

BLADE in sagittal T2-weighted imaging of the cervical spine: reduction of artifacts and value for clinical application

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INTRODUCTION:

Up to now, Periodically Rotated Overlapping Parallel Lines with Enhanced Reconstruction (PROPELLER) or BLADE imaging has been proposed either to reduce motion artifacts in uncooperative patients, in cardiac or abdominal imaging or to reduce geometric distortions in echo planar imaging. Sagittal T2-weighted images of the cervical spine are prone to several kinds of artifacts such as flow artifacts (vessels, CSF), motion artifacts (swallowing), and truncation artifacts – even in cooperative patients. Therefore, the aim of this study was to evaluate if BLADE imaging might be helpful in a routine clinical setting to improve image quality and diagnostic reliability.

METHODS:

Sagittal T2-weighted turbo spin echo (TSE) sequences with conventional rectilinear k-space trajectory ("TSE") were compared to TSE sequences with BLADE trajectory ("BLADE") in 60 successive patients (33 men, 27 women; 19-86 years old, mean: 51 years). The findings in those patients included degenerative disk disease (n=44), lesions of the vertebral body (n=24) and of the spinal cord (n=12). Both sequences were applied with identical spatial resolution (FOV: 250 mm x 250 mm, matrix size: 384 x 384, slice thickness: 3 mm) and nearly identical parameters for TR (3000-3560 ms) and TE (112-113 ms). The TSE sequence was performed with flow compensation and a head-feet phase encoding direction to reduce motion artifacts. All examinations were done on 1.5 T scanners (Magnetom Symphony TIM and Magnetom Avanto; Siemens) with comparable coil configuration.

Image quality was graded by 2 independent readers on a scale from 1 to 5 (1: excellent, 2: good, 3: moderate, 4: fair, but still diagnostic, 5: non-diagnostic) according to the following criteria: Image sharpness, overall motion artifacts, truncation artifacts, flow phenomena, metal artifacts, contrast vertebral body / disk, contrast spinal cord / CSF, and diagnostic reliability for the depiction of the spinal cord. Results for TSE and BLADE were compared using the Wilcoxon test ($p < 0.05$) – for each individual reader as well as for means of both readers. Furthermore, another 2 readers in consensus assessed TSE and BLADE images side-by-side for each patient and selected the technique they would prefer for diagnostic purpose. All evaluations were done blinded to the imaging technique and blinded to clinical informations or other imaging material.

RESULTS:

The BLADE technique gave statistically significant better results for all criteria except for metal artifacts, which were seen in 9 patients after surgery. This result was true for each individual reader as well as for the means of both readers (see Fig. 1). The diagnostic reliability for the spinal cord depiction was insufficient (grade 5) in 10 patients (reader 1) resp. 9 patients (reader 2) using TSE but only in 2 patients (reader 1) resp. 1 patient (reader 2) using BLADE. The number of examinations which were graded as non-diagnostic due to overall motion artifacts was also somewhat lower with BLADE (reader 1: 1 patient, reader 2: 0 patients) than with TSE (reader 1: 1 patient; reader 2: 2 patients). Furthermore, the visual evaluation revealed improved contrast between vertebral body and vertebral disk and between spinal cord and CSF for BLADE compared with TSE.

The consensus reading demonstrated important advantages for BLADE, too: In 50 of 60 patients the BLADE sequence was preferred for diagnostic purpose, in 3 of 60 patients TSE was preferred, and in 7 patients both sequences were graded as equivalent.

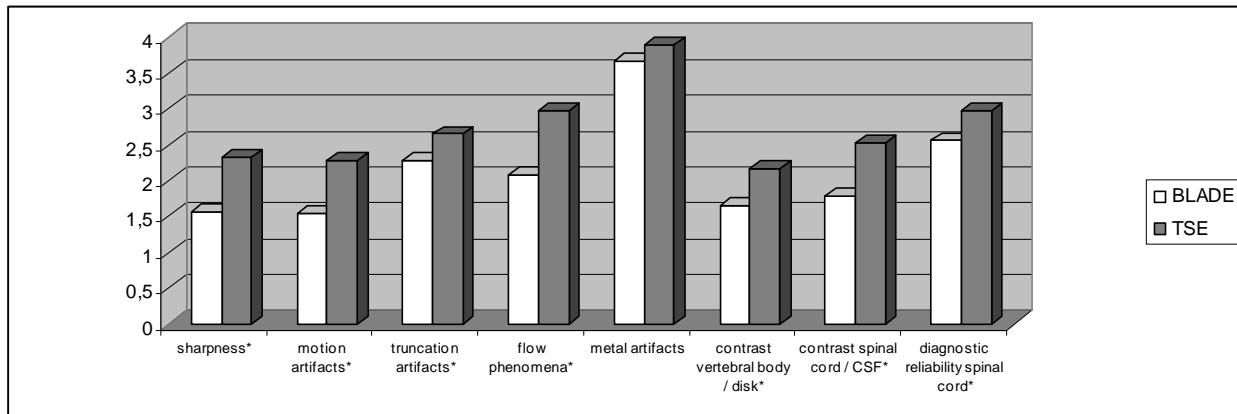


Fig. 1: Results of the visual evaluation on a scale from 1 (excellent) to 5 (non-diagnostic): means of 2 independent readers (*: $p < 0.001$, Wilcoxon test)

CONCLUSION:

Using the BLADE technique for sagittal T2-weighted images of the cervical spine instead of a TSE technique with rectilinear k-space trajectory seems to be advantageous not only for uncooperative patients, but also for routine clinical imaging. The most important artifacts like motion, truncation, and flow artifacts were significantly reduced with BLADE, the diagnostic reliability for depiction of the spinal cord was increased and contrast behavior of relevant structures was improved compared with TSE. Nevertheless, more detailed investigations concerning lesion detection are necessary until BLADE can be generally recommended to substitute TSE for sagittal T2-weighted imaging of the cervical spine.