Comparison of a newly developed multi-shot echoplanar imaging (EPI) diffusion weighted imaging (DWI) sequence and different types of single-shot EPI DWI sequences

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Purpose: EPI DWI sequences are used for the detection of intracranial ischemia in clinical routine. A drawback of conventional single shot EPI DWI is the low spatial resolution and the vulnerability to artifacts, especially in the region of the skull base. The purpose of the project was to compare the image quality of conventional single-shot EPI DWI sequence used in clinical routine to a multi-shot EPI DWI sequence. Advances in pulse sequence design have led to the latter sequence which demonstrates less artifacts and distortions and is thus of potentially higher diagnostic value, when compared to the conventional EPI DWI sequence.

Materials and Methods: 15 healthy volunteers (mean age 27.6 ±5.8, 9m, 6f) were investigated with three different EPI DWI sequences within the same session. All exams were performed on a 3.0T MR system (Magnetom Verio, Siemens, Erlangen, Germany) with a 32-channel head coil. The imaging protocol included a newly developed multi-shot EPI DWI sequence, a clinical routine single-shot EPI DWI sequence, as well as a single-shot EPI DWI sequence with sequence parameters adjusted to those of multi-shot EPI. The latter was included in the imaging protocol for better comparison because sequence parameters of an optimized multi-shot EPI DWI sequence and those of an optimized single shot EPI DWI sequence differ significantly from each other. Image quality of the different sequences was rated qualitatively on a 4-point Lickert scale in regard to the overall image quality, the differentiation of grey and white matter, the delineation of anatomical structures in several locations and the presence of artifacts with 1 being the best and 4 being the worst rating. In addition quantitative measurements of SNR were performed at different locations. In sequences with parallel imaging the difference method was used for calculating the noise in the image.

Results: Qualitative assessment of the three different sequences yielded best results for the multi-shot EPI sequence with 1.07±0.26 for overall image quality (**table 1**), 1.07±0.26 for the presence of disturbing artifacts and 1.23±0.58 for the differentiation between grey and white matter and the delineation of anatomical structures. Quantitative assessment of SNR revealed best results for the clinical routine single-shot EPI sequence with a mean SNR of 50.45 compared to 35.43 and 35.37 for the multi-shot EPI and the single-shot EPI with adjusted parameters respectively (**figure 1**).

Conclusion: Due to a higher spatial resolution and less blurring the multi-shot EPI DWI sequence offers a better differentiation between anatomical structures compared to a single-shot EPI-DWI. However, a multi-shot approach leads to increased noise within the image and thus to a lower SNR. However, due to the performance of all exams at 3.0T even the lowered SNR is sufficient for diagnostic image quality.

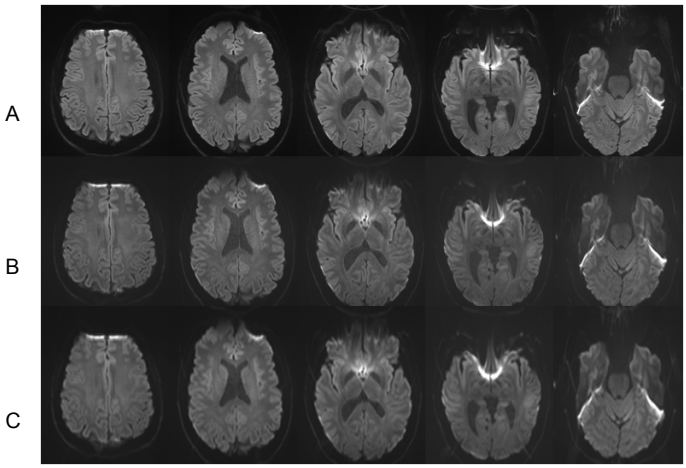

Figure 1: Examples of all used EPI DWI sequences: A)multi-shot DWI EPI, B) single-shot EPI DWI clinical routine, C) single-shot EPI DWI with matched parameters

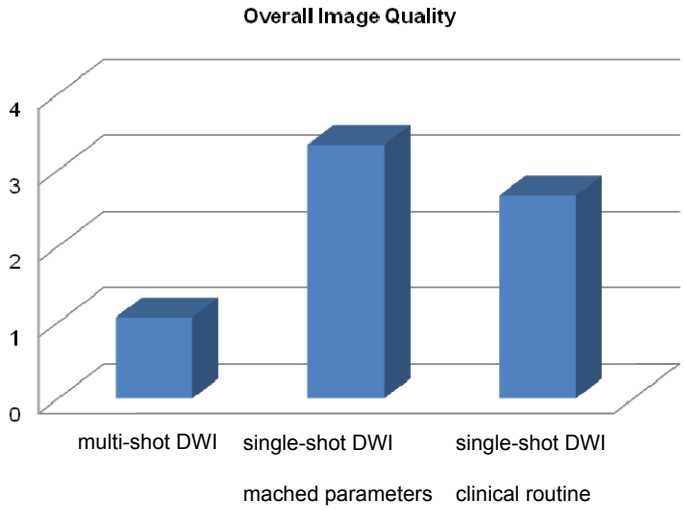

Table 1: Qualitative assessment of overall image quality