

Role of MRI in Anorectal Fistula

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Abstract:**Introduction:** The following study has emphasized that MRI is the best modality to evaluate anal fistula preoperatively.

It helps in diagnosis, characterization and monitoring disease.

Furthermore, MRI accurately depicts fistulous tracts, associated abscesses, and their relation both sphincters. It helps in proper surgical planning and lowers recurrence rates. Poorer patient outcomes are associated with Higher MRI grades. T2-weighted and post-gadolinium T1-weighted imaging is also helpful in assessment of anal fissures.

Aims and Objectives: The aim of this study is to analyze and determine the best management for anorectal fistulas with the help of magnetic resonance imaging (MRI).**Methods:** This retrospective study was done at university medical center for determining the accuracy of MRI in identifying fistula-in-ano, from January 2021–January 2022 in surgical patients. Ethics committee approval with written informed permission was obtained for the study.

MRI scans were assessed by radiologist, with surgical records as a reference. MRI data were compared to surgical analysis to assess the MRI's accuracy in recognizing primary and secondary tracts, opening location and associated abscesses.

Results: Table 1 shows fistula type with' external opening-anal margin distances. Table 2 analysis of Parks-classified main tract classifications from MRI and surgery. Table 3 MRI and surgery agreement on secondary tract locations analyze 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 was used to diagnose abscesses wall with lower specificity but better sensitivity.**Conclusion:** This study has concludes that MRI is statistically efficient in mapping and characterization of fistula-in-ano and can contribute significantly in surgical prognosis.**Keywords:** MRI, anal fistulas, sphincters, fistula-in-ano, endorectal ultrasonography.This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.**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 categorized 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, and "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 continuously 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 characterize 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 centimeters 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 sequale 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 reduce 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 anemia, 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 regain, and additional blood tests [8].

MRI should be the "gold standard" in preoperative evaluation in this situation, replacing surgical examination under anesthetic (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 utilized 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 ischioanal fossa with abscess, or secondary track intersphincteric fistulas that are straightforwardly linear, those that have secondary tracks or abscesses, supralelevator, translevator disease, and normal appearance. It has been demonstrated that this MR grading correlates Grades 3-5 are connected with less favorable 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 harboring a fistula tract or abscess that is deeply concealed, making clinical detection of the condition challenging. This is now significant because Anti-TN alpha 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 normalize enhancement.

3. The majority of radiology experts are employed by hospitals with surgical teams that specialize in treating fistulas surgically. Surgical planning is the indication of imaging at these sites. These centers' 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 analyzed 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 cannot have MRI scan 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 fistula	66 (94.28%)	3 (4.28%)	0 (0%)
Low transsphincteric fistula	52 (74.28%)	16 (22.85%)	9 (12.85%)
High transsphincteric fistula	6 (8.57%)	59 (84.28%)	4 (5.71%)
Supra and extrasphincteric fistula	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

MRI	Surgery							
	Inter	Trans	Supra	Extra	Superficial	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
Superficial	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 intersphincter secondary tracts in 16 of the patients they examined. Twelve cases had a consensus regarding ischiorectal secondary tracts. Nine out of ten supra

elevator secondary tracts had consensus. There was consensus in three instances of deep post anal secondary tracts. No instances were found to have sub mucosal 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	Peri-anal	In-ter	Is-chio	Su-pra	Deep postanal	Sub	No secondary tract	To-tal
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: Characterizing fistulas 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 anesthesia (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 computerized 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 characterizing 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 improves 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 specialized 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.

References

1. PARKS AG. Pathogenesis and treatment of fistula-in-ano. *Br Med J.* 1961 Feb 18;1 (522 4):463-9.
2. Hämäläinen KP, Sainio AP. Incidence of fistulas after drainage of acute anorectal abscesses. *Dis Colon Rectum.* 1998 Nov; 41(11):1357-61; discussion 1361-2.
3. Scoma JA, Salvati EP, Rubin RJ. Incidence of fistulas subsequent to anal abscesses. *Dis Colon Rectum.* 1974 May-Jun;17(3):357-9.
4. Sainio P. Fistula-in-ano in a defined population. Incidence and epidemiological aspects. *Ann ChirGynaecol.* 1984;73(4):219-24.
5. Owen HA, Buchanan GN, Schizas A, Cohen R, Williams AB. Quality of life with anal fistula. *Ann R Coll Surg Engl.* 2016 May; 98(5): 334-8.
6. Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. *Br J Surg.* 1976 Jan ;63(1):1-12.
7. Xu Y, Liang S, Tang W. Meta-analysis of randomized clinical trials comparing fistulectomy versus fistulotomy for low anal fistula. *Springerplus.* 2016;5(1):1722 .

8. Read DR, Abcarian H. A prospective survey of 474 patients with anorectal abscess. *Dis Colon Rectum*. 1979; 22(8):566–568
9. Lunniss PJ, Jenkins PJ, Besser GM, Perry LA, Phillips RK. Gender differences in incidence of idiopathic fistula-in-ano are not explained by circulating sex hormones. *Int J Colorectal Dis*. 1995; 10 (1):25–28
10. Robinson AMJr, DeNobile JW. Anorectal abscess and fistula-in-ano. *J Natl Med Assoc*. 1988;80(11):1209–1213.
11. Quah HM, Tang CL, Eu KW, Chan SY, Samuel M. Metaanalysis of randomized clinical trials comparing drainage alone vs primary sphincter-cutting procedures for anorectal abscess-fistula. *Int J Colorectal Dis*. 2006; 21(6):602–609
12. Makowiec F, Jehle EC, Becker HD, Starlinger M. Perianal abscess in Crohn's disease. *Dis Colon Rectum*. 1997; 40(4):443–450.
13. Saino P. Fistula-in-ano in a defined population: incidence and epidemiological aspects. *Ann ChirGynaecol*. 1984; 73:219–224
14. Lunniss PJ, Armstrong P, Barker PG, Reznick RH, Phillips RK. Magnetic resonance imaging of anal fistulae. *Lancet*. 1992; 340:394–396.
15. Vo D, Phan C, Nguyen L, Le H, Nguyen T, Pham H. The role of magnetic resonance imaging in the preoperative evaluation of anal fistulas. *Sci Rep*. 2019 Nov 29;9(1):17947.
16. Mullen R, Deveraj S, Suttie SA, Matthews AG, Yalamarathi S. MR imaging of fistula in ano: indications and contribution to surgical assessment. *ActaChir Belg*. 2011 Nov-Dec;111(6):393-7.
17. Buchanan GN, Halligan S, Williams AB, Cohen CR, Tarroni D, Phillips RK, Bartram CI. Magnetic resonance imaging for primary fistula in ano. *Br J Surg*. 2003 Jul;90(7):877-81.
18. Buchanan GN, Halligan S, Bartram CI, Williams AB, Tarroni D, Cohen CR. Clinical examination, endosonography, and MR imaging in preoperative assessment of fistula in ano: comparison with outcome-based reference standard. *Radiology*. 2004 Dec; 233(3):674-81.
19. Lunniss PJ, Barker PG, Sultan AH, Armstrong P, Reznick RH, Bartram CI, Cottam KS, Phillips RK. Magnetic resonance imaging of fistula-in-ano. *Dis Colon Rectum*. 1994 Jul;37(7): 708-18.
20. Madhusmita, Ghasi RG, Mittal MK, Bagga D. Anorectal malformations: Role of MRI in preoperative evaluation. *Indian J Radiol Imaging*. 2018 Apr-Jun;28(2):187-194.
21. Garg P, Yagnik VD, Kaur B, Menon GR, Dawka S. Role of MRI to confirm healing in complex high cryptoglandular anal fistulas: long-term follow-up of 151 cases. *Colorectal Dis*. 2021 Sep;23(9):2447-2455.
22. Chaudhari NH, Sinkar AD, Swoyam S. Role of magnetic resonance imaging in evaluation of perianal fistulas. *International Journal of Research in Medical Sciences*. 2016;4:482.
23. Konan A, Onur MR, Özmen MN. The contribution of preoperative MRI to the surgical management of anal fistulas. *Diagnostic and Interventional Radiology*. 2018;24:321.
24. Parks A, Gordon PH, Hardcastle J. A classification of fistula-in-ano. *British Journal of Surgery*. 1976;63:1–12.
25. Morris J, Spencer JA, Ambrose NS. MR imaging classification of perianal fistulas and its implications for patient management. *Radiographics: a review publication of the Radiological Society of North America, Inc*. 2000;20:623–635.
26. Singh K, Singh N, Thukral C, Singh KP, Bhalla V. Magnetic resonance imaging (MRI) evaluation of perianal fistulae with surgical correlation. *Journal of clinical and diagnostic research: JCDR*. 2014;8:RC01.