

The Comparison of the Performance of MRI Clinical Sequences for Ankle Imaging at 3T vs 7T

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Purpose: Recently, the development of ultra-high field MR scanners is growing rapidly. In theory, if the coil and the subject are equivalent then the SNR will be almost linearly related to B_0 . SNR behavior, however, is apparently more complex, especially for human applications at 7T (mostly due to susceptibility artifacts and widened chemical shift) [1]. The aim of this study was to investigate the performance of clinical MR sequences in in-vivo ankle imaging at ultrahigh-field (7T). Ultrahigh-field MR imaging may substantially benefit from higher signal-to-noise ratio (SNR) and better spatial resolution.

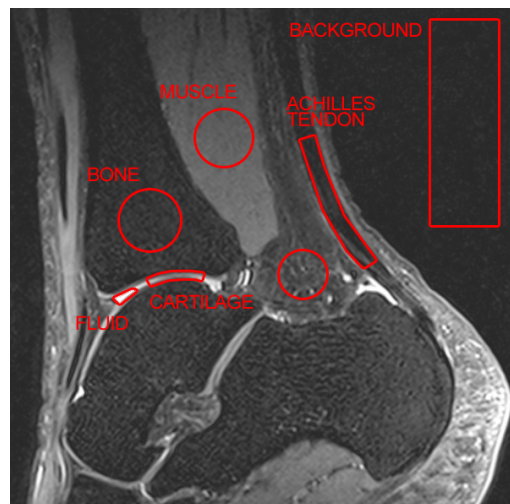


Fig. 1 Definition of region-of-interests on 3T image (similarly done on 7T) drawn in JiveX (Visus, Bochum, Germany).

Conclusion: The study revealed a significantly better performance of clinical MR sequences in ankle joint imaging at 7T in comparison to 3T in two of three investigated sequences. This proves the clinical applicability of 7T MR in routine ankle scanning. One of the possible study limitations was the SNR calculation procedure which may be slightly inappropriate for multi-element coils. Advanced methods of SNR estimation from multi-elements coils (such as multiple-acquisition or multi-pseudo replica) are not suitable in clinical applications. Therefore, the noise was estimated from images measured with zero voltage. The same procedure of SNR calculation was used for similar coils, and therefore the potential bias was minimized. We can conclude that the substantial benefit from ultrahigh-field could be demonstrated.

[1] Regatte, R.R., JMRI, 25, 2, pp. 262-269, 2007, [2] Steckner, M.C., Medical Physics 37, 9, pp. 5072-5079, 2010

↓ Fig. 3. SNR comparison of 2 field strength showed significantly positive difference ($SNR_{7T} > SNR_{3T}$) in seq.1 (A) and seq. 2. (B) (marked by asterisk) Seq. 3 showed higher SNR in 3T due to strong artifacts on 7T images (originating from incorrect frequency settings for fat excitation, typical problem for ultra-high field MR (Fig. 2F)).

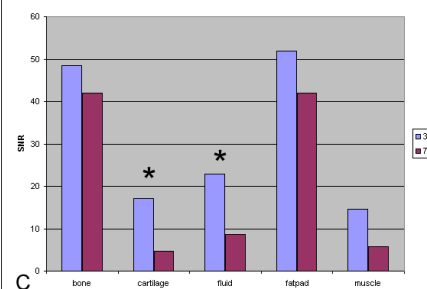
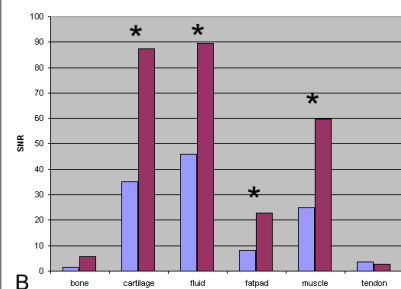
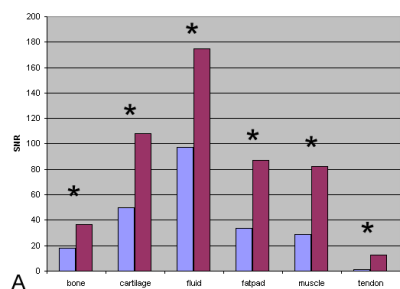


Fig. 2 Examples of images obtained at 3T (A - seq. 1, B - seq. 2, C - seq. 3) and 7T (D - seq. 1, E - seq. 2, F - seq. 3). The improvement of image quality of 7T images (resolution, SNR) is clearly demonstrated for seq. #1 and #2.