

Comparison of conventional and limited selected sequences of MRI in evaluation of Perianal Fistulas

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Abstract

Background: The purpose of the study was to establish a protocol for application of limited selected sequences in MRI and to establish pitfalls and negative predictive factors in MR imaging of perianal fistulas with limited sequences. **Materials and methods:** Total 50 patients who were clinically diagnosed with perianal fistula diagnosis were included in this study. MR findings were recorded as per St. James's University Hospital classification of perianal fistulas. We have correlated findings of conventional MRI sequences with surgery followed by comparison of scores of conventional and limited sequences based on MRI findings. In our scoring system, each MRI finding was given a single score. **Results:** Of the total 50 patients, 42 patients in conventional sequences confirmed as perianal fistula per-operatively. Sensitivity, specificity, PPV, NPV and accuracy of conventional sequences in correlation to surgery was found to be 95%, 67%, 95%, 67% and 92% respectively. Limited sequences were compared with conventional sequences on the basis of scoring system. Total scores for internal opening and primary tract were decreasing whereas there was no change in total score for external opening, secondary tracts and abscesses. **Conclusion:** Conventional sequences can detect relatively more number of primary tracts, internal openings and secondary tracts in comparison to the limited sequences, so conventional sequences should be preferred over limited sequences for the diagnosis of perianal fistulas except in uncooperative patients where limited sequences consume less time than conventional sequences.

Keywords: MRI Fistulogram, Conventional sequences, Limited sequences, Scoring system.

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Introduction

Fistula means an abnormal connection between two structures or organs, or between an organ and the skin surface[1]. In case of perianal fistula, it is defined as an abnormal communication between skin of the perineum and the anal canal. Its prevalence is about 0.01%[2]. Perianal fistula is uncommon and leads to significant morbidity. Commonly affects young males, with a male-to-female ratio of 2:1[2]. Discharge is the most common presenting symptom, but local pain due to inflammation is also common[2]. MRI with Unenhanced and enhanced sequences helps in identification of primary and secondary tracks, along with complications like abscesses which guides the surgeons to plan appropriate treatment strategy. The advantages of MR imaging include multiparametric, multiplanar imaging and a high degree of soft-tissue differentiation, which demonstrate the location and course of fistulous track in relation to the underlying anatomy in a projection relevant to surgical exploration [3]. The imaging and technique require no patient preparation. The anal canal is the terminal part of the large intestine. The anal canal consists of sphincter apparatus, fibromuscular supporting tissues, dense neuronal networks, inner epithelial lining,

and a vascular sub epithelium. The anal canal's sphincter apparatus consists of 2 sphincters the internal and external. They can be considered as 2 tubular structures overlying each other[4]. The circular muscle layer of the rectum continues distally to form the thickened and rounded internal sphincter. The mucosal surface of the proximal anal canal is lined by a series of longitudinal mucosal columns, known as the columns of Morgagni[5]. The spaces between the columns are known as the anal sinuses (or crypts of Morgagni), which receive drainage from the anal glands. Distally, the columns are connected to each other circumferentially by small anal valves, which collectively form the dentate line. According to the "cryptoglandular hypothesis" most of the perianal fistulas (90%) are believed to arise secondary to impaired drainage of the anal gland [6,7]. Infection and anal gland drainage obstruction may lead to an acute perianal abscess. Perianal abscess and perianal fistula are thought to be acute and chronic manifestations of the same disease process, and as many as 87% of patients with acute perianal abscess may subsequently develop a fistula[8,9]. The uncommon or 10% of cases may result from other causes, such as Crohn disease, tuberculosis, diverticulitis, pelvic infection, trauma, anorectal cancer, or radiation therapy. Perianal fistulas frequently complicate Crohn disease, with a cumulative incidence of up to 26% after 20 years[10]. The aim of our study is to establish a protocol for application of limited selected sequences in MRI and to establish pitfalls and negative predictive factors in MR imaging of perianal fistulas with limited sequences.

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St. James's University Hospital classification

The Radiologists introduced this classification based on MR findings which has no official surgical reference[11]. It classifies the perianal fistulas into 5 grades which are based on consideration of the primary fistulous tract, secondary tracts and abscesses in classification of fistulas.

- I. Simple linear intersphincteric fistula
- II. Intersphincteric fistula with abscess and secondary tract
- III. Trans sphincteric fistula
- IV. Transsphincteric fistula with abscess or secondary tract
- V. Supralelevator and Translevator disease

Materials and methods

Total 50 patients who were clinically diagnosed with perianal fistula and referred for MR Fistulogram to the Department of Radio diagnosis were included in this study. Our study is a hospital based prospective observational study. After obtaining approval from medical research, ethics committee and informed consent from the patients, they were subjected to MR Fistulogram using 1.5- Tesla MRI (GE Signa HD x T 1.5 Tesla MRI, 16-channel body Coil) unit system. No patient preparation was required. Contrast was not used in our study. Study was done by using 7 conventional sequences (Table 1) like axial T2 FSE, axial T2 Fat Sat, coronal T2 FSE, Coronal STIR, Sagittal STIR, axial T1 FSE and axial 3D T2 fat sat and images were analyzed by one senior radiologist followed by surgery and surgical findings were noted in the operation theatre under the guidance of senior surgeon. Then the findings of conventional sequences were compared with intra-operative findings and sensitivity, specificity, PPV, NPV and diagnostic accuracy were calculated. After surgery 5 limited sequences (Table 2) like Axial T2 Fat Sat, coronal T2 FSE, Coronal STIR, Sagittal STIR and axial 3D T2 fat sat were picked up from above mentioned 7 conventional sequences. Then two skilled radiologists, who were blinded to the surgical findings, analyzed the conventional and limited sequences imaging retrospectively in a gap of 7-10 days in between. In our study, we have used Scoring system for comparison of findings in conventional sequences with surgery followed by comparison of scores between conventional and limited sequences. The findings which were taken into consideration for the above scoring system were like internal opening, external opening, secondary tracts, abscess and primary tract (type/grade of fistula, intersphincteric/transsphincteric and supralelevator/translevator) and each of these findings was given 1 score. So the cases were given scores according to presence of their findings, out of maximum 5 scores. In case of absence of any of these findings, 0 score was allotted. The orientation and course of anal canal is not vertical, but it is tilted forward from the vertical by approximately 45° in the sagittal plane; due to this reason the routine straight axial and coronal images will not be appropriate and sufficient to detect the site, source and course of the fistulous track[12-15]. Therefore, it is compulsory to obtain oblique coronal and axial images which are oriented orthogonal and parallel to the anal canal, respectively. Images are acquired in different planes- axial, coronal and sagittal. A set of sagittal, coronal and axial planes are needed for details.

Inclusion Criteria

1. Patients with clinically suspected perianal fistulas and demonstrated by MRI Fistulogram and those patients have also undergone surgery.
2. Those MRI Fistulograms whose conventional and limited sequences were analysed by two radiologists retrospectively and were blind folded to the surgical or initial conventional MRI findings.

Exclusion Criteria

1. Those patients who have undergone only MRI Fistulogram or have been operated without MRI Fistulogram in this institution.
2. Those cases where both conventional and limited sequences of MR Fistulogram were not analysed as per protocol.
3. Suboptimal studies due to any cause.

Results

Among the 50 patients in our study group, perianal fistulas were seen in 42 patients in conventional MR and 39 patients in limited MR sequences respectively. The age group of the patients included in the study ranged from 18 to 75 years. Most of the patients in our study were in the age group of <30 years. Out of 50 patients in our study, 44 patients (88%) were males and 6 patients (12%) were females. Our study showed grade I fistulas in 15 (36%) out of 42 patients in conventional and 13 (33%) out of 39 patients in limited MR sequences respectively. Grade II fistulas in 10 patients (23% and 26%) in both conventional and limited MR sequences respectively. Grade III and Grade IV fistulas in 7 (17%) and 7 (17%) out of 42 patients in conventional and 7 (18%) and 6 (15%) out of 39 patients in limited MR sequences respectively. Intersphincteric type (grade I and II) which was seen in 25 patients (59%) in conventional MR sequences and 23 patients (59%) in limited MR sequences. Trans sphincteric (grade III and IV) type of fistula was seen in 14 patients (34%) in conventional and 13 patients (33%) in limited MR sequences. Grade V (supralelevator and translevator) type of fistula was seen in 3 (7%) patients in conventional and 3 (8%) patients in limited MR sequences respectively. In this study, single external opening was seen in 42 (84%) out of 50 patients and multiple external openings were seen in remaining 8 (16%) patients in both conventional and limited MR sequences respectively. 4 to 6'o clock position was found in 22 (52%) out of 42 patients with single external opening. 7 to 9'o clock position seen in 7 (17%) patients. Single internal opening was found in 40 (80%) out of 50 patients and multiple in 2 patients (4%) and absent in remaining 8 patients (16%) in conventional MR sequences. In limited MR sequences, 38 patients (76%) showed single internal opening, 1 patient (2%) showed multiple openings and remaining 11 patients (22%) show no internal opening. So, sensitivity, specificity, PPV and NPV of conventional sequences for detection of internal openings was calculated to be 95%, 100%, 100% and 75% respectively in correlation to surgery. The single internal opening position was found to be 4-6'o clock in 22 (55%) out of 40 patients with single internal opening in conventional and 22 (58%) out of 38 patients with single internal opening in limited MR sequences. In our study, both conventional and limited sequences showed 23 (46%) out of 50 patients had secondary tracts and remaining 27 patients didn't show any secondary tracts in both the sequences. Sensitivity, specificity, PPV and NPV of MRI in conventional sequences in surgical correlation for detection of secondary tracts were calculated to be 92%, 100%, 100% and 93%. In our study, abscesses were identified in 8 (16%) out of 50 patients. 7 (88%) patients had simple abscess, 1 (12%) patient had horse shoe abscess. Sensitivity and specificity of MRI on conventional sequences with surgical correlation for detection of abscesses in our study was found to be 100% and 100% respectively. In conventional sequences of MR, 42 perianal fistulas were detected, 4 cases were found to be sinuses and out of remaining 4 cases, 2 cases reported as intersphincteric grade I and II fistulas respectively on MRI which were found to be sinuses preoperatively and 2 cases reported as sinuses on MRI were found to be intersphincteric grade I fistulas on surgery. So Sensitivity, specificity, PPV, NPV and accuracy of conventional sequences for detection of perianal fistulas in correlation to surgery was found to be 95%, 67%, 95%, 67% and 92% respectively (Table 3, Fig 3).

Table 1: Protocol for Conventional sequences of MR imaging of perianal fistula

Parameters	Sagittal STIR	Axial T1 FSE	Axial T2 FSE	Axial T2 Fat sat	Coronal STIR FSE	Coronal T2 FSE	Axial T2 Fat sat 3D
Imaging plane	Sagittal	Oblique axial	Oblique axial	Oblique axial	Oblique coronal	Oblique coronal	Oblique axial
TR/TE(msec)	3225/36	450/12	3980/85	8620/85	3225/36	4280/85	2000/95
FOV(sec)	36x36	26x26	34x34	32x32	34x34	34x34	30x30
Slice thickness(mm)	4	4	4	3	4	4	2
Intersection gap(mm)	0.5	0.8	0.5	0.5	0.5	0.5	No gap
Matrix	288x224	288x192	320x256	320x256	288x224	320x224	256x256
Acquisitiontime(minutes)	3.46	4.36	2.47	6.28	3.46	3.13	6
Total time ~30 mins							

Table 2: Protocol for Limited sequences of MR imaging of perianal fistulas

Parameters	Sagittal STIR	Axial T2 Fat sat	Coronal STIR FSE	Coronal T2 FSE	Axial T2 fat sat CUBE(3D sequence)
Imaging plane	Sagittal	Oblique axial	Oblique coronal	Oblique coronal	Oblique axial
TR/TE(msec)	3225/36	8620/85	3225/36	4280/85	2000/95
FOV(sec)	36x36	32x32	34x34	34X34	30X30
Slice thickness(mm)	4	3	4	4	2
Intersection gap(mm)	0.5	0.5	0.5	0.5	No gap
Matrix	288x224	320x256	288x224	320x224	256x256
Acquisition time(minutes)	3.46	6.28	3.46	3.13	6
Total time~23 minutes					

Table 3: MRI (Conventional sequences) in correlation with surgery

Parameters	Percentage	95% CI
Sensitivity	95%	85 % to 99 %
Specificity	67%	22 % to 96 %
PPV	95%	87 % to 98 %
NPV	67%	32 % to 90 %
Accuracy	92%	81 % to 98 %

Table 4: Comparison of Conventional and Limited sequences of MRI on the basis of Scoring System

Parameters	Number of patients in Conventional sequences (total score)	Number of patients in Limited sequences (total score)	Remarks
Primary tract	42 (42)	40(40)	↓
Internal opening	42(42)	39(39)	
External opening	50(50)	50(50)	No change
Secondary tract	23(23)	23(23)	No change
Abscess	8(8)	8(8)	No change

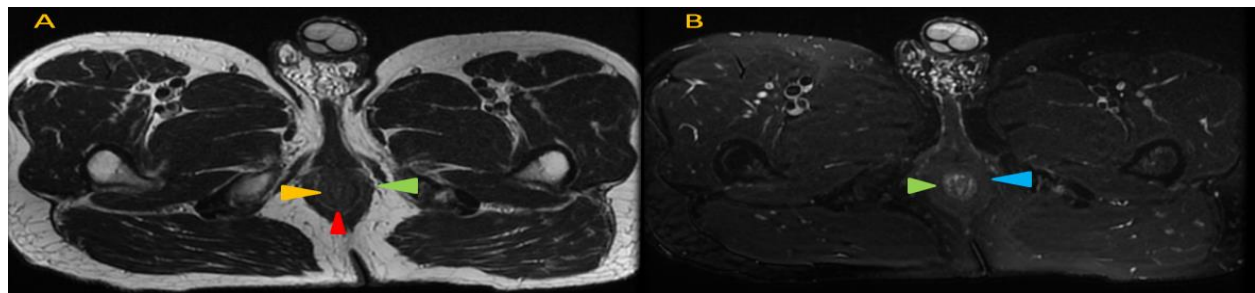


Fig 1 : (A) Axial T2 FSE image showing hypointense external sphincter (green arrowhead), internal sphincter (yellow arrowhead) and intersphincteric space (red arrowhead). (B) Axial T2 Fat sat image showing hypointense external sphincter (blue arrowhead) and internal sphincter (green arrowhead) with suppressed intersphincteric fat.

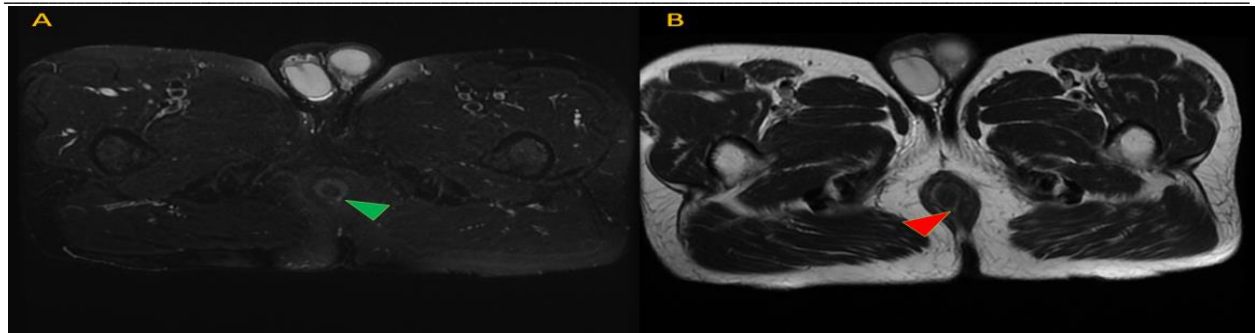


Fig 2: (A) Axial T2 Fat sat image showing hyperintense intersphincteric tract (green arrowhead). (B) Axial T2 FSE image showing faint hyperintense intersphincteric tract (red arrowhead) in comparison to T2 Fat sat image.

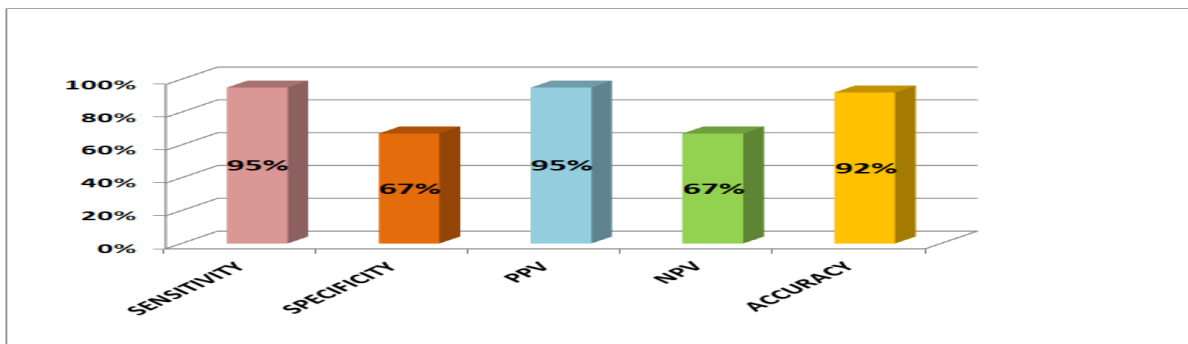


Fig 3: MRI (conventional) sequences in correlation with surgery

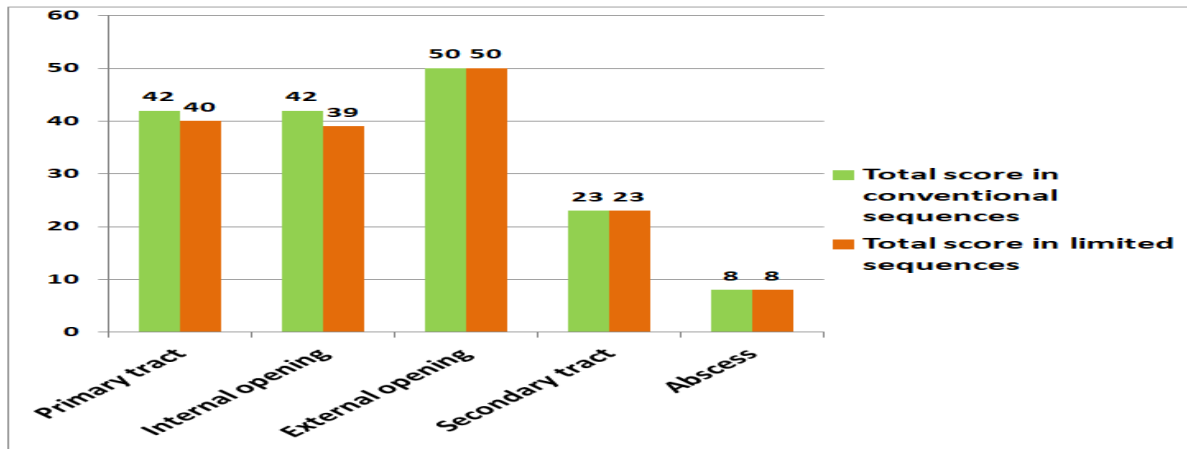


Fig 4: Comparison of Conventional and Limited sequences of MRI on the basis of Scoring System

Discussion

In our study we found that perianal fistulas were more prevalent in male than female which is according to the studies done by Al-Khawari HA et al, Waniczek et al and Buchanan et al[16,17]perianal fistulas were more prevalent in males than females. Our study revealed that most common type of fistula was grade I intersphincteric followed by grade II intersphincteric in both conventional and limited sequences respectively. So, our study is in accordance with the studies done by Baskan et al[18], Morris et al[11] and Criado J et al[1] showing similar observations where

intersphincteric fistulas were commonest followed by transsphincteric and supralelevator /translevator types. Parks et al(1976), [19]in their study, reported intersphincteric type of fistula to be the commonest. In our study, three internal openings were missed in limited sequences possibly due to extremely thin caliber and also due to absence of T2 axial sections resulting in unclear anatomy of anal sphincters[20]. As per our study sensitivity, specificity, PPV and NPV of conventional sequences for detection of internal openings is consistent with a study done by Singh et al[21] where sensitivity, specificity and PPV were reported as

95.83%, 80% and 97.87% respectively. Our study also correlates well with previous study by Beets-Tan et al[22] who reported sensitivity, specificity and PPV of 96%, 90% and 90% respectively. Similarly Barker et al[23] reported 80% sensitivity of MRI in detecting internal openings.

In our study most, common location for the single internal opening was found to be 4-6 o'clock position in both conventional and limited sequences. This is in accordance to the study done by Kuster GG et al[24] who explained the relationship of anal glands and lymphatics, and opined that 6 o'clock position is the most common location seen in most cases with single internal opening. This is because anal glands are more abundant posteriorly. Sensitivity, specificity, PPV and NPV of MRI in conventional sequences in detection of secondary tracts were in accordance with the study done by Pramod Shaha et al[20], where MRI had a sensitivity, specificity PPV and NPV of 89.6%, 100%, 100% and 91.8 % in detecting secondary tracts. For complete eradication of the disease identification of all secondary tracts is essential. Active fistulous tract is hyper intense on T2 and STIR sequences because of its fluid component. This helps in better delineation of fistulous tracts[25,26,3,12]. Sensitivity and specificity of MRI on conventional sequences with surgical correlation for detection of abscesses in our study were 100% and 100% respectively, which is in consistent with the result given by a study conducted by Pramod shaha et al[20] in which MRI showed sensitivity, specificity, PPV and NPV of 100%, 100%, 100% and 100% in detecting abscess. Our study results are also consistent with the studies done by Maier et al[27] and Mahjoubi et al[28]. T2 axial fat sat sequences has the maximum accuracy for detection of abscesses and secondary tracts[20]. In comparison to the surgery, total scores for primary tracts, internal opening and secondary tracts were seen to be decreased in conventional sequences of MRI as shown above. When limited sequences were compared with conventional sequences on the basis of scoring system as per our methodology, total scores for internal opening and primary tract were decreasing whereas there was no change in total score for secondary tracts and abscesses (Table 4, Fig 4). Axial T2 FSE gives better anatomical picture about sphincters and intersphincteric space (Fig 1). So limited sequences in our study detected relatively less number of internal openings and primary tracts in comparison to conventional sequences due to absence of T2 axial FSE sequence. However there was no significant difference between them because T2 fat sat sequences also can detect anatomy as well as primary tract better than T2 sequences (Fig 2). According to Pramod Shaha et al[20] the diagnostic accuracy of T2 fat sat sequence (98.8%) is relatively more in comparison to T2 FSE sequence (88.58%) in detection of fistula. So the spectrum of findings which were demonstrated on conventional sequences in our study was found to be more accurate than limited sequences. According to Charles et al[29] T2 FSE and fat sat sequences provide a good contrast between the hyperintense fluid tract and the hypointense fibrous wall of the fistula and good anatomical delineation of the layers of the anal sphincter. So our study is consistent with the study done by John A Spencer et al[14] in detection of perianal fistulas with the help of conventional sequences in correlation to surgery where they concluded that MRI had sensitivity, specificity, PPV and NPV of 97%, 67%, 88% and 89% respectively. Rishi Philip Mathew et al[30] also in their study concluded that MRI had a sensitivity and specificity of 96.15% and 75% respectively which is similar to our study.

Conclusion

Conventional sequences can detect relatively a greater number of primary tracts, internal openings and secondary tracts in comparison to the limited sequences, so conventional sequences should be preferred over limited sequences for the diagnosis of perianal fistulas. 3D T2 Fat sat sequences can provide source data for post

processing reformation of images into any desired plane which helps surgeons for planning of surgery. T2 FSE sequence is good for anatomical depiction of fistula; helpful in the assessment of internal opening and type of fistula, whereas T2 Fat sat sequence is the best sequence for anatomical delineation as well as the detection of active and partially active fistula. However, in cases of uncooperative patients, limited sequences can be advised, as it is likely to save ~7 minutes in comparison to conventional sequences. Suboptimal result is expected due to relatively poor resolution and imaging.

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