Section: Radiodiagnosis

Original Research Article

ROLE OF THREE DIMENSIONAL (3D) THIN MR SEQUENCE IN PERIANAL FISTULA

Received : 01/05/2024
Received in revised form : 19/07/2024
Accepted : 04/08/2024

Keywords:
Perianal Fistula; Three Dimensional Magnetic Resonance Imaging; Multiplanar; Recurrence.

Corresponding Author:
Dr. Ashvini Kumar,
Email: chandana.nayak89@gmail.com

DOI: 10.47009/jamp.2024.6.4.91

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (4); 461-467

Chandana Nayak[1], Ashvini Kumar[2]

[1]Assistant Professor, Department of Radiodiagnosis, Karwar Institute of Medical Sciences, Karwar, Karnataka, India
[2]Professor, Department of Radiodiagnosis, Kasturba Medical College, Mangalore(MAHE) Karnataka, India.

Abstract

Background: Objectives: 1.To assess sensitivity and specificity of 3D MRI in perianal fistula. 2. Characterization of perianal fistula and comparison of 3D MRI with conventional MRI. **Materials and Methods:** Prospective analysis of 36 patients clinically diagnosed to have perianal fistula underwent conventional and 3D MRI. 15 of these patients underwent surgery and correlation with imaging finding was done. The study was done over a period of 2 years. A statistical package of Kendall's Tau-b SPSS version 17 was used. **Results:** The sensitivity and specificity of conventional and 3D MRI in correctly detecting the thick primary fistulous tract was found to be 100%. The sensitivity of conventional MRI in detecting thin primary fistulous tracts and thin side branches are 50% and 71.4% respectively. The specificity of conventional MRI in detecting thin primary fistulous tract and thin side branch is poor. The sensitivity and specificity of 3D MRI in detecting thin primary fistulous tract and thin side branch is 100%. Grade I (36 %) inter-sphincter fistula (53%) is the most common type of fistula and 6'O clock (53%) is the most common type of internal opening. **Conclusion:** It is important to correctly depict fistulous tract anatomy preoperatively to avoid recurrence. 3D MRI is better in detecting thin tracts, thin side branches and fistula morphology as acquisition is done in thin slice and multiplanar capability.

INTRODUCTION

Perianal Fistula is an inflammatory tract that describes abnormal communication between the anal canal (the internal opening) and skin of perineum (the external opening). Perianal Fistula occurs approximately 10 per 1,00,000 population and has male predominance (M: F =2-4:1).[2]

Interpretation of perianal fistula requires knowledge of the relevant pelvic anatomy of the anal sphincter complex.[1] Anal canal is a cylindrical tube measuring about 3cm1. Internal and external sphincters are responsible for 85% and 15% of the resting anal tone respectively.[2] Anal clock is a transversal view of the anal region with the patient in the lithotomy position used for fistula surgery, which corresponds to the radiological view as well.[3] At 12 o'clock position lies the anterior perineum, at 6 o'clock- the natal cleft, at 3 o'clock- left lateral aspect and 9 o'clock- right lateral aspect of the anal canal.

Multiple classification systems have been established to describe and subsequently categorize the risk of recurrence and possible surgical outcome in anal fistulae. Initial classification of perianal fistulas was based on surgical anatomy described.[4,2] Subsequently, the classification system was modified on the basis of radiologic anatomy on pelvic MRI, and the modification is known as the St. James' University Hospital.

Adequate knowledge of perianal fistula extension, all hidden tracts, relationship of the fistula to the anal sphincter (Fig.17) and its complex features are important before surgery to reduce recurrence rate. For this purpose Magnetic Resonance Imaging (MRI) is the appropriate imaging modality.[3,5,6] MRI provides excellent anatomical detail and relations of the fistulous tract with the sphincter complex, levator ani, ischioanal fossa, associated abscesses, horse shoe and secondary tracts.[7] MRI is painless, non-invasive and has non-ionizing radiation property, thus making it as the modality of choice in perianal fistula.[7] 3D MRI has superior contrast resolution, multiplanar reconstruction and post processing reformation of images into any desired plane (Axial plane, Coronal plane and Sagittal plane), and can potentially replace conventional sequences.[7,8,9] The results obtained from Magnetic Resonance Imaging should be regarded as the "Gold Standard" for preoperative assessment,[3] of patients. In most cases, surgical

ISSN (O): 2687-5365; ISSN (P): 2753-6556

intervention is the mainstay for anal fistula management. The main aim of treatment is to eradicate the recurrence of fistula, preserve anal continence and decrease the risk of recurrence. MRI is reported to be the most sensitive imaging method.[10] The main purpose of this study is to compare 3D MRI with conventional MR sequences.

Table 1: St. James's University Hospital MRI classification system[2]

St. James's University Hospital MRI classification system	
Grade	**Description**
0	Normal appearance
1	Simple linear intersphincteric fistula
2	Intersphincteric fistula with inter-sphincteric abscess or secondary fistulous track
3	Transsphincteric fistula
4	Transsphincteric fistula with abscess or secondary track within the ischioanal or ischiorectal fossa
5	Supralevator and translevator disease

MATERIALS AND METHODS

The study was done in the Department of Radio diagnosis at KMC hospitals, Ambedkar circle and Attavar Mangalore. This is a prospective study of 36 patients carried on 1.5T MRI machines (Magnetom Siemens Avanto & Signa excite GE Health Care) over a period of from September 2016 to June 2018.
The study was approved by the institutional ethics committee. Data was collected from across all age groups, who came to the department of Radio diagnosis KMC hospitals, Mangalore, for MRI scan with clinical suspicion of perianal fistula.

All the patients were subjected to conventional and 3D MRI using a standardized protocol Images were acquired with the following parameters.
Acquired images were studied by experienced radiologist with at least 20 years of experience in reporting such studies. All the images along with reports are archived and the analysis was done after the completion of the study. A statistical package of Kendall's Tau-b SPSS version 17 was used.
In this study thick and thin side branches assigned based on visual assessment. Simple tract is a linear tract with no side branches. Complex tract is a branching tract having communication with abscess cavity.

Table 2: Protocol for MR Imaging of Anal Fistulas: (1.5T MRI system Signa excite GE Health Care)

Parameters	T1 W FS	T2 W FS	T2 W FS	T2 W FS	3D SPGR
Imaging plane	Axial	Axial	Coronal	Sagittal	
TR/TE(msec)	560/10	4600/104	4600/104	4600/104	24/9
FOV(cm)	28x28	28x28	28x28	24x24	28x28
Section Thickness(mm)	5mm	5mm	5mm	5mm	1.8mm
Spacing	1	1	1	1	0
Matrix	384X192	320X256	320X256	384X224	256X192
NEX	1	2	2	4	0.75

[TR-Repetition Time; TE-Echo Time; FOV-Field-of-View; NEX-Number of Excitations]

Table 3: Protocol for MR Imaging of Anal Fistulas: (1.5 T Magnetom Siemens Avanto)

Parameters	T1 W FS	T2 W FS	T2 W FS	T2 W FS	3D SPACE	3D STIR
Imaging plane	Axial	Axial	Coronal	Sagittal		
TR/TE	711/10	3165/39	4100/30	4100/30	2000/126	3800/212
FOV	300	250	280	280	256	280
Section Thickness	4mm	4mm	3.5mm	3.5mm	1mm	2mm
Matrix	320x288	250x205	256x230	256x230	256x256	256x256
NEX	2	1	2	2	1.6	1.6
Intersection Gap	30%	30%	30%	30%	0	0

[TR-Repetition Time; TE-Echo Time; FOV-Field-of-View; NEX-Number of Excitations]

RESULTS

Total of 36 patients with suspected perianal fistula by clinical examination were evaluated in our study, of which 29(81%) were males and 7(19%) were females.

Characteristics used to assess perianal fistula

1. Internal Opening
2. Course of the tract
3. Grade (St James University)
4. Side branches
5. Complex/simple tract
6. Complications (abscess/collections/secondary tracts)

Internal Opening

The most common internal opening was at 6'O clock position 19 (53%) followed by 5'O clock position 4(11%) at the anal canal. Conventional MRI fails to identify one fistulous tract at 1'O clock and three fistulous tracts at 6'O clock position, which were subsequently identified on 3D MRI. [Figure 8, Figure 12]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

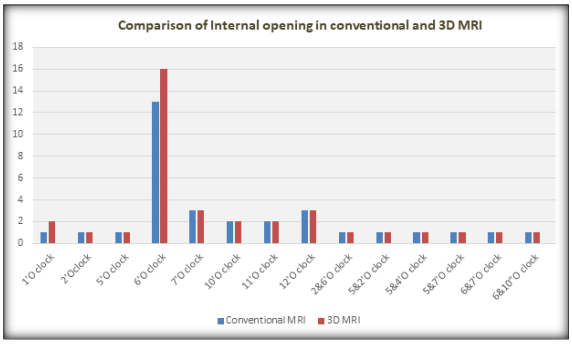


Figure 1: The distribution of patients according to the internal opening

Course of the tract

In this study all 36 primary fistulous tracts and internal openings were detected on 3D MRI. Conventional MRI could identify 32 thick fistulous tracts out of 36 and failed to identify 4 thin fistulous tracts which were identified on 3D MRI. Depicting the exact course of the fistulous tract is important in management.

The plane of fistula in this study is as follows,

Intersphincteric fistula 19(52.8%)

Transsphincteric fistula 15(41.6%)

Supralevator extension 2(6%)

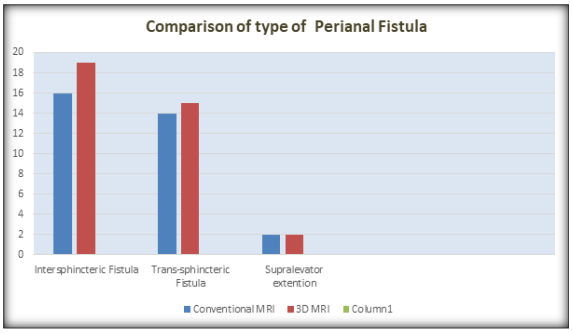


Figure 2: Comparison of conventional and 3D MRI in assessment of course of perianal fistula: 3 inter-sphincteric fistula and 1 trans-sphincteric fistula were not identified on conventional MRI and which were picked up on 3D MRI

Grade

According to the St. James University Hospital classification of perianal fistula, our study revealed the following results:

Grade I or simple inter-sphincteric fistula in 13(36%) patients.

Grade II or inter-sphincteric fistula with an abscess or secondary tract in 6 (16.7%) patients.

Grade III or trans-sphincteric fistula in 7 (19.4%) patients.

Grade IV or trans-sphincteric fistula with an abscess or secondary tract 8 (22.2%)

Grade V or supralevator or translevator extension in 2(6%) patients.

Grade I or simple inter-sphincteric fistula is the most common type of fistula followed by grade IV or trans-sphincteric fistula with an abscess or secondary tract. (Fig.14), (Fig.15), (Fig.16)

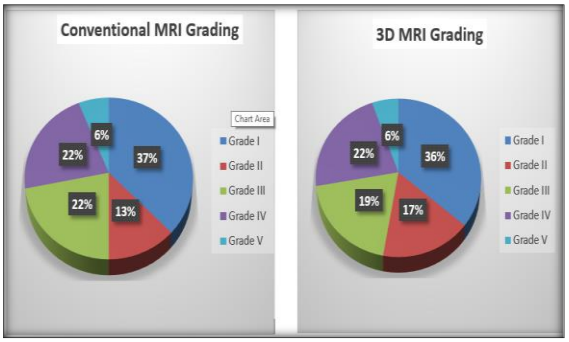


Figure 3: Frequency distribution of cases based on St James University Classification of perianal fistula is given in the pie chart below: It was observed that Grade I is the most common type of fistula

Side branches

Out of 36 patients, 14 patients had side branches in which 7 were thick and 7 were thin. 7 thick side branches were identified by both conventional and 3D MRI (Fig.11). There was poor delineation of 4 thin side branches with non-visualization of 3 thin side branches by conventional MRI. All 7 thin side branches were correctly identified by 3D MRI. (Fig.9), (Fig.10)

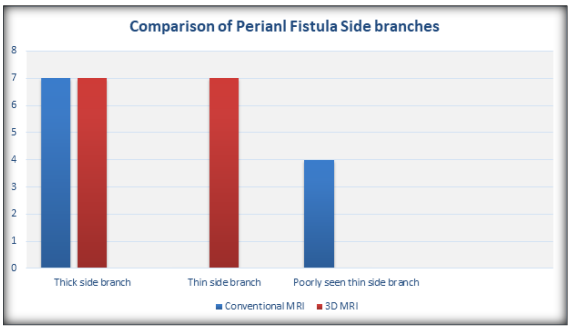


Figure 4: Comparison of conventional and 3D MRI in assessment of side branches of primary perianal fistula

Complex/ simple tract

In this study, 16(44%) were simple tracts and 20(56%) were complex tracts, which were correctly identified by 3D MRI. Conventional MRI failed to identify 1 simple tract and 3 complex tracts.

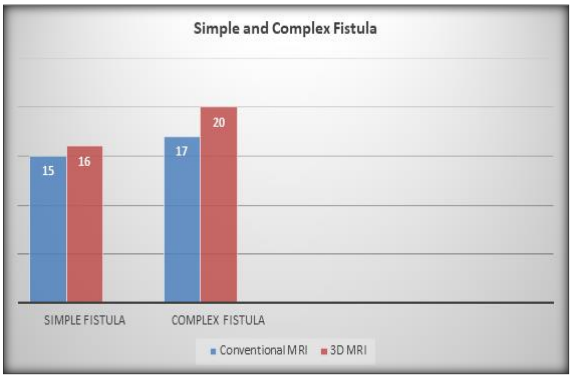


Figure 5: Illustration of simple and complex perianal fistulae in conventional and 3D MRI

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Complications (bscess/collections/communication with viscera)

In our study there were 4 perianal abscesses (Fig.13). There were no case with internal communication with urinary bladder or bowel loops.

Surgery

15 patients out of the total 36 were operated. On evaluation of per- operative findings, it was found out that findings were more or less consistent with the 3D MRI imaging findings and the comparison is as follows:

Thick fistulous tracts that were detected on conventional and 3D MRI, and also confirmed by per-operative findings are 12 and 12 respectively.

Thin fistulous tracts with internal openings detected on conventional and 3D MRI, and confirmed by per-operative findings are 0 and 3 respectively.

Thin side branches detected on conventional and 3D MRI, and further confirmed by per-operative findings are 0 and 5 respectively.

According to our study (Table.4) the sensitivity and specificity of conventional MRI in detecting thick primary fistulous tracts is 100%. The sensitivity of conventional MRI in detecting thin primary fistulous tract and thin side branch are 50% and 71.4% respectively. The specificity of conventional MRI in detecting thin primary fistulous tract and thin side branch is poor. [Table 4]

According to our study (Table.5) the sensitivity and specificity of 3D MRI in detecting thick primary fistulous tract, thin primary fistulous tract and thin side branch is 100%. [Table 5]

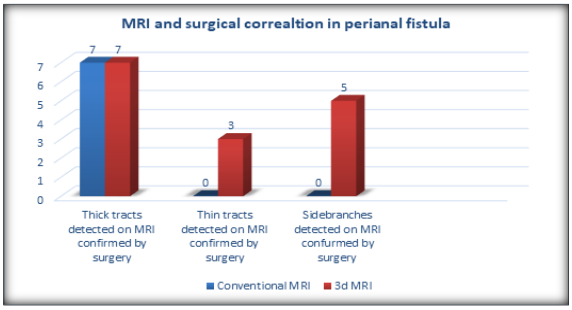


Figure 7: Correlation/comparison of MRI and per-operative findings

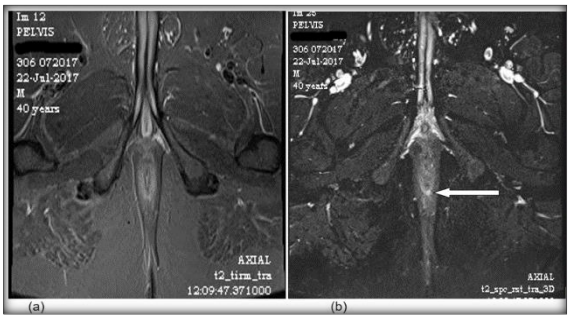


Figure (a): Axial STIR showing non visualization of internal opening. (b) Axial 3D SPACE demonstrates internal opening (Straight arrow) at 5-6'o clock position

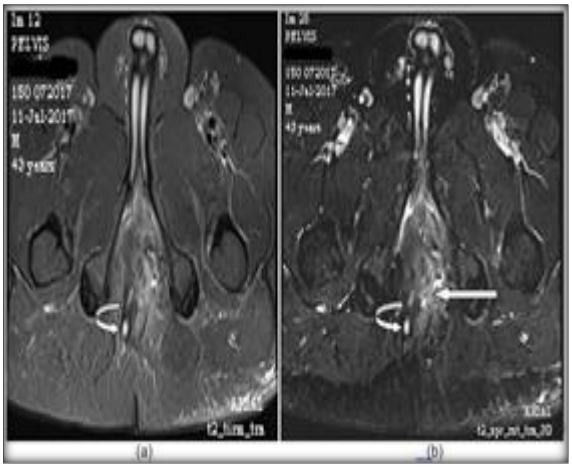


Figure 9: a) Axial STIR image not able to demonstrate thin side branch. (b) Axial 3D SPACE showing thin side branch (Straight arrow).
Right sided primary fistulous tract (Curved arrow)

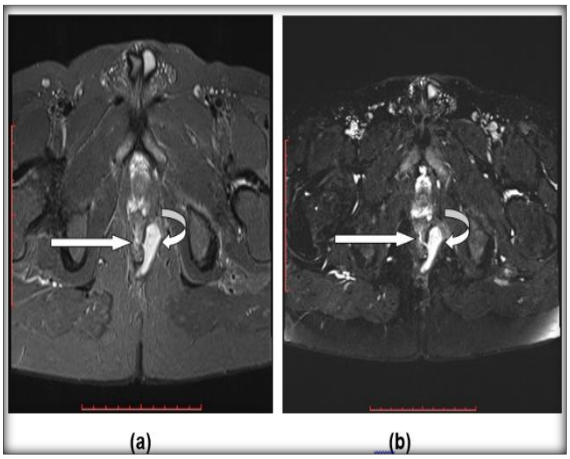


Figure 10: Case of trans-sphincteric fistula with abscess (Curved arrow) and side branches (Straight arrow). (a) Axial STIR poorly demonstrates thin side branch (Straight arrow). (b) Axial 3D SPACE showing better delineation of thin side branch (Straight arrow)

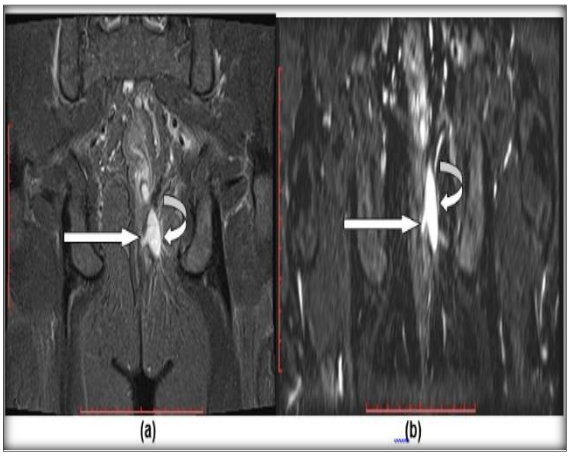


Figure 11: Case of trans-sphincteric fistula with abscess (Grade IV). (a) Coronal STIR and (b) 3D (SPACE) demonstrating thick side branch (Straight arrow) and abscess (Curved Arrow)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

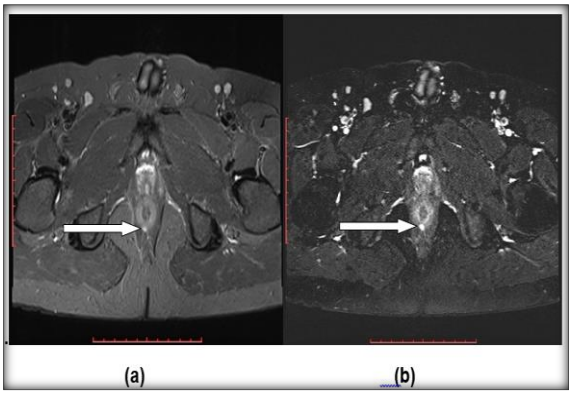
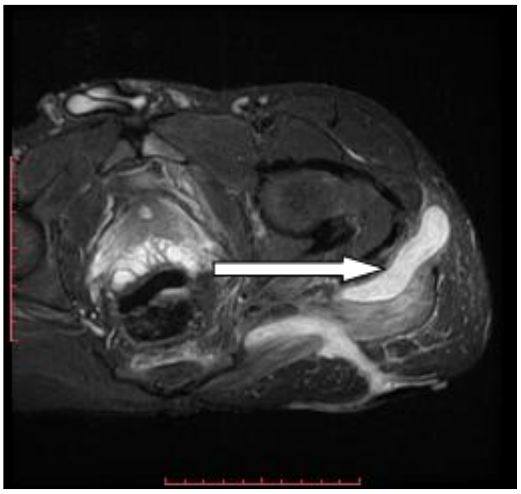


Figure 12: Case of simple inter-sphincteric fistula (Grade I) with internal opening at 6'o clock. (a) Axial STIR- Poor delineation of internal opening. (b) Axial 3D SPACE- better demonstration of internal opening



A

B

C

Figure 13: (a) Axial STIR, (b) Sagittal STIR and (c) Coronal STIR demonstrating complex perianal fistula 9 Straight arrow) with left ischioanal and and ischirectal abscess, tracking into the left gluteal region (Curved arrow)

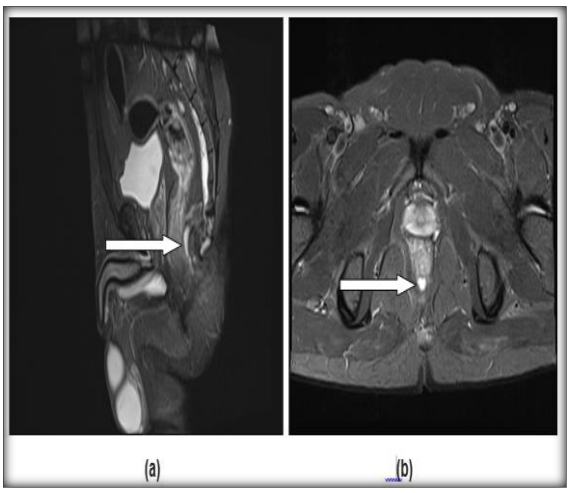
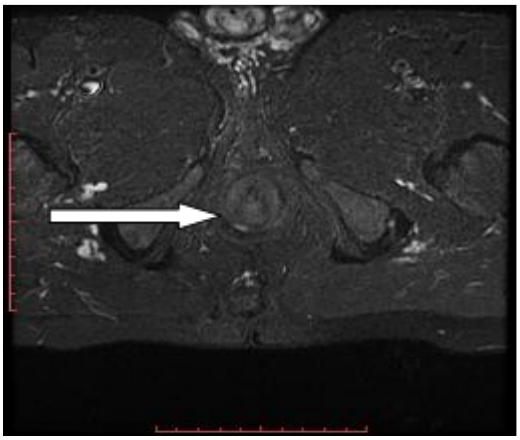
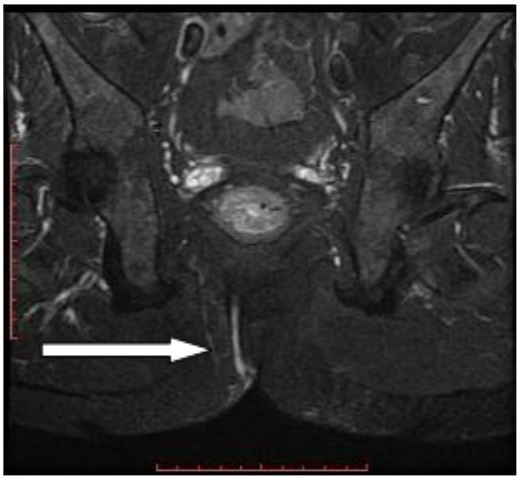


Figure 14: (a) Sagittal STIR and (b) Axial STIR showing simple inter-sphincteric fistula (Grade I) internal opening at 6'O clock

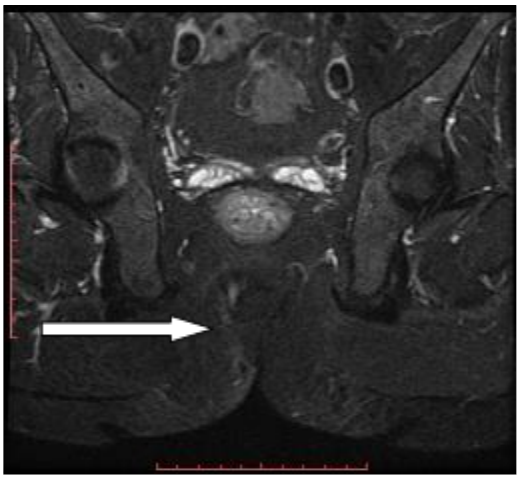


A

ISSN (O): 2687-5365; ISSN (P): 2753-6556



B



C

Figure 15: (a) Axial STIR, (b) and (c) Coronal depicting simple inter-sphincteric fistula (Grade I) with internal opening at 6-7'O clock

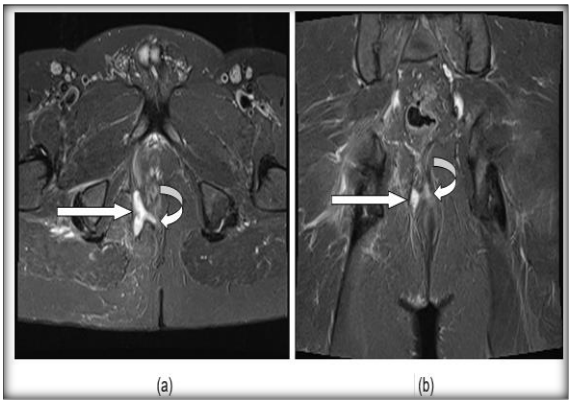


Figure 16: Case of trans-sphincteric fistula with abscess (Grade IV). Axial STIR (a) and Coronal STIR (b) showing right ischioanal abscess (straight arrow) with internal opening (curved arrow) at 6'O clock

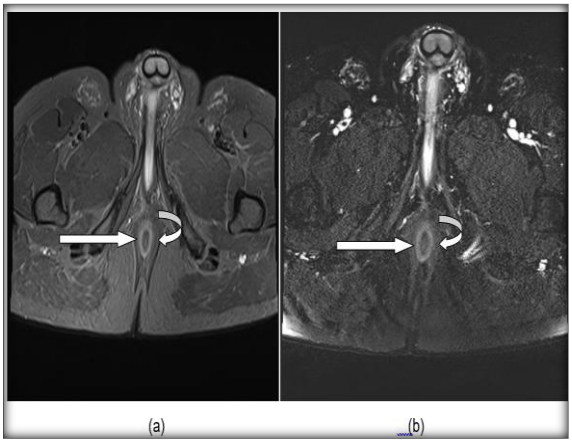


Figure 17: Normal anatomy of Anal Sphincter Complex. (a) Axial STIR and (b) Axial 3D SPACE showing internal anal sphincter (Straight arrow) and external anal sphincter (Curved arrow) which are better delineated in 3D MRI

Table 4: Conventional MRI findings and surgical correlation

Conventional MRI findings	True positives	False positives	False negatives	True negatives
Thick primary tracts	12	0	0	0
Thin primary tracts	3	0	3	0
Thin Side branches	5	0	2	0

Table 5: 3D MRI findings and surgical correlation

3D MRI findings	True positives	False positives	False negatives	True negatives
Thick primary tracts	12	0	0	0
Thin primary tracts	3	0	0	0
Thin side branches	5	0	0	0

DISCUSSION

In this prospective study of 36 patients with clinically diagnosed perianal fistula, radiological evaluation was done by employing conventional and 3D MRI in all the cases. For diagnostic accuracy surgical correlation was done where ever possible.

As N. Daabis and his colleagues mentioned in 2013,[11] that MRI is very useful in successful evaluation of perianal fistula by correctly assessing the extent of the tract, relationship with the sphincter complex, secondary tracts and abscess resulting in complete assessment and higher possible diagnostic accuracy, thus aiding increased success rate in management. Therefore, by this analysis the best use of 3D MRI can make a distinguishable difference in diagnostic accuracy and ultimately in the management of perianal fistula.

A study was conducted by Manar T Alaat EI Essawy in 2013,[12] total of 56 patients studied, 46 (82.1%) patients were males and 10 (17.9%) patients were females. Another study conducted by Kulvinder Singh et all in 2014,[13] total of 50 patients studied, 45 (90%) patients were males and 5 (10%) patients were females. In our study we

ISSN (O): 2687-5365; ISSN (P): 2753-6556

observed that perianal fistula more commonly affects males 29 (81%) than females 7(19%) which is similar to the above studies.

In our evaluation of 36 (100%) primary fistulae and internal openings were detected on 3D MRI. Conventional MRI could identify 32(89%) thick fistulous tracts out of 36 and failed to identify 4(11%) thin fistulous tracts which were identified on 3D MRI.

As in study done by, John Morris Et all in 20002, inter-sphincteric fistula is the most common type of fistula. Another study by Hoda Salah Darwish et all14 involved a sample size of 35 patients with 38 fistulous tracts. Out of those 38 fistulous tracts, 24(63%) were intersphincteric fistula, 11(29%) were transsphincteric fistula and 2(5%) were supra-sphincteric. Our study showed 19(52.8%) were intersphincteric fistula followed by 15(41.6%) were transsphincteric suggesting inter-sphincteric is the most common type of perianal fistula. We found that the most common location for internal opening is at 6'0 clock position.

Amongst the 36 patients 14 patients had side branches in which 7 were thick and 7 were thin. 7 thick side branches were identified by both conventional and 3D MRI. All 7 thin side branches were correctly identified by 3D MRI. There was poor identification of 4 thin side branches with non-visualization of 3 thin side branches by conventional MRI.

A study conducted by Jaime De Miguel Criado et all,[9] on 178 patients, 44 (24.7%) had Grade I, 33 (18.5%) had Grade II, 43(24.2%) had Grade III, 45(25.3%) had Grade IV and 13(7.3%) had Grade V perianal fistula. In our study we found that 13(16%) had Grade I which is the most common type of fistula followed by 8 (22.2%) had Grade IV, 7(19.4%) had Grade III, 6(16.7%) had Grade II and 2(6%) had Grade V which is in concordance with the above mentioned study.

From our study involving 36 patients, 15 patients underwent surgery. The sensitivity and specificity of conventional MRI in detecting thick primary fistulous tracts is 100%. The sensitivity of conventional MRI in detecting thin primary fistulous tract and thin side branch are 50% and 71.4% respectively. The specificity of conventional MRI in detecting thin primary fistulous tract and thin side branch is poor.

According to our study the sensitivity and specificity of 3D MRI in detecting thick primary fistulous tract, thin primary fistulous tract and thin side branch is 100%.

In our study we observed that

1. Thin fistulous tract and thin side branch are better seen on 3D MRI.
2. Definition of internal opening is better seen on 3D MRI.
3. Delineation of sphincter complex anatomy is better seen on 3D MRI.
4. Limitations of 3D MRI:
5. Limited field of vision (FOV) hampering the evaluation of complexity (abscess and secondary tracts) of the fistula.
6. 3D MRI is time consuming (Time required for 3D SPACE sequence is 6 minutes).

CONCLUSION

It is important to correctly depict fistulous tract anatomy preoperatively to avoid recurrence. 3D MRI ensures all angles are accounted and every single cross sectional image is available for interpretation. 3D MRI is better in detecting thin tracts, thin side branches and fistula morphology as acquisition is done in thin slice and multiplanar capability. Main drawbacks of 3D MRI are limited FOV which may lead to missing an abscess and extra time requirement, thus making it as an additional sequence and not a substitute.

REFERENCES

1. Ryan B. O'Malley1 Mahmoud M. Al-Hawary Ravi K. Kaza Ashish P. Wasnik Peter S. Liu Hero K. Hussain O'Malley RB, Al-Hawary MM. Rectal Imaging: Part 2, Perianal Fistula Evaluation on Pelvic MRI—What the Radiologist Needs to Know: AJR 2012; 199:W43–W53.
2. John Morris, FRCR • John A. Spencer, MD, FRCR • N. Simon Ambrose, MS, FRCS. MR Imaging Classification of Perianal Fistulas and Its Implications for Patient Management. RadioGraphics 2000; 20:623–635.
3. Michael R Torkzad, Urban Karlbom. MRI for assessment of anal fistula. Insights Imaging 2010; 1:62-71.
4. Parks AG, Gordon PH, Hardcastle JD (1976) A classification of fistula-in-ano. Br J Surg 63: 1-12.
5. Michael R Torkzad, Håkan Ahlström, Urban Karlbom. Comparison of different magnetic resonance imaging sequences for assessment of fistula-in-ano. World J Radiology 2014 May 28; 6(5): 203-209.
6. Gordon N. Buchanan, Steve Halligan, Clive I. Bartram, Andrew B. Williams, Danilo Tarroni, C. Richard G. Cohen. Clinical Examination, Endosonography, and MR Imaging in Preoperative Assessment of Fistula in Ano: Comparison with Outcome-based Reference Standard. 2004; Vol. 233, No. 3.
7. U George MD DNB PDCC; A Sahota DMRD; S Rathore MD. MRI in evaluation of perianal fistula. Journal of Medical Imaging and Radiation Oncology 2011,55: 391–400.
8. Halligan S, Healy JC, Bartram CI. Magnetic resonance imaging of fistula-in-ano: STIR or SPIR? Br J Radiol 1998; 71: 141-145.
9. Jaime de Miguel Criado, Laura García del Salto, Patricia Fraga Rivas, Luis Felipe Aguilera del Hoyo, Leticia Gutiérrez Velasco, M. Isabel Díez Pérez de las Vacas, et al. MR Imaging Evaluation of Perianal Fistulas: Spectrum of Imaging Features. RadioGraphics 2012; 32(1):175–194.
10. Nalan Yıldırım, Gökhan Gökalp, Ersin Öztürk, Abdullah Zorluoğlu, Tuncay Yılmazlar, İlker Ercan, et al. Ideal combination of MRI sequences for perianal fistula classification and the evaluation of additional findings for readers with varying levels of experience. Diagn Interv Radiol 2012; 18:11–19.
11. Naglaa Daabis, RashaEl Shafey, YehyaZakaria, OsamaElkhadrawy. Magnetic resonance imaging evaluation of perianal fistula. The Egyptian Journal of Radiology and Nuclear Medicine. 2013; Pages 705-711.
12. Manar T Alaat El Essawy. Magnetic Resonance Imaging in Assessment of Anorectal Fistulae and its Role in Management; Alaat El Essawy, J Gastroint Dig Syst 2013, 3:3.
13. Kulvinder Singh, Navdeep Singh, CL Thukral, Kunwar Pal Singh, and Varun Bhalla. Magnetic Resonance Imaging (MRI) Evaluation of Perianal Fistulae with Surgical Correlation. J Clin Diagn Res. 2014 Jun; 8(6): RC01–RC04.
14. Hoda SalahDarwishaHossam AbdelhafizZaytounbHanaa AhmedKamelbSadia RaheezQamarc. Magnetic Resonance Imaging Evaluation of Perianal Fistulas. The Egyptian Journal of Radiology and Nuclear Medicine. Volume 44, Issue 4, December 2013; Pages 747-75.

ISSN (O): 2687-5365; ISSN (P): 2753-6556