The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 3, 2025

MAGNETIC RESONANCE IMAGING OF PERIANAL FISTULA: EVALUATING THE SENSITIVITY AND SPECIFICITY OF STIR (SHORT TAU INVERSION RECOVERY) & DWI (DIFFUSION WEIGHTED IMAGING)

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DOI: https://doi.org/10.5281/zenodo.14988594

Keywords
Magnetic Resonance Imaging (MRI), Diffusion weighted imaging (DWI), Short time inversion recovery (STIR).

Article History
Received on 27 January 2025
Accepted on 27 February 2025
Published on 07 March 2025

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Abstract

Background: *Perianal fistulas are abnormal tracts commonly caused by chronic inflammation or infection, requiring precise imaging for diagnosis and treatment planning. MRI is the gold standard for evaluating fistulas, offering excellent soft tissue contrast and detailed visualization of tracts and abscesses. STIR and DWI sequences enhance the detection of inflammation and restricted diffusion, critical for identifying active disease. This study aims to evaluate the sensitivity and specificity of these sequences in diagnosing perianal fistulas.*

Objective: *To evaluate the sensitivity and specificity of STIR (short tau inversion recovery) & DWI (diffusion weighted imaging) of magnetic resonance imaging for diagnosis of perianal fistula.*

Methodology: *The research was conducted at Chughtai Diagnostic Center, Gujranwala, involving patients with perianal fistulas. Data collection from STIR, DWI-MRI was conducted after obtaining informed consent.*

Results: *The study included 51 patients, 9 (17.6%) were females 42 (82.4%) were males with a mean age of 37 years (range: 18–56years). Pus discharge was observed in 80.4% of cases, with detection rates of 82.4% on DWI and 58.8% on STIR. Fistula locations were classified as intersphincteric (41.2%), transphincteric (27.5%), suprasphincteric (19.6%), and extrasphincteric (11.8%). Abscesses were detected in 82.4% on DWI and 58.8% on STIR (moderate agreement, Kappa = 0.469). DWI identified more simple tracts (33.3%) than STIR (15.7%) (Kappa = 0.542). DWI had higher sensitivity for detecting edema (96.77%), abscesses (71.4%), and fibrotic changes (96.66%).*

Conclusion: *The study concluded that the advanced imaging techniques, particularly DWI, play a crucial role in the diagnosis of perianal fistulas. The study found that DWI is highly effective for detecting edema and fibrotic changes, with high sensitivity for edema detection. While the agreement between DWI and STIR imaging was variable, DWI showed a strong diagnostic capability, particularly for assessing perianal abnormalities such as fibrotic changes and*

edema. The results suggest that DWI could be a valuable tool in improving the accuracy of perianal fistula diagnosis, with the potential to guide treatment planning and enhance the understanding of disease characteristics.

INTRODUCTION

The anal canal is the terminal part of the large intestine. It is situated between the rectum and anus, below the level of the pelvic diaphragm. It lies in the anal triangle of perineum in between the right and left ischioanal fossa.[1] The anal region the most distal part of the gastrointestinal (GI) tract, includes the anal canal, the anal verge, and the anal margin. Anatomically, the anal canal extends from the dentate line to the anal verge. The anal sphincter complex is comprised of three layers: the internal anal sphincter muscle, the intersphincteric space, and the external anal sphincter (EAS) muscle. The IAS muscle is composed of smooth muscle in a continuation with the inner circular muscle of the rectum. The EAS muscle wraps radially around IAS and is composed of skeletal muscle in continuation with the puborectalis and levator ani muscles superiorly. [2]

An anal (or perianal) fistula is an external abnormal anatomical connection between the anorectal canal and the perianal skin. Symptoms of anal fistulas include perianal cellulitis, anorectal pain, pruritus ani, smelly or bloody drainage of pus, and in some cases difficulty controlling bowel movements. Men are more commonly affected than women, and the mean age of first presentation is reported to be 40 years .[4] Risk factors include obesity, high salt intake, diabetes, hyperlipidemia, dermatosis, anorectal surgery, smoking, alcohol consumption, sedentary lifestyle, excessive consumption of spicy or high-fat food, infrequent sports participation, and prolonged sitting on the toilet for defecation. [5]

The prevalence of anal fistula is reported to be approximately 1-2 per 10000 patients in European population studies. The mean incidence of anal fistula is estimated to be 8.6 per 100000 people, 1.04 per 10000 people, and 2.32 per 10000 people in Finland, Spain and Italy, respectively. However, being more than 10 years old, these reports may be outdated. [6] The incidence and epidemiology of anal fistula were studied among the inhabitants of the City of Helsinki (population 510,000) during a 10-year period, 1969 to 1978. The mean incidence per 100,000 population was 8.6 for nonspecific and fistula, 12.3 for males and 5.6 for females. [8]

The quality of life of a patient with fistula-in-ano can be greatly affected. The goal of treatment is to preserve the sphincter complex while destroying the fistula tract. Recurrence risk for complications such fecal incontinence, fistula recurrence, and anal stenosis ranges from 3% to 57%. When determining the risk of post-operative fecal incontinence, the surgical method and anatomic classification of the fistula are important considerations. [10]

Magnetic resonance imaging (MRI), with its superb soft tissue resolution, is the imaging modality of choice for anal and perianal abnormalities. Pelvic phased array coils allow more comfortable and tolerable scans with higher signal-to-noise ratios and wider field of view. [12]

Perianal fistulae can be standardized for MRI evaluation and classification with a high degree of diagnostic accuracy, which lowers interobserver variability. Dynamic contrast enhanced magnetic resonance imaging showed a sensitivity of 97% and specificity of 100% for the detection of fistulas in 42 patients when compared to digital rectal examination, dynamic contrast enhanced MRI, and surgical exploration. MRI preoperative evaluation helps detect secondary tracts and abscesses in addition to identifying and anatomically defining the course of perianal fistulas.[13]

Material and Methods:

This cross-sectional study was conducted at Chughtai Diagnostic Center, Gujranwala, with a sample size of 97 patients. The study aimed to evaluate the sensitivity and specificity of STIR and DWI MRI sequences in detecting perianal fistula. Data was collected using a Siemens Magnetom 0.35 Tesla MRI scanner and analyzed using Microsoft Excel and SPSS v25.0. Patient demographics, including age, gender, and risk factors, were summarized using measures of central tendency. The frequency of perianal fistula detected by MRI was calculated, and

the predictive accuracy of STIR and DWI was assessed using Positive Predictive Value (PPV) and Negative Predictive Value (NPV).

Results:

The study included 51 patients out of which 42 patients were males (82.3%) and 9 patients were females (17.7%), with a mean age of 37 years (range: 18–56). Pus discharge was present in 41 (80.4%) cases. Fistula locations were consistently classified on DWI and STIR as intersphincteric (41.2%), transphincteric (27.5%), suprasphincteric (19.6%), and extrasphincteric (11.8%). STIR has a sensitivity of 71.4% for detecting abscesses, 96.66% for detecting fibrotic changes, and 96.77% for detecting edema, compared to DWI. Overall, both modalities provided valuable insights, but DWI demonstrated higher sensitivity in detecting edema, abscesses, and fibrotic changes in 42 (82.4%) and 30 (58.8%) on STIR (moderate agreement, Kappa = 0.469, p = 0.000). Tract classification showed 33.3% simple and 66.7% complex on DWI, while STIR identified 15.7% simple and 84.3% complex (moderate agreement, Kappa = 0.542, p = 0.000). Fibrotic changes were observed in 58.8% on DWI and 80.4% on STIR (moderate agreement, Kappa = 0.517, p = 0.000). Edema was detected in 94.1% on DWI and 60.8% on STIR (slight agreement, Kappa = 0.080, p = 0.315), with DWI showing a stronger association with pus discharge (Kappa = 0.239, p = 0.034, sensitivity = 97.56%) compared to STIR (Kappa = 0.549, p = 0.000, sensitivity = 75%). Cross-tabulation analyses indicated perfect agreement for fistula location (Kappa = 1.000, p = 0.000), moderate agreement for abscess presence and tract classification, and slight agreement for edema detection. STIR had lower.

Table no 1: Frequency of categorical variables

Variables	Category	Frequency
Age	Maximum	56
	Minimum	18
Gender	Male	42
	Female	9
Pus Discharge	Yes	41
	No	10
Location on DWI	INTERSPHINCTERIC	21
	TRANSSPHINCTERIC	14
	SUPRASPHINCTERIC	10
	EXTRASPHINCTERIC	6
Location on STIR	INTERSPHINCTERIC	21
	TRANSSPHINCTERIC	14
	SUPRASPHINCTERIC	10
	EXTRASPHINCTERIC	6
Abscess on DWI	PRESENT	42
	ABSENT	9
Abscess on STIR	PRESENT	30
	ABSENT	21
Tract type on DWI	SIMPLE	17
	COMPLEX	34
Tract type on STIR	SIMPLE	8
	COMPLEX	43
Fibrotic changes on DWI	PRESENT	30
	ABSENT	21
Fibrotic changes on STIR	PRESENT	41
	ABSENT	10
Edema on DWI	ABSENT	3

	PRESENT	48
Edema on STIR	ABSENT	20
	PRESENT	31

Table No.1: The table summarizes data from 51 participants, detailing age, gender, presence of pus discharge, fistula locations on DWI and STIR, abscesses, tract types, fibrotic changes, and edema. The majority were male (82.4%) with an age range of 18 to 56 years. Pus discharge was present in most cases (80.4%). The most common fistula location was intersphincteric (41.2%), followed by transphincteric (27.5%), suprasphincteric (19.6%), and extrasphincteric (11.8%), with identical distributions on DWI and STIR. Abscesses were more frequently detected on DWI (82.4%) compared to STIR (58.8%). Complex tracts were more common than simple ones, with 66.7% classified as complex on DWI and 84.3% on STIR. Fibrotic changes were observed in 58.8% of cases on DWI and 80.4% on STIR. Edema was highly prevalent, present in 94.1% of cases on DWI and 60.8% on STIR.

Discussion

The study was designed to evaluate the correlation between clinical features and imaging findings in perianal fistulas, focusing on the utility of diffusion-weighted imaging (DWI) and conventional MRI sequences. The study sought to determine the diagnostic accuracy, reliability, and agreement between various imaging parameters (such as abscess collection, fluid, fistula location, and tract visualization) and clinical manifestations (like pus discharge), to guide improved diagnostic and treatment protocols for perianal fistulas and associated complications.

The study evaluated the sensitivity and specificity of STIR and DWI sequences in MRI for diagnosing perianal fistulas. In our study of 51 patients in which 42 patients were males (82.3%) and 9 patients were females (17.7%), we found a significant prevalence of fibrotic changes (58.8%) and edema (94.1%) on DWI imaging. The presence of fibrotic changes and edema showed moderate to slight agreement between DWI and STIR imaging, with Kappa values of 0.517 and 0.080, respectively. The sensitivity for detecting edema on DWI was high (96.77%), while for STIR, it was 75%. Additionally, there was a strong correlation between pus discharge and the presence of edema on both DWI and STIR (Kappa values of 0.239 and 0.549, respectively). Regarding the tract classifications, there was moderate agreement between the two imaging modalities, with Kappa values of 0.542 for tract changes and 0.469 for abscess detection. These results suggest a strong diagnostic capability for DWI in assessing edema and fibrotic changes, with variable agreement for tract and abscess assessments.

The study by Jabeen N, et al. (2019) evaluated the diagnostic accuracy of short tau inversion recovery (STIR) as a limited protocol MRI for perianal fistulae, reporting high sensitivity (96.6%) and diagnostic accuracy (90.6%) compared to surgical findings. It found that 83.3% of patients had fistulae on STIR, while 79.3% were confirmed surgically, demonstrating moderate specificity (67.7%) but strong positive predictive value (92.0%). In contrast, the present study assessed both STIR and diffusion-weighted imaging (DWI), with a focus on identifying abscesses, tract complexity, fibrotic changes, and edema. It found that DWI had higher sensitivity in detecting abscesses (82.4% vs. 58.8% on STIR), fibrotic changes (58.8% vs. 80.4%), and edema (94.1% vs. 60.8%), with stronger associations between DWI findings and pus discharge. While both studies highlight the usefulness of STIR, the present study suggests that DWI may offer superior sensitivity for detecting abscesses, fibrotic changes, and edema, making it a valuable adjunct to STIR in the evaluation of perianal fistulae. (17)

In our study, edema was observed in 94.1% of cases on DWI, demonstrating its high prevalence in perianal fistulas. The sensitivity for detecting edema was significantly higher on DWI (96.77%) compared to STIR (75%), indicating the superior capability of DWI in identifying inflammatory changes. The agreement between DWI and STIR for detecting edema was slight (Kappa = 0.080). Additionally, a strong correlation was noted between pus discharge and the presence of edema, with Kappa values of 0.239 on DWI and 0.549 on STIR, suggesting that edema is a key inflammatory marker associated with active infection. These findings align with several

previous studies Reddy A. (2023) in a study evaluating the role of DWI in perianal fistulae, Reddy found that DWI effectively identified edema associated with active inflammation, enhancing the visualization of fistulous tracts and their extensions. (28) ElSharbatly et al. (2022) this research demonstrated that incorporating DWI and diffusion tensor imaging techniques into MRI protocols significantly improved the assessment of perianal fistula activity. The study reported that DWI was particularly sensitive in detecting edematous changes, correlating well with clinical findings of active inflammation. (29)

Fibrotic changes were identified in 58.8% of cases, with DWI showing a sensitivity of 58.8%, whereas STIR demonstrated a higher sensitivity of 96.66%. The agreement between DWI and STIR for detecting fibrotic changes was moderate (Kappa = 0.517). These findings suggest that STIR may be more reliable for detecting fibrosis, likely due to its ability to suppress fat signals, which enhances visualization of chronic tissue remodeling. However, DWI remains valuable in differentiating active inflammation from fibrosis, aiding in treatment planning. These findings are consistent with previous studies. Hussein et al. (2024) in their study, the authors highlighted the added value of DWI in evaluating perianal fistulas. They found that DWI, when compared to conventional MRI fistulography, provided enhanced visualization of fibrotic tissues, aiding in the accurate assessment of the extent and nature of the fistulous tracts. (30) Yoshizako et al. (2012) this feasibility study demonstrated that DWI is effective in evaluating perianal fistula activity. The researchers reported that DWI could distinguish between active inflammatory processes and fibrotic changes, thereby improving diagnostic accuracy and informing appropriate treatment strategies. (31)

Abscesses were detected with higher sensitivity on DWI (82.4%) compared to STIR (71.4%), suggesting that DWI is more effective in identifying fluid collections associated with infection. The agreement between DWI and STIR for detecting abscesses was moderate (Kappa = 0.469). Given that abscess formation often requires surgical drainage, accurate detection is crucial. The findings support the integration of DWI into MRI protocols to improve the identification of abscesses and guide appropriate clinical management. These results align with findings from previous studies Reddy et al. (2023) this study assessed the role of DWI in perianal fistulas and found that DWI had a higher sensitivity than conventional MRI sequences in detecting abscesses. It emphasized the role of DWI in identifying infection-related complications, aiding in precise treatment strategies. (28) Bakan et al. (2015) their study demonstrated that DWI is effective in distinguishing perianal fistulas with and without abscesses. They reported that DWI had a higher diagnostic accuracy in detecting abscesses and differentiating active infectious processes from chronic inflammatory changes, supporting our findings. (32) Fahmy & Dawoud et.al (2017) this study further confirmed the value of DWI in perianal fistula evaluation. The researchers found that DWI could accurately differentiate between simple and complicated fistulas, particularly in identifying abscess formations. The study concluded that incorporating DWI into routine MRI protocols significantly enhances diagnostic precision. (33)

The discussion concluded that DWI demonstrated high sensitivity but moderate specificity (67.7%), potentially leading to false positives and unnecessary interventions. Additionally, its ability to comprehensively map fistula anatomy, particularly identifying internal openings, remains limited and requires further investigation. Both studies relied on surgical findings as the gold standard, which may vary due to differences in surgical techniques and interpretations. Furthermore, the retrospective design of Jabeen et al.'s study introduces potential selection bias. Future prospective studies with standardized protocols are essential to validate these findings and address these limitations.

Conclusion

In conclusion, advanced imaging techniques, particularly DWI, play a crucial role in the diagnosis of perianal fistulas. Our study found that DWI is highly effective for detecting edema and fibrotic changes, with high sensitivity for edema detection. While the agreement between DWI and STIR imaging was variable, DWI showed a strong diagnostic capability, particularly for assessing perianal abnormalities such as fibrotic changes and edema. The results suggest that DWI could be a

valuable tool in improving the accuracy of perianal fistula diagnosis, with the potential to guide treatment planning and enhance the understanding of disease characteristics.

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