Purpose:
Applicators and seeds for brachytherapy composed of metal have very short T2/T2* species, that induce severe susceptibility artifacts in the surrounding tissue with conventional MR imaging turbo spin echo (TSE) methods, making accurate dose planning and treatment assessment difficult. Nevertheless, recent advances may facilitate imaging of these short T2/T2* species and simplify the current workflow. We propose to use these techniques for improved visualization of brachytherapy devices using MRI. Various imaging strategies for metal artifact reduction, such as an ultrashort echo time (UTE), slice encoding for metal artifact correction (SEMAC), view angle tilting (VAT), and multi acquisition variable resonance image combination (MAVRIC) were investigated.

Methods:
The tandem from an MR-compatible FSD-style applicator set (Varian Medical Systems, Palo Alto, CA, USA) was embedded in 20% gelatin. Scanning was performed on an Achieva 3.0T TX system using a 16 element phased array coil (Philips Healthcare, Best, NL). Images were acquired along the plane parallel to the tandem axis. Sequences parameters are summarized in Table 1. Studies were repeated for a gold seed embedded in 20% gelatin and seed dimensions quantified by the profile image full width half maximum along longitudinal and transverse seed axes.

Results:
The SEMAC sequence imaged the tandem tip exceptionally well, Figure 1. The gold seed was distinctly visible with all sequences, Figure 2, and the SEMAC dimensions were closest to the true dimensions.

Conclusions:
All investigated sequences outperform conventional TSE imaging. Overall, the SEMAC sequence is timely (6x< MAVRIC) with superior metal artifact reduction, and the UTE sequence is ideally suited for quick survey scans and may be useful for distinguishing seeds. MAVRIC has the greatest SNR, but requires long scan times. Although VAT limits in-plane metal artifact, it is poorly suited for brachytherapy planning. Therefore, the use of a SEMAC sequence is beneficial in brachytherapy planning.

Funding Support, Disclosures, and Conflict of Interest:

I have the following conflict of interest to disclose with regard to the subject matter of this presentation:

Company Name: Philips Healthcare

Type of Relationship: Employer