

The Clinical Advantages of T2-weighted MR Imaging in the Female Pelvis with *syngo* BLADE

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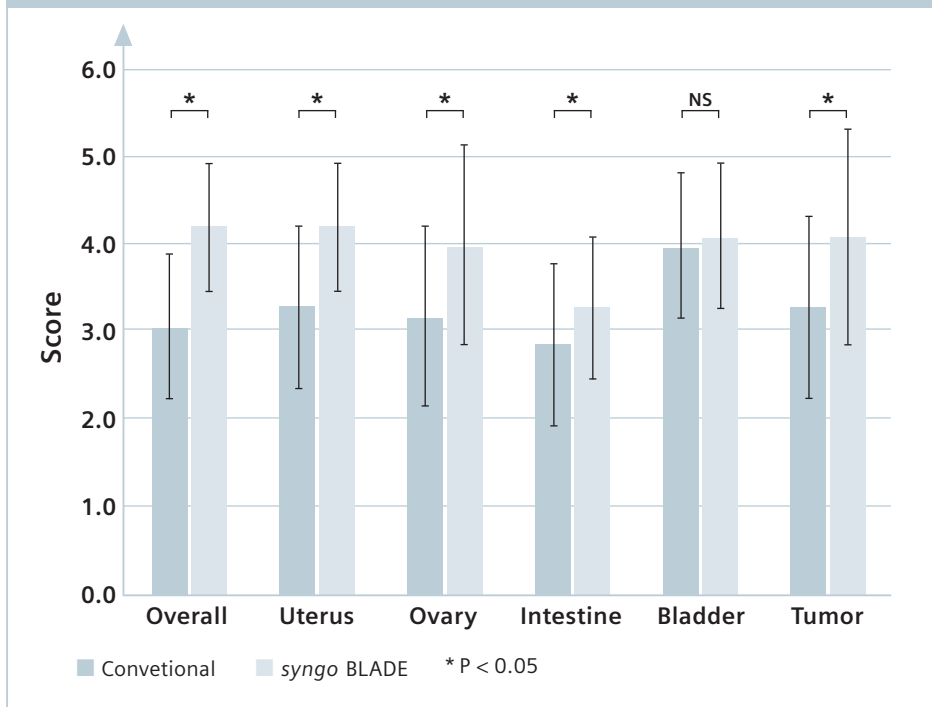
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Introduction

syngo BLADE is a non-Cartesian data acquisition technique that has been applied for motion correction in brain imaging. In *syngo* BLADE, the echo trains in each TR are acquired in the same way as in a conventional turbo spin-echo sequence. Each echo train is made up like a blade, and the blade rotates to fill k-space. This trajectory makes the BLADE sequence motion insensitive.

Although the artifacts from respiratory motion are limited in the female pelvic region, motion artifacts from the abdominal wall and intestine degrade MR images. In this article, we would like to show the advantages and limitations of BLADE technique compared to turbo spin-echo T2-weighted imaging (T2WI) of the female pelvic region, introducing our recent study that was presented at the ISMRM meeting in Berlin, Germany in 2007. In our study, we compared sagittal T2WI with BLADE (TR/TE = 6760-9500/113) and T2WI with conventional acquisition (TR/TE = 3730/105-120) in 34 subjects, including 6 healthy volunteers (age: 28 ± 3) and 28 patients (age: 50 ± 16) who underwent pelvic MRI for gynecologic diseases. MRI was performed at 1.5T scanner (MAGNETOM Symphony) utilizing a multi-

Table 1: Visual evaluation



This graph represents the results of visual evaluation. The overall image quality, delineation of the **pelvic organs** including the uterus, the ovary, the intestines and tumors were superior in BLADE-T2WI compared with conventional T2WI, **except for the bladder**.

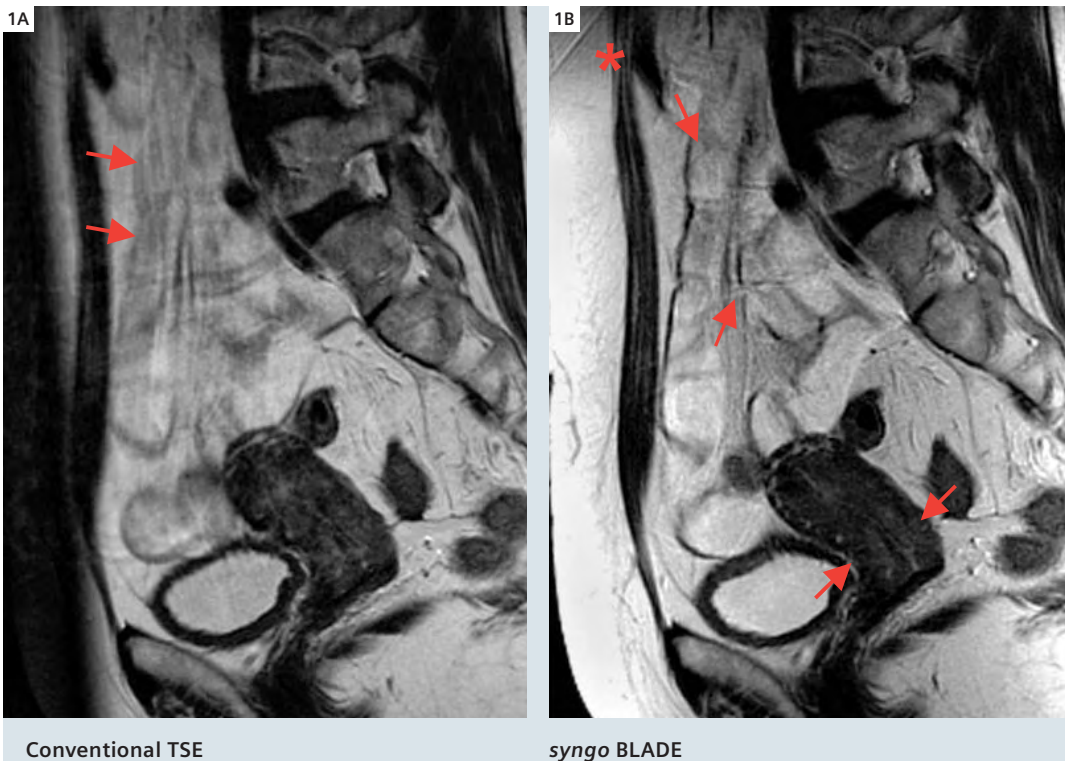
	<i>syngo</i> BLADE	Conventional	P Value*
Overall (n = 34)	4.1 ± 0.7	3.0 ± 0.8	< 0.001
Uterus	4.1 ± 0.7	3.2 ± 0.9	< 0.001
Ovary	3.9 ± 1.1	3.1 ± 1.0	0.001
Intestine	3.2 ± 0.8	2.8 ± 0.9	0.009
Bladder	4.0 ± 0.8	3.9 ± 0.8	0.395
Tumor	4.0 ± 1.2	3.2 ± 1.0	0.001

* Calculated by Wilcoxon's signed-rank test. P < 0.05 was considered statistically significant.

channel phased array coil. Sequence protocols other than TR, TE were identical in both T2-weighted scanning; FoV of 260 mm, slice thickness of 5 mm, interslice gap of 0.9–1.5 mm and matrix of 320. All MR images were independently evaluated by two radiologists using a 5-point scale, regarding the overall image quality, the sharpness of the configuration of the intestine, uterus, bladder and tumor, if present. The presence and type of artifacts in each sequence were also described. The results of MR image evaluation were compared in each subject.

The results of the evaluation of MR images are summarized in Table 1. T2WI with *syngo* BLADE provided better overall image quality and less ghosting artifacts, which were always present in T2WI with conventional turbo spin echo technique. The delineation of the pelvic organs and tumors in T2WI with BLADE was superior to T2WI with conventional turbo spin echo, except for the bladder. In one patient with cervical carcinoma, T2WI with *syngo* BLADE could successfully depicted tumor that was hardly recognizable on conventional T2WI (Fig. 1). On the other hand,

T2WI with BLADE was associated with some minor but unique artifacts, including fine linear artifacts in the intestine (n = 34) and bladder roof (n = 12), faint sunburst like radiating lines from the body in all, wrap around artifacts (n = 20), sharp lines at the corner of the FoV (n = 14). The fine linear artifacts around the bladder roof may result from motions associated with urine influx and intestinal peristalsis. The unique sunburst-like artifact may represent a kind of wrap around artifact, resulting from rotating data acquisition. However, these artifacts were



1 Uterine Cervical Cancer
Sagittal T2-weighted images with *syngo* BLADE provide better overall image quality and clearer delineation of the uterus and intestine by reducing ghosting and blurring caused by motion artifacts (A arrows), and demonstrates uterine cervical carcinoma (B arrowheads) that is hardly recognizable on conventional T2-weighted image. Nonetheless, the T2-weighted image with *syngo* BLADE has fine linear artifacts in the small intestine (B arrows) and sharp lines at the corners of FoV (B asterisk).



Conventional TSE



T2-weighted image with syngo BLADE

2 Pregnant Woman

A case of a pregnant* woman. Ghosting artifact is eliminated in the T2-weighted image with syngo BLADE, but delineation of the uterus, the placenta, and the fetus is severely degraded by prominent linear artifacts.

*The safety of imaging fetuses/ infants has not been established.

only minor, and did not significantly degrade the overall image qualities, except in one pregnant* woman. In one of three pregnant women in our series, artifacts from fetal motion severely degraded T2-weighted images with syngo BLADE. In summary, T2-weighted images with syngo BLADE can provide better image quality and clearer delineation of the organs in

the female pelvis by eliminating the ghosting artifacts, compared with T2-weighted images with conventional acquisition. We believe that T2-weighted images with syngo BLADE have high potentials to improve image quality of T2-weighted images in other body regions.

*The safety of imaging fetuses/infants has not been established.

References

- 1 Wintersperger, B.J., Runge, V.M., Biswas, J. et al., Brain magnetic resonance imaging at 3 Tesla using BLADE compared with standard rectilinear data sampling. Invest Radiol, 2006. 41(7): p. 586-92.
- 2 Seo H, Masui T, Katayama M, et al, Comparison of PROPELLER Fast Spin Echo, Respiratory-Triggered Fast Spin Echo and Single-Shot Fast Spin Echo Sequences for Transverse T2-Weighted Magnetic Resonance Imaging of the Female Pelvis. 13th Scientific Meeting and Exhibition ISMRM 2005. 5 Miami Beach.
- 3 Pipe; Motion Correction With PROPELLER MRI: Application to Head Motion and Free-Breathing Cardiac Imaging; MRM 1999; 42; 963-969.

Table 2: artifacts evaluation

	N = 35	Conventional	PROPELLER
Motion artifact		35	0
Fine linear artifacts		0	35(intestine) 12(bladder)
Sharp lines at the corner of FOV		0	20
Wrap-around artifact		0	14

Regarding the artifacts, motion artifacts (which are) seen in all conventional technique were successfully eliminated in BLADE-T2W images. However, in BLADE images, there were several minor artifacts including fine linear artifacts in the intestine and the bladder, sharp lines at the corner of FOV and unique wrap-around artifacts.