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Original Research Article

Role of Magnetic Resonance Imaging (MRI) in Anorectal Fistula

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Abstract:

Introduction: The following study has discussed anal fistulas being best evaluated preoperatively with MRI. It helps diagnose, characterise, and monitor disease, treatment, and therapy. Furthermore, MRI accurately visualises fistulous tracts, buried abscesses, and their closeness to internal and external sphincters. It guides surgical planning and lowers recurrence rates. Higher MRI grades are connected with poorer patient outcomes. Even, anal fistulas are assessed using T2-weighted and post-gadolinium T1-weighted imaging.

Aims and Objectives: The purpose of this investigation is to analyse and determine the best course of treatment for anorectal fistulas using magnetic resonance imaging (MRI).

Methods: MRI's accuracy in identifying fistula-in-ano was examined in this retrospective investigation at the University Medical Centre. MRI data from January 2021–January 2022 surgical patients were analysed. Written informed permission was acquired, and the ethics committee approved the study procedure. Radiologists assessed MRI scans, using surgical records as a reference. MRI data were compared to surgical observations to determine MRI's accuracy in recognising primary and secondary tracts, abscesses, and opening locations.

Results: Table 1 shows fistula kinds' external opening-anal margin distances. Table 2 compares Parks-classified main tract classifications from MRI and surgery. MRI and surgery agree on secondary tract locations in Table 3. Table 4 compares T2W TSE with post-contrast FS T1W TSE fistula characterization. T2W TSE performed well for internal openings and secondary tracts. Post-contrast FS T1W TSE diagnosed abscesses well with better sensitivity but lower specificity.

Conclusion: This study has concluded that MRI is statistically efficient in characterization and mapping fistula-in-ano and can contribute significantly in surgical prognosis.

Keywords: MRI, anal fistulas, sphincters, fistula-in-ano, endorectal ultrasonography.

Introduction

The intersphincteric plane's anal glands, which are infected and blocked and result in a cryptoglandular abscess, are the most common cause of anal fistulas. Up to 40% of perirectal abscesses that are surgically and spontaneously drained may still develop into fistulas; however, abscesses that spontaneously drain more frequently become fistulas up to 66% of the time. The average incidence was 8.6 per 100,000. For patients, having an acute or ongoing anal fistula may be upsetting and have an adverse effect on one's quality of life. They are frequently categorised according to their anatomical placements, which Parks, Gordon, & Hardcastle initially identified in 1976 [1].

Fistulas have many different causes, however, the commonly used mnemonic "FRIEND" here helps with memorization. "F" stands "F" denotes foreign substance, while "R" denotes radiation, "I" stands for inflammation and epithelialization, "E" for inflammatory bowel disease, "N" stands for "D" denotes distal obstruction in neoplasms, like in the cryptoglandular hypothesis).

Inflammatory and granulation tissue is present within an anal fistula, which is an epithelialized connection between the anal canal and the peri-anal area on the outside. The fistula cannot heal because of the distal blockage. Because of this, the fistula tract was continually clogged with material. the ongoing turnover of cells, which leads to blockage and hinders healing. This is demonstrated by the application of a seton, which permits continuous draining from the fistula that usually causes migration and healing of the fistula [2].

Anorectal fistulas are diagnosed clinically, however, imaging is helpful in tracing the path through a fistulous canal or figuring out its cause. Imaging tests include CT pelvis, CT-fistulography, endo-anal ultrasound, and pelvic MRI.

Endoanal Ultrasound

In addition to MRI, endorectal ultrasonography is a good tool for detecting abscesses, however, it is less specific than MRI. Endoanal ultrasonography is more accurate when detecting fistulous tracts and concealed abscesses when hydrogen peroxide is added to an external fistulous entrance canal. This method may be comparable with anal MRI for the diagnosis of fistulous tracts. Its usage for patients who have persistent fistulas, such as those with Crohn's disease who need long-term monitoring, is made possible by the fact that it may be done in the office and is less expensive than MRI [3].

CT scan and CT Fistulogram

Computerised tomography can be rapid and easily accessed for the majority of clinical situations, making it beneficial for detecting abscesses & drainable fluid collections. Although it cannot classify anal fistulas with the same accuracy or precision as pelvic MRI. A CT scan could be the best imaging to speed up a patient's diagnosis and treatment in the clinical context if a serious infection from Suspected to be an anal fistula with an underlying abscess [4].

CT-epistolography is a helpful and effective method for preoperatively locating fistula tracts in the outpatient scenario. However, it needs experienced radiologists to interpret the pictures and a qualified surgeon to administer the contrast during the examination. If MRI is used instead, there can be savings. during trying to cut expenses or in cases when patients are unwilling or unable to have an MRI, it should be taken into account during complicating anal fistula preoperative planning. Fistulous tracts and underlying abscesses have both been detected with multidetector CT with comparable success [5].

Magnetic Resonance Imaging (MRI)

In order to coordinate efficient planning, an MRI of the pelvis helps to identify fistulous tracts, and concealed abscesses, and characterise the closeness of tracts to both internal and external sphincters. Despite being helpful for evaluating underlying abscesses, CT pelvis is less effective at detecting fistulous tracts than MR. MRI has been shown in multiple studies to help with surgical planning and decrease the need for further surgeries or fistula recurrence because it enables the surgeon can identify hidden fistulous channels and get ready for more complex surgery as required.

Particularly in complicated fistulas as well as those having MRI is performed on an external orifice that is over two centimetres distant from the anus a convincing preoperative tool. When identifying fistulous tracts and describing their interior and exterior apertures, MRI is incredibly sensitive and precise. Preoperative diagnoses were made for half of the simple and over a third of difficult fistulas in a study by Garg et al. with 229 patients who were altered by the use of MRI [6].

In particular between six and 12 weeks postoperatively, it is effective in detecting postoperative sequelae such as an abscess or recurring fistula. The use of a balloon rectal tube catheter enhances the precision of internal opening identification in complicated fistulas. By enabling a thorough first operation, Buchanan & colleagues discovered that using MRI to design surgery was related to reduced fistula recurrence. Internal openings were easier to detect by MRI versus CT-posturography Preoperative outcomes from a combination of all imaging modalities were most compatible with operational findings in a case-controlled study of 41 patients compared to the two (85.3% vs. 68.2%) [7].

Laboratory Findings

Several common laboratory examinations, including an extensive metabolic panel along with a full blood count, should be done on patients. Low haemoglobin levels can be a sign of underlying anaemia, which can be brought on by inflammatory bowel disease or gastrointestinal cancer. Along with an underlying bacterial illness or hidden abscess, an elevated C reactive protein is shown by leukocytosis. Inflammatory bowel illness, fast plasma reagin, and additional blood tests [8].

MRI should be the "gold standard" in preoperative evaluation in this situation, replacing surgical examination under anaesthetic (EUA). However, many surgeons use endoanal ultrasonography to assess anal fistulas prior to surgery . Despite some conflicting results, hydrogen peroxide-enhanced endoanal ultrasound may be comparable to MRI. In simpler circumstances, endoanal ultrasonography alone may be sufficient, however, MRI is often more accurate than endoanal ultrasound. In addition to precisely demonstrating the extent of the disease, MRI aids in prognosis prediction, therapy selection, and therapy monitoring. Missed surgical extensions typically lead to recurrence, and more severe sicknesses need more extensive surgery. MRI has been shown to reduce recurring illness and, as a result, reoperation. Patients with Crohn's disease may experience a relapse brought on by insufficient medical care. Even in individuals with Crohn's disease, MRI can be utilised to track treatment progress and determine the prognosis [9].

Classification by MRI Numerous studies have shown that MRI was a very reliable predictor of patient outcomes. This MRI grading scale is used at St. James' University Hospital: Transsphincteric fistula, Simple linear intersphincteric fistula, intersphincteric fistula in the ischioanal and ischiorectal fossa with abscess, or secondary track intersphincteric fistulas that are straightforwardly linear, those that have secondary tracks or abscesses, supralevator, translevator disease, and normal appearance. It has been demonstrated that this MR grading correlates Grades 3-5 are connected with less favourable outcomes (resulting in

recurrences demanding reoperations), whereas levels 1 and 2 are related to good outcomes (i.e., the recurrences and therefore no need for reoperations) [10].

MRI procedures and Results

The imaging protocol is mostly determined by the imaging indication.

1. general surgeons and gastroenterologists are non-surgical experts practitioners may occasionally ask whether there are any fistulas present. On rare occasions, the exterior hole may close while still harbouring a fistula tract or abscess that is deeply concealed, making clinical detection of the condition challenging. This is now significant because Anti-TNFalpha medication is not advised as a means of treating perianal Crohn's disease patients cases when an abscess is present. The pelvic anatomy was unimportant for this reason, hence a less complicated technique can be enough [11].

2. Follow-up of openings treated using nonsurgical approaches, particularly in Crohn's disease, might be another justification for imaging. Perhaps a less complicated technique would be sufficient for the aforementioned indications. It makes sense that regions with strong signals on T2-weighted images would vanish and that post-gadolinium T1-weighted images would normalise enhancement.

3. The majority of radiology experts are employed by hospitals with surgical teams that specialise in treating fistulas surgically. Surgical planning is the indication of imaging at these sites. These centres' MRI protocols must show the pelvic anatomy including its musculature, as well as the fistula tract regardless of its fluid content [12].

Sequences The most frequent sequences include T1-weighted pictures prior to and following gadolinium enhancement along with fat saturation, as well as pictures that are T2-weighted and have different levels of fat saturation [13]. T2-weighted images of fistulas show a wall with comparatively low signal intensity around a tract with high signal intensity in the core. The interior of the high-signal intensity region is composed of the true lumen as well as granulation tissue portion, whereas fibrotic tissue makes up the outside section of low signal intensity. The luminous signal's strong strength declines with advancing fibrosis, indicating a fistula's chronic phase [14].

Method

Research design

The purpose of this retrospective study, which was carried out at the University Medical Centre was to evaluate the reliability of magnetic resonance imaging (MRI) in diagnosing fistula-in-ano. Between January 2021 and January 2022, information was gathered from individuals who had an MRI before their surgery. All participants provided written informed permission, and the Human Research Ethics Committee reviewed and approved the study methodology. Both 1.5T and 3.0T MRI scanners were used, with a wide variety of examination protocols being put into use. Initially, two radiologists analysed the photos separately, with a senior radiologist settling any disagreements that arose. The benchmark for this evaluation was the official surgical record. The diagnostic accuracy of MRI was assessed in a retrospective study that looked at factors such as the detection of primary and secondary tracts, the development of abscesses, and the localization of their openings. The MRI results were compared to the surgeon's findings to see how accurate the imaging really was.

Inclusion and exclusion criteria

Inclusion

- Patients who had an MRI to diagnose fistula-in-ano prior to surgery.
- All patients who had imaging or surgery records acquired or updated between January 1, 2021, and January 31, 2022.
- Patients of all ages and genders, both men and women.

Exclusion

- Patients who did not get an MRI evaluation before undergoing fistula-in-ano surgery.
- Patients who are missing or have just partial access to their imaging or surgery records.
- Patients were imaged with MRI machines other than 1.5T or 3.0T magnets for support.
- Patients who are unable to have an MRI due to factors like claustrophobia or the presence of non-MRI compatible implants.

Statistical analysis

This study calculated sensitivity, specificity, PPV, NPV, and diagnostic accuracy for each MRI characteristic. This analysis used 2x2 contingency tables. MRI and surgical findings were compared using the weighted kappa coefficient (k) with a 95% confidence interval. The degree of agreement was evaluated as poor ($k < 0.2$), fair (0.2–0.4), moderate (0.4–0.6), good (0.6–0.8), or very good (0.8+). All statistical analyses were done in STATA 14. For all analyses, $P < 0.05$ was significant and the data were mean values ± SDs.

Ethical approval

University Medical Centre Human Research Ethics Committee accepted the study protocol. The study was ethically approved to protect research participants' rights, safety, and well-being.

Results

Table 1 shows the distance between the fistula's external opening and the anal margin in three groups: <3 cm, 3-5 cm, and >5 cm. 66 intersphincteric fistulas (94.28%) had a distance of <3 cm, 3 (4.28%) had 3-5 cm, and none had greater than 5 cm. 52 cases (74.28%) of low transsphincteric fistulas had a distance of <3 cm, 16 cases (22.85%) had 3-5 cm, and 9 cases (12.85%) had >5 cm. For high transsphincteric fistulas, 6 instances (8.57%) were less than 3 cm, 59 (84.28%) were 3-5 cm, and 4 (5.71%) were larger than 5 cm. Supra and extrasphincteric fistulas had no cases under 3 cm, 9 (12.85%) between 3-5 cm, and 2 (2.85%) over 5 cm.

Table 1: Distance between external opening and anal verge

	≤3 cm	3–5 cm	>5 cm
Intersphincteric fstula	66 (94.28%)	3 (4.28%)	0 (0%)
Low transsphincteric fstula	52 (74.28%)	16 (22.85%)	9 (12.85%)
High transsphincteric fstula	6 (8.57%)	59 (84.28%)	4 (5.71%)
Supra and extrasphincteric fstula	0 (0%)	9 (12.85%)	2 (2.85%)

The concordance between MRI and surgical findings in identifying the Parks categorization of the main tract is displayed in Table 2. There were 9 instances of consensus under the "Inter" category. There were 6 instances of consensus in the "Trans" group. There were three examples that were deemed "Supra" after both MRI and surgical evaluation. In 8 out of 10 instances involving the "Extra" group, there was consensus. In 8 of the 10 cases, there was consensus under the "Superficial" heading. Eight cases of the "Blind tract" group had a consensus. In the "No primary tract" group, consensus was not seen. Out of a total of 70 patients, 20 were classified as Park's main tract by both MRI and surgery.

Table 2: Classification of primary tract as observed with MRI and surgically

	Surgery							
MRI	**Inter**	**Trans**	**Supra**	**Extra**	**Superfcial**	**Blind tract**	**No primary tract**	**Total**
Inter	9	11	0	0	0	0	0	11
Trans	0	6	0	0	0	0	3	9
Supra	0	0	3	0	0	0	2	5
Extra	0	0	0	8	0	0	3	11
Superfcial	0	0	0	0	8	0	2	10
Blind tract	0	0	0	0	0	8	0	8
No primary tract	0	3	0	1	0	0	3	7
Total	9	20	3	9	8	8	13	70

In Table 3, MRI and surgery agree in pinpointing secondary tracts' locations. In three patients, the MRI and surgical evaluations both confirmed the presence of perianal secondary tracts. MRI and surgery concurred on the presence of inter-sphincteric secondary tracts in 16 of the patients they examined. Twelve cases had a consensus regarding ischiorectal secondary tracts. Nine out of ten supra levator secondary tracts had consensus. There was consensus in three instances of deep postanal secondary tracts. No instances were found to have submucosal secondary tracts. In total, 25 secondary tracts were found during operations, with MRI and surgery confirming the diagnosis in 17 instances. There were 90 total cases included in this comparison.

Table 3 MRI and surgery agree on secondary tract location.

MRI	Surgery	Perianal	Inter	Ischio	Supra	Deep postanal	Sub	No secondary tract	Total
Perianal	3								3
Inter		16						6	22
Ischio			12					3	15
Supra				9				2	11
Deep postanal					3				3
Sub						0	0		0
No secondary tract		1				1	1	16	19
Total	3	17	12	9	3	1	1	25	90

Comparison of T2-weighted turbo spin-echo (T2W TSE) and post-contrast fat-saturated T1-weighted turbo spin-echo (FS T1W TSE) sequences for characterization of fistulas is shown in Table 4. T2W

TSE had a sensitivity of 95.8%, a specificity of 93.1%, a PPV of 98.9%, an NPV of 66.1%, and an accuracy of 97.1% when identifying the internal opening. With a PPV of 97.9%, an NPV of 77.9%, and an accuracy of 96.3%, post-contrast FS T1W TSE was shown to be more sensitive (98.5% vs. 82.5%, respectively) but less specific (82.1%). When used for the diagnosis of abscesses, these sequences showed a perfect 100 per cent in all measures of sensitivity, specificity, PPV, NPV, and accuracy. As for the secondary tracts, T2W TSE exhibited a sensitivity of 97.3%, specificity of 98.9%, PPV of 99.1%, NPV of 97.8%, and accuracy of 97.2%. Although the PPV, NPV, and accuracy of post-contrast FS T1W TSE were all lower than those of pre-contrast, they were still quite high at 96%, 98.9%, and 98.2%, respectively.

Table 4: Characterizingfistulas with T2W and post-contrast FS T1W TSE sequences.

	Sequence	Sensitivity	Specificity	PPV	NPV	Accuracy
Internal opening	T2W TSE	95.8	93.1	98.9	66.1	97.1
	Postcontrast FS T1W TSE	98.5	82.1	97.9	77.9	96.3
Abscess	T2W TSE	not calculated	not calculated	not calculated	not calculated	not calculated
	Postcontrast FS T1W TSE	100	100	100	100	100
Secondary tract	T2W TSE	97.3	98.9	99.1	97.8	97.2
	Postcontrast FS T1W TSE	95.1	96.5	96	98.9	98.2

Discussion

Its objective was to determine how magnetic resonance imaging (MRI) affected the diagnosis and explanation of fistula-in-ano features, as well as the consistency between MRI and surgical results. As a result, MRI may be regarded as a reliable method for the fistula-in-ano preoperative examination, and thus a significant predictor of the surgical result. Both T2W TSE and post-contrast FS T1W TSE sequencing may accurately depict the features of fistula-in-ano. To distinguish between active inflammation and abscesses, contrast injection is advised if there aren't any contraindications [15].

The preferred imaging method for fistula in ano is magnetic resonance imaging (MRI). This study's goal was to examine how often MRI was used and determine how much it contributed to diagnosing this occasionally challenging disease [16]. The current research adds to the body of evidence that MRI is a useful tool for diagnosing ano fistula. By determining the architecture of the fistula and directing future surgery, connecting EUA results, or eliminating a clinically suspected fistula, it was beneficial when employed in a small group of patients in 85% of instances [17]

This prospective study's objectives were to evaluate the result and ascertain magnetic resonance imaging (MRI) and primary fistula in ano: therapeutic effects. Preoperative MRI was performed on thirty individuals who have suspected primary ano fistula, and the results emerged following an examination under anaesthesia (EUA), during surgery. Any changes to the operational strategy were reported. Results were evaluated after a median age 12 months.In the hands of a skilled physician, MRI has a 10% therapeutic impact for initial fistula in ano, causing surgery that in a small but substantial portion of patients will probably avoid recurrence [18].

To compare the relative precision of computerised inspection, For the preoperative identification of a fistula in comparison to a reference standard, anal endosonography and magnetic resonance imaging (MR) were determined from outcomes. The digital examination is inferior to endosonography using a high-frequency transducer for a fistula in ano's preoperative diagnostic. Although MR imaging is still the best method for locating internal openings, endosonography is a practical substitute [19].

Accurate evaluation of the original tract or any secondary extensions is necessary for effective therapy of anal fistulas. Preoperative imaging has been underwhelming thus far.A prospective investigation combining magnetic resonance imaging to independently verified operational results was conducted on 35 individuals having a clinical diagnosis of fistula-in-ano [20]. Additionally, 20 individuals had their magnetic resonance imaging and anal endosonography compared. Experienced coloproctologists can use magnetic resonance imaging to accurately diagnose pathology that was overlooked during surgery. Anal endosonography is outperformed by magnetic resonance imaging. Experienced coloproctologists can use magnetic resonance imaging to accurately diagnose pathology that was overlooked during surgery. Anal endosonography is outperformed by magnetic resonance imaging. Magnetic resonance imaging is used when imaging for anal fistulas is required and should be considered as the best technique [21].

In order to assess the range Using surgery is the gold standard to evaluate the accuracy of magnetic resonance image (MRI) results having distal cologram (DC) results in young patients having anorectal

malformations (ARM). Preoperative MRI was performed on 30 paediatric ARM patients, 19 boys, & 11 girls, who were under the age of 14 [22]. The growth of the sphincter muscle complex (SMC) and the angle between the pelvic floor and the rectal pouch were assessed using MRI imaging. The lumbar area & pelvis were also examined for any associated spinal or additional irregularities. 26 individuals who had colostomies underwent DC. For related malformations, an ultrasound of the pelvis and abdomen was also performed. MRI enables trustworthy preoperative assessment of ARM and needs to be taken into consideration as a supplemental imaging modality for ARM [23].

After complete medical healing took place, complex fistula-in-ano might reoccur. Long-term healing rates and "radiological healing" of fistulas in MRI are consistent, however, this has not yet been scientifically evaluated [24]. The purpose of this study was to compare anal fistula repair to long-term healing based on by long-term follow-up in order to assess the dependability of anal fistula repair based on MRIs. Patients with patients with radiological healing were verified by postoperative MRI and clinically healed anal fistulas. Complex fistula in ano: long-term healing corresponds well with radiological healing on MRI [25].

Conclusion

This study has concluded that our work shows how important MRI is for characterising and mapping fistula-in-ano before surgery, which makes a big difference in the surgical prognosis. To get the complete image of a fistula-in-ano, use both T2-weighted turbo spin-echo (T2W TSE) and post-contrast fat-saturated T1-weighted turbo spin-echo (FS T1W TSE) examinations. A contrast study is also needed to tell the difference between an abscess and an ongoing inflammation. MRI helps guide surgical treatment and improve patient results in this complicated condition by giving important information about the anatomy and size of fistulas. Patients who had previous surgery or recurrent fistulas were not included in our research, which is one of the study's limitations. It is essential to note several restrictions, such as the use of a retrospective study design and the fact that the surgeons, all of whom specialised in proctology, had varying levels of expertise. Both of these factors may have had an effect on the quality and consistency of the reference standard that was applied.

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