Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

Role of conventional fistulography and magnetic resonance fistulography in pre-operative evaluation of fistula in ano

Dr. Illuru Anusha [1], Dr. J. Vamshi Priya[2], Dr. B. Immanuel Navin Kumar [3]
[1]Assistant Professor, Department of Radio diagnosis, Malla Reddy Institute of medical sciences, Suraram, Hyderabad, Telangana
[2]senior resident, Department of Radio diagnosis, Malla Reddy Institute of medical sciences, suraram, Hyderabad, Telangana
[3]Professor, Department of Anatomy, Malla Reddy Institute of medical sciences, suraram, Hyderabad , Telangana

*Corresponding Author

Article History
Received: 07.10.2025
Revised: 28.10.2025
Accepted: 18.11.2025
Published: 06.12.2025

Abstract: ***Background***: A fistula is an abnormal connection between organs or between an internal organ and the skin. Ano-rectal fistulas are chronic inflammatory conditions involving the perianal tissues, creating a pathway between the anal canal and the surrounding skin . These fistulas are more prevalent in middle-aged men than in women, with a male-to-female ratio of 2:1. It is thought that anal gland obstruction leads to abscess formation followed by ruptures through the skin, resulting in fistula development. Many imaging modalities are used to evaluate this area. Magnetic resonance imaging (MRI) has been considered the gold standard procedure over conventional fistulography for perennial fistula assessment. It provides accurate road-maps to select the best surgical approach for a surgeon. It determines the extent of sphincter division, estimates the risk of postoperative incontinence.It is a prospective study of 60 patients (mean age 42.44±13.29years) with perennial fistulas who underwent pelvic MRI with a 1.5 Tesla scanner using multiple Sequences included oblique axial and coronal T1W FSE, T2W FSE. Results: Inter-sphincter fistulas were the most common type of perennial fistula observed based on Parks' classification. Inter-sphincter, trans-sphincter, extra-sphincter, and supra-sphincter fistulas were found in 32 (60%), 13 (24.5%), 4 (7.5%), and 4 (7.5%) patients, respectively. According to St. James' classification, 19 (31.7%), 12 (20%), 15(25%), 9 (15%), and 5 (8.3%) patients had perennial fistula grades I, II, III, IV, and V, respectively. The combination of variable MR sequences and MR fistulogram increased the diagnostic validity of MRI examinations. Our results correlated with surgical results (reference standard) with perfect inter-observer reliability. ***Conclusions:*** Of all imaging modalities, MRI has become a prerequisite for a successful surgery of a perennial fistula. MRI can identify morphology of fistula, the connection between the fistulous tract and the anal sphincter, fistula wound healing, an active versus chronic scarred fistula, postoperative stigmata, and a perennial fistula from its mimics. MRI with variable sequences and MRI fistulogram are successful combinations that increase diagnostic efficiency with technical safety by avoiding both ionizing radiation and systemic gadolinium.

Keywords: Perianal fistula, MRI, MR fistulogram.

INTRODUCTION

A fistula is an abnormal connection between organs or between an internal organ and the skin. Anorectal fistulas are chronic inflammatory conditions involving the peri-anal tissues, creating a tract between the anal canal and the perineal skin[1-3]

The incidence rate of perianal fistulas is~1 in 1000 individuals and it usually occurs in adult males with a maximum occurrence in the third to fifth decades[1-3]. Perianal fistulous disease is divided into two groups: (1) nonspecific and related to anal gland infection, comprising the majority (90%), and (2) related to secondary pelvic pathology, comprising the minority.[1-3]

Cryptoglandular disease is surgically treated by closing the fistula tract and eradicating the infection, whereas other category is medically treated to maintain disease remission

Park's classification categorizes perianal fistulas based on the path of the fistulous tract in relation to the external anal sphincter. It identifies four main types: intersphincteric, trans sphincteric, suprasphincteric, and extra sphincteric[4]. Additionally, there is a group of superficially located, subcutaneous fistulas. Other classifications, such as simple, complex, multiple, high, and recurrent, describe fistulas based on their course, the presence of additional tracts and openings, or prior treatment history. These characteristics are key in determining the appropriate treatment approach[5].

Around 5% of fistulas follow a complex, branched pathway, often extending above the puborectal muscle. In such cases, the internal opening is commonly narrowed, small, or intermittently closed. Failure to remove the infected intersphincteric gland associated with the internal opening, or to identify and properly address all branches of the fistula, significantly increases the risk of recurrence. Many surgical failures are attributed to incomplete mapping of the fistula tract or failure to locate all branches and internal openings. Additionally, challenging anatomical conditions can hinder comprehensive diagnostics and treatment, both before and during surgery, due to the risk of sphincter damage and subsequent fecal incontinence.[6]

Three primary radiological imaging techniques are used to assess perianal fistulas, providing crucial information about the extent of the fistula, the types of tissues involved, the presence of inflammatory or purulent foci, and the locations of the external and internal openings, as well as the main tract and any additional branches. These techniques include contrast fistulography, endorectal ultrasonography, and magnetic resonance imaging (MRI)[7] Each method offers unique advantages and limitations and may be used interchangeably in cases where initial results are inconclusive. Diagnostic imaging plays a vital role in determining the precise extent of the required surgical intervention. Fistulography, though the least commonly utilized, is useful primarily for visualizing the main fistula tract. However, its sensitivity, as reported by various studies, ranges from 24% to 50%. It is less effective at detecting additional branches, as these are often filled with granulation tissue and may not be accessible to the contrast agent used during the procedure.[8]

This study aimed to study the role of conventional fistulography and magnetic resonance fistulography as imaging techniques in the preoperative evaluation of fistula-in-ano.

To compare the diagnostic accuracy of conventional fistulography over magnetic resonance fistulography in the preoperative assessment of fistula-in-ano using surgical findings as reference standards.

To assess the role of MRI fistulography in classifying fistula-in-ano according to Parks' or St. James's classification systems.

To compare the impact of the imaging findings from each modality on surgical planning and operative outcomes

MATERIAL AND METHODS

Study Design: Hospital based prospective observational Study.

Study Setting: Patients attending dept of radio-diagnosis, Malla Reddy Institute of Medical Sciences, Suraram, Medchal.

Study Period: 18 months.

Study Population:Patients diagnosed with perianal fistulas, confirmed clinically or through initial diagnostic imaging, and referred for preoperative evaluation.

Sample Size: A sample of 60 patients is taken using non probability consecutive sampling method.

Inclusion Criteria:

- Patients aged between 18 and 70 years.
- Patients of both genders
- Patients diagnosed with perianal fistula.
- Patients who give consent for the study.

Exclusion Criteria:

- Patients with a prior history of surgery in the anorectal region.
- Cases of fistula-in-ano associated with rectal malignancies, Crohn's disease, high or complex fistulas, tuberculosis, recurrent fistulas, or immunocompromised conditions.
- Patients who do not provide written informed consent.

Ethical Considerations:

Approval from the institutional scientific committee and institutional ethics committee was obtained prior to the study.The details of the study were clearly explained to all parents/guardians in their own language, and written informed consent was obtained.

Study procedure:

Patients diagnosed with anorectal fistulas and referred to the Department of Radio Diagnosis were included in the study. Approval from the medical research ethics committee was obtained, and informed consent was secured from all participants.

Conventional Fistulography (CF):

- Patients meeting the inclusion criteria and providing informed consent underwent CF first if both modalities were advised on the same day. If both were advised on different days, MRF was conducted two days after CF.
- Procedure:

The external opening of the fistula was identified, and its location relative to the anal opening was recorded using the clock-face orientation in the supine position.

Track patency was assessed by inserting a catheter of appropriate size into the external opening after cleansing with an antiseptic solution.

The catheter was introduced 1–2 cm into the external orifice, and 5–10 ml of 60% iodine contrast was injected into the tract.

Spot films were captured in frontal and lateral projections.

Magnetic Resonance Fistulography (MRF):

- Equipment: A 1.5-Tesla MRI unit was used for imaging.
- Imaging Protocol:

Sequences included oblique axial and coronal T1W FSE, T2W FSE, fat-suppressed oblique axial and coronal T1 and T2W FSE, and contrast-enhanced oblique axial, coronal, and sagittal FAT SAT T1W FSE images.

Gadolinium DTPA (0.1 mmol/kg) was administered at a rate of 1 ml/second as the contrast agent.

- Positioning: Patients were positioned supine for imaging.
- Imaging Sequences:

T2-weighted sagittal spin-echo sequence.

Spin-echo T1-weighted axial sequence.

Fast spin-echo T2-weighted axial sequence.

Spin-echo T1-weighted coronal sequence.

Short Tau Inversion Recovery (STIR) axial and coronal sequences.

Heavily T2-weighted (HASTE) imaging with saline instillation (MR Fistulography).

Comparison:

Findings from conventional fistulography and MR fistulography were systematically compared to assess their diagnostic performance and ability to evaluate the extent and complexity of the fistula.

RESULTS

Data was entered into MS Excel 2016 and analyzed using SPSS software version 20. Results are presented as frequencies and percentages, displayed through tables.Descriptive statistics, including frequency and percentage analysis, were used for categorical variables, while mean and standard deviation were calculated for continuous variables. Bivariate analysis was conducted using the chi-square test, with a p-value of less than 0.05 considered statistically significant.

It was observed that the highest proportion of patients belonged to the 41–50 years age group (33.3%), followed by the 31–40 years group (31.7%). The 51–60 years group comprised 11.7% of the study population, while individuals above 60 years accounted for 10.0%. Patients in the age group <30 yearswere 13.3%.
It was observed that the majority of the study population comprised males (68.3%), while females constituted only 31.7% of the total.

Table 1. Demographic data of enrolled patients [***N***=60**]**

Age (years)	42.44±13.29
Range	18-70
Age-group	
<30 years	8[13.3%]
31-40	19[31.7%]
41-50	20[33.3%]
51-60	7[11.7%]
>60	6[10%]
Gender	
Male	41[68.3]
Female	19[31.7]

Table 2. Parks and St. James classification of perianal fistula in our study

Parks classification	
Intersphincteric	32 (60%)
Trans-sphincteric	13 (24.5%)
Extrasphincteric	4 (7.5%)
Suprasphincteric	4 (7.5%)
St. James classification	
Grade I	19 (31.7%)
Grade II	12 (20%)
Grade III	15 (25%)
Grade IV	9 (15%)
Grade V	5(8.3%)

Table 3. Number and site of external opening among enrolled patients

Single	51[85%]
Multiple	9 [15%]
Site of external opening	
1° - 3°	5[8.3%]
4° - 6°	31[51.7%]
7° - 9°	9[15%]
10° - 12°	6[10%]

Table 4 Number and site of internal opening among enrolled patients

No. of internal opening	
single	52[86.7]
Multiple	5[8.3]
others	**3[5%]**
Site of internal opening	

1° - 3°	13[21.7%]
4° - 6°	21[35.0%]
7° - 9°	11[18.3%]
10° - 12°	7[11.7%]

It was observed that the majority of individuals (85.0%) had a single external opening, while only 15.0% presented with multiple external openings.

It was observed that the most common location of the external opening was between the 4°–6° clock positions, accounting for 51.7% of the cases. This was followed by the 7°–9° position with 15.0%, and the 10°–12° position with 10.0%. The least common location was between the 1°–3° positions, observed in 8.3% of the individuals.

Majority of the patients (86.7%) had a single internal opening. Multiple internal openings were present in 8.3% of the cases, while 5.0% were categorized under others.

It was observed that the most common location of the internal opening was between the 4°–6° clock positions, accounting for 35.0% of the cases. This was followed by the 1°–3° region with 21.7%, and the 7°–9° region with 18.3% of the cases. The 10°–12° position was observed in 11.7% of individuals.

Table 5: Validity of conventional fistulography (CF)

Statistic	Value
Sensitivity	80.95%
Specificity	92.31%
Positive Predictive Value	85.0%
Negative Predictive Value	90.0%
Accuracy	88.3%

The sensitivity was 80.95%, indicating that CF correctly identified approximately 81% of true positive cases. The specificity was 92.31%, reflecting its strong ability to correctly detect cases without secondary tracks. The positive predictive value (PPV) was 85.0%, meaning that when CF detected a secondary track, there was an 85% chance it was truly present. The negative predictive value (NPV) was 90.0%, indicating a high probability that absence on CF corresponded with true absence.

Table 6 : Validity of conventional MRI

Statistic	Value
Sensitivity	80.95%
Specificity	92.31%
Positive Predictive Value	85.0%
Negative Predictive Value	90.0%
Accuracy	88.3%

The sensitivity of MRI was 80.95%, indicating that MRI correctly identified around 81% of the true positive cases. The specificity was 92.31%, showing its high reliability in detecting true negative cases. The positive predictive value (PPV) was 85.0%, meaning that when MRI indicated the presence of a secondary track, it was accurate in 85% of cases. The negative predictive value (NPV) was 90.0%, suggesting a strong likelihood that a negative MRI truly indicated the absence of a secondary track.

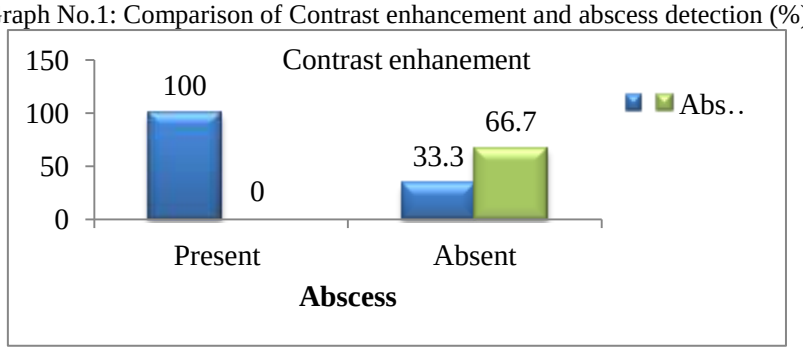
Table 7 :Concordance Rates of conventional fistulography (CF) and MRI

St James Grade	Surgical Finding	CF	Concordance Rate	MRI	Concordance Rate
I	19	15	78.95	19	100
II	12	10	83.3	11	91.67
III	15	10	66.67	15	100
IV	9	3	33.33	9	100
V	5	2	40	4	80
Total	60	40	66.67	58	96.67

MRI showed a significantly higher overall concordance rate (96.67%) compared to CF (66.67%).For Grade I, MRI achieved complete concordance (100%) while CF had a concordance rate of 78.95%.In Grade II, MRI matched surgical findings in 91.67% of cases, compared to 83.3% with CF.For Grade III, MRI again showed full concordance (100%), whereas CF was concordant in only 66.67% of cases.In more advanced disease (Grade IV and V), MRI maintained high

accuracy with concordance rates of 100% and 80%, respectively. In contrast, CF showed much lower concordance—33.33% in Grade IV and 40% in Grade V.

Graph No.1: Comparison of Contrast enhancement and abscess detection (%)



All 12 cases with abscesses (100%) demonstrated contrast enhancement, whereas none of the abscess cases were without contrast enhancement. Among the 48 cases without abscesses, contrast enhancement was present in 33.3% and absent in 66.7%. The presence of contrast enhancement and abscess was found to be statistically significant ($p<0.05$)

Image 1: Coronal and Axial T2 weighted MRI Fistulogram

Image 2: MRI T2 FS hyper intense tract with external opening at left side of the natal cleft

Image3 : Contrast fistulogram with external opening at left natal cleft

DISCUSSION

In the present study, the majority of the patient were within the age group of 41–50 years (33.3%), with a substantial proportion also in the 31–40 year range (31.7%). This suggests that fistulous disease predominantly affects individuals in their third to fifth decades of life,with the age-related peak incidence observed in other studies. Younger individuals (<30 years) constituted a smaller portion (13.3%), while older patients, particularly those aged 51–60 years and above 60 years, made up 11.7% and 10.0%, respectively. This trend is comparable with findings from a study conducted by Ibrahim et al.[9] which also reported a peak incidence among males aged 41–50 years, supporting the notion that fistulous disease primarily affects individuals in middle age.

The male predominance observed (68.3%) is consistent with existing literature, which often reports a higher incidence of fistulous disease in males. Monson et al.reported a male-to-female ratio of 2:1 in a large study[10]. This gender disparity was further emphasized in the MRI-based study by Mohammed et al.which documented an even higher male prevalence of 80%, supporting the observation that males are disproportionately affected by perianal fistulas.[11]

Clinically, most patients (85.0%) presented with a single external opening, whereas only a minority (15.0%) had multiple external openings, indicating that simple fistulae were more common than complex types. The location of the external opening was most frequently noted between the 4°–6° clock positions (51.7%), a finding that could correlate with common sites of abscess formation and drainage pathways in perianal fistulas. Other external opening sites included 7°–9° (15.0%), 10°–12° (10.0%), and 1°–3° (8.3%), indicating a relatively lower frequency of atypical locations.

This finding is consistent with MRI-based observations by Singh K et al.who noted that intersphincteric and transsphincteric fistulas types that typically present with single openings were the most prevalent.[12]

In contrast, a retrospective surgery-based study by Zhao et al. found that complex fistulas were more frequent, accounting for 67.7% of cases, while simple fistulas comprised 32.3%. This discrepancy may reflect differences in referral patterns, with more complex cases being selected for surgical intervention in their cohort, whereas the present study captured a broader range of cases, including simpler presentations.[13]

The anatomical location of external and internal openings in the present study showed a clear predominance in the 4°–6° clock position, consistent with the findings of Bhayaet al.Their study also reported that intersphincteric and transsphincteric types commonly located in the midline were the most frequent, reinforcing the pattern observed in the present study.[14]

Similarly, internal openings were predominantly singular (86.7%), with only a small proportion showing multiple internal openings (8.3%) or falling into other less-defined categories (5.0%). The 4°–6° clock position was again the most commonly involved site for internal openings (35.0%), followed by 1°–3° (21.7%), 7°–9° (18.3%), and 10°–12° (11.7%). These anatomical preferences for both internal and external openings may have implications for diagnosis and surgical planning, as they support the typical distribution of fistulous tracts around the anal canal.

Diagnostic Performance:

In the present study Contrast fistulography (CF) and MRI both showed a sensitivity of 80.95% and specificity of 92.31% in detecting secondary tracks, with positive predictive value (PPV) and negative predictive value (NPV) at 85.0% and 90.0%, respectively. For abscess detection, CF had a lower sensitivity of 58.33% but high specificity (95.83%). CF's PPV and NPV for abscess detection were 77.78% and 90.20%, respectively. In contrast, MRI demonstrated perfect diagnostic accuracy for abscesses with 100% sensitivity, specificity, PPV, and NPV.

MRI demonstrated superior diagnostic accuracy in the evaluation of perianal fistulas, particularly in complex cases, with an overall concordance rate of 96.67% with surgical findings. These findings align with the results reported by Liang et al. (2013), who emphasized the effectiveness of fistulography in preoperative evaluation, especially in mapping complex spatial relationships and identifying secondary tracts and abscesses. While fistulography was noted for its capability to visualize the direction and location of fistulous tracts using both coronal and transverse planes, the authors acknowledged its limitations in soft tissue resolution, reinforcing MRI's role as the preferred modality when detailed soft tissue assessment is required.

In a subsequent study, Liang et al. [15] highlighted the complementary use of fistulography and MRI in complex fistula-in-ano cases. Similar to our findings, where MRI outperformed contrast fistulography (CF) in identifying secondary tracts and abscesses, Liang et al. suggested that combining the anatomical clarity of CT with the superior soft tissue contrast of MRI provides a comprehensive approach in challenging cases. This supports the current study's conclusion that MRI is indispensable in evaluating disease complexity.

In the present study, MRI demonstrated superior diagnostic accuracy compared to contrast fistulography (CF), particularly in identifying secondary tracts,

internal openings, and complex fistula anatomy. This aligns with the findings of Mohammed et al.[16] who reported in the that MRI successfully identified both simple, non-branching, and complex fistulous tracts. Their study highlighted the advantage of MRI's multiplanar capabilities and excellent soft tissue contrast, which are essential in delineating intricate fistulous pathways.

Subbukrishnanet al. further supported this observation, emphasizing MRI's ability to visualize branching tracts and horseshoe extensions critical components often missed by conventional techniques such as CF. Their study reinforced the role of MRI in surgical planning, where precise anatomical mapping directly influences operative outcomes and recurrence rates.[17]

In terms of abscess detection, MRI has been consistently reported as the gold standard. Mohammed et al noted that MRI identified ischiorectal and ischioanal abscesses with remarkable clarity, particularly on STIR T2-weighted sequences, which provide high contrast resolution for fluid-containing structures. This level of detail is often unattainable with CF, which lacks soft tissue characterization.

Similarly, Singh K et al demonstrated MRI's superiority in preoperative assessment, particularly in identifying fluid collections and delineating the full extent of fistula anatomy. Their findings align with the current study, where MRI provided comprehensive information that closely correlated with surgical findings, thus proving more reliable than CF, especially in complex or recurrent cases[18].

The comparative study by Soker G et al. found MRI to be significantly more accurate than CT fistulography in classifying fistulas (92.7% vs. 73.1%) and in detecting internal openings and secondary extensions. This is consistent with our results, where MRI achieved high diagnostic accuracy across all St. James grades and showed stronger agreement with surgical findings than CF. The reported kappa values by Soker et al. for MRI (0.896) and CT (0.621) reflect a similar trend observed in our study, highlighting MRI's superior inter-modality agreement.[19]

Abdelnaby et al. further supported MRI's high diagnostic accuracy, reporting near-perfect concordance with examination under anesthesia for identifying the number and position of tracts, secondary extensions, and abscesses. Their study showed MRI had sensitivities ranging from 89.4% to 98% across key parameters, comparable to our findings where MRI achieved 100% sensitivity and specificity for abscess detection and high overall agreement with surgical grading. These results collectively confirm the pivotal role of MRI in the comprehensive preoperative evaluation of complex fistulas.[20]

The utility of multi-detector CT fistulography (MDCTF) was discussed by Bhatt et al who demonstrated its value in anatomical mapping, particularly when MRI is contraindicated. While MDCTF provided clear visualization of fistula types and extensions, its diagnostic performance was not on par with MRI. Our study's comparison between CF and MRI reinforces this, as MRI yielded superior accuracy in detecting higher-grade disease (Grades IV and V), where CF performance significantly declined.[21]

In the large-scale study by Vo D et al. MRI exhibited excellent performance in identifying internal openings, primary and secondary tracts, and abscesses, with sensitivities as high as 99%. The use of specific sequences, such as post-contrast fat-saturated T1-weighted images, was highlighted for their role in detecting inflammatory and abscess components an observation mirrored in our study, where contrast enhancement on MRI was significantly associated with secondary tracts and abscesses ($p < 0.05$). This further validates the utility of contrast-enhanced MRI in determining disease severity.[22]

The importance of structured MRI reporting was emphasized by Barbosa et al. who found that standardized reports improved clarity and clinical utility. While our study did not formally assess reporting styles, the high concordance between MRI findings and surgical grades suggests that clear documentation of internal and external openings, tract classification, and contrast enhancement significantly contributes to clinical decision-making. Adoption of structured formats may further enhance MRI's value in clinical practice.[23]

Minordi et al. also highlighted the limitations of conventional contrast fistulography in assessing deeper anatomical compartments and highlighted MRI's multiplanar capabilities and high soft tissue contrast. Their reported diagnostic accuracy of up to 93% for MRI is consistent with our findings, where MRI achieved near-perfect agreement in Grades I, III, and IV of the St. James classification and maintained high performance in complex scenarios. This further supports MRI as the gold standard in preoperative fistula-in-ano assessment.[24]

CONCLUSION

This study emphasizes the critical role of magnetic resonance imaging (MRI) in the comprehensive evaluation of perianal fistulous disease. The findings confirm that MRI is superior to conventional contrast fistulography (CF) in diagnostic accuracy, particularly in detecting secondary tracts, internal openings, and associated abscesses. With its superior soft tissue resolution, multiplanar imaging capability, and ability to delineate the complex anatomical relationships of fistulous tracts, MRI demonstrated near-perfect concordance with surgical findings, making it the

imaging modality of choice for preoperative assessment.

Clinically, accurate characterization and classification of perianal fistulas are essential to guide appropriate surgical management and minimize complications such as recurrence and fecal incontinence. Preservation of the external anal sphincter is paramount during surgical intervention, and this necessitates precise mapping of the fistulous tracts in relation to the sphincter complex. Furthermore, contrast-enhanced MRI not only enhances visualization of fistulous tracts but also distinguishes active inflammatory tissue from fibrosis or scarring, which is particularly important in recurrent or previously treated cases. The use of advanced sequences, such as the 3D T1-weighted fat-saturated (FAT SAT) sequence, has proven especially valuable due to its ability to provide detailed anatomical information in a time-efficient manner. These imaging features are critical for correct grading of fistulous disease, particularly using systems such as the St. James classification, which directly influence surgical management.

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