Magnetostimulation limits in magnetic particle imaging.

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Public Summary:
For magnetic particle imaging (MPI), specific absorption rate (SAR) and more critically magnetostimulation (i.e., dB/dt) safety limits will determine the optimal scan parameters, such as the drive field strength and frequency. These parameters will impact the scanning speed, field-of-view (FOV) and signal-to-noise ratio in MPI. Understanding the potential safety hazards of the drive field is critical for scaling MPI for human use. In this work, we demonstrate that magnetostimulation is the primary magnetic safety consideration in MPI, and we describe the first human-subject magnetostimulation threshold experiments for MPI using homogeneous coils. Our experiments, performed on the arm and leg, indicate that magnetostimulation thresholds monotonically decrease with increasing frequency. Additionally, we show for the first time that a strong inverse correlation exists between the threshold and the body part size. The chronaxie time, on the other hand, did not vary with body part size. We conclude with an estimation of the magnetostimulation thresholds for a full-body MPI scanner: a mean asymptotic threshold of 14.3 mT-pp (peak-to-peak) with a mean chronaxie time of 289 mus, which correspond to a magnetostimulation threshold of about 15 mT-pp for frequencies between 25 and 50 kHz. These findings will have a great impact on the optimization of MPI parameters, especially in determining the number of partial FOVs required to cover a region of interest.

Scientific Abstract:
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