Usefulness of Diffusion-weighted MR Imaging for Perianal Fistulas: A Pictorial Review

Poster No.: C-0631
Congress: ECR 2011
Type: Educational Exhibit
Authors: T. Yoshizako¹, A. Wada¹, T. Takahara², T. Kwee³, T. Katsube¹, E. Fukuba¹, M. Nakamura¹, M. Tsurusaki¹, H. Kitagaki¹; ¹Izumo/JP, ²Kangawa/JP, ³Utrecht/NL

Keywords: Inflammation, Fistula, Abscess, Education, Complications, Abscess delineation, MR-Diffusion/Perfusion, Gastrointestinal tract

DOI: 10.1594/ecr2011/C-0631

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Learning objectives

1. To present several examples of diffusion weighted MR imaging (DWI) in perianal fistulas.
2. To assess the feasibility of using DWI for evaluating perianal fistula activity.
3. To review and discuss the utility of DWI findings in perianal fistulas compared to other sequences.
Background

Perianal fistulae and abscesses are a disorder of the anorectum with a prevalence of 1 per 10,000 of population with underlying causes of cryptoglandular infection, Crohn's disease, radiotherapy, or secondary malignancy(1). Although many anal fistulae are easy to treat surgically, some have a tendency to recur despite seemingly adequate surgery. Recurrence is most often due to infection that has escaped surgical detection and gone untreated. Therefore, the importance of pretreatment and follow up imaging to evaluate the disease extent is now well recognized. Magnetic resonance (MR) imaging is accepted as an accurate pretreatment technique for the detection of fistulae and associated secondary tracts and abscesses. Pretreatment MR imaging can impact surgical planning, diminish the chance of recurrence, and alter surgical outcome of fistulae (2-7).

In this article, first we present several examples of diffusion weighted MR imaging (DWI) in perianal fistulae. Second we review and discuss the utility of DWI findings in perianal fistulae compared to other sequences.
Imaging findings OR Procedure details

MR technique

MR imaging
All patients are examined with a 1.5-T system (Signa CV/i ver. 9.1 GE Medical System Milwaukee, WI) using a pelvic phased-array coil.

DWI

DWI is performed in the axial plane (i.e. true axial plane), using a single-shot spin-echo echo-planar-imaging (SE-EPI) sequence. Imaging parameters include a TR/TE of 4000/83.7 ms, a flip angle of 90°, a slice thickness of 5 mm with an interslice gap of 0.5 mm, an actual matrix size of 128x192 with reconstruction to 256x256, a FOV of 420x210 mm², a bandwidth of 110 kHz, number of signal averages of 8, and b-values of 0 and 1000 s/mm². Three orthogonal directions of motion probing gradients are used.

Detection of the small lesions and many lesions once

Hori et al. (8) report that the fistula appears high signal intensity, whereas the background signal is significantly suppressed on DWI. Some fistulae can be diagnosed with improved confidence by adding DWI to fat-suppressed T2-weighted imaging (T2WI). DWI can detect small lesion (Figure 1). In addition DWI has high contrast resolution (Figure 2). DWI and fat-suppressed T2WI can detect some lesions once (Figure 3). In particular, DWI can detect many lesions once clearly (Figure 4).

Detection of the spread area of the lesions

Fistula and adjacent structure show similar high signal intensity on fat-suppressed T2WI. On the other hand, on DWI, fistula shows high signal intensity to easy distinguish to adjacent structure. DWI can easily detect the spread area of the lesions (Figures 5 and 6). However DWI can not understand anatomic position. Hori et al. (8) report that DWI has inherent poor spatial resolution compared to spin-echo or gradient-echo sequences. Therefore, high spatial resolution imaging would be required for anatomic orientation (Figures 7 and 8).

Guess of inflammatory degree

Active fistulae are filled with pus and granulation tissue and, as such, appear as high signal intensity structures on T2WI (9-15). Occasionally, some high signal intensity may be seen even in the fibrous area, probably reflecting edema (14). On enhanced T1WI,
active granulation tissue will enhance while pus fluid in the fistula itself remains low signal intensity (14, 15) (Figures 9 and 10).

An abscess, which contains inflammatory cells, a matrix of proteins, cellular debris, and bacteria in high-viscosity pus (16), can also exhibit a low diffusivity, and have consequent high signal intensity at DWI. The signal intensity on DWI will vary with inflammatory degree, too (Figure 11).

**Usefulness of anal fistulas follow up**

Post inflammatory granulation tissue appears as high signal intensity structures on fat-suppressed T2WI (9-15). On DWI, non inflammatory granulation tissue appears as low signal intensity structures (Figure 10). DWI is useful to evaluation the activity of lesion on the change condition of post-treatment (Figures 12 and 13). DWI is useful to evaluation the activity area of lesion.

When digital examination can not do, such as, post Miles operation state, DWI can show abnormal intensity to un-palpated lesion (Figure 14).
**Fig. 0**: Figure 1: 26-year-old man with anal pain. A: Left anal lesion (arrow) shows spotty high signal intensity on fat-suppressed T2WI. B: The lesion shows high signal intensity and the lesion is suggested small active inflammation on DWI.

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**Fig. 0:** Figure 2: 54-year-old man with anal pain on post prostatectomy state. There is no abnormal finding on physical examination. But there is anal pain. A: Anal region shows spotty high signal intensity on fat-suppressed T2WI. B: The lesion shows high signal intensity and the lesion is suggested small active inflammation on DWI.

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![Image](image1.png)

**Fig. 0:** Figure 3: 38-year-old man with anal abscess and fistula. A: Two anal lesions (arrow/arrow head) show spotty slightly high signal intensity on fat-suppressed T2WI. B: The right lesion (arrow) shows high signal intensity and the left lesion (arrow head) shows no abnormal lesion on DWI. The right lesion is suggested active inflammation and the left lesion is suggested non-active lesion.

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**Fig. 0:** Figure 4: 34-year-old man with anal fistula and gluteus abscess on Crohn's disease. A: Small anal fistula and gluteus abscess (arrow) show high signal on fat-suppressed T2WI. B: The small lesion and gluteus abscess show high signal intensity on DWI. The gluteus abscess is large lesion, but anal fistula is small lesion. Small anal lesion is easy to find as clearly high signal intensity on DWI.

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**Fig. 0:** Figure 5: 37-year-old man with anal deep abscess. A: Fat-suppressed T2WI shows that the abscess spread at deep and large area in the hip. B: DWI shows the active inflammation spread at deep and large area. DWI can be distinguish the activity of lesions and easy understand spread area of abscess.
Fig. 0: Figure 6: 33-year-old woman with anal fistula on Crohn's disease. A: Anal fistula shows slightly high signal on fat-suppressed T2WI. B: The lesion shows high signal intensity and the active inflammatory part in lesion shows strongly high signal intensity (arrow) on DWI. DWI is useful to evaluation the activity area of lesion.
Fig. 0: Figure 7: 59-year-old man with right anus levator muscle abscess. A: Fat-suppressed T2WI shows the abscess in right anus levator muscle as high signal intensity (arrow). B: DWI shows high signal intensity on the abscess. DWI can not understand anatomic position and connection with adjacent structure.

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Fig. 0: Figure 8: 44-year-old woman with left supura levator muscle abscess on ulcer colitis. A: Fat-suppressed T2WI shows the abscess in right supra levator muscle as high signal intensity (arrow). B: DWI shows high signal intensity on the abscess. DWI can not understand anatomic position. On the other hand, fat-suppressed T2WI can understand the location of abscess connection with the ans levator muscle. The association to anus levator muscle is important for treatment method.

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**Fig. 0:** Figure 9: 24-year-old woman with perirectal abscess on Crohn's disease. A: Fat-suppressed T2WI shows that one anal abscess have pus fluid and fistula. B: Fat-suppressed enhanced T1WI shows the enhanced wall of the abscess (arrow). C: DWI shows high signal intensity on pus fluid and abscess wall. The cystic mass (curved arrow) with thickness wall existe right back of the uterus is suggested right ovary with inflammation. DWI shows high signal intensity as active inflammation area (arrow head) in right follicle. And DWI is useful to evaluation to inflammation spread adjacent organ.

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**Fig. 0:** Figure 10: 27-year-old woman with anal scar. A: T2WI shows the anal scar (arrow). B: Fat-suppressed enhanced T1WI enhances the scar (arrow). C: DWI shows no abnormal intensity on scar (arrow). Fat-suppressed enhanced T1WI enhances the granulation tissue and DWI shows no abnormal intensity on no active inflammation lesion (scar).
**Fig. 0:** Figure 11: 33-year-old man with anal abscess. A: Right anal region (arrow) shows spotty slightly high signal intensity on fat-suppressed T2WI. B: The lesion shows high signal intensity and the lesion is suggested small active inflammation on DWI. C: But chief doctor have suggested non-active lesion and done follow up. The lesion become abscess on enhanced CT after 1 month.
**Fig. 0**: Figure 12: 56-year-old woman with perirectal abscess on post rectal cancer operation state. A: On pre-treatment, fat-suppressed T2WI shows that the perirectal abscess (arrow) is high signal intensity. B: DWI shows the lesion as strongly high signal intensity. C: On post-treatment, fat-suppressed T2WI shows that the perirectal abscess (arrow) is slightly high signal intensity. D: DWI shows the lesion as no abnormal intensity. DWI is useful to follow up for abscess.

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**Fig. 0:** Figure 13: 38-year-old woman with Crohn's disease on treatment by catheter. There is no abnormal finding on physical examination on Crohn's disease on treatment by catheter (arrow). But there is anal pain. A: On fat-suppressed T2WI, anal region shows spotty high signal intensity, but not clear due to catheter. B: On DWI, the lesion shows no abnormal intensity and the lesion is suggested no active inflammation. DWI is useful to evaluation the activity of lesion near catheter.

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Fig. 0: Figure 14: 58-year-old man with perineum abscess on post Miles operation state. A: On fat-suppressed T2WI, perineum fistula (arrow) shows high signal intensity. B: On DWI, the lesion shows spotty partial high signal intensity (arrow) and the lesion is suggested spotty active inflammation. This case is post rectum resection state, so the lesion can not be palpated. DWI can show abnormal intensity to not palpated lesion.

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Conclusion

The utility of DWI in perianal fistulae are; detection small lesions and many lesions once, detection the spread area of the lesions, guess of inflammatory degree, and to be useful to perianal fistulae follow up.
Personal Information

Corresponding Author
Takeshi Yoshizako
Department of Radiology, Shimane University Faculty of Medicine
P.O. Box 00693-8501, 89-1 Enya Izumo, Japan
TEL : +81-853-20-2289
FAX : +81-853-20-2285
e-mail : yoshizako@med.shimane-u.ac.jp
References


