

Added value of Diffusion-Weighted Images & Contrast Enhanced Magnetic Resonance Imaging for the Diagnosis of Perianal Fistula

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Abstract

Background: The perianal surgical procedure is aimed at removing all infection sources related to the fistula and its tract, while preserving anal sphincter functions. Various peri-operative risk factors impact perianal fistula recurrence. Managing perianal fistula faces many challenges. MRI represents the preferred imaging technique for detecting the fistula's type as well as related adverse events

Objectives: This work was aimed at differentiating between plain, DWI as well as contrast MRI studies, thus establishing the final protocol.

Patients and methods: This prospective non-randomized study included a sample of 80 cases suspected to have perianal fistula, MRI was done for all of them including T2, contrast injection & DWI. The radio logical findings were correlated with surgical outcome.

Results: This study included 80 patients developing perianal discharge or external perianal fistulous opening, contrast deemed to be beneficial within twenty-eight subjects since the enhancement of perifistulous inflammatory changes as well as the abscesses exhibited better delineation. Regarding to original tract; there was an agreement between Plain T2 and (DWI, contrast and surgery) while there was no agreement between DWI and (contrast and surgery) . Regarding to fibrosed tract, abscess and 2ry tract; there was an agreement between the four groups.. Regarding to internal opining; there was no agreement between Plain T2 and DWI and between DWI and (contrast and surgery) (P value =0.001).

Conclusions: DWI represents a beneficial tool while assessing perianal fistula, yet contrast administration exhibits more sensitivity as well as specificity when identifying fistulas as well as their complications. It can be reliable especially in patient with any contraindication to contrast injection.

Keywords: fistula, MRI, DWI, T2 , enhancement, contrast .

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Introduction

Perianal fistula represents a prevalent disorder characterized by an atypical epithelialized connection between the perianal skin as well as the anal canal, often induced through anal gland infections. (Gupta et al., 2021; Boles et al., 2023), addressing an occurrence rate falling between 0.7% and 37% in addition to a recurrence rate between seven percent and fifty percent. (Boles et al., 2023)

The perianal surgical procedure is aimed to remove all infection sources related to the fistula and its tract, while preserving anal sphincter functions. Various peri-operative risk factors impact perianal fistula recurrence. Managing perianal fistula faces many challenges as a result of inadequate drainage and sepsis elimination, which could increase recurrence rates as well as adverse events following the surgical procedure. Therefore, a thorough preoperative evaluation of fistula extensions, type, along with related findings remains crucial for favorable surgical outcomes. (Cavusoglu et al., 2017; Boles et al., 2023).

Magnetic resonance imaging (MRI) represents the preferred imaging technique for detecting the fistulous type and related adverse events. (Gupta et al., 2021)

Our research question investigated the variation among plain ,DWI as well as contrast MRI studies. The research was meant to define and implement the final protocol for routine working practice. (Gupta et al., 2021)

Patients and Methods

Case population and study design

Our prospective non-randomized study commenced following the ethical committee's approval. All participants were allowed to sign an informed consent. 80 patients were enrolled in this study between May 2020 to June 2023. We involved all participants

suspected to develop perianal fistula. They were transferred to radiology department following an examination by a licensed surgeon. An MRI examination was employed for a preoperative assessment. MRI findings underwent a comparison surgical findings. Additionally, further comparison was employed among DWI, T2 as well as post-contrast T1-weighted fat saturated sequences.

We excluded post-surgical cases, established inflammatory bowel condition, tumors, as well as pregnant. Additionally, the MRI exclusion criteria involved claustrophobic cases, cases having pacemakers, metallic implants or foreign bodies, as well as reduced creatinine clearance

MRI imaging

MRI scans were conducted employing a 1.5 Tesla closed magnet (Signa Explorer 1.5 Tesla). No patients' preparation deemed to be necessary prior to scan. Subjects were supine. Additionally, a phased-array coil was employed for capturing images.

These sequences were captured: localizer, T1 turbo spin echo (TSE) axial, T2 TSE axial, T2 TSE coronal, T2 Fat Sat Axial, Coronal T2 FS sequences, as well as DWI (Plain MRI fistulography). A contrast study was conducted utilizing a 287 mg/ml Omniscan Gadodiamide administered intravenously. Subjects received a dosage of 0.1mmol/kg body weight. Contrast MRI fistulography was performed with post-contrast T1 FS axial, coronal, as well as sagittal sequences.

Image interpretation

Radiological examination was aimed at identifying the fistula's anatomical features:

(a) **The primary tract;** identified based on the St James University

Hospital classification criteria (Morris et al,2000.)

Type 1 refers to a simple intersphincteric fistula. Type 2 refers to an inter-sphincteric fistula linked to secondary abscesses' extension. Type 3 as well as type 4 exhibit transsphincteric fistulas, with the latter being exacerbated by abscesses or secondary tracks. Group type 5 comprises supralelevator as well as translevator fistulas.

(b) **The internal opening**; a clock face as well as distance from the anal verge were employed to determine its location.

(c) **Secondary extensions**; involving horse shoe, intersphincteric, ischioanal or supralelevator.

(d) **Abscess cavity** & inflammatory reaction [size, location as well as extensions].

ADC values for the fistula, abscess cavity, as well as surrounding inflammatory response were determined utilizing axial DWMRI with a b value of 50 s/mm² as a reference.

Images' interpretation was accomplished by three radiologists: N.S. possessing sixteen years of expertise, Y.F. having fifteen years of expertise, along with A.A. possessing fourteen years of expertise.

Statistical analysis

Data underwent a statistical analysis with SPSS v26 (IBM Inc., Chicago, IL, USA). Quantitative variables were exhibited as mean and SD. Qualitative variables were exhibited as frequency and percentage (%), which underwent analysis with the Chi square test. A two tailed P value of below 0.05 deemed to exhibit a statistically significance.

Results

Our study included 80 patients, developing perianal discharge or external perianal fistulous opening, The patients' mean age exhibited 40.13 ± 13.88 years (range 19–75 years). Most patients were male and represents seventy patients while ten involved females (M/F ratio exhibited 7:1), as mentioned in (Table.1).

Table 1.The studied cases' demographic data

Variables		N=80
Age (years)		40.13 ± 13.88
		19–75
Sex	Male	70 (87.5%)
	Female	10 (12.5%)

The anus deemed to be a clock; the fistula's external as well as internal openings were observed on axial images then documented based on this clock. In lithotomy position, 12

o'clock referred to anterior midline, 6 o'clock referred to posterior midline, 3 o'clock referred to to the left while 9 o'clock to the right. (Fig.1).

internal opening



Fig.1.Internal opening of the studied patients

The prevalent fistula type according to St. grade of fistula (Fig.2) was type I (Intersphincteric fistula) observed among thirty-eight cases (47.5%) (Figs. 3-5), type II in 10 (12.5%) (Fig.6), type III in 13 (16.25%) (Fig.7), type IV in 17 (21.25%) patients (Figs.8,9) and type V in 2 patients (2.5%) (Fig.10).

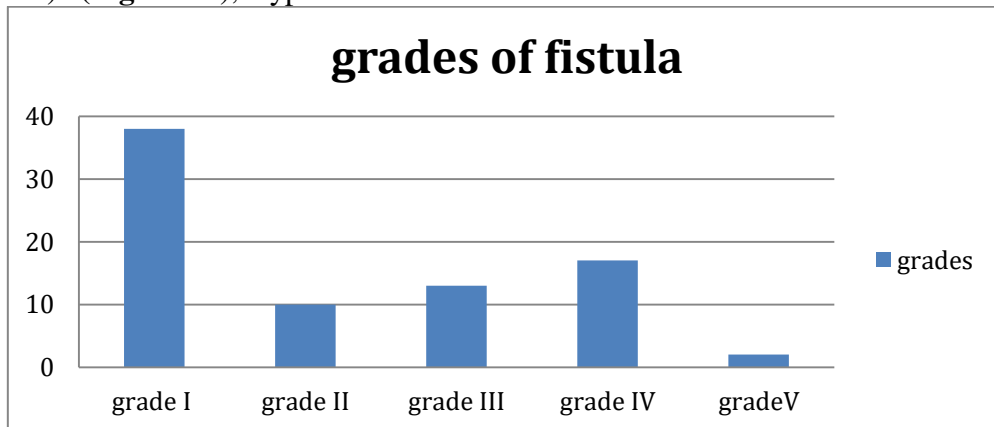


Fig. 2.Grades of fistula of the studied patients

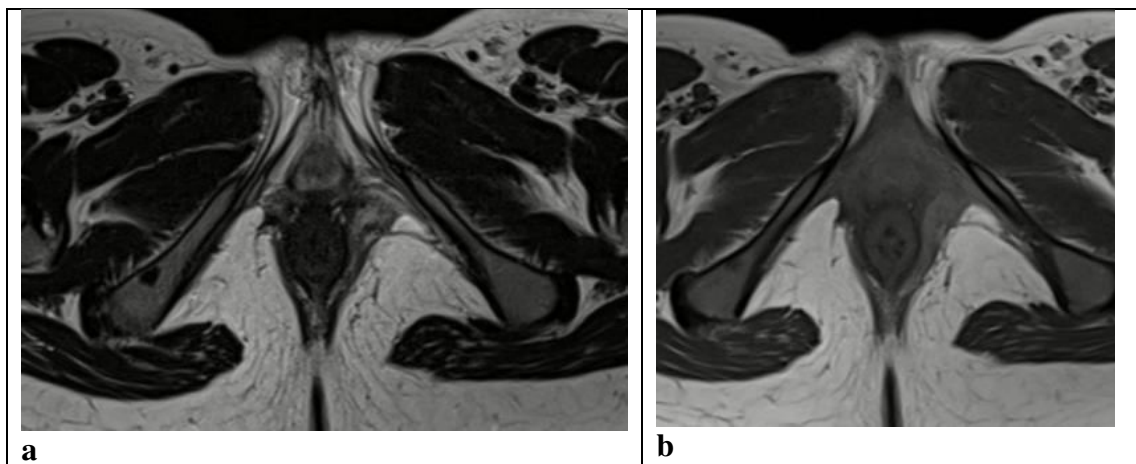


Fig.3. A)axial T2, B)axial t1 with contrast: fistulous tract measuring about 6 cm in length is seen in the left peri anal region extending from cutaneous opening through inter-sphencteric space & reaching the left elevator ani sling , then passed postioerly in intersphencteric space to reach posterior at the anal canal at 6 o'clock with minimal fluid seen within type 1

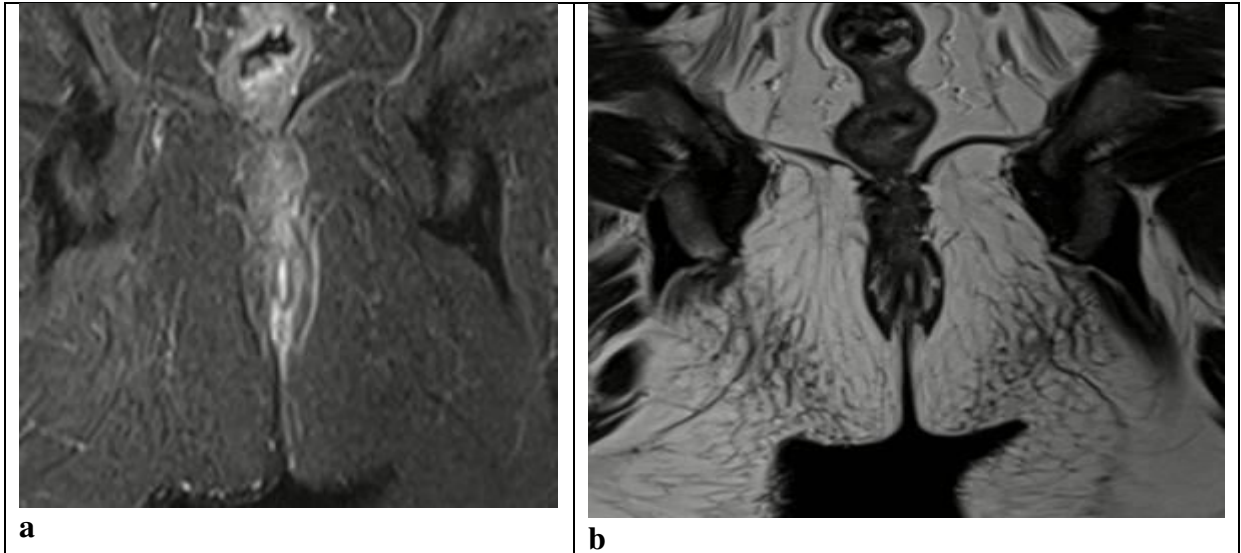


Fig.4. A) Coronal STIR, B) coronal T2: A short fistulous tract measuring about 2.5 cm in length is seen in the posterior peri anal region extending from cutaneous opening at the anal verge, through inter-sphencteric space & opens into the anal canal at 6 o'clock. -----type I peri anal fistula.

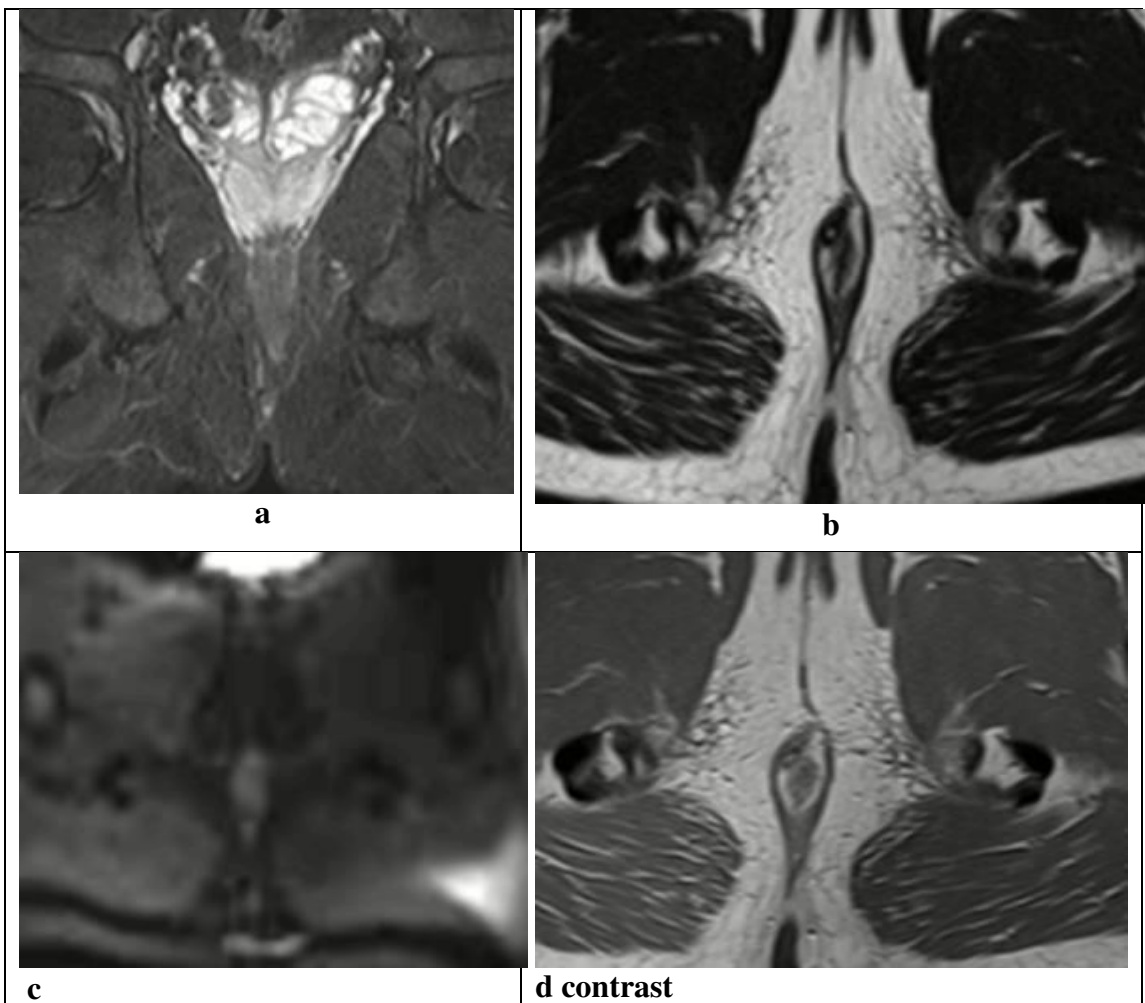


Fig.5. A) coronal STIR, B) axial T2, C) DWI, D) axial T1 with contrast: fistulous tract measuring about 2.8 cm in length is seen in the right peri anal region reaching

the external anal sphincter at 10 o'clock through inter sphenctric pathway -----Right perianal fistula type I

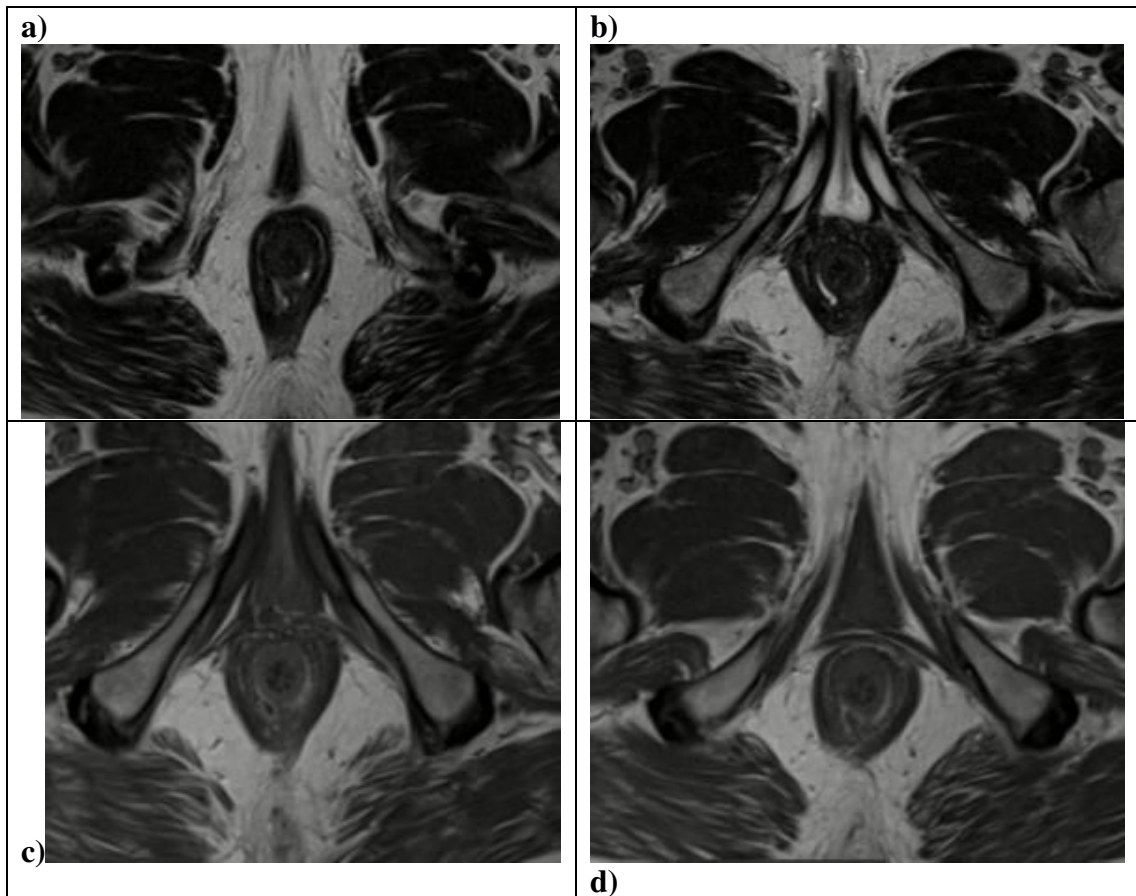
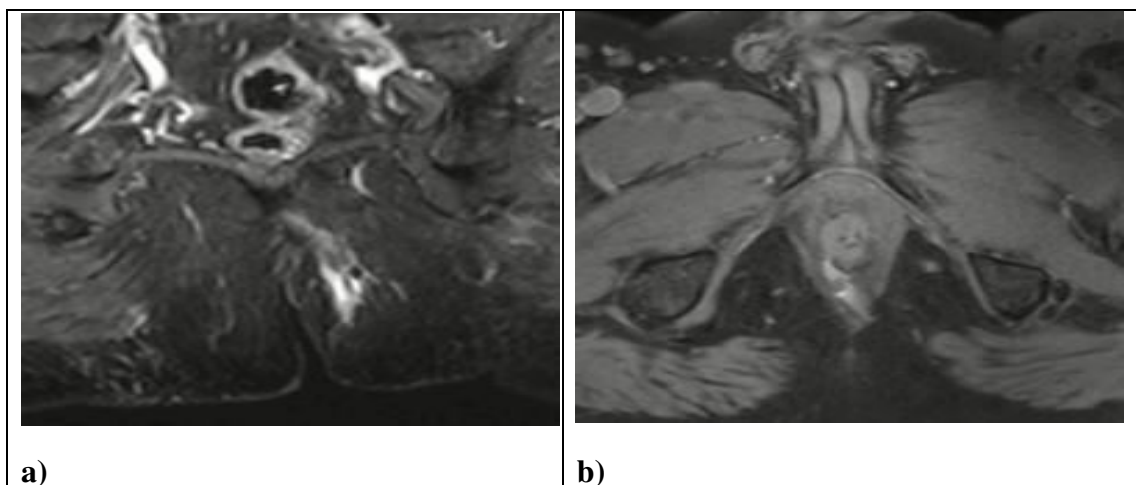


Fig.6.A & B axial T2, C& D axial T1 with contrast: A fistulous tract is seen in the right posterior peri anal region extending from cutaneous opening through just at anal verge through inter-sphincteric space & opens at the anal canal at 9 o'clock, another smaller side branch is seen directed to the left side from 6-3 o'clock measuring 1.5 cm -----Type II right peri anal fistula



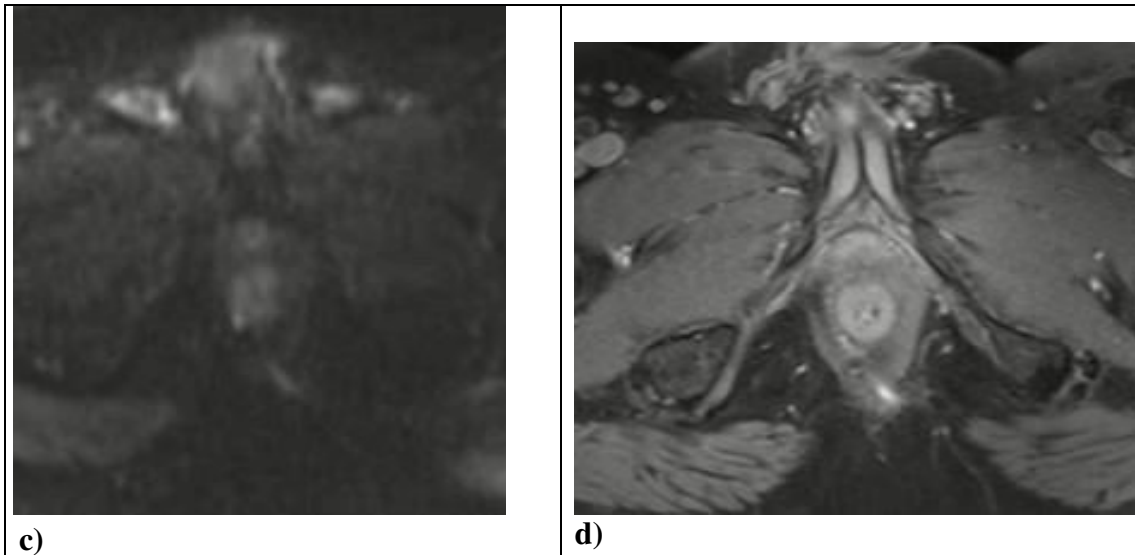


Fig.7.A)coronal STIR, B) axial T2FS C) DWI, D) axial T1FS with contrast: A fistulous track measures 10 cm in length is seen in the left peri-anal region crossing the left ischioanal fossa piercing external anal sphincter at 5 oclock with inter sphincter component reaching internal anal sphincter at 7-8 O'clock just beneath levator ani .-----Type III perianal fistula.

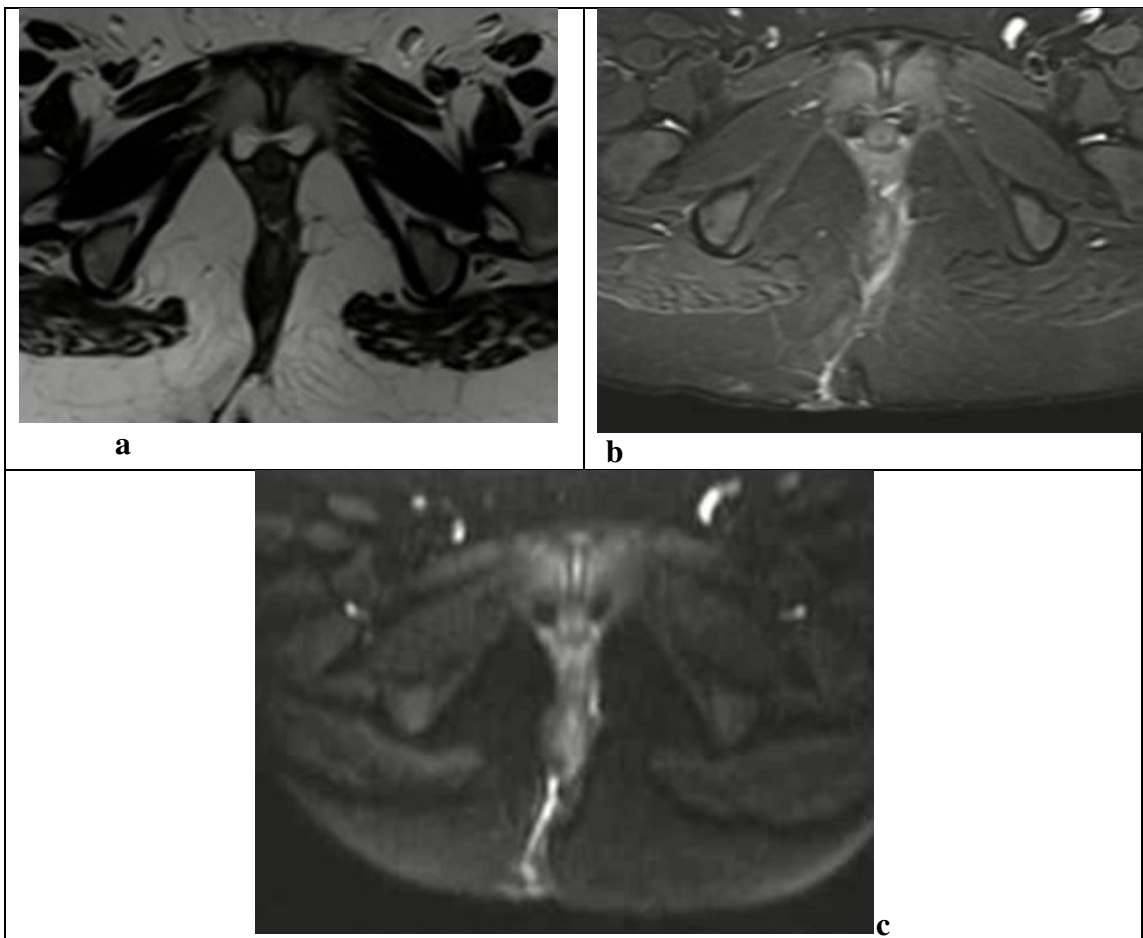


Fig.8.A)axial T2, B)axial STIR, C)DWI: A fistulous tract is seen extending from skin opening just right to anal cleft extending anteriorly passing through transsphincteric pathway reaching to the anal sphincter at 6-7 o'clock, 3 cm from the anal verge with

inter sphincteric horse shoe side branches are noted with short segment on the right side & long one on the left side extending just caudal to left levator ani with no supra levatoric extension----type IV

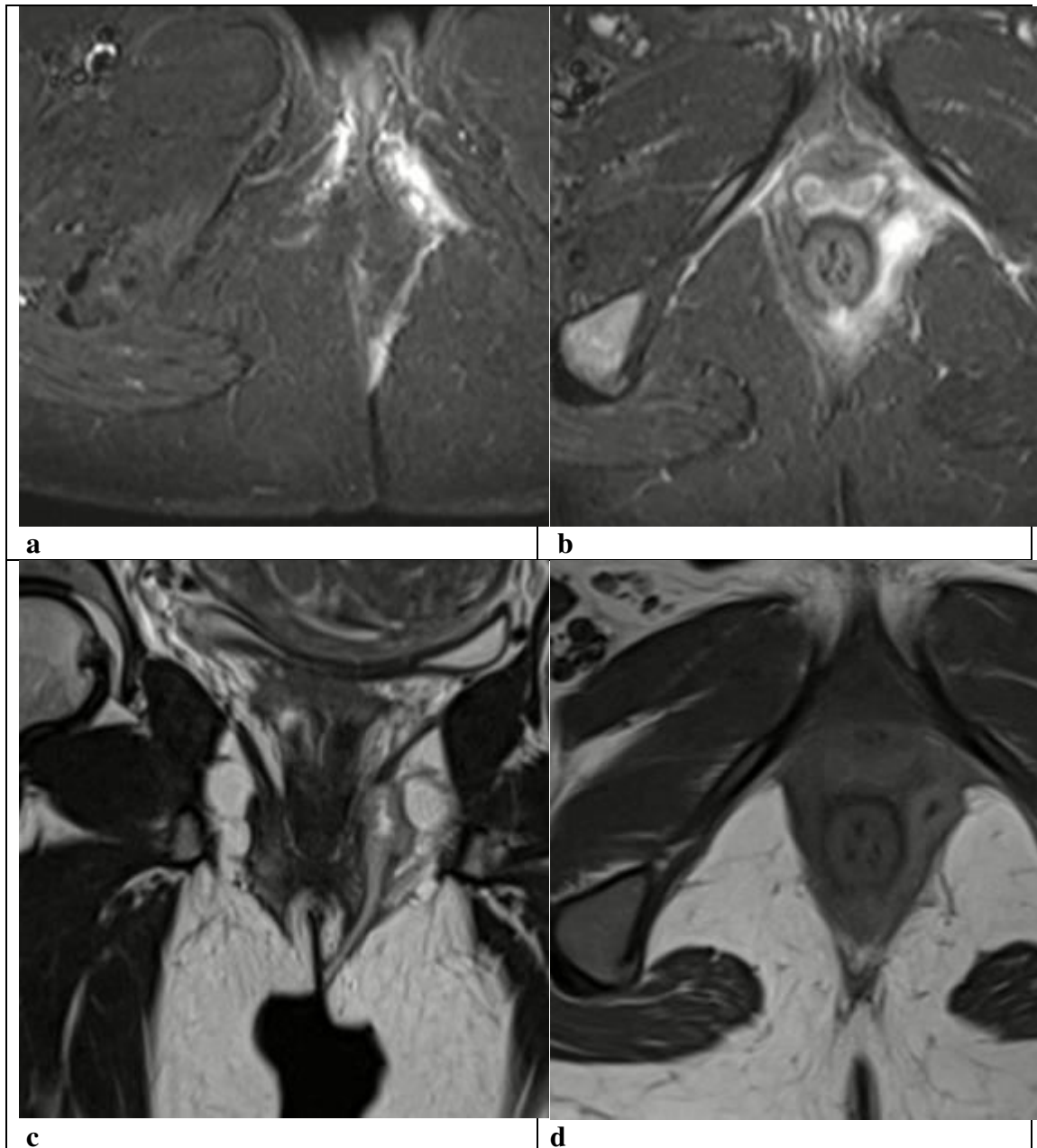


Fig.9. A & B axial T2, C) coronal post contrast .D) axial post contrast: A fistulous tract measuring about 6 cm in length is seen in the left peri -anal region extending from cutaneous opening to pass transsphincteric with abscess formation at inter-sphincteric space at 2 O'clock measures 14 x 14 mm passing posteriorly in inter-sphincteric space with another small abscess formation at 6 o'clock measures 12 x 12 mm and internal opening at 6 O'clock at a distance 3.5 cm form the anal verge ----- Left transsphincteric fistulae with two intersphincteric abscesses -----as described type IV fistulae

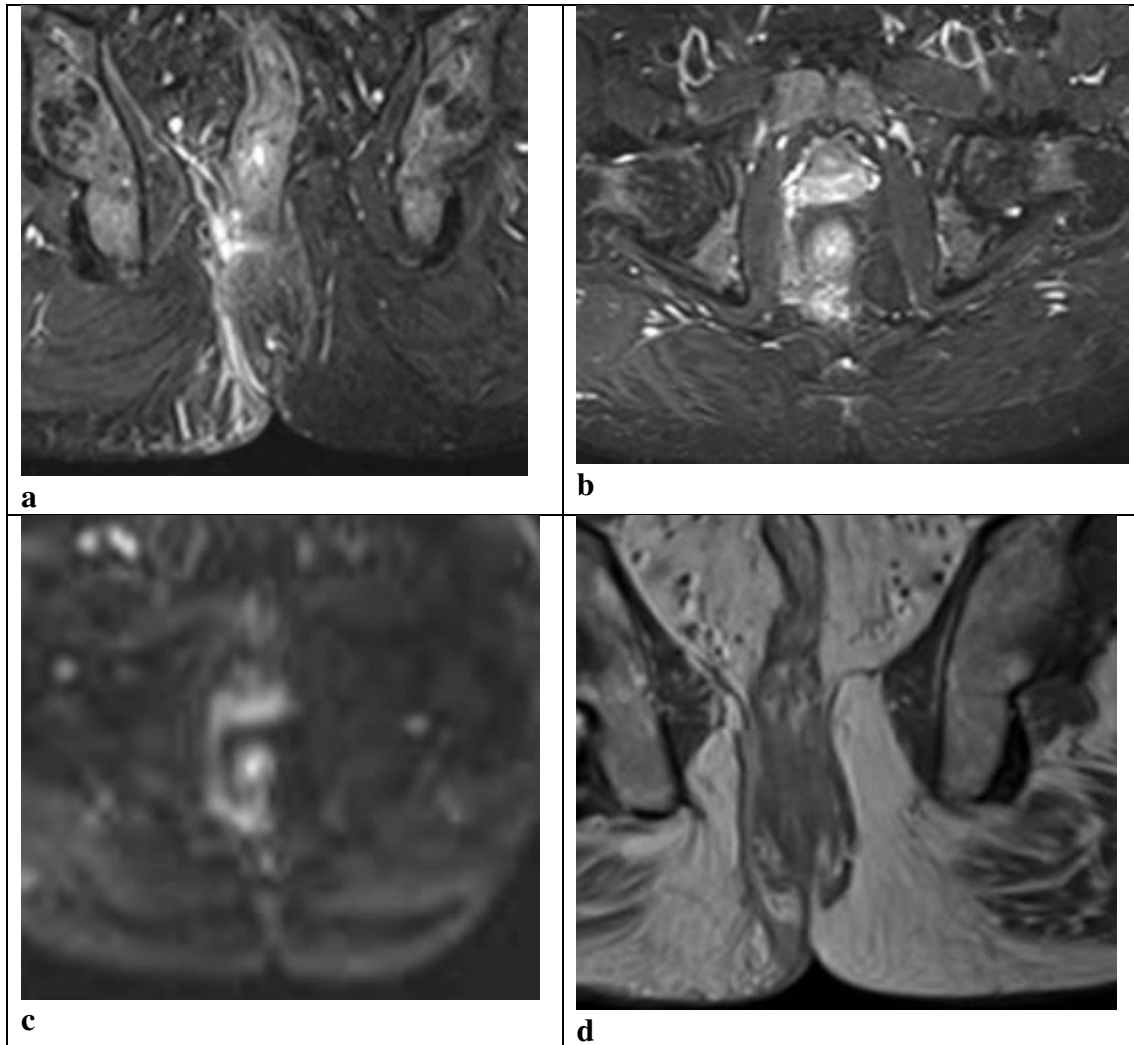


Fig .10. A) coronal STIR,B) axial STIR, C) DWI & D) coronal T1 with contrast : A long fistulous tract measuring about 10 cm in length is seen in the right peri anal region passing through right ischio anal region piercing right levator ani sling abutting the right postero lateral aspect of the rectum-----Right extra sphincteric supra levotoric fistula

Out of 80 subjects, 66 (82.5%) had internal openings at 6 o'clock, four (5%) patients at 1-2 o'clock, 3 (3.75%) patients at 10-11 o'clock, 5(6.25%) patients at 5 o'clock and 3 patients had sinus tracts with no internal opening (**Fig. 1**).

Regarding secondary tracts, intersphincteric tract was seen in 5 (6.25%) patients, Ischioanal tract in

7(8.75%) patients and supralelevator one in 3(3.75%) patients.

On other side Horseshoe tract, intersphincteric was seen in 5(6.25%) patients and Ischioanal in 5(6.25%) patients. Abscess, intersphincteric one was seen in 3(3.75%) patients and transphincteric one in 5(6.25%) patients. Peri-fistulous Inflammation occurred in 20(25%) patients.This all summarized in (**Table.2**).

Table 2. Anatomical features of the studied patients

Anatomical features	No	Percent
Grade of fistula		
I	38	47.5%
II	10	12.5%
III	13	16.25%
IV	17	21.25%
V	2	2.5%
Internal opening		
6	66	82.5%
1-2	4	5%
10-11	3	3.75%
5	5	6.25%
Secondary tracts		
Intersphincteric	5	6.25%
Ischioanal	7	8.75%
Suprlevator	3	3.75%
Horseshoe tract		
Intersphincteric	5	6.25%
Ischioanal	5	6.25%
Abscess		
Intersphincteric	3	3.75%
Transphincteric	5	6.25%
Peri fistulous Inflammation	20	25%

The tract's peripheral enhancement was observed among 8 cases, suggestive of abscess, while enhancing perifistulous inflammatory tissue observed among 20 patients. Generally, contrast deemed to be beneficial within 28 patients since the

perifistulous inflammatory changes' enhancement along with the abscesses exhibited better delineation. Correlating these different sequences to the post-operative findings (Table.3).

Table 3. The agreement among Plain T2, DWI, Contrast and surgery

Variables	Plain T2	DWI	Contrast	Surgery	P value	
Original tract	77(96.25%)	70(87.5%)	80 (100%)	80 (100%)	< 0.001*	P1= 0.079 P2= 0.245 P3=0.245 P4=0.001* P5=0.001* P6=----
Fibrosed tract	0 (0%)	0 (0%)	2 (2.5%)	2 (2.5%)	0.256	
Internal opening	80(100%)	70(87.5%)	80 (100%)	80 (100%)	< 0.001*	P1=0.001* P2= ---- P3=--- P4=0.001* P5=0.001* P6=---
Abscess	8 (10%)	7 (8.75%)	8 (10%)	8 (10%)	0.991	
2ry tract	26(32.5%)	24 (30%)	26(32.5%)	26(32.5%)	0.981	

*Significant as P value \leq 0.05, P1: P value between Plain T2 and DWI, P2: value among Plain T2 and Contrast, P3: P value among Plain T2 and surgery, P4: P value among DWI and Contrast, P5: P value between DWI and surgery, P6: P value between Contrast and Surgery

The post contrast images were helpful in detecting all findings needed by surgeons (including the original, 2ry, fibrosed tracts ,internal opening and abscess formation) with sensitivity & specificity 100%, while DWI could detect the original tract ,internal opening and secondary tracts with sensitivity = 88.89% , neither fibrosed tracts nor abscess formation could be detected in DWI.

T2WI detected the original tract with sensitivity = 96.39 % but fibrosed tracts couldn't be detected while internal openings ,secondary tracts and abscess formation were detected with 100% sensitivity .

Discussion

Contrast enhanced MRI represents the primary imaging technique utilized while characterizing perianal fistulas (including their extension , secondary tracts and horseshoe fistula), as well as concomitant abscess formation. (Cavusoglu et al.,2017)

Since surgical excision is the main treatment, precise pre-operative assessment of the fistulous tract's extent and associated pathologies is crucial to prevent post-operative recurrence and the concomitant morbidities. (Boruah et al., 2021) Recently, a number of researchers have studied DWI and compared its efficacy with post-contrast series in order to evaluate fistulous tracts, especially those associated with abscess cavities and the inflammation of surrounding tissue. (Mohsen and Osman ,2020)

In our study, we compared plain T2WI , DWI images & post-contrast T1 FS TSE images for assessment of perianal fistula in correlation to surgery as a gold standard .

Khera et al. (2010) used 1.5T MRI to examine 44 fistulae in 35 patients. They found that 61% of the fistulas were simple, 33% were transphincteric, 7% were

extrasphincteric, and the remaining fistulae showed complications. According to Boruah et al.(2021), grade 1 perianal fistulas were prevalent among 40.7% of cases, whereas grade 2 fistulas were found among 23.7% of cases. Our study comes in in agreement with both studies as well.

Regarding a research performed by Daabis et al.(2013), twelve cases out of twenty-four exhibited internal opening at the 6 o'clock position. Additionally, type-I fistula was prevalent among (37.5%) and twelve of the twenty-four cases developed an internal opening at 6 o'clock, with type-I fistulas accounting for the majority (37.5%).

Regarding our research, twenty-three patients exhibited internal opening at 6 o'clock posteriorly (76%). Moreover, type-I fistula was prevalent. Therefore, current results support those of earlier studies.

The Goodsall rule's accuracy was examined among 216 cases by Cirocco et al. (2020), they found that whereas only forty-nine percent of the a total of ninety-two cases developing an external opening anterior to the transverse anal line, exhibited anal fistulas tracked within radial fashion, which Goodsall predicted, ninety percent of the 124 cases developing an external opening posterior to the transverse anal line, exhibited anal fistulas tracking to the midline. With up to 95% accuracy, Cirocco et al. proposed, the midline represents the principal internal opening site in most fistulas. The Goodsall rule, according to the authors, is not applicable to anterior off-midline external fistulous openings since these openings typically bend rather than follow a straight path, ending in a midline internal opening. As a result, the location of the primary (internal) origin was more accurately predicted by the midline rule (71%), as opposed to 49%

when utilizing the Goodsall rule. Most of the participants in our study complied with both the midline and Goodsall rules.

The majority of recent research, including **Boruah et al. (2021)** and this study have shown increased accuracy and sensitivity between MRI and surgery, making it the most valuable imaging modality for preoperative fistula assessment.

According to **Vo et al. (2019)**, they evaluated 411 fistulas in 367 patients, MRI and surgical findings agreed well. The postcontrast T1 FS TSE sequence exhibited an accuracy of 100% when detecting abscesses, while combining T2W TSE to postcontrast fat sat T1W TSE sequences showed greater sensitivity (96.6% and 98.4%, respectively) with a specificity of 92.6% as well as 81.5%, respectively as regards internal openings along with secondary tracts' detection, which supported our findings.

Multiple research have examined the DWI's impact on detecting perianal fistulas, particularly those with abscess formation, in order to decrease the need for contrast administration—especially for patients with renal failure and other contraindications to contrast media—and to reduce the cost of the examination,

In a study of **Fahmy et al. (2017)**, that included 35 patients, DWI exhibited similar findings to the post contrast images when identifying acute abscess formation as well as secondary tracts. But, in our study DWI detected abscess formation in 7 out of 8 (sensitivity =88.8 %) patients while secondary tracts were detected in 24 out of 26 (sensitivity =92.86 %) patients. Both studies demonstrated a significant variance among DWI as well as post contrast images as regards internal openings' identification (P=0.001). Artifacts at the air/soft

tissue interface were identified as the cause of poor image quality.

In a research by **Fahmy et al. (2017)** included 35 patients, DWI showed similar findings to post-contrast images when identifying secondary tracts as well as acute abscess formation. However, in this study, DWI found secondary tracts in 24 out of 26 patients (sensitivity = 92.86 %) and abscess formation in 7 out of 8 patients (sensitivity = 88.8%). As shown in (table 3), both studies showed a significant difference (P=0.001) as regards internal openings' detection between DWI and post contrast pictures. It was attributed to artifacts at the air/soft tissue interface that decreased the clarity of the images.

In the study of **Cavusoglu et al.(2017)**, they came to a conclusion that the combination of DWI and T2WI was equal to the combination of contrast enhanced and T2WI as regards perianal fistulas' diagnosis, which disagreed with the current investigation, as contrast-enhanced images showed somewhat higher sensitivity for perianal fistula detection compared to DWI.

Conclusion

We addressed, DWI represents a beneficial tool while assessing perianal fistulas, yet contrast administration exhibits more sensitivity as well as specificity when identifying fistulas along with their complications. DWI can be reliable especially in patient with any contraindication to contrast administration.

Further studies are recommended including a larger sample of patients and measurement of ADC values that may add to the diagnosis as demonstrated by some authors.

References

- **Al-Khawari HA, Gupta R, Sinan TS, Prakash B, Al-Amer A and AlBolushi S.(2005)**. Role of

- magnetic resonance imaging in the assessment of perianal fistulas. *Medical Principle and Practice*, 14(01):46–52
- **Ani AN and Lagundoye SB. (1979).** Radiological evaluation of anal fistulae: a prospective study of fistulograms. *Clinical Radiology*, 30(01):21–24
 - **Boles M, El-Sayed R, Shawali H, Farag A, Fawzy F and Awadallah M(2023).** Introducing 3D modeling of MRI in the preoperative mapping of perianal fistula: How it could help the surgeons?. *Egyptian Journal of radiology & nuclear medicine*, 54:54
 - **Boruah D, Hazarika k, Ahmed H, Borah K, Borah S, Malakar S,etal (2021).** Role of Diffusion-Weighted Imaging in the Evaluation of Perianal Fistulae. *Indian Journal of Radiology and Imaging*, 31 (1).
 - **Cavusoglu M, Duran S, Ciliz D S, Tufan G, Cetin H G, Ozsoy A, etal (2017).** Added value of diffusion-weighted magnetic resonance imaging for the diagnosis of perianal fistula. *Diagnostic and Interventional Imaging*, 98, 401—408
 - **Cirocco WC and Reilly JC. (2020).** It is time to retire Goodsall's Rule: the Midline Rule is a more accurate predictor of the true and natural course of anal fistulas. *Techniques in Coloproctology*, 24(04):317–321
 - **Daabis N, El Shafey R, Zakaria Y and Elkhadrawy O. (2013).** Magnetic resonance imaging evaluation of perianal fistula. *Egyptian journal of radiology & nuclear medicine*, 44(04):705–711
 - **Criado J D, del Salto LG, Rivas PF, Del Hoyo L F, Velasco LG, De las Vacas M I,et al. (2012).** MR imaging evaluation of perianal fistulas: spectrum of imaging features. *Radiographics*, 32(1):175–194
 - **Emile SH (2020).** Recurrent anal fistulas: When, why, and how to manage? *World Journal of Clinical Cases*, 8:1586–1591.
 - **Fahmy, D. M., and Dawoud, M. G. (2017).** Value of diffusion weighted MRI in assessment of simple and complicated perianal fistula. *The Egyptian Journal of Radiology and Nuclear Medicine*, 48(3), 553–562.
 - **Goodsall DH and Miles EW. (1982).** David Henry Goodsall 1843–1906. *Disease of Colon Rectum*,25(03):262–278
 - **Gupta R, Kumar S, Kumar A, Tiwari R & Sinha N (2021).** Magnetic Resonance Imaging of Perianal Fistulas in Clinically Symptomatic Patients and the Correlation Among Plain, Contrast, and Post Jelly MRI Fistulography. *Journal of Coloproctology*, 41(3):265–274
 - **Joshi A, Bhuta M, Kulkarni S, Singh S and Modi T (2016).** MR. imaging in perianal fistulas : a comparative study of 25 patients. *world journal of Pharmaceutical And Medical Research*, 2 (05):253–259
 - **Khera PS, Badawi HA and Affi AH. (2010).** MRI in perianal fistulae. *Indian Journal of radiological Imaging*, 20(01):53–57
 - **Mohsen LA and Osman NM. (2020).** Diffusion-weighted imaging in the evaluation of perianal fistula and abscess. *Egyptian journal of radiology & nuclear medicine*, 51:71
 - **Morris J, Spencer, J A & Ambrose N S (2000).** MR Imaging Classification of Perianal Fistulas and Its Implications for Patient Management. *Radiographics*,20(3).

- **Parks AG, Gordon PH & Hardcastle JD (1976).** A classification of fistula-in-ano. British journal of surgery,63(01):1–12
- **Vo D, Phan C, Nguyen L, Le H, Nguyen T and Pham H2 (2019).** The role of magnetic resonance imaging in the preoperative evaluation of anal fistulas. Scientific reports 9, 17947
- **Waniczek D, Adamczyk T, Arendt J, Kluczevska and Kozińska-Marek E. (2011).** Usefulness assessment of preoperative MRI fistulography in patients with perianal fistulas. Polish journal of radiology,76(04):40–44