

Evaluation of Diffusion-Weighted Magnetic Resonance Imaging in the Diagnosis of Perianal Fistula

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ABSTRACT:

BACKGROUND:

Perianal fistulas and other inflammatory diseases of the anus and inflammation of perianal soft tissues area cause substantial morbidity. Diffusion-weighted magnetic resonance imaging (MRI) plays a great role in the evaluation of anal fistulae.

OBJECTIVE:

To evaluate the value of DWI in the examination of perianal fistula.

PATIENTS AND METHODS:

The study included 38 patients (30 males and 8 females) with clinical suspicion of perianal fistula. It was done in MRI department (3.0T) of AL-Imamain AL-Kadhimiyan Medical city, Baghdad/ Iraq during the period from November 2020 to January 2021. MRI images were assessed for the presence of visible fistulas, internal openings, secondary extension, horse shoe and abscess.

RESULTS:

68.4% of the fistulas were at Lt. side and 31.6% in the Rt. Side. Intra-sphincteric was 63.2%, trans-sphincteric was 31.6% and supra-sphincteric was 5.3%. The primary tract detection rate at T1 was 81.6%, at T2 was 92.1%. The internal opening, the detection rate in T1 was only 10.5%, at T2 was 21.1%, at T2 Fat was 81.6%, T1+contrast was 63.2%, at DWI was 89.5% and T2 Fat+DWI was 100%. (P< 0.001. The detection rates at T2 fat sat, T1+contrast, DWI and T2 fat sat+DWI were 100%, 89.5%, 86.6% and 100%, respectively, indicating a higher detection rate at T2 sequence and T2 fat sat+DWI, with highly significant differences (p<0.001). According to the detection rates reported above, the best accuracy rate in combined T2 Fat+DWI, (P< 0.001, highly significant).

CONCLUSION:

Both DWI and CE sequences have high accuracy in the diagnosis and detecting complications of PAF. The combined FS-T2W + DWI and FST2W + CE data sets have equal sensitivity and specificity, and the use of the combined FS-T2W + DWI data set can prevent unnecessary use of contrast agent and prevent both cost and contrast-related complications.

KEYWORDS: Magnetic resonance imaging, Diffusion-weighted imaging, Perianal fistula.

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INTRODUCTION:

Perianal fistula is defined as a tract lined by granulation tissue which may have external opening, internal opening, or both external and internal openings. Perianal fistula may be of high level, which opens at or above the level of anorectal ring, or lower level, which opens below the level of the anorectal ring⁽¹⁾. It may result in a significant morbidity with a prevalence of approximately 0.01%, predominantly affecting young adults with a male-to-female ratio of 2:1^(2,3). Perianal fistula is one of the most difficult

surgical disorders, protecting anal function and preventing anal incontinence and is very difficult for surgeons, especially complex perianal fistulas⁽⁴⁾. Around 35% of patients develop recurrent disease after initial presentation for cryptoglandular perianal abscess^(5, 6). Perianal fistulae are relatively common in Crohn's disease, occurring in around 20% of patients^(7, 8). Risk factors for the development of fistulizing perianal Crohn's disease include male gender⁽⁹⁾, rectal inflammation^(9, 10), and Sephardic Jewish

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ethnicity⁽⁸⁾. Younger age (less than 40 years) has been reported as a risk factor for recurrence of cryptoglandular disease in patients without IBD⁽⁵⁾. Studies have suggested an increased risk of recurrence in non-diabetic patients^(5, 9), although the trend was not found to reach statistical significance. The assessment of fistulous extension is the most important clinical indication for imaging in fistula in ano. This is due to the fact that the perianal fistula can affect the anal sphincter complex resulting in impaired continence⁽¹¹⁾. Recurrence is inevitable if the internal opening was not correctly identified; this is because in such cases the original source of sepsis will not be eliminated, so identification of these parameters with proper imaging methods pre-operatively will decrease the percentage of recurrence^(12,13,14). Prior to implementation of the MRI, multiple imaging methods were used to test the fistula in ano, but sadly these showed poor outcomes⁽¹⁵⁾.

AIM OF THE STUDY:

To evaluate the value of DWI and other MRI sequences in the evaluation of perianal fistula.

PATIENTS AND METHODS:

A cross sectional analytic study was conducted on (38) patients (30 males and 8 females) clinically suspected to have perianal fistula, in the department of radiology/ MRI Units of (AL-Imamain AL-Kadhimyian Medical City), from November 2020 to January 2021.

Inclusion criteria: patients clinically suspected to have perianal fistula, or patients presented with signs and symptoms of one or more of perianal discharge, pain, perianal swelling and induration.

Exclusion criteria: patients with no visible external orifice, those with only peri-anal abscesses or sinuses and had no evidence of fistula, patients with general contraindications for MRI (e.g. patients with metallic shells or cardiac pacemakers) and patients with allergy to gadolinium contrast.

The study was approved by the scientific committee of the Iraqi board of diagnostic radiology. An oral informed consent was obtained from all patients included in the study.

MRI examination: was performed using 3Tesla MRI system (Achieva, PHILIPS medical system, Netherland), using a body surface coils. The imaging volume included the distal rectum anal canal, the internal and external sphincters, ischioanal fossa, levator muscle, supra-levator space and subcutaneous tissue in the perineal field.

All patients were examined with the following sequences: T1 weighted images in oblique axial and coronal planes with fat suppression (Repetition time (TR)=400-60msec, Echo time(TE)=5-10msec, slice thickness 4-5mm, gap 0.5-1 mm, field of view 370-430mm and a flip angle of 90 degree, T2 weighted images in oblique axial and coronal planes with and without fat suppression (TR=4000-5000msec, TE=100-130msec, slice thickness 4-5mm, gap 0.5-1mm, field of view 370-430mm and a flip angle of 90 degree, repeated T1 weighted images in oblique axial and coronal planes with fat suppression after given IV contrast (Gadolinium was used as contrast material, given intravenously by direct injection, in a dose of 0.1 ml/kg body weight). Since the anal canal is tilted 45 degree anteriorly in the sagittal plane so it was necessary to obtain oblique axial and coronal images that is oriented perpendicular and parallel to the anal canal respectively. Therefore we used a sagittal T2 singleshot image with centerline along anal canal serving as a localizer for the subsequent sequences. Diffusion weighted images (DWI) The body coil (dStream Torso coil) was used with the following parameters: (TR/TE = 6400/101msec, slice thickness = 4-5mm; interslice gap= 0.5mm; number of slices = 24, matrix size = 188×192, with reconstruction to 256×256, FOV= 385mm×385mm, bandwidth = 173kHz; number of signal averages = 4; b-values of 400, 800 and 1000 s/mm². The scan time for DWMRI was 3min). The axial plane was used for DWI.

Statistical analysis: data were analyzed using the statistical package for social sciences (SPSS) version 26. Kappa statistics used to assess value of agreement of sequences with surgical findings and was interpreted as follows : 0.01-0.20 Slight, 0.21-0.40 Fair, 0.41-0.60 Moderate 0.61-0.80 Substantial, 0.81-0.90 strong and 0.91-1.00 as Almost perfect.

RESULTS:

In this study, 38 patients with peri-anal fistula were included, mean age was 44.4±15.2 years, males were dominant (78.9%) with a male to female ratio of 3.75 to 1. Out the 38 patients 26 patients (68.4%) were Lt. sided and 12 patients (31.6%) were Rt. Sided. Intrasphincteric was seen in 24 patients (63.2%), trans-sphincteric in 12 patients (31.6%) and supra-sphincteric in 2 patients (5.3%).

Regarding the site of internal opening 8 (21.1%) had fistulas located at 12 O'clock, 7 (18.4%) at 6-7

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O'clock, 6 (15.8%) at 6 O'clock and 6 (15.8%) at 10-11 O'clock, 4 (10.5%) at 5-6 O'clock, 3 (7.9%) at 1-2 O'clock, 2 (5.3%) at 3-4 O'clock and 2 (5.3%) 8-9 O'clock.

Regarding the primary tract: T1 sequence detected correctly 31/38 patients giving a detection rate of

81.6%, T2 detect 35/38 patients with detection rate of 92.1%, while using T2 fat suppression, T1 with contrast, DWI and T2 fatsuppression+DWI, the detection rate was 100% in these sequences, with a highly significant difference ($P < 0.001$) as in table (1).

Table 1: Detection rates of different MRI sequences in detection of primary tract.

Sequence	Yes	No	Total	Detection rate (%)	Kappa(κ)	Level of Agreement
T1	31	7	38	81.6%	0.90	Strong
T2	35	3	38	92.1%	0.96	Almost perfect
T2 fs	38	0	38	100.0%	1.00	Almost perfect
T1+contrast	38	0	38	100.0%	1.00	Almost perfect
DWI	38	0	38	100.0%	1.00	Almost perfect
T2 Fs +DWI	38	0	38	100.0%	1.00	Almost perfect
P. value < 0.001 (high significance)						

For the internal opening, the detection rate in T1 sequence was 4/38, in T2 8/38, T2 Fs 31/38, T1 with contrast 24/38, DWI 34/38 and T2 Fs +DWI

38/38 with higher detection rate of 100% with a highly significant difference ($P < 0.001$) as revealed in table (2).

Table 2: Detection rates of the internal opening at different MRI sequences.

Sequence	Yes	No	Total	Detection rate (%)	Kappa (κ)	Level of Agreement
T1	4	34	38	10.5%	0.10	Slight
T2	8	30	38	21.1%	0.18	Slight
T2 fs	31	7	38	81.6%	0.90	Strong
T1+contrast	24	14	38	63.2%	0.72	Substantial
DWI	34	4	38	89.5%	0.95	Almost perfect
T2 Fs +DWI	38	0	38	100%	1.00	Almost perfect
P. value < 0.001 (high significance)						

Secondary tract was present in only 26 cases while not present in the remaining 12. At T1 17/26 were detected with detection rate of 65.4%, at T2 19/26 with detection rate of 73.1%. The detection rates at T2 fat sat, T1+contrast, DWI and T2 fat sat+DWI

were 100%, 89.5%, 86.6% and 100%, respectively, indicating a higher detection rate at T2 sequence and T2 fat sat+DWI, with highly significant differences ($p < 0.001$) as shown in table (3).

Table 3: Detection rates of the secondary tract at different MRI sequences.

Sequence	Yes	No	Total	Detection rate (%)	Kappa (κ)	Level of Agreement
T1	17	9	26	76.3%	0.82	Strong
T2	19	7	26	81.6%	0.90	Strong
T2fs	26	0	26	100.0%	1.00	Almost perfect
T1+contrast	22	4	26	89.5%	0.95	Almost perfect
DWI	21	5	26	86.8%	0.93	Almost perfect
T2 Fs+DWI	26	0	26	100.0%	1.00	Almost perfect

Associated collection was seen in 26 cases, the detection rates ranged between 73.7% at T1 to 100% at T1+contrast and T2 Fs +DWI, and

at T2 it was 92.1% and at T2 Fs it was 84.2%, with highly significant differences ($p < 0.001$) as illustrated in table (4).

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Table 4: Detection rates of the associated collection at different MRI sequences.

Sequence	Yes	No	Total	Detection rate (%)	Kappa(κ)	Level of Agreement
T1	16	10	26	73.7%	0.78	Substantial
T2	23	3	26	92.1%	0.96	Almost perfect
T2fs	20	6	26	84.2%	0.92	Almost perfect
T1+contrast	26	0	26	100.0%	1.00	Almost perfect
DWI	22	4	26	89.5%	0.95	Almost perfect
T2 Fs+DWI	26	0	26	100.0%	1.00	Almost perfect

The overall accuracy of different MRI sequences was 50.7% at T1, 63.9% at T2, 89.6% at T2 fs, 83.1% at T1 with contrast, 83.9% at DWI and 100% at T2 Fs + DWI, indicating the best accuracy rate in combined T2 Fs + DWI, with a highly significant difference ($p < 0.001$) as seen in table (5).

Table 5: Accuracy rates of different MRI sequences in detection of perianal fistula and its associated characteristics.

Parameter	T1	T2	T2 Fst	T1+contrast	DWI	T2 Fs+DWI
Primary tract	65.4%	73.1%	100.0%	84.6%	80.8%	100.0%
Internal Opening	10.5%	21.1%	81.6%	63.2%	89.5%	100.0%
Secondary tract	65.4%	73.1%	100.0%	84.6%	80.8%	100.0%
Associated collection	61.5%	88.5%	76.9%	100.0%	84.6%	100.0%
Accuracy	50.7%	63.9%	89.6%	83.1%	83.9%	100.0%

P. value (comparison of accuracy rates) < 0.001 (high significance)

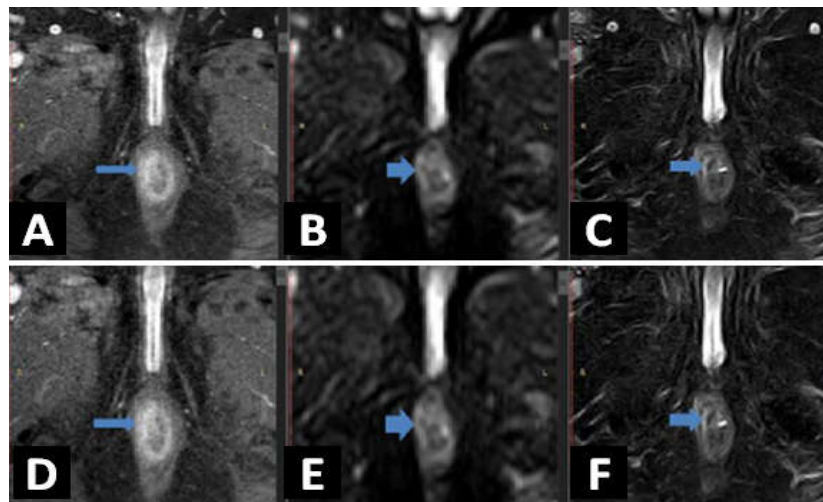


Figure 1: 57 years old male, presented with Rt. sided perianal discharge, grade II inter-sphincteric fistula, A= axial T1 PC. B= DWI. C= T2 Fs (internal opening). D= axial T1 PC. E=DWI. F=T2 Fs (main tract).

DISCUSSION:

Perianal fistula (PAF) is one of the significant health problem with major burden on the patients who suffered. It affects people at working age and interferes with their quality of life. However, there are some difficulties in identification the internal opening, primary tract, secondary tract and course

of fistula in addition to associated collection of abscess, these difficulties in recognition of fistula tract can be a challenge for surgeons and successful surgeries^(16, 17).

MRI represents the reference standard and guiding surgery for PAF. Hence, MRI is crucial technique

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particularly with selection of sequences for assessment and characterization of PAF with the special selection being between standard anatomical sequences: T1 and T2, T2 fat-saturated and T1 post-contrast MRI image to diffusion weighted imaging^(17, 18, 19).

In the present study 63.2% of the PAF were Intersphincteric, 31.6% Transsphincteric and the least frequent was Suprasphincteric. Baba and Weerakkody⁽²⁰⁾ from Tunisia reported that the majority of PAF (70%) were Intersphincteric followed by Transsphincteric 25% and Suprasphincteric 5%.

The present study found that MRI had significantly high detection rate and agreement with surgical findings in a rate ranged between 81.6% to 100% in detection of primary tract of PAF, however, the highest detection rate was reported with T2 fat, T1+contrast DWI and T2 Fat +DWI with 100% agreement and almost perfect agreement ($\kappa = 1.00$). These findings indicated that all sequences were precise in detection of primary tract of fistula which revealed that MRI can detect primary tract in a true positive rate that reach to 100% compared to surgical findings. In detection of internal opening, the DWI had a detection rate of 89.5% and when combined with T2 fat and combined the accuracy reached to 100% with a kappa value of 1.0 indicated almost perfect agreement with surgical findings, all other sequences had lower detection rates than DWI or DWI+T2Fat regarding detection of internal opening. In detection of secondary tract, T2 fat, had 100% detection rate (kappa= 1.0), DWI had high detection rate of 86.5% (kappa = 0.93) and higher detection and agreement rate of 100% (kappa=1.00) reported with T2 Fat +DWI. A study by Singh et al.⁽²¹⁾ reported high accuracy of MRI in detection for the sensitivity and specificity of MRI in correctly detecting and grading the primary tract at 95.56%, and of secondary tract (93.75%) and correct localization of internal opening in a rate of (95.8%). Algazzar et al.⁽¹⁷⁾ study from Egypt in 2019, reported that MRI can detect 95.4% of internal opening of fistula. Conversely, Karanikas et al.⁽²²⁾ reported lower detection rate for DWI of 77.4% to detect the fistula. Cavusoglu et al.⁽²³⁾ in their study to evaluate the added value of DWI for diagnosis of fistula found that almost perfect agreement was found with T2 (kappa 0.868) and higher agreement and accuracy obtained in combination of DWI and T2-weighted images resulting in 96% agreement. Furthermore,

Mohsen and Osman⁽¹⁹⁾ documented that DWI had a good performance in the evaluation of perianal inflammatory disease. However, combined DWI and T2W evaluation had better performance which was not significantly different from combined T2W and post-contrast images. Aslan S.⁽²⁴⁾ concluded that adding DWI to the FS-T2W data set in the diagnosis of PAF has been shown to detect both diagnosis and complications with high accuracy. Combined FS-T2W+DWI and FS-T2W+CE data sets have equal sensitivity, specificity and the use of the FS-T2W+DWI data set can prevent unnecessary use of contrast agent. Also his results showed the detecting of the perianal abscesses, when using intraoperative findings as a reference, moderate agreement for isolated FS-T2W data set ($\kappa = 0.41$) and almost perfect agreement for combined FS-T2W + DWI and FS-T2W + CE data sets ($\kappa=1.00, 1.00 - 1.00, 1.00$, respectively). In addition he suggest that adding DWI to the FS-T2W data set will not make a difference in diagnosis and is as useful as contrast series, while avoiding the use of contrast agent in detecting perianal abscesses and secondary tracts. Singh et al.⁽²¹⁾ also revealed that combined FS-T2W + DWI data sets had high sensitivity, specificity, PPV, and NPV in the detection of secondary fistulous tracts.

CONCLUSION:

Both DWI and CE sequences have high accuracy in the diagnosis and detecting complications of PAF. The combined FS-T2W + DWI and FST2W + CE data sets have equal sensitivity and specificity, and the use of the combined FS-T2W + DWI data set can prevent unnecessary use of contrast agent and prevent both cost and contrast-related complications.

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