# Role of Magnetic Resonance Imaging in the Evaluation of Perianal Fistula: An Institutional Based Retrospective Study

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**Abstract:** *Introduction: MRI evaluation of perianal fistula plays a crucial role in the diagnosis, classification and surgical management of the fistulous disease. Perianal fistulisation is an unusual condition but significantly contribute to gastrointestinal morbidity. Proper technique and dedicate protocol of MRI helps in identification of detail anatomy, primary and secondary tracks, classification, complications like abscesses and hence guides the surgeons to plan an appropriate treatment strategy. Our study aims to evaluate the role of MRI in preoperative classification and its management of perianal fistula. Materials and Methods: A total of 124 patients who were diagnosed to have perianal fistula clinically and referred for MRI Imaging during the study period Jan 2019 to June 2020 included. MRI findings were reviewed, tabulated and analysed. Results: MRI fistulography prove to have a 100% detection rate of the fistulous tract, its extension and relation to internal and external sphincter. MRI Imaging has exactly type and reveals the extent of perianal fistula. Conclusion: MRI Imaging prove to be highly sensitive and investigation of choice for perianal fistula evaluation. In our study, there was a significant correlation between the fistulous tracts identified on MRI and the surgical findings.*

**Keywords:** Perianal Fistula, MRI Classification, Fistula-in-ano, MR Fistulography

## 1. Introduction

A fistula is defined as an abnormal connection between two structures or organs or between an organ and the surface of the body. In perianal fistula abnormal connection exists between the perineum and anal canal. Perianal fistulisation is a less common but crucial morbid condition involving the lower gastrointestinal tract, mainly anal canal. Imaging evaluation of perianal fistula can be done by fistulography, and contrast-enhanced CT fistulography, anal endoanal sonography [1].

Early in the 20th century, Goodsall's observed a tendency in the relation between the location of the external opening and the internal opening of perianal fistulas. If the external opening is located posteriorly to the coronal plane, the fistula probably originates from the dorsal midline. If the opening is anterior, it probably runs directly to the nearest crypt. If the distance from the anal verge is more than 3 centimeters (on either side of the anus), the tract is likely to run in a curved track to the posterior commissure—this tendency recorded in the rule, commonly known as Goodsall's rule [1]–[2].

Majorities of fistula are simple linear track which can quickly identify and treated surgically, but 15% of the fistulas are of complex variety as they are having more than one track called secondary tracks along with the spread of disease through sphincter to ischiorectal, ischioanal, and supralevator space with abscess formation. Complex fistulas are always associated with a high rate of recurrence and Crohn's disease and challenging to treat surgically. MRI fistulography plays a crucial role in the management of complex fistula. MRI allows identification of secondary tracks and disease extension to perianal and supralevator space that would otherwise remain undetected [3].

Contrast-enhanced fistulography and CT scan fail to demonstrate subtle fistulous extension and abscess formation because of low resolution. (4). Endoanalsonography provides better resolution and relation of the fistula to sphincter but difficult to depict fistulous track because of the limited field of view. [5]. MRI fistulography considered as a superior imaging modality as it provides excellent anatomical detail about the fistulous track, its relation to the sphincter and also gives an idea about subtle extensions or secondary abscess formation, thereby allowing us to choose a best surgical approach for the excision of fistula and significantly reduce the risk of recurrence and fecal incontinence secondary to surgery [6]-[7].

## 2. Material and Methods

**2.1 Study Design:** a retrospective observational study

**2.2 Study Location:** This was tertiary care teaching hospital-based study done in Sahyog Imaging Centre, Department of radio-diagnosis, at PDU medical college and civil Hospital, Rajkot, Gujarat.

**2.3 Study Duration:** Jan 2019 to June 2020.

**2.4 Sample size:** 124 patients

**2.5 Inclusion criteria:** Suspected or known case of perianal fistulas (fistula-in-ano) or perianal abscess having positive MRI findings regardless of the age and sex. Patients coming for follow-up evaluation / Recurrence in previously surgically treated patient.

**2.6 Exclusion criteria:** Patients with normal clinical examination. Patients with cardiac pacemaker or implants where MRI contraindicated Claustrophobic or uncooperative patients.

**2.7 Methodology:** MRI analyzed a total of 124 patients. A brief history regarding recent complains and previous surgery was review. We follow ST. JAMES' university hospital MRI classification of the perianal fistula to classify perianal fistula in this study. We classify the type of fistulous disease and incidence of each type along with symptoms, age and gender-wise incidence calculated. MRI Imaging Plane (Figure1) and Protocol we followed for MRI examination are listed Table 1, assessment of the obtained MRI images done according to Table 2.
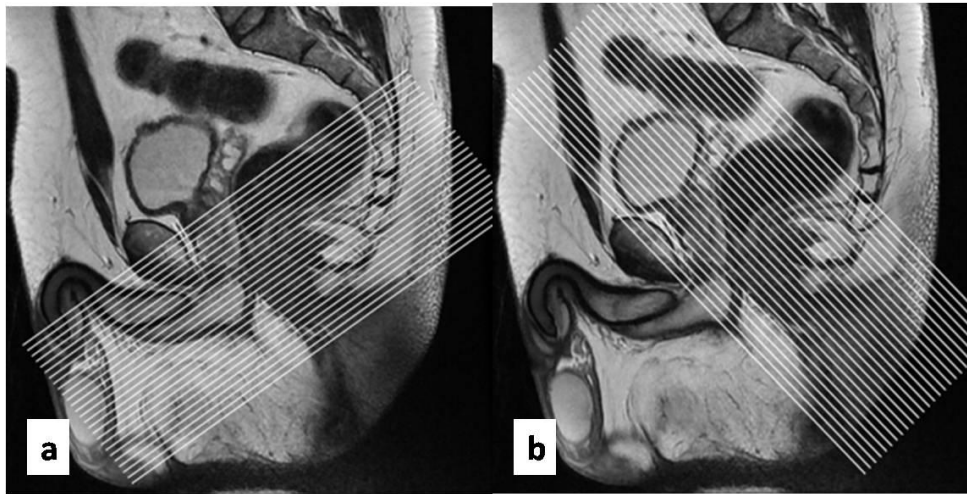


**Figure 1:** (a) Suggested orientation for axial MR imaging of the anal canal. Sagittal T2-weighted image through the midline is used to obtain images that are truly axial relative to the anal canal. (b) Suggested orientation for coronal MR imaging of the anal canal. Coronal MR imaging is performed at 90° relative to the axial plane to obtain images parallel to the long axis of the anal canal

**Table 1:** MRI Imaging protocol & parameters performed during examination. T1W -T1 weighted, T2W - T2 weighted, STIR - Short tau inversion recovery, FSE- Fast Spin Echo, OTRA- Oblique Transverse, OCOR- oblique Coronal, SAG – sagittal TR- Repetition Time, TE- Echo Time, FOV- Field of View, NSA- Number of Signal Averages, ST: slice thickness

| Sequences | TR | TE | FOV | NSA | ST |
|---|---|---|---|---|---|
| T2W FSE SAG | 4500 | 70 | 400 | 3 | 4 |
| T2W FSE OCOR | 4500 | 70 | 400 | 3 | 4 |
| T2W FSE OTRA | 4500 | 70 | | | |
| STIR SAG | 7000 | 40 | 400 | 3 | 4 |
| STIR OCOR | 7000 | 40 | | | 4 |
| STIR OTRA | 7000 | 40 | | | 4 |
| T1W TSE OTRA | 500 | 12 | 400 | 3 | 4 |
| T1W TSE FS POST-CONTRAST - OTRA/COR | 500 | 12 | 400 | 3 | 4 |

**Table 2:** Assessment of Perianal Fistula on MRI

| |
|---|
| Internal Opening: clock face |
| Internal Opening distance from anal verge (cm) |
| Fistula Type: Intersphincteric, Transsphincteric, supraspincteric, extrasphincteric |
| Secondary Tracts: none, single – branched/unbranched, Multiple |
| Extensions: infralevator / supralevator |
| Exit Site /External Opening: gluteal, scrotum, vagina, labia, blind ending |
| Hyperintensity on T2: absent /mild/pronounced |
| Tract Diameter > 3mm |
| Abscess > 1cm: present /absent |
| Anovaginal fistula: yes /no |
| Rectal wall thickening: yes/no |
| Enhancement within Tract: no – tract is fluid filled / yes – if high T2 + enhancement = granulation tissue / yes – progressive + dark T2 = fibrosis |

# 3. Results

Total of 124 cases examined for the presence of perianal fistula formation. The occurrence of fistula concerning age, sex, symptoms, variety of fistula and surgical correlation assessed to understand the incidence rate of perianal fistula. Significant findings of this study shown in Tables 3 to 10, and Figures 2 and 3.
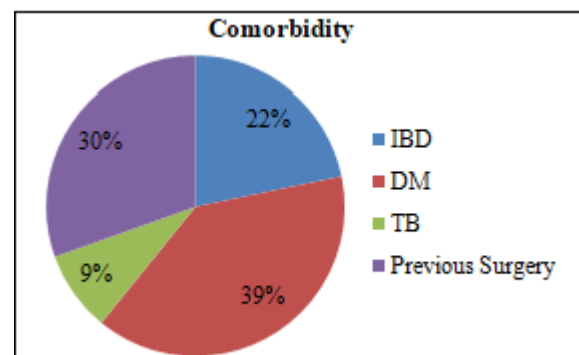


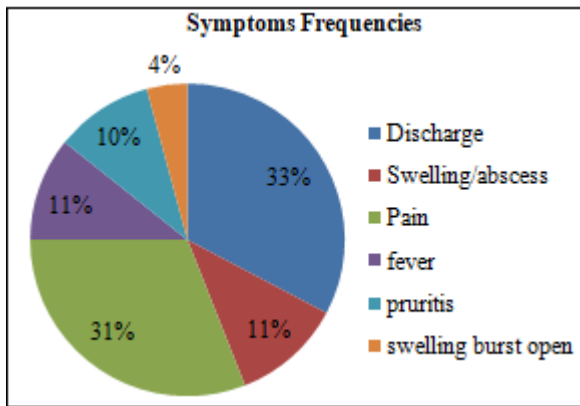**Figure 2:** Comorbidities associated with perianal fistula

**Figure 3:** Symptoms Frequencies associated with perianal fistula

Out of 120 cases with perianal fistulas, the most commonly affected age group was 31-40 years which comprised 35.5%, which is followed by 21% of the patients in the range of 41-50 years (Table 3). There was a male predominance with 98 cases (79% of the total patient population), while there were only 26 (21%) females (Table 4). The most common comorbidities associated with the diagnosis were diabetes mellitus (39% of the cases), previous surgery (30%) and inflammatory bowel disease (22%) (Figure2). Meanwhile, the most frequent clinical presentation was discharge seen in about 33% of the patients, followed by pain in the perianal region observed in 31% of the patients (Figure 3).

**Table 3:** Age wise distribution of patients

|  | *Frequency* | *Valid Percent* |
|---|---|---|
| <30 yrs | 22 | 17.7 |
| 31-40 | 44 | 35.5 |
| 41-50 | 26 | 21 |
| 51-60 | 18 | 14.5 |
| 61-70 | 12 | 9.7 |
| >70 | 2 | 1.6 |
| Total | 124 | 100 |

**Table 4:** Gender wise distribution of patients

| *Sex* | *Frequency* | *Percentages* |
|---|---|---|
| Females | 26 | 21 |
| Males | 98 | 79 |
| Total | 124 | 100 |

**Table 5:** Distribution of perianal Fistulas as per St. James' University Hospital MRI classification (n=120)

|  | *St. James' University Hospital MRI classification of perianal fistula* | *No. of cases* | *% of cases* |
|---|---|---|---|
| Grade 0 | Normal appearance | 0 | 0 |
| Grade 1 | Simple linear intersphincteric fistula | 26 | 21.7 |
| Grade 2 | Intersphincteric fistula with intersphincteric abscess or secondary fistulous track | 24 | 20 |
| Grade 3 | Trans–sphincteric fistula | 16 | 13.3 |
| Grade 4 | Trans–sphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa | 50 | 41.7 |
| Grade 5 | Supralevator and translevator disease | 4 | 3.3 |
| Total | Total | 120 | 100 |

**Table 6**: Distribution of simple & Complex Perianal Fistulas (n=120)

| *Type of Fistulas* | *Number* | *% of Distribution* |
|---|---|---|
| Simple | 36 | 30 |
| Complex | 84 | 70 |
| Total Fistulas | 120 | 100 |

**Table 7:** Detection of perianal Fistulas by MRI (Total Fistulas = 120)

|  | Number | Surgery correlation |
|---|---|---|
| Total Fistulas Detected by MRI | 120 | 120 |
| Active Primary tract | 112 | 112 |
| Fibrous Primary Tract | 8 | 8 |

**Table 8:** Detection of Involvement of Internal & External anal Sphincter by MRI (Total Fistulas = 120)

|  | *Involved* | *Not Involved* | *Surgery correlation* |
|---|---|---|---|
| External anal sphincter | 66(55%) | 54(45%) | 100 % confirmed |
| Internal Anal Sphincter | 116(96.6%) | 4(3.33) |  |

**Table 9:** Distribution / Occurrence of Single or multiple fistulas in patients (Total patients = 112, excluding 12 patients with submucosal fissure)

| *Ext opening* | *Frequency* | *Percent* |
|---|---|---|
| multiple | 8 | 7 |
| single | 104 | 93 |
| Total | 112 | 100 |

**Table 10:** Surgical correlation of MRI Findings Based on first table

| *MRI Findings* | Sensitivity | Specificity | PPV | NPV | Accuracy |
|---|---|---|---|---|---|
| Primary tract | 100% | 100% | 100% | 100% | 100% |
| Abscess | 100% | 96.8% | 96.5% | 100% | 98.3% |
| Secondary tracts | 100% | 82.6% | 90% | 100% | 93.3% |
| Horseshoeing | 100% | 100% | 100% | 100% | 100% |
| Internal openings | 100% | 100% | 100% | 100% | 100% |

Upon staging, it was found that of total 120 fistulae (n = 120), 26 (21.7%) were Grade I (Simple linear intersphincteric fistula), 24 (20%) Grade II (Intersphincteric fistula with intersphincteric abscess or secondary fistulous track), 16(13.3%) Grade III (Trans–sphincteric fistula), 50 (41.7%) Grade IV (Trans–sphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa) and 4 (3.3%) were Grade V (Supralevator and translevator disease) (Table 5). Out of total patients, 36 patients (30%) had simple, and 84 patients (70%) had complex perianal fistulas (Table 6). The most common location of the internal opening of the fistula was at 6 o'clock position. Active fistulous tracts were seen in 112 patients (93.3%) and chronic fibrosed tracts in 8 patients (6.7%) (Table7). Most of the cases (number of fistulae, n= 112, excluding 12 patients with submucosal fissure) 104 (93%) had single, and 8 (7%) had multiple external opening (Table 9).

In our study, MRI detected the presence of fistulous tracks and its complication in all 124 patients diagnosed with perianal fistulae, indicating 100% sensitivity with 100%

accuracy for primary tracks, horseshoeing and internal opening, 98.3% accuracy for abscess and 93.3% accuracy for secondary tracts (Table 10). Out of these fistulae, 26 were simple, whereas the rest of them showed associated abscess formation, inflammation, and branching course. The MRI findings were following surgical findings most of the cases (Table 11).

## 4. Discussion

Total of 124 patients who were referred for MRI examination were studied with MR Fistulograms. They were followed upto surgery and the operative findings were correlated with the preoperative MRI findings.

MRI fistulography helps visualize the anatomy of the fistulous track in multiple planes and gives a good idea about the extent of the disease. MRI is beneficial in case of Crohn's disease with multiple and recurrent fistulous track. Anatomical knowledge is necessary to accurately perform an imaging evaluation of a perianal fistula. Preoperative MRI evaluation provides information about the location and anatomy of the fistulous track, location of internal and external openings, location of deep abscesses, state of the anorectal wall and perirectal space, and damage to sphincter. The external anal sphincter appears hypointense on T1W, T2W, and fat suppressedT2W images, and is bordered laterally by the fat in the ischioanal fossa. The internal sphincter appears hypointense on T1W and T2W TSE images and is relatively hyperintense on fat-suppressed T2W images. It shows enhancement on post gadolinium T1W images. Coronal reformatted images are helpful to locate levator ani muscle, which plays crucial role to differentiate between supralevator and infralevator disease (Figures 4 and 5).
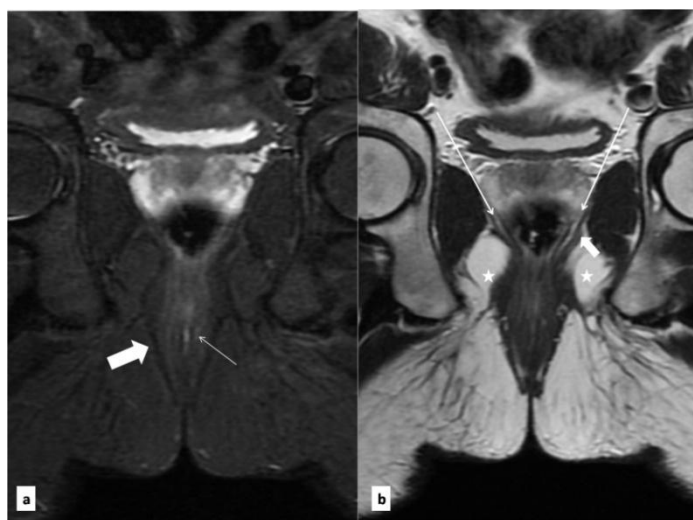


**Figure 4:** Anal canal anatomy (a) STIR OCOR images shows anatomical relation of Internal sphincter (thin arrow) and external sphincter (thick arrow) of anal canal. (b) T2W OCOR images shows supralevator space (long white arrow), levator ani muscle (thick white arrow) and ischioanal fossa (star).
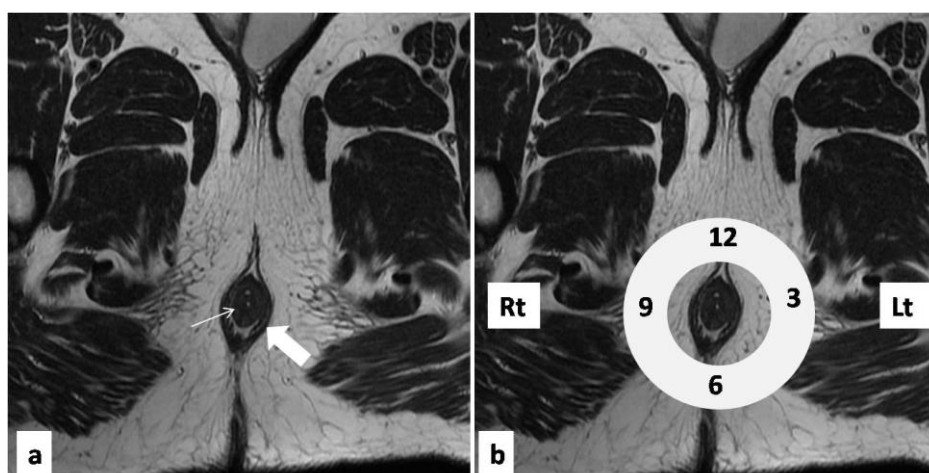


**Figure 5:** (a) T2W OTAR images shows anatomical relation of internal sphincter (thin arrow) and external sphincter (thick arrow) of anal canal. (b) Anal clock used to correctly locate fistulas with respect to the anal canal. Rt: right, Lt: Left

Of the 124 patients who underwent MRI Examination of the perianal region, the maximum number of patients was in the age group of 31-40 years which comprised 35.5 % of the series followed by 21% of the patients in the range of 41-50 years. The youngest patient was 21 years of age while the oldest was 80 years old. The mean age was 42.09 years. A large number of young patients (33 patients below 40 years) underwent MRI examination and suffered from perianal disease. Majority of the patients who underwent MRI examination were male (79%), predominating over female

patients (21%). This is consistent with previous reports such as those of Halligan et al. [8] who stated that the disease predominantly strikes young adults, and men are more commonly affected.

It was observed in this study that discharges (33 %) and pain (31 %) were the predominant symptoms in the patients with perianal sepsis, followed by swelling, fever and purities. The commonly associated risk factors for perianal anal sepsis were Diabetes mellitus, IBD, TB and Pervious Surgery. In present study, Diabetes mellitus (39 %) was the most prevalent comorbidity among the patients tested, followed by history of previous surgery (30 %). Of the 124 patients, approx. 37 patients had past history of surgery.

In the present study, Grade 4 perianal fistula (Trans–sphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa) was the most prevalent condition, identified in 50 cases (41.7%), followed by Grade 1 (Simple linear intersphincteric fistula) accounting for 26 cases (21.7%). Complex perianal fistulas occurred more commonly (70% of the cases) than simple perianal fistulas

(30%). Patients definitely benefit from a detailed preoperative examination that provides a clear map for the surgeon. The findings of our study seem to be in contrast with the findings of Stoker et al [9], who studied 27 patients and found that preoperative MR imaging was of little use in the surgical treatment of perianal fistulas. This difference seems to be due to the fact that the study by Stoker et al. consisted mainly of patients with a primary simple fistula, whereas in the present study, the percentage of complex and recurrent fistulas was higher.

In the present study, according to St. James's University Hospital MR Imaging Classification of Perianal Fistulae, 26 cases of grade 1 (simple linear intersphincteric fistula), 24 cases of Grade 2 (intersphincteric fistula with abscess or secondary track), 16 cases of grade 3 (trans-sphincteric fistula), 50 cases of grade 4 (Trans–sphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa) and 4 cases of grade 5 (supralevator and translevator disease one case for each) were detected (Figures 6 to 9).
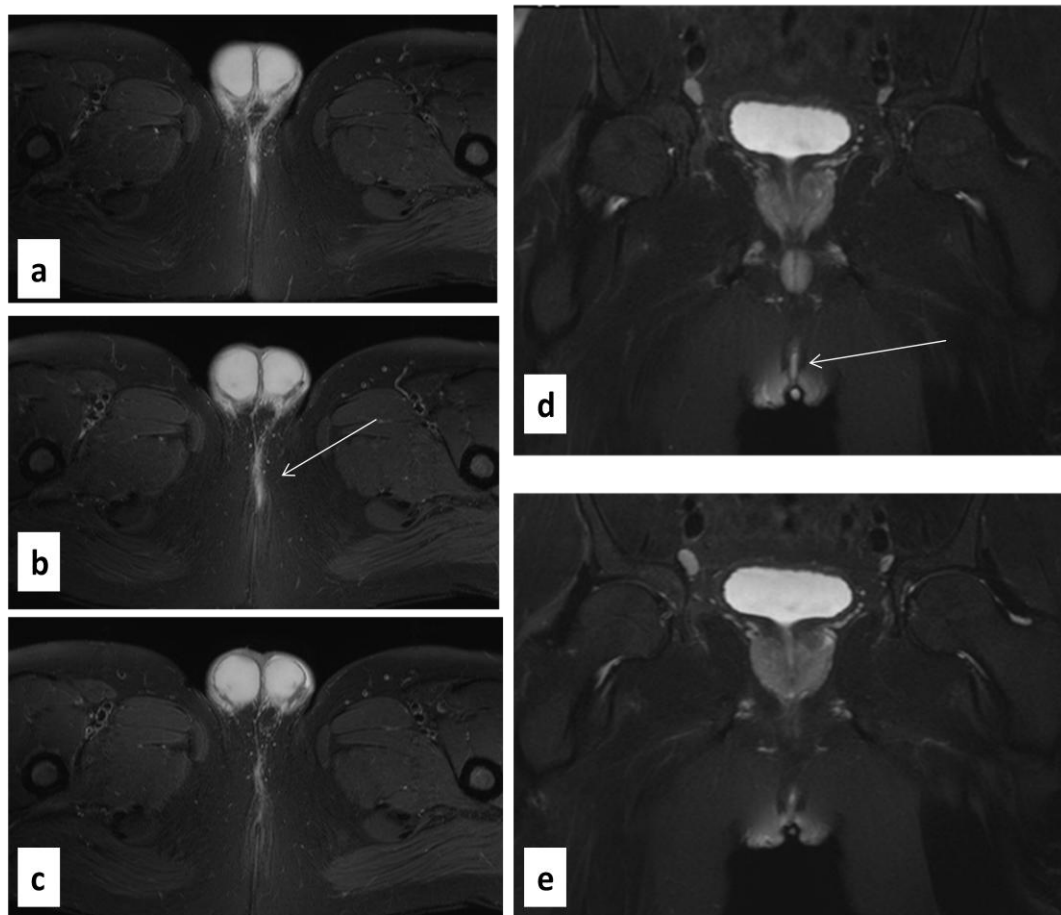


**Figure 6:** T2W FS sequential OTRA (a, b, c) & OCOR (d, e) images shows a small linear hyperintense primary fistulous track (arrow in b and d) in perianal region at midline and left paramedian location with single internal opening at 12 clock positions in midline. Grade 1- Intersphincteric fistula - Simple Linear Intersphincteric Fistula (St. James University Hospital MR Imaging Classification of Perianal Fistulae)
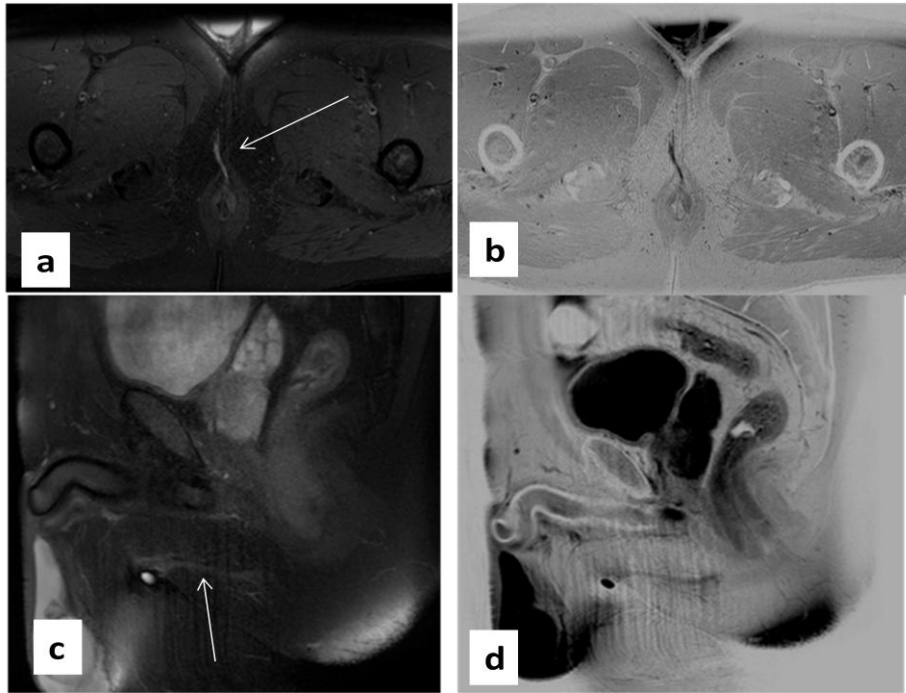
**Figure 7:** T2W FSSequential OTRA (a,b)& Sagittal (positive & negative images) reveal a linear hyperintense fistulous tract (arrow in a and c) at right paramedial anterior aspect of perianal region (ischioanal fossa) with external opening posterior to scrotum (marked by Tablet marker). The tract is traversing posteriorly through subcutaneous plane, piercing both layer of the sphincter complex at anterior aspect of anal canal and showing internal opening at 12 clock position. No evident secondary extensions or abscess formation. Grade 3Trans-sphincteric Fistula – Perianal Fistula (St. James University Hospital MR Imaging Classification of Perianal Fistulae)
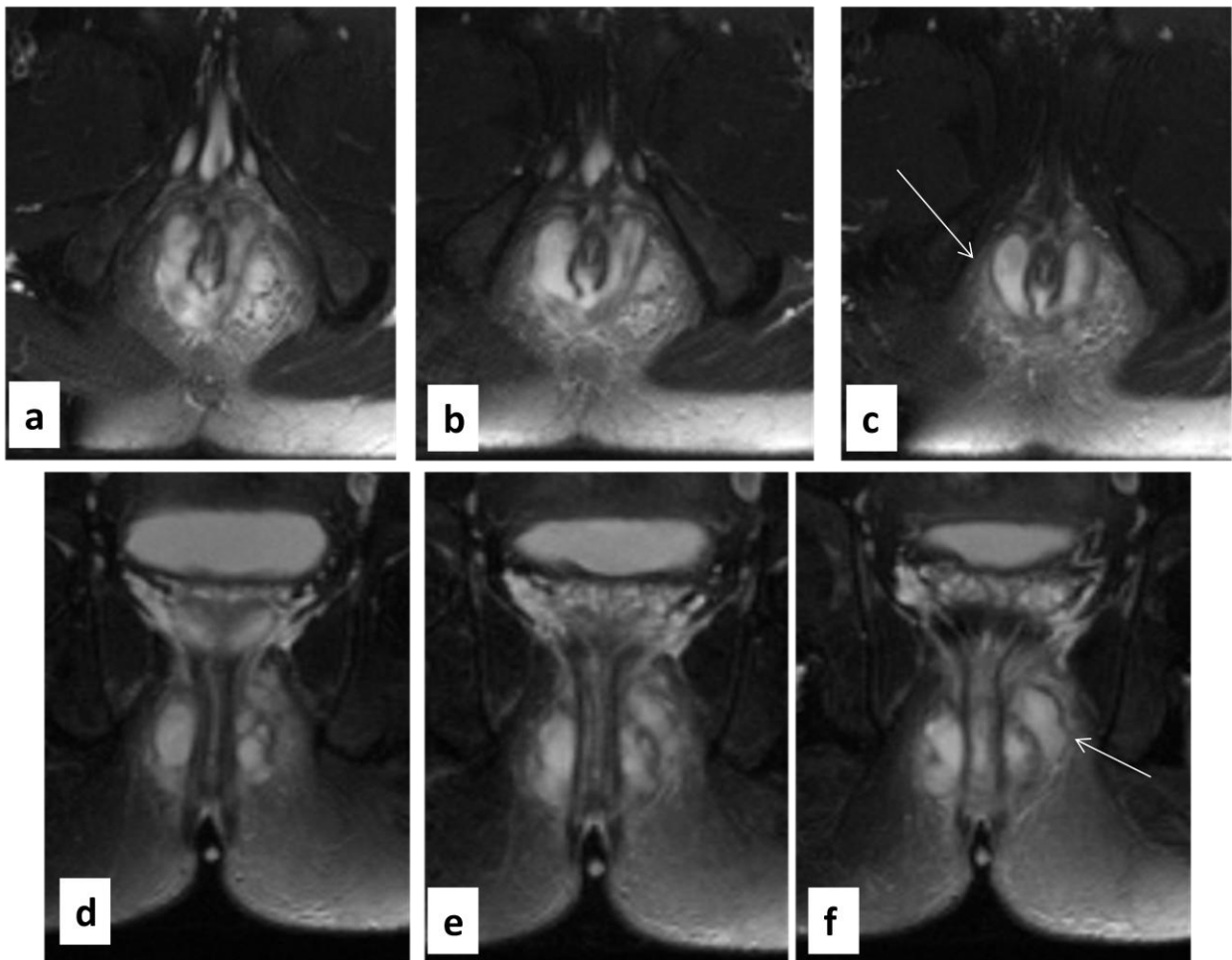


**Figure 8:** T2W FS sequential OTRA (a, b, c) and OCOR (d, e, f) images reveals a large hyperintense linear track at left paramedial posterior perianal region (ischioanal fossa) with external opening posterior to anal canal (marked by Tablet

marker). The tract is traversing cranially, piercing both layer of the sphincter complex at posterior aspect of anal canal and showing internal opening at 6 o' clock position. Large secondary horseshoe abscess (arrow in c) formation is seen within the posterior intersphincteric plane and within left ischioanal fossa (arrow in f) surrounding inflammatory and edematous changes. It is thus classified as grade 4 – Perianal Fistula Grade 4 - Trans-sphincteric Fistula with secondary extension &abscess formation in intersphincteric plane (Horseshoeing)& left ischioanal fossa(St. James University Hospital MR Imaging Classification of Perianal Fistulae)
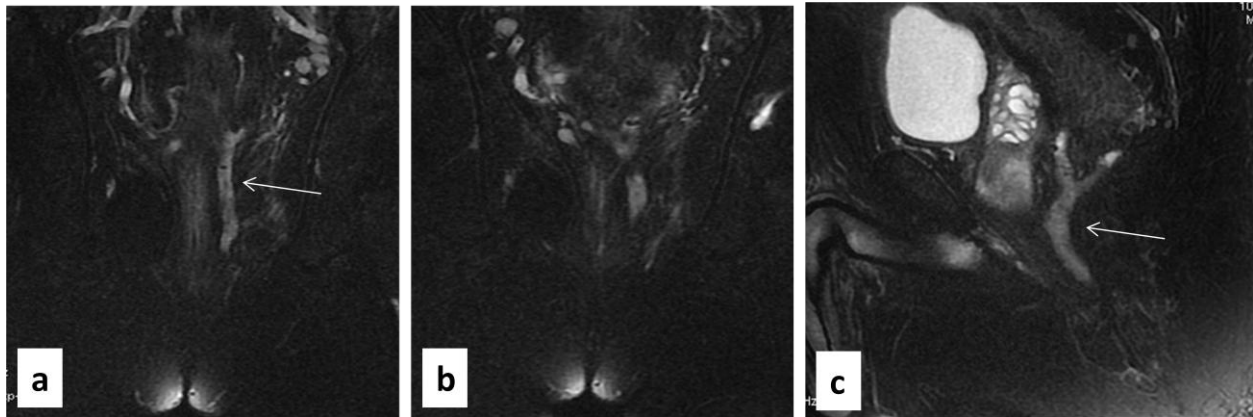


**Figure 9:** T2W FS OCOR (a,b) and SAG images reveal a large hyperintense branching fistulous track (arrow in a and c) extending in the left posterolateral aspect of ischioanal fossa passing through the left levator ani to form a supralevator abscess that opens at 5 o'clock at the pelvis diaphragm level. Grade 5: Supralevator and Translevator Disease

Majority of the patients studied had single external opening (104 patients), while eight patients had multiple external openings. The most common site of external opening in the perianal fistula in perineum is Right Paramedian location (28.8%) followed by left Paramedian location (19.7%).

In the present study, MRI identified 8 fibrous primary tracts. This finding seems to be in contrast with the findings of Beets-Tan. et al. [10] , who stated that it is difficult to differentiate a healed fibrotic track from an open inactive track. However, while the MR imaging appearance of a healed fibrotic track typically lacked the hyperintense signal of fluid inside the active fistula track, post-contrast study shows enhancement which in turn helps in identification of the tract.

In our MRI protocol, both coronal and axial planes were found to be important for complete evaluation. Charles et al. [11], reported that T2W images (TSE and fat-suppressed) provide a good contrast between the hyperintense fluid in the tract and the hypointense fibrous wall of the fistula, while providing a good delineation of the layers of the anal sphincter. They also found that gadolinium-enhanced T1W images are useful to differentiate a fluid-filled tract from an area of inflammation. This agrees with our study, in which axial T2W fat-suppressed images were the most useful for locating the fistulous tract and after Gd injection the tract wall enhances, whereas the central portion is hypointense. Fibrous tracts & abscesses are also very well depicted on post-gadolinium images. Routine use of T2W TSE FS and occasional post-contrast T1W TSE FS images in previously operated perianal fistulae, are correctly detecting and providing similar information regarding primary tracts, abscesses, secondary tracts, horseshoeing and internal openings.

In this study, MRI identified the involvement of external anal sphincter in 66 cases (55%) and internal anal sphincter

in 116 cases (96.6%). This is confirmed and correlated with surgery (100%). Moreover, in our study, MRI has 100% sensitivity, specificity and positive predictive value for correctly detecting and grading the primary tract. In contrast, initial reports by Lunniss et al., suggested a concordance rate of 86% to 88 % [12]-[13]. Later studies by Beets-Tan et al reported up to 100% sensitivity for detecting and grading the primary tract [10].

In our study, it was assumed that fluid collection larger than 10 mm in diameter is an abscess; whereas a fluid filled tubular structure with a diameter smaller than 10 mm is a fistula. MRI and Post-contrast study correctly identified abscess in 56 cases with correct establishment of their relation to levator ani and puborectalis muscles. In one case where MRI detected and abscess, but came out negative on surgery, can be attributed to the fact that it was operated after a delay of 2 week and abscess might have drained in or drained out in mean course of time. MRI was found to have a sensitivity of 100%, specificity of 96.8%, positive predictive value of 96.5%, and negative predictive value of 100% and Accuracy of 98.3% in correctly detecting abscess. Previous studies done by Beets-Tan et al [10] and Mahjoubi et al. [14] reported similarly high sensitivity and specificity of 96% and 80% respectively.

Secondary tracts were detected on surgery in total 80 cases, and MRI could correctly identify all the secondary tracts in 72 cases. In 8 cases MRI failed to detect the secondary tracts due to their fibrous nature. MRI was found to have a sensitivity of 100 %, specificity of 82.6 %, positive predictive value of 90 %, negative predictive value of 100 % and accuracy of 93.3 % in correctly detecting secondary tracts. It correlates well with previous study by Mahjoubi et al. [14] who reported sensitivity and specificity of 80% and 100% respectively.

MRI correctly identified all the124 internal openings found upon surgery. Furthermore, the present study has reported 100 % sensitivity, specificity and PPV of 100% in detecting internal openings. This is in concurrence with previous study by Beets-Tan et al.[10] who reported sensitivity of 96 %, specificity of 90 % and PPV of 90 %. Stoker et al. [9] stated that the internal opening was successfully detected by FS-CE-T1WI and T2WI and STIR images were in agreement with the surgical findings. This agrees with our study. According to Halligan et al [8], the area of maximal intersphincteric sepsis is the probable site of an internal opening. An internal opening was considered as correctly identified when it was at the correct level in the anal canal and was within the correct quadrant[10].

The Parks classification system used to classify perianal fistulae is basically a surgical classification. To easily report all the relevant imaging findings, the St. James's University Hospital MR Imaging Classification of Perianal Fistulae was proposed by radiologists though it does not represent an official surgical reference [1]. Being a simple classification to apply and remember, it helps in better describing the disease so that surgeons can understand the relevant findings.

A particular advantage of MR imaging is its ability to demonstrate occult intersphincteric space sepsis (ie. pus is trapped within the intersphincteric space with no cutaneous exit and thus cannot be found by probing). In cases of "high" fistulas (trans-sphincteric and extrasphincteric, grades 3–5), probing or exploration may be abandoned when anatomic landmarks are uncertain and the operator is unsure whether he or she is above or below the levator plate.

Overall, in the present study, we found that 1.5 Tesla MRI has 100% sensitivity, specificity and positive predictive value for accurately detecting and grading the primary tract, and identifying secondary extensions. Based on our findings, we propose the use of St. James's University Hospital MR Imaging Classification of Perianal Fistulae for reporting of relevant imaging findings. Magnetic resonance imaging is advocated as the method of choice and is superior to preoperative digital examination, probing, conventional fistulography, CT and anal endosonography when imaging is required for anal fistulas.

## 5. Conclusion

Perianal fistula is a common chronic problem having complications like secondary tracks and abscess formation, whose incomplete evaluation leads to residual-recurrent disease and fecal incontinences. This study evaluated role of MRI in evaluation of Perianal Fistula, it is clearly a highly sensitive non-invasive patient friendly imaging modality of choice for detecting anal fistulas and is recommended in their preoperative work-up. We concluded that evaluation with Fat-suppressed T2W images in three oblique planes provides most of the details necessary for accurate evaluation of perianal fistulae. CEMRI also identified more secondary fibrous tracks and was more accurate at identifying complex fistulas. MRI has highest possible diagnostic accuracy aiding successful surgical interventions, aiming to reduce complications and recurrences, and superior patient outcome.

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