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Original Article

Added Value of Diffusion Weighted Magnetic Resonance Imaging in diagnosis of Perianal Fistula at Zagazig University Hospitals

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ABSTRACT

Background: Diffusion-weighted imaging (DWI) sequences offer a novel way in which the scope of application of magnetic resonance imaging (MRI) could be broadened, which can help assess perianal fistula. The present research aims to assess the use of diffusion-weighted MRI in diagnosing perianal fistulas and to emphasize its superiority over other MRI sequences in detecting and diagnosing such cases at Zagazig University Hospitals.

Methods: The present research is a retrospective analysis that involved a cohort of 36 individuals who were clinically diagnosed with perianal fistula. These participants underwent MRI evaluation using a 1.5-T scanner. Three distinct b-values were utilized to conduct DWI sequences. Additional regular MRI sequences were incorporated. MRI images were analyzed to assess and evaluate the diagnostic effectiveness of the diffusion-weighted (DW) MRI sequence with other sequences in the diagnosis of perianal fistula. Post-surgical data has always been considered the main reference for assessing diagnostic efficacy.

Results: Among 36 cases confirmed with perianal fistula by surgical intervention, MRI detected 28 cases (true positive), and 8 cases were missed (False negative) while DWI detected all 36 cases, so MRI had (77.8%) sensitivity while DWI had (100%) sensitivity, with adding value 22.2% over MRI in diagnosing of fistulas. In the current research, we reported the presence of abscesses in 11.1% of examined cases.

Conclusion: MRI is currently the preferred imaging modality for assessing perianal fistula before surgery. However, DWI had an added value over other MRI sequences in the detection and diagnosis of such cases. This highlights the role of DWI-MRI in drawing a map, especially for surgeons aiming for successful surgical interventions.

Key Words: Perianal fistula, DWI, added-value, MRI, Zagazig

INTRODUCTION

A fistu-in-ano (or perianal fistula) is a pathological condition characterized by inflammation around the area of the anal canal, accompanied by the formation of a fistulous tract that extends through the anal sphincters. Fistula-in-ano is a prevalent benign colorectal condition characterized by the presence of an epithelized aberrant tract that connects two areas, typically the perianal skin and rectal mucosal surfaces [1]. The perianal fistulas had a significantly high probability of recurrence due to the presence of undiagnosed infection during surgical intervention, resulting in considerable

morbidity and frequently necessitating multiple surgical interventions [2].

The occurrence of perianal fistula and anal gland obstruction is believed to be associated with many inflammatory disorders and diseases, such as Crohn's syndrome, tuberculosis, birthing trauma, malignancies, and exposure to radiotherapy [3].

The occurrence of an acute perianal abscess can be attributed to the restriction of anal gland drainage and the presence of infection. Some abscesses can heal naturally by draining into the anal canal, while others may require a surgical procedure involving incision and evacuation of the abscess [4].

According to Sahni et al. [5], Imaging through MRI has grown to be the established technique for anatomically evaluating ano- or rectovaginal and perianal fistulas. The study conducted by Villa et al. reveals a remarkable level of accuracy in characterizing both the primary tract and abscesses. The major tract showed a sensitivity of 100% and specificity of 86%, while abscesses exhibited a sensitivity of 96% and specificity of 97% [6]. Therefore, due to its capacity to identify tracts, delineate complicated anatomical structures, and detect abscesses, this imaging modality has emerged as a preferred tool for visualizing anal fistulas [7]. This technique facilitates the assessment of alternative pathways and the identification of potential extensions to the supralevator fossa. Prior studies conducted to ascertain the relevance of magnetic resonance imaging in this particular issue have demonstrated the important nature of this modality. [8].

The utilization of DWI sequences gives a novel opportunity to enhance the capabilities of magnetic resonance imaging, thus offering additional insights into the alterations associated with inflammatory bowel illness [9].

Diffusion-weighted imaging has been discovered to offer a significant degree of differentiation between lesions, such as cancer or acute inflammatory processes, and the surrounding tissues [10]. Several studies have shown evidence of the significant role that it plays in the identification of primary peri-anal fistula [11], as well as its ability to detect complicating abscesses and measure activity [10]. There is an increasing interest in assessing the effectiveness of diffusion-weighted MRI when utilized alongside T2W imaging. The researchers asserted that the addition of supplemental diffusion can enhance the visualization of specific fistula tracks, increasing both confidence and sensitivity through pictures with a weight assigned to them [12].

The primary objective of this study is to assess the additional benefit of DW-MRI in diagnosing perianal fistula, using surgical treatment as a reference for our results.

METHODS

This study was conducted retrospectively and observed a total of 36 patients who had perianal fistulas. The research protocol was approved by the research ethical committee of the Faculty of Medicine, Zagazig University, Institutional Research Board (IRB) number #4805/7-8-2018. The Declaration of Helsinki, issued by the World Medical Association to ensure the protection of individuals participating in medical research, was strictly adhered to during this study. Informed verbal and written consent were obtained from the studied participants before joining the study.

The study was performed at the MRI unit of the Radiology Department, Zagazig University Hospitals in the period from October 2018 until October 2019.

In this study, specific eligibility criteria were applied to the participants. Inclusion criteria comprised individuals experiencing perianal pain accompanied by discharge, those previously diagnosed with a perianal fistula and scheduled for MRI, patients with recurrent perianal fistulas and abscesses that did not respond to treatment, Before conducting MRI scans, a comprehensive consent was obtained from each patient. Conversely, exclusion criteria were used to exclude patients with metallic ocular implants, pacemakers, or other implanted cardiology devices incompatible with MRI. Additionally, individuals with aneurysm clips and those who chose to decline surgery were not included in the study.

Full history was taken from each case including Complete history taking: including age, and sex. Inflammatory conditions, pelvic infection, bleeding, diarrhoea, birthing trauma, any malignancies or metastasis, and exposure to radiotherapy. History including any systemic diseases or surgery. Presence of any contraindications to MRI.

All patients were subjected to Clinical examination to detect the provisional site of the perianal fistula, taking the anal clock as a reference—MR imaging using Philips Achieva 1.5T MRI System at the Radio-diagnosis Department of Zagazig University Hospital.

Technique: Magnetic resonance imaging had been conducted using surface coils that offer exceptional anatomical resolution of the anal sphincters and the anatomical limits of the pelvis. The evaluation of pathological diseases of the anal canal often relies on high-resolution T2-weighted MR images, which are considered the standard of reference. The evaluation protocol for anal disease at our radiology unit involves the use of oblique axial T1-weighted fast spin-echo MR pulse patterns oblique axial and coronal T2-weighted fast spin-echo sequences and fat-saturated T2-weighted sequences, and oblique axial and oblique coronal fat-saturated T1-weighted fast spin-echo sequences. The T2-weighted rapid spin-echo sequence in three dimensions serves as the primary data source for post-processing, utilizing image reformatting techniques to provide reformatted images in any desired plane. The parameters were sequenced as follows: The sagittal turbo spin echo sequence was performed with a repetition time (TR) of 4000 milliseconds and an echo time (TE) of 83 milliseconds. The field of view (FOV) was 270 millimeters, and the matrix size was 392 by 448. The total acquisition time (TA) was 150 seconds, with an echo train length (ETL) of 20. Two acquisitions were made with a slice thickness of 3 millimeters and a gap of 0.3 millimeters. The imaging protocol includes Turbo Inversion Recovery Magnitude (TIRM) sequences acquired in both axial and coronal planes. The parameters used are as follows: repetition time (TR) of 4840-4500 ms, echo time (TE) of 29 ms, inversion time (TI) of 230 ms, flip angle (A) of 130 degrees, field of view (FOV) of 350 mm, matrix size of 320 x 240, slice thickness of 3 mm, and a gap of 0.5 mm between slices. The imaging protocol included T1-weighted axial and coronal spin echo sequences with specific parameters: repetition time (TR) of 649-98 ms, echo time (TE) of 10 ms, field of view (FOV) of 270 mm, matrix size of 260 x 320, acquisition of 1, slice thickness of 3 mm, and a gap of 0.5 mm. Additionally, T1-weighted gradient echo (turbo spin echo) contrast-enhanced axial, sagittal, and coronal images were obtained with fat suppression, using a TR of 772-644 ms, TE of 10 ms, total acquisition time (TA) of 126 seconds, total echo train length (TLE) of 3, FOV of 230 cm, matrix size of 320 x 240, slice thickness of 3 mm, and a gap of 0.5 mm.Diffusion weighted imaging (DWI) was conducted in the oblique axial plane using a single-shot echo-planar imaging (SE-EPI) sequence called RESOLVE, with the specified parameters:The imaging parameters used were as follows: repetition time (TR) of 6900 ms, echo time (TE) of 68 ms, time to last echo (TLE) of 49, a field of view (FOV) of 230 mm, flip angle of 80 degrees, matrix size of 300 x 384, slice thickness of 3 mm with no gap, a bandwidth of 173 kHz, 8 signal averages, and b-values of 0, 50, and 800 s/mm2. Three perpendicular axes of motion probing gradients were utilized. The duration of the DWI scan was 90 seconds.

STATISTICAL ANALYSIS

The statistical analysis was conducted using SPSS 20. Qualitative information is expressed numerically and as percentages (N. %), and quantitative information, after undergoing normality testing using the Shapiro-Wilk test, is given as normally distributed data with mean±SD (range). Inferential statistics: The significance level, denoted by the P value, is used to determine the statistical significance of a result. If the P value is greater than 0.05, the result is considered non-significant. On the other hand, if the P value is less than or equal to 0.05, the

result is considered significant. For data that was quantitative, a t-test for independent samples was employed when the data followed a normal distribution. We utilized post-surgical data as the benchmark for comparison with cMRI and DWI, to determine the sensitivity of the diagnostic methods. The sensitivity was calculated with 95% confidence intervals.

RESULTS

The current study included 36 patients. The study included participants aged 21 to 70 years, with an average age of 40.69 years and a standard deviation of 15.25. The gender distribution was predominantly male, with males representing 69.4% of the total, while females made up 30.6%.

Most of perianal fistulas among patients were located on the right side (36.1%), followed by the left (30.6%), middle 6 o'clock (25%), and horseshoe U shape (8.3%) (Table1).

The majority of fistulas were trans-sphincteric (77.7%), while (22.3%) of fistulas were inter-sphincteric. We reported presence of abscess in 4 patients (11.1%) (Complicated type) (Table 1).

Among 36 cases confirmed with perianal fistula by surgical intervention, MRI detected 28 cases (true positive), and 8 cases were missed (false negative) while DWI detected all 36 cases, so MRI had (77.8%) sensitivity with (60.8% - 89.9%) confidence interval, while DWI had (100%) sensitivity, with adding value 22.2% over MRI for diagnosis of fistula, specificity could not be calculated as we didn't have negative cases (Table 2).

On assessing the association between detected and missed fistulas by MRI with fistulas characters; we reported that missed cases were significantly associated with middle site fistula (62.5%), also highly significantly associated with U shape fistula (37.5%) (P <0.001) (Table3).

Table 1: Demographic and clinical data among studied group

Variables	All patients (n=36)
Age *mean±SD* *median (range)*	 40.69 ± 15.25 38 (21- 70)
Sex *n.%* – Male – Female	 25 (69.4%) 11 (30.6%)
Side: *n.%* – Left – Right – Middle 6 o'clock – U-shaped	 11 (30.6%) 13 (36.1%) 9 (25%) 3 (8.3%)
Site: *n.%* – Inter sphincteric – Trans sphincteric	 8 (22.3%) 28 (77.7%)
Abscess: *n.%* – Absent – Present	 32 (88.9%) 4 (11.1%)

Table 2: Diagnosis and detection of fistula by different methods among the studied group

		Gold standard Surgical results		Total	Sensitivity 95% CI
		Positive	Negative		
MRI	Positive	28	0	28	77.8 % (60.8% - 89.9%)
	Negative	8	0	8	
	Total	36	0	36	
DWI	Positive	36	0	36	100% (90.3-100%)
	Negative	0	0	0	
	Total	36	0	36	

Table 3: Relation between detected and missed cases by MRI and patients and fistula characters

	MRI Peri-anal fistula		t/X^2	P-value
	Negative (n=8)	Positive (n=28)		
Age *mean±SD*	38.0±8.79	41.46±14.7	-0.56	0.57
Sex *n.%* – Male – Female	 7 (87.5%) 1 (12.5%)	 18 (64.3%) 10 (35.7%)	1.58	0.21
Side: *n.%* – Left – Right – Middle 6 o'clock – U-shaped	 0 (0%) 0 (0%) 5 (62.5%) 3 (37.5%)	 11 (39.3%) 13 (46.4%) 4 (14.3%) 0 (0%)	23.1	<0.001
Site: *n.%* – Inter sphincteric – Trans sphincteric	 3 (37.5%) 5 (62.5%)	 5 (17.9%) 23 (82.1%)	1.39	0.24
Abscess: *n.%* – Absent – Present	 8 (100%) 0 (0%)	 24 (85.7%) 4 (14.3%)	1.28	0.25

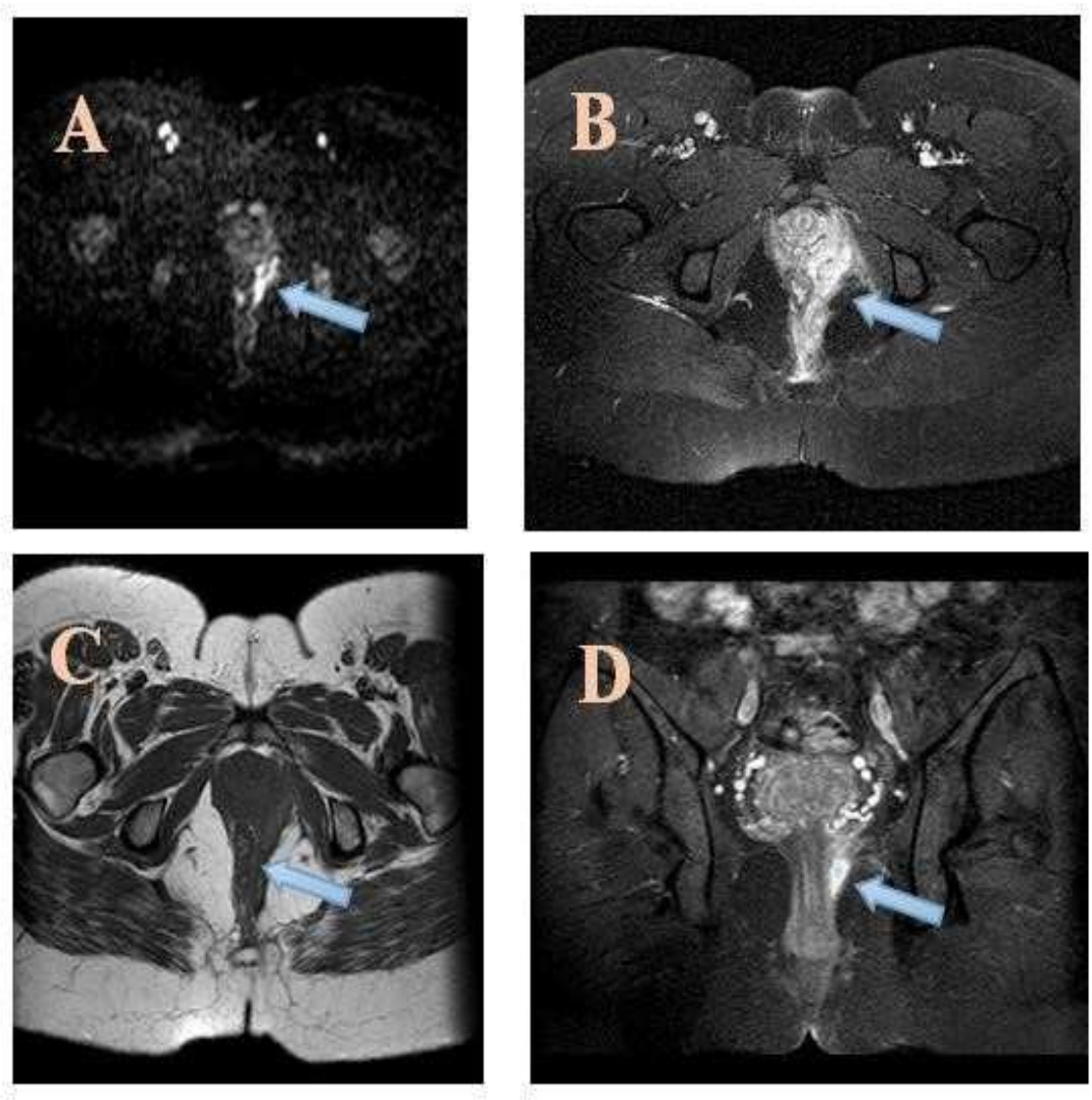

Figure 1: MRI of 21 years Female showing Trans-sphincteric perianal fistula detected in between 5 and 6 O`clock merging superiorly with surrounding inflammatory below the level of levator ani muscle (low fistula) Diffusion (A) STIR (B) and T1WI FSE axial (C) &coronal (D).

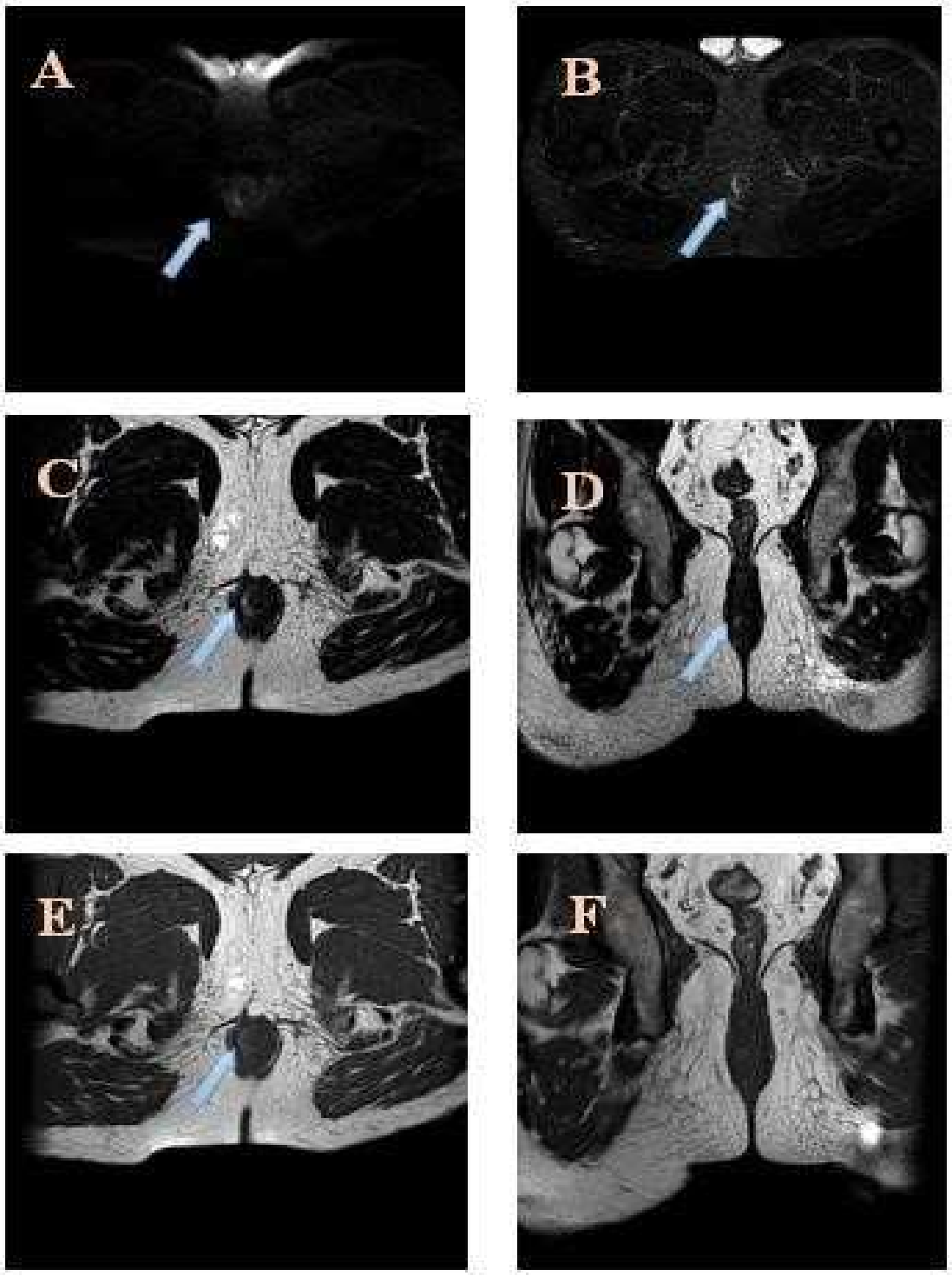

Figure 2: MRI of 48 years male patient axial cuts showing right trans-sphencteric perianal fistula detected at 10 O`clock not reaching the level of levator ani muscle (Low fistula) with no inflammation (healed) , axial cuts Diffusion (A) STIR (B) T2WI (C) coronal T2WI (D) and T1WI axial (E) & coronal (F).

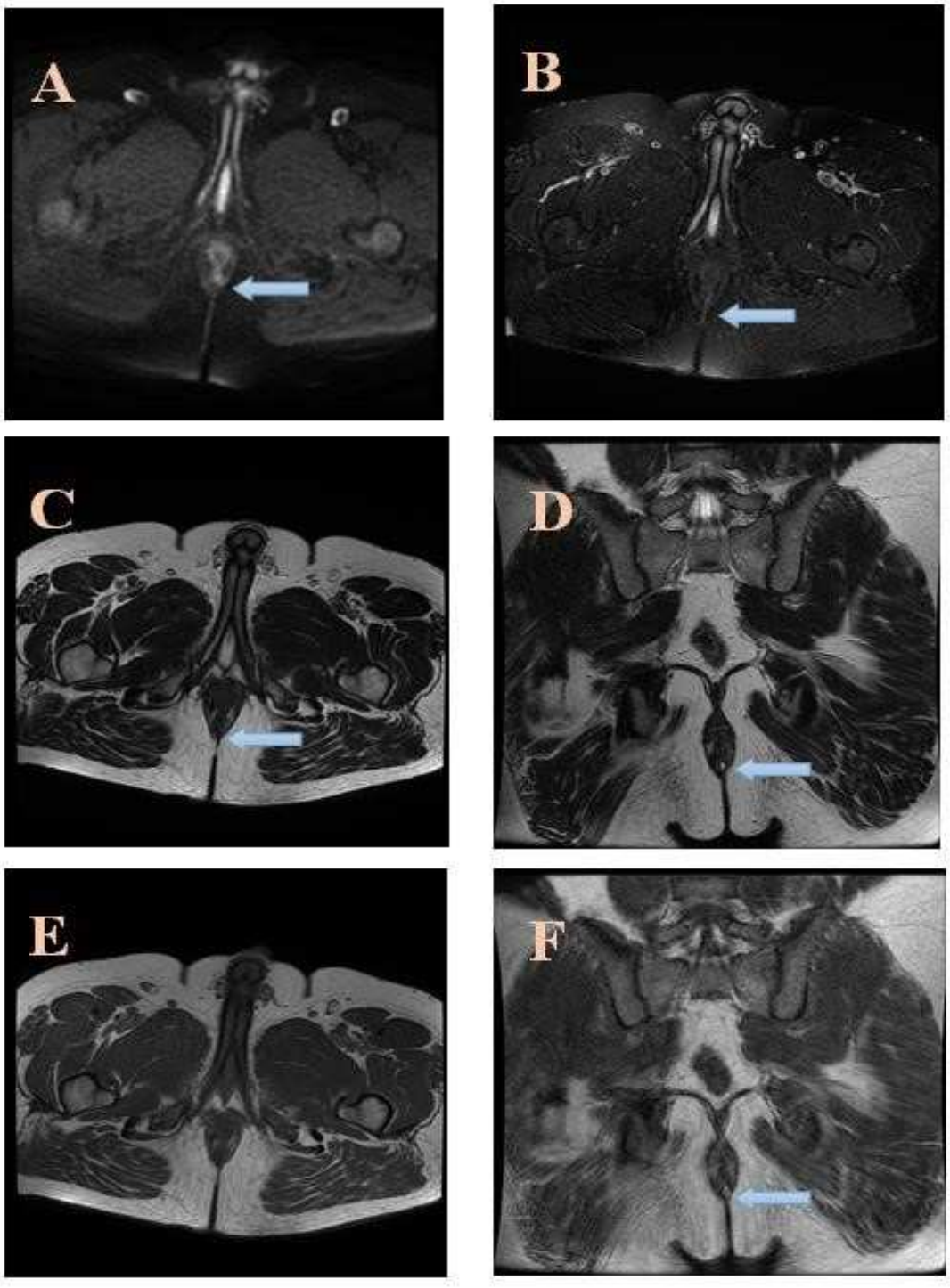

Figure 3: MRI of 45years male patient axial cuts showing inter-sphincteric peri-anal fistula at 6 O`clock with no signs of inflammation (healed) axial cuts Diffusion (A) STIR (B) T2WI (C) coronal T2WI (D) and T1WI axial (E) &coronal (F)

DISCUSSION

Numerous researches have been conducted to assess the significance of DW MRI in the identification of perianal fistula. MRI can be beneficial in the guiding of surgical interventions of recurring or intricate anal fistulas. The MRI is a suitable tool for recording the gastrointestinal tract due to its lack of ionizing radiation, ability to provide excellent tissue characterization, and offer functional imaging [13]. Our study revealed that DWMRI together with axial, coronal, and STIR were found important in the detection and evaluation of perianal fistula.

The current research reported that MRI success in the detection of 28/36 cases of perianal fistula with a sensitivity of 77.8 % whereas DWI success in the detection of perianal fistula in all studied cases with a sensitivity of 100% with an adding value of 22.2% over MRI. Buckingham et al. conducted a study on forty-two patients and found that dynamic contrast-enhanced MRI had a sensitivity of 97% and specificity of 100% in detecting fistulas [14]. The study conducted by Singh et al. found a sensitivity of 93.75%, specificity of 94.12%, positive predictive value of 88.24%, and negative predictive value of 96.97% [15].

Identifying the precise location of the internal opening is crucial to provide effective therapy and minimize the likelihood of fistula recurrence. According to our analysis, the internal opening was most frequently found on the right side, accounting for 36.1% of the studied participants. The left side accounted for 30.6%, the middle accounted for 25%, and the horse shoe U shape accounted for just 8.3% of the cases. Kraban et al., observed that the internal hole was most frequently seen at the 6 o'clock position [16].

Our study reported that simple perianal fistulas occurred in about 88.9 % of the studied cases while complicated perianal fistulas occurred in about 11.1 % of the studied cases. Drager et al., reported in his study of 241 cases of perianal fistula that simple fistulas occurred in 137 patients (56.9 %) while complicated fistulas occurred in 22 patients (9.1 %) of the studied cases [17].

In our study trans-sphincteric fistula represents about 77.7% then inter-sphincteric with a percentage of 22.3% of the cases. In contrary to another study conducted by Morris et al., [18], who observed in their research that 70% of the participants had inter-sphincteric type fistulas, trans-sphincteric fistulas accounted for 20% of the total cases. In his retrospective analysis, Baskan et al. found that 69.9% of all detected perianal fistulas were classified as inter-sphincteric type [19].

The findings of our study indicate that the perianal fistulas tract exhibits a higher intensity on diffusion weighted pictures, while the surrounding signal is notably reduced. The addition of diffusion-weighted imaging to T2-weighted imaging can enhance the accuracy of diagnosing some fistulae. Furthermore, in certain instances, diffusion-weighted pictures can provide a more distinct visualization of the extent of perianal fistulas. These enhancements are likely a result of the increased contrast between the fistula and the background, which aided in the detection of fistulae and tracking their pathways on diffusion-weighted images. However, it is also essential to assess the trajectory of the fistula in relation to neighbouring structures for preoperative planning. Thus, in order to accurately determine anatomical orientation, it is necessary to use imaging techniques with a high spatial resolution. Diffusion-weighted imaging is at a disadvantage in this aspect due to its inherent lower spatial resolution when compared to spin-echo or gradient-echo sequences. Consequently, we did not assess the individual significance of diffusion-weighted imaging. Alternatively, we assessed the supplementary benefit of the method for fat-suppressed T2-weighted imaging. This indicates that DWI ought to be consistently included in the standard MRI strategy for assessing perianal fistula.

Small sample size in one of the main limitations in our study, so we recommend further studies on a larger population to

ensure the validity of our results. Also we did not use post-contrast sequences in our analysis.

CONCLUSION

MRI is currently the preferred imaging modality for assessing perianal fistula before surgery. However, DWI had an added value over other MRI sequences in detection and diagnosis of such cases. This highlights the role of DWI-MRI in drawing a map, especially for surgeons aiming for successful surgical interventions.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

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