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Improved Assessment of MRI Artifact Following Cervical Total Disc Arthroplasty
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Introduction: Distortion of the magnetic field by a metallic implant in postoperative MRI evaluation of the cervical spine can cause poor image quality, making it difficult to assess boney and neurologic structures at the implanted and adjacent levels. A clinical classification technique using MRI T2-weighted images in categorizing the amount of artifact for the Bryan, Prodisc-C, Prestige LP and PCM devices has been described. Although effective, this classification system is open to intra- and interobserver errors. The purpose of this study was to quantify the amount of MRI artifact produced by cervical total disc implants and examine the artifact for both T1 and T2-weighted images.

Methods: A baseline cervical (C2-T1) scan was performed on an unembalmed human cadaver using a 1.5T whole body MRI scanner with a synergy spine coil. Turbo spin-echo images were obtained and T1 and T2-weighted scans in the sagittal and axial planes were collected. Six cervical total disc devices (ProDisc-C, ProDisc-C Ti, Prestige ST, Prestige LP, Discover, and Bryan) were sequentially implanted into the C5/6 motion segment and scans were repeated for each condition. Twenty-four axial images from C4 to C7 were analyzed for artifact by comparing each slice with the corresponding baseline slice and the volume of the artifact was determined. The volume of artifact for both T1 and T2-weighted scans was evaluated by three investigators and averaged. The neural elements at the adjacent and the index level were also evaluated and categorized as either distorted or visualized.

Results: T2 weighted sagittal and axial images displayed less artifact when compared to the T1 weighted images. With the exception of the Prestige ST, artifact was apparent in 33-42% and 25-38% of the images for T1 and T2-weighted images, respectively. The artifact was apparent in 83% of the images for the Prestige ST. The artifact was not symmetric and typically skewed at the distal slices (Figure 1). The volume of the artifact in the T2 weighted images was 58.6±7.3 cm³ for Prestige ST, 14.2±1.3 cm³ for ProDisc-C, 7.5±0.8 cm³ for Discover, 8.0±0.3 cm³ for Prestige LP, 6.6±0.7 cm³ for Bryan, and 7.3±0.6 cm³ for ProDisc-C Ti implant. The adjacent and implanted level neural elements were easily visualized on the T2 weighted images after the implantation of ProDisc-C Ti, Discover, Prestige LP, and the Bryan discs. The adjacent level neural elements were easily visualized on T2 weighted images after implantation of the ProDisc-C device, whereas the implanted level was distorted and could not be fully visualized.

Conclusion: Artifact varied depending on type of implant (geometry and material properties), was not symmetric and was smaller on T2 vs. T1 weighted images. This quantitative technique was sensitive for comparing different cervical implants.
Figure 1. Histogram of areal artifact based on axial slice level.