% in STIR images for Cobalt-Chromium prosthesis.

**CONCLUSIONS**

- VAT was shown to reduce metal artifacts in two types of metals and with two types of image contrasts. This represents an important strategy in improving the evaluation of bone and tissue near metal implant devices.

- Quantifying area of artifact reduction may prove more reliable with the fabrication of a larger phantom.

**REFERENCES & ACKNOWLEDGEMENTS**


- I would like to thank Dr. Kim Kirschner, M.D.(UTMB Radiology) for her assistance in acquiring the knee implants. I also acknowledge Dr. Frank L. Goerner, Ph.D, Tao Ai, M.D., Val Rungen, A.D., and Abraham Padua, R(MR) for their encouragement and help throughout this work.