



## Reliability of MR Fistulogram in the Surgical Management of Fistula-In-Ano

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### Abstract

*A fistula is defined as an abnormal connection between two structures or organs or between an organ and the surface of the body. In case of perianal fistula, it is an abnormal connection between anal canal and perianal skin.*

*In the past, imaging techniques played a limited role, but now it is increasing, especially the use of MRI. In this study we tried to correlate MRI and intra-operative findings and discussed the usefulness of MRI in surgical management of perianal fistula.*

*MRI is able to adequately evaluate and classify perianal fistula disease with a high degree of accuracy.*

**Keywords:** *fistula-in-ano, MRI, intraoperative findings.*

### 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 case of perianal fistula, it is an abnormal connection between anal canal and perianal skin. This defect is characterized by three basic components: internal opening as primary opening in the anal canal, fistulous tract and external opening as secondary opening in the perianal skin. It is an inflammatory condition that affects perianal region causing significant morbidity and often requiring repeated surgical interventions due to its high tendency to recur.

Prevalence of perianal fistula is approximately 10 in 1,00,000, affecting males 2-4 times more frequently than females.<sup>1</sup> Anal fistulas are

diagnosed following drainage of perianal abscess in 25-37% of cases.<sup>2-3</sup> They are usually diagnosed following recurrence of the abscess. The most common presenting symptom is discharge (65%), but local pain is frequent due to inflammation.<sup>4</sup> Antibiotic therapy does not have an effect on the development of fistulae following abscess drainage.<sup>5</sup> The management priorities follow three central and sequential principles: control of sepsis, closure of the tract, and preservation of sphincter function. One of the treatment of fistula is surgical management, which is successful in most cases but it is associated with significant recurrence.<sup>6</sup> Successful surgical management requires accurate preoperative assessment of the course of primary tract and site of any secondary extension/abscesses.<sup>7</sup>

In the past, imaging techniques played a limited role, but now it is increasing, especially the use of MRI as it provides more precise information on the anatomy of anal canal, sphincter complex, and relationship of fistula to the pelvic floor structures and to the plane of levator ani muscle. It allows identification of primary tracts and abscesses or secondary extensions, which is not possible on physical examination, thereby allowing surgeons to choose the best surgical treatment, reducing recurrence of disease or possible complications, such as fecal incontinence.<sup>8,9</sup>

In this study, we review the role of imaging techniques in evaluation of perianal fistula and characterise the findings in detail according to the type of primary tract (park's classification), location of internal opening, length of the tract, secondary tracts and abscesses. We then correlated MRI and intra-operative findings and discussed the usefulness of MRI in surgical management of perianal fistula.

### Materials and Methodology

**Source of Data:** Patients admitted with fistula-in-ano at ST.ISABEL'S HOSPITAL.

**Study Period:** September 2015 to March 2017.

Aprospective observational study.

A total number of 30 patients were studied.

Demographic data was obtained from all patients and they were examined clinically and standard data was collected. They were subjected for 3Tesla MRI. All of the MR Images were reported by a single senior radiologist of more than 10years experience.

The following findings were compared between MRI and intra-operatively. Primary tract was considered as per park's classification. Internal opening was considered as whether it's opening anterior or posterior. Length of the primary tract was measured in MRI and intra-operatively. Then other findings like abscess/secondary tracts/horse shoe tract were observed in MRI and intra-operatively whether present or absent.

### Inclusion Criteria

1. Patients with anal fistula.

2. Patients who gave consent and planned for operative management.

### Exclusion Criteria

1. Patients who were in acute pain.
2. Recurrent fistula.
3. Patients who underwent anal procedure earlier.
4. Patients having associated malignant disease.

### Results

#### MRI Findings

**Table 1:** Descriptive Analysis of Primary Tract Type in MRI

PRIMARY TRACT	Frequency	Percentage
Inter-sphincteric	25	83.33%
Trans-sphincteric	5	16.66%

25 cases were inter-sphincteric (83.33%) and 5 cases were trans-sphincteric (16.66%).

**Table 2:** Descriptive Analysis of Internal Opening in MRI

Internal opening (MRI)	Frequency	Percentage
Anterior	13	43.33%
Posterior	17	56.66%

13 cases (43.33%) were found to have internal opening anteriorly and 17 cases posteriorly (56.66%).

**Table 3:** Analysis of Secondary Tracts/ Abscess/ Horse Shoe Tract in MRI (N=30)

MRI findings	Frequency	Percentage
Secondary tract	10	33.33%
Abscess	11	36.11%
Horseshoe tract	1	3.33%

10 cases were found to have secondary tracts (33.33%), 11 cases had abscess (36.11%), and 1 case had horse-shoe tract (3.33%).

#### Per-Operative Findings

**Table 4:** Descriptive Analysis of Primary Tract Per-Operatively (N=30)

Primary Tract (PER-OPERATIVELY)	Frequency	Percentage
Inter-sphincteric	26	86.66%
Trans-sphincteric	4	13.33%

26 patients were identified as inter-sphincteric (86.66%) and 4 patients as trans-sphincteric type (13.33%).

**Table 5:** Descriptive Analysis of Internal Opening in Per-Operatively

Internal opening (PER-OP)	Frequency	Percentage
Anterior	12	40%
Posterior	18	60%

12 patients were identified as internal opening at anterior (40%) and in 18 cases internal opening at posterior (60%).

**Table 6:** Descriptive Analysis of other per operative findings (N=30)

Parameter	Frequency	Percentage
Secondary tract	9	30.0%
Abscess	13	43.3%
Horseshoe tract	1	33.33%

9 cases were with secondary tracts (30%), 13 cases were with abscess (43.03%), and 1 patient was with horse shoe extension (33.33%).

**Agreement between MRI and Per-Operative Findings**

**Table 7:** Association of Primary Tract in MRI vs Per-op (N=30)

Primary Tract-Mri	Primary Tract Per – Operatively		Chi Square	P- Value
	Inter-Sphincteric	Trans-Sphincteric		
Inter-Sphincteric (N=25)	25 (100%)	0 (0%)	23.077	<0.001
Trans-Sphincteric (N=5)	1 (20%)	4 (80%)		

MRI showed inter-sphincteric type in 25 cases and the same number were identified intra-operatively (100%). MRI showed 5 cases as trans-sphincteric type but intra operatively 4 cases (80%) were found as trans-sphincteric tracts and other 1 case identified as inter-sphincteric type (20%) (p<0.001).

**Table 8:** Predictive Validity of MRI in Identifying primary Tract

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	96.15%	81.1%	99.32%
Specificity	100.00%	100%	100%
False positive rate (FPR)	1%	0%	1%

False negative rate (FNR)	3.85%	-3.54%	11.23%
Positive predictive value (PPV)	100.00%	86.68%	100%
Negative predictive value (NPV)	80.00%	37.55%	96.38%
Diagnostic accuracy(DA)	97%	83.33%	99.41%

Sensitivity: 96.15% (95 CI 81.1 TO 99.32).

Specificity: 100% (95 CI 100% to 100%).

FPR: 1% (95 CI 0% to 1%).

FNR: 3.85% (95 CI -3.54 to 11.23).

PPV: 100.00% (95 CI 37.55 to 96.38).

NPV: 80.00% (95 CI 37.55 to 96.38).

DA: 97% (95 CI 83.33 to 99.41).

**Table 9:** Association of Internal Opening: Per-op vs MRI (N=30)

Internal Opening (MRI)	Internal Opening (Per Op)		Chi Square	P- Value
	Anterior	Posterior		
Anterior (N=13)	12 (92.30%)	1 (7.692%)	26.154	<0.001
Posterior (N=17)	0 (0%)	17 (100%)		

MRI showed internal opening anteriorly in 13 cases but intra operatively 12 cases had internal opening anteriorly (92.32%) and other one case posteriorly (7.692%). 17 cases were identified internal opening posteriorly both in MRI and intra-operatively (100%) (p<0.001).

**Table 10:** Predictive Validity of MRI in Identifying Internal Opening

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	100.00%	75.75%	100%
Specificity	94.44%	74.24%	99.01%
FPR	5.56%	-5.02%	16.13%
FNR	0.00%	0%	24.25%
PPV	92.31%	66.69%	98.63%
NPV	100.00%	81.57%	100%
DA	97%	83.33%	99.41%

Sensitivity: 100.00% (95 CI 75.75 TO 100).

Specificity: 94.44% (95 CI 74.24 to 99.01).

FPR: 5.56% (95 CI -5.02 to 16.13).

FNR: 0.00% (95 CI 0% to 24.25).

PPV: 92.31% (95 CI 66.69 to 98.63).

NPV: 100% (95 CI 81.57 to 100).

DA: 97% (95 CI 83.33 to 99.41).

**Table 11:** Association of Secondary Tract: Per-Op vs MRI (N=30)

Secondary Tract (MRI)	Secondary Tract (Perop)		Chi Square	P-Value
	Yes	No		
Yes(N=10)	8 (80%)	2 (20%)	17.857	0.00
No(N=20)	1 (5%)	19 (95%)		

MRI showed 10 patients with secondary tract but intra operatively 8(80%) cases had secondary tract and other 2(20%) were without secondary tract. MRI showed no secondary tract in 20 cases out of which 19 cases(95%) had no secondary tract intra-operatively but 1(5%) patient had secondary tract intra-operatively(P=0.00).

**Table 12:** Predictive Validity of MRI in Identifying Secondary Tract

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	88.89%	56.5%	98.01%
Specificity	90.48%	71.09%	97.35%
FPR	9.52%	-3.03%	22.07%
FNR	11.11%	-9.42%	31.64%
PPV	80.00%	49.02%	94.33%
NPV	95.00%	76.39%	99.11%
DA	90%	74.38%	96.54%

Sensitivity: 88.89% (95 CI 56.5 TO 98.0).  
 Specificity: 90.48% (95 CI 71.09 to 97.3).  
 FPR: 9.52% (95 CI 2.65 to 28.9).  
 FNR: 11.11% (95 CI 1.99 to 4.35).  
 PPV: 80.00% (95 CI 49.0 to 94.3).  
 NPV: 95.00% (95 CI 76.3 to 99.1).  
 DA: 90% (95 CI 74.3 to 96.5).

**Table 13:** Association of Abscess: Per-Op vs MRI (N=30)

Abscess (MRI)	Abscess(Per-Operative)		Chi Square	P-Value
	Yes	No		
Yes(N=11)	10(90.90%)	1(9.090%)	16.010	0.00
No(N=19)	3(15.78%)	16(84.21%)		

MRI showed abscess in 11 subjects, of which 10 cases (90%) had abscess intra-operatively and 1(9.09%) patient had no abscess. MRI showed no

abscess in 19 subjects out of which 16(84.21%) had no abscess and 3(15.78%) had abscess intra-operatively (p=0.00).

**Table 14:** Predictive Validity of MRI in Identifying Abscess

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	76.92%	54.02%	99.82%
Specificity	94.12%	73.02%	98.95%
FPR	5.88%	1.05%	26.98%
FNR	23.08%	0.173%	45.97%
PPV	90.91%	62.27%	98.38%
NPV	84.21%	62.43%	94.48%
DA	87%	74.50%	98.83%

Sensitivity: 76.92% (95 CI 54.0 TO 99.8).  
 Specificity: 94.12% (95 CI 73.0 to 98.9).  
 FPR: 5.88% (95 CI 1.0 to 26.9).  
 FNR: 23.08% (95 CI 0.17 to 45.9).  
 PPV: 90.91% (95 CI 62.2 to 98.3).  
 NPV: 84.21% (95 CI 62.4 to 94.8).  
 DA: 87% (95 CI 74.5 to 98.8).

**Table 15:** Association of Horseshoe: Per-op vs MRI (N=30)

Horseshoe (MRI)	Horseshoe (Per-Operatively)		Chi Square	P-Value
	Yes	No		
Yes(N=1)	1(100%)	0(0%)	30.000	<0.001
No(N=29)	0(0%)	29(100%)		

MRI showed 1 case with horse-shoe tract and it was detected intra-operatively (100%) (p=<0.001).

**Table 16:** Predictive Validity of MRI in Identifying Horse-Shoe Tract

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	100.00%	100%	100%
Specificity	100.00%	100%	100%
FPR	0.00%	0%	0%
FNR	0.00%	0%	0%
PPV	100.00%	100%	100%
NPV	100.00%	100%	100%
DA	100%	100%	100%

Sensitivity, Specificity, PPV, NPV, DA: 100% (CI 100 to 100).  
 FPR, FNR: 0% (CI 0% to 0%).

**Table 17:** Correlation between Lengths of the primary tract as identified by MRI and per-operatively

Spearman Rank Correlation Coefficient		Length of the tract-MRI	Length Of The Tract-Per Op
Spearman's Rho	length of the tract in(MRI)	1.000	.985**
	P Value	.	<.001

Spearman's correlation co-efficient in MRI is 1.000 and intra-operatively it is 0.985 with significant p value ( $p < 0.001$ ).

## Discussion

The study aimed to identify the anatomy of the fistula during operative surgery in comparison with radio diagnostic method.

In a study done by Kulvinder Singh et al.<sup>10</sup> 45 patients (90%) were males out of 50 cases, Alexander et al.<sup>11</sup> study stated that this disease is more predominant in males(66/80 men) (82.5%), Halligan et al.<sup>12</sup> study showed that the disease predominantly strikes young adults, and men are more commonly affected. Naglaa Daabis et al.<sup>13</sup> showed 21 cases were males out of 25 patients in their study population and in our study 26 males (86.67%) out of 30 cases and remaining 4 were females(13.33%) and it agrees with the above studies.

Naglaa Daabis et al.<sup>13</sup> showed that this disease is predominate in the age group of 21-40 years with mean age of 34.8 years, in the study by Buchanan GN et al.<sup>14</sup> median age group is 37 years and Manar T Alaat El Essawy et al.<sup>15</sup> study stated the mean age for this disease is 39 years and in our study population showed the age group of 30-39 is more predominate (11/30) with the mean age of 38.4 years.

With regard to total duration of hospital stay, 7 cases stayed for one day(23.33%), 9 cases stayed for 2 days(30%), 9 cases stayed for 3 days(30%), 4 cases stayed for 4 days(13.33%) , and 1 patient stayed for max 8 days(3.33%) as the patient developed urinary incontinence post-operatively . Perianal discharge is the most common symptom in our study population (73.33%) and then followed by perianal pain (66.67%). Sainio p et

al.<sup>4</sup> stated that the most frequent clinical presentation is either discharge (seen in about 65% patients) or pain in the perianal region and its agreed with our study.

Co-morbidities in our study population, 1 case had hypothyroidism (3.33%),6 cases had hypertension (20%), 3 cases had diabetes mellitus(10%), and 3 patients had coronary artery disease(10%).

We classified the primary tract according to park's classification, 25 cases were inter-sphincteric (83.33%), and 5 cases were trans-sphincteric (16.66%) in MRI and there were no supra – sphincteric and extra-sphincteric type in our study population. In our study inter-sphincteric type is the most common type (83.33%).

With regard to primary tract intra operatively, 26 patients were identified as inter-sphincteric (86.66%), the most common type in our study and 4 patients were identified as trans-sphincteric type (13.33%).

In a study done by Naglaa Daabis et al.<sup>13</sup>depicted the primary tract with sensitivity-100%; specificity-86%, Villa C et al .<sup>16</sup> study stated that MRI is highly accurate for depiction of the primary tract(sensitivity, 100%; specificity, 86%), Beckingham et al.<sup>8</sup> depicted in their study as MRI is highly sensitive and specificity for primary tract as 97% and 100 % respectively,in Beets-Tan et al<sup>17</sup> study also the sensitivity and specificity for detecting fistula tracts were 100% and 86% respectively, Kulvinder Singh et al.<sup>10</sup> study the sensitivity and specificity of MRI in correctly detecting the primary tract was found to be 95.56% and 80% respectively. In study conducted by Akhtar S et al.<sup>18</sup> MRI has a sensitivity of 90%, specificity of 100% and diagnostic accuracy of 90% in determining type and extent of peri-anal fistula. Manar T Alaat El Essawy et al.<sup>15</sup> study stated that MRI has sensitivity, specificity, NPV, and PPV for primary tract as 96%.

In our study MRI has sensitivity-96 %, specificity-100%, PPV-100%, NPV-80% and diagnostic accuracy -97% for detecting the type of primary tract which is almost agreed with all above studies.

With regard to internal opening in MRI, 13 cases(43.33%) were found to have internal opening at anterior and 17 cases posteriorly (56.66%) and the opening at posterior site is with maximum number in our study population. The location of the level of the internal opening is important since this will determine the extent of sphincter division during fistulotomy. Excessive sphincter division will leads to fecal incontinence.

Intra-operatively 12 patients were identified as internal opening at anterior (40%) and in 18 cases internal opening at posterior (60%) with maximum number.

In a study done by Beets-Tan et al.<sup>17</sup> who reported sensitivity of 96 %, specificity of 90 % and PPV of 90 % of MRI for internal opening, Similarly Barker et al.<sup>19</sup> study reported that sensitivity of MRI is 80% in detecting internal openings, in a study done by Stoker et al.<sup>20</sup> stated that the internal opening was successfully depicted by FS-CE-T1WI and T2WI and STIR images were in agreement with the surgical findings, in the study of Kulvinder Singh et al.<sup>10</sup> noticed the high sensitivity of MRI in correctly localization of internal opening (95.83%) and in Manar T Alaat El Essawy et al.<sup>15</sup> study the sensitivity, specificity, NPV and PPV for MRI in locating the correct internal location 96%.

In our study for identifying the internal opening MRI has sensitivity-100%, specificity-94 %, PPV-92%, NPV-100%, and DA-97%.

10 cases were noticed to have secondary tracts (33.33%), 11 cases were of abscess (36.11%), and 1 case was of horse shoe tract(3.33%) in MRI.

Intra operatively, 9 cases were with secondary tracts (30%), 13 cases were with abscess (43.03%) and 1 patient was with horse shoe extension (33.33%).

Naglaa Daabis et al.<sup>13</sup> depicted the abscesses with sensitivity- 96%; specificity- 97%, Beets-Tan et al.,<sup>17</sup> and Mahjoubi et al.<sup>21</sup> reported a similar high sensitivity and specificity of 96% and 80% respectively for abscess, study conducted by Villa C et al.<sup>16</sup> reported that MRI is highly accurate for

depiction of abscesses(sensitivity-96%; specificity-97%), Kulvinder Singh et al.<sup>10</sup> study stated the sensitivity and specificity of MRI in correctly detecting for abscess was 87.50% and 95.24% respectively with PPV of 77.78 % and NPV of 97.56 % in correctly detecting abscess. In Manar T Alaat El Essawy et al.<sup>74</sup> study the sensitivity, specificity, NPV and PPV for MRI in detecting abscess is 100%.

In our study MRI has sensitivity-76%, specificity-94%, PPV-90%, NPV-84% and diagnostic accuracy-87% for identifying abscess.

In a study done by Beets-Tan et al.<sup>17</sup> who reported sensitivity, specificity and PPV of 100% for identifying horse shoe tracts.

Barker et al.<sup>19</sup> reported sensitivity of 97% for horse shoeing, Kulvinder Singh et al.<sup>10</sup> study depicted the sensitivity of MRI in correctly detecting the horse-shoeing(87.50%) and in Manar T Alaat El Essawy et al.<sup>15</sup> study the sensitivity, specificity, NPV and PPV of MRI in identifying horse-shoe extensions is 100%.

In our study population the sensitivity, specificity, NPV, PPV and diagnostic accuracy for MRI in identifying horse-shoe tracts is 100% which is agreeing with all above studies.

In a study done by Mahjoubi et al.<sup>21</sup> who reported sensitivity and specificity of 80 and 100% respectively for identifying secondary tracts and in the study of Kulvinder Singh et al.<sup>10</sup> the sensitivity of MRI in identification of secondary tract (93.75%) and in our study MRI has sensitivity-88%, specificity-90%, PPV-80%, NPV-95%, and diagnostic accuracy-90% for identifying secondary tracts.

The length of primary tract measured in MRI and intra-operatively showed significant correlation which was done by spearman's correlation coefficient, in MRI it is 1.000 and intra-operatively it is 0.985 with significant p value ( $p < 0.001$ ).

### Conclusion

MRI is a useful procedure for successful management of perianal fistula by correct assessment of the extent of disease and

relationship to sphincter complex. Also it helps in identification of secondary extensions, particularly horseshoe tracts and abscesses resulting in complete evaluation and highest possible diagnostic accuracy aiding successful surgical interventions, aiming to reduce complications and recurrences.

With current level of advancement of imaging science, MRI is able to adequately evaluate and classify perianal fistula disease with a high degree of accuracy. The use of multiplanar coil arrays and the use of multiple imaging planes and sequences significantly maximize MRI analysis.

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