

Needle artifact characteristics and insertion accuracy using 1.2-T open MRI: a phantom study

Abstract

Rationale and Objectives: To evaluate the characteristics of needle artifact and the accuracy of needle insertion using a 1.2-T open magnetic resonance imaging (MRI) system in a phantom.

Materials and Methods: First, the apparent width of the needle on the MR image and the needle tip position error of 16- and 18-gauge (G) MR-compatible introducer needles and a 17-G cryoneedle were examined with different needle angles (0° , 30° , 45° , 60° , and 90°) to the main magnetic field (B_0), sequence types (balanced steady-state acquisition with rewind gradient echo [BASG] and T2-weighted fast spin echo [FSE] sequence), and frequency encoding directions. Second, the accuracy of needle insertion was evaluated after 10 MR fluoroscopy-guided insertions in a phantom.

Results: The apparent needle widths tended to be larger when the angle of the needle axis relative to B_0 was larger. The needles appeared larger on BASG than on T2-weighted FSE images, with the largest apparent widths of 16-, 17-, and 18-G needles of 14.3, 11.6, and 11.0 mm, respectively. The apparent needle tip position was always more distal than the actual position on BASG images, with the largest longitudinal error of 4.0 mm. Meanwhile, the 16- and 18-G needle tips appeared more proximal on T2-weighted FSE images with right-to-left

frequency encoding direction. The mean accuracy of MR fluoroscopy-guided needle insertion was 3.1 mm.

Conclusion: These experiments clarified the characteristics of needle artifact in a 1.2-T open MRI. With this system, the MR fluoroscopy-guided needle insertion demonstrated an acceptable accuracy for clinical use.