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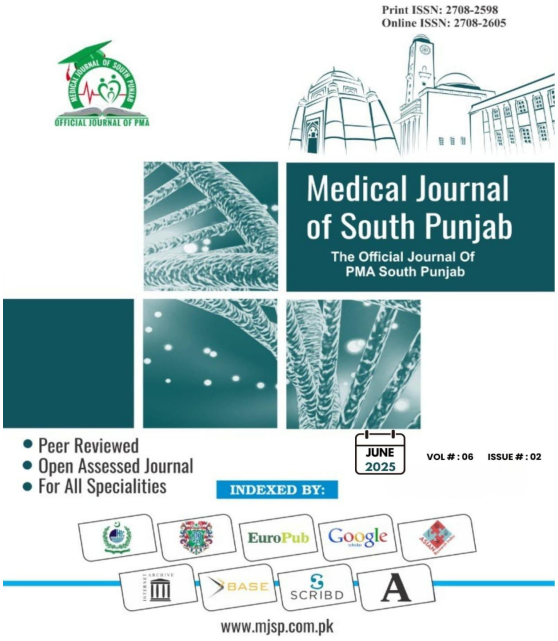

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Original Article

The Role of Magnetic Resonance Imaging in the Intra-Operative Evaluation of Fistula in Ano

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ABSTRACT

Objective*:* Assessing the role of magnetic resonance (MRI) imaging in intraoperative evaluation of fistula in ano.

Methods*:* Sixty patients were referred to the hospital's Radiology Department. Subsequently, these patients were referred for MRI scans in the Radiology Department. The MRI scanner used was equipped with a 16 channel body coil and a surface-coil. The data of all 60 patients who underwent surgical intervention were included in the study. The interval between MRI and surgery was from one week to two months. The gold standard was considered to be surgical findings, which were recorded independently by the surgeon.

Results*:* The demographic profile of the study patients revealed a mean age of 39.73±12.95 years. Among the 60 patients, 25.0% (n=15) were male, and 75.0% (n=45) were female. Diagnostic performance indicated sensitivity (94.9%) and specificity (100.0%). The PPV was 100.0%, and the NPV was 25.0%, with an overall diagnostic accuracy of 95.0%.

Conclusion: MRI offers precise anatomical and pathological information essential for directing pre-surgical decisions and planning in the management of perianal fistulas.

Keywords*:* Magnetic Resonance Imaging (MRI), Intra-operative, Evaluation, Fistula in Ano, Accuracy, Sensitivity, Specificity.

1. INTRODUCTION

A perianal fistula is an abnormal connection between the rectum or anal canal and the skin around the anus. This is usually a result of an infection that develops in the anal glands. If allowed to remain, the infection can form a tunnel or tract called a fistula, and that can be uncomfortable it as well as a possible complication if not treated properly. In this regard, abscesses and fistulas are two stages of the same disease process, with abscesses being the acute phase and fistulas a chronic complication[1]. The incidence of perianal fistulas is about 1 in 1000 people. Most often, they are seen in adult males in their 30s to 50s[2, 3]. Although perianal fistulas may seem like a simple condition, they can be very morbid, especially when untreated or when the treatment is inappropriate[4].

There are two main types of this condition: (1) nonspecific, which is caused by infection in the anal glands and is by far the most common (about 90% of cases), and (2) secondary, in which the fistulas are caused by other pelvic conditions, such as Crohn's disease or cancer. Management of these types differs. The most common form of cryptoglandular fistulas are treated surgically with closure of the fistula tract and eradication of the infection. On the other hand, secondary fistulas may need more specific medical treatment to control the underlying condition and keep the patient in remission[5, 6]. The ability to control bowel movements relies on the functioning of the anal sphincters. The internal sphincter, formed from smooth muscle, operates automatically without conscious control, while the external sphincter, made of striated muscle, allows for voluntary regulation. Fecal incontinence can occur if the external sphincter is divided too much during surgery[7].

Therefore, execution of the surgical treatment of perianal fistulas requires precise techniques of this therapy to avoid the complications. Unsuccessful attempts to find and define the fistulous tract are often made. Unfortunately, overly aggressive or overly cautious surgical approach can be complicated by a recurrence of the infection or injury to the anal sphincter, resulting in devastating consequences of fecal incontinence[8]. As such, preoperative management of perianal fistulas involves detailed anatomical mapping which is most often achieved using advanced imaging techniques.

Three main imaging techniques are used to assess perianal fistulas: contrast fistulography, endoanal ultrasonography and magnetic resonance imaging (MRI). The methods have differing benefits and limitations and the problem becomes one of choosing the best imaging modality for the best possible information. In addition, the "As Low as Reasonably Achievable" (ALARA) principle should also be applied, especially when repeated imaging is needed[9]. The role of MRI in the evaluation of perianal infections and fistulas has been studied in numerous studies[10]. The purpose of this research was twofold: (A) to evaluate the diagnostic accuracy of pelvic MRI/MR fistulography in the evaluation of perianal fistulas, and (B) to determine the MRI associated findings of perianal fistulas.

2. METHODOLOGY

This study was conducted at the Department of Radiology, Combined Military Hospital Gujranwala, from September 1, 2023 to August 30, 2024 by following a cross sectional, analytical approach. The hospital’s ethical review committee gave ethical approval. Sixty patients were referred to the hospital's Radiology Department. The study included both male and female patients aged 24 to 51 years. The attending surgeons made the diagnosis of perianal fistula by clinical evaluation, probing, and rectoscopy examination.

The patients were first referred to the Radiology Department for MRI scans. The imaging was carried out using an MRI system with a 16-channel body coil and a surface coil. A series of body-coil MRI sequences were

applied to each patient to capture both anatomical and pathological dataincluding included T1, T2 sagittal, T2 and STIR axial oblique, T2 and STIR coronal oblique, and post-contrast T1 FAT SAT in axial oblique, sagittal, and coronal oblique planes. The scans were analyzed by a senior radiologist with more than five years of experience in body MRI. All data from the 60 patients who underwent surgical intervention were incorporated into the study, with the interval between MRI and surgery ranging from one week to two months.The gold standard was considered to be surgical findings, which were recorded independently by the surgeon. Park's classification[11] was then compared with MRI results.

Inter-sphincteric, this type of fistula passes through the internal sphincter, moves into the intersphincteric space, and ultimately reaches the perineum.Trans-sphincteric, It traverses the internal and external sphincters to the ischiorectal fossa and then to the perineum.Supra-sphincteric, from the inter-sphincteric space, tract ascends above the puborectalis muscle, enters the ischiorectal fossa, and then the perineum.Extra-sphincteric, it originates from the perianal skin, traverses the levator ani muscles, and reaches the rectal wall without traversing the sphincter mechanism.

The data for this study was gathered firsthand by the researcher and analyzed with SPSS version-24. Descriptive statistics, such as standard and mean deviation, were applied to continuous variables like age, while categorical variables such as gender were assessed using frequency and percentage distributions.

3. RESULTS

A total number of 60 patients, who met the inclusion criteria, were included in our study. The demographic profile of the study patients revealed a mean age of 39.73±12.95 years. Among the 60 patients, 25.0% (n=15) were male, and 75.0% (n=45) were female. (Table. I).

The most common findings in MRI and per-operative were Intersphincteric (53.3% vs. 55.0%), respectively followed as trans-sphincteric (36.7%) vs. 36.7%), respectively. (Table. II)

Among the 59 patients with positive MRI findings, 94.9% (n=56) were demonstrated as positive per-operative and positive MRI results, known as true positive, whereas none were classified as negative per-operative and positive MRI, known as false positive. Further, 5.1% (n=3) had negative MRI but positive per-operative findings, known as false negative. While one case was recorded as negative with MRI and negative per-operative findings as well, known as true negative. A statistically significant association was observed between MRI and per-operative findings ($\chi^2 = 14.24$, d.f. = 1, $p < 0.001$). (Table. III).

Diagnostic performance indicated sensitivity (94.9%) and specificity (100.0%). The PPV was 100.0%, and the NPV was 25.0%, with an overall diagnostic accuracy of 95.0%. (Table. VI).

Table: No I

Demographics profile

Characteristic	N (%)	Mean ± S.D
Age (years)		39.73±12.95
Gender		
Male	15 (25.0)	
Female	45 (75.0)	

Table:No II

MRI and per-operative findings

Findings	N (%)
MRI	
Intersphincteric	32 (53.3)
Trans-sphincteric	22 (36.7)
Extra-sphincteric	2 (3.3)
Superficial	3 (5.0)
Not identical\other	1 (1.7)
Per-operative	
Intersphincteric	33 (55.0)
Trans-sphincteric	22 (36.7)
Extra-sphincteric	3 (5.0)
Superficial	2 (3.3)
Not identical\other	0 (0.0)

Table:No III
Association of MRI and per-operative findings

MRI findings	Per-operative Findings		Total	Test of sig.
	Positive	Negative		
Positive	56 (94.9)	0 (0.0)	56 (93.3)	χ^2=14.24, d.f=1, p<0.001
Negative	3 (5.1)	1 (100.0)	4 (6.7)	
Total	59 (100.0)	1 (100.0)	60 (100.0)	

Table: No IV
Accuracy measures for MRI findings and per-operative findings

Sensitivity	Specificity	PPV	NPV	Accuracy
94.9%	100.0%	100.0%	25.0%	95.0%
PPV= Positive Predictive Value, NPV= Negative Predictive Value				

4. DISCUSSION

As MRI gives excellent contrast resolution and can clearly demonstrate the anatomy of sphincter muscles, it has become the gold standard to evaluate perianal fistulas. MRI has higher soft tissue resolution and three dimensional imaging capability than other imaging techniques, such as fistulography, computed tomography (CT) scans and endoanal ultrasonography, and is the most reliable in correlating with clinical and surgical findings[8, 11-13]. Fistulous tracts are classified by MRI, underlying infections are identified and surgical planning is greatly improved, resulting in a reduction in recurrence of the disease[14, 15]. Its usefulness is particularly evident in the recurrent or complex fistula patients.

Our findings emphasize the essential role MRI plays in accurately identifying the nature and scope of perianal fistulas. With a 94.9% sensitivity and 100% specificity, the results closely mirror those found in global studies[16, 17]. A crucial insight from our study is the importance of selecting the optimal imaging sequences to enhance diagnostic precision. Various sequences were utilized, including T2 sagittal, post-contrast T1 FAT SAT in coronal, T2 and STIR coronal oblique, T1, and STIR axial oblique. Of these, the T2-axial sequence, along with the T1 post-contrast fat-saturated and coronal sequences, proved most effective in accurately characterizing the disease and its progression.

The T2 axial sequence was especially effective in locating the fistulous tract among these. It was also useful in determining the disruption of the external anal sphincter, an important discriminator between intersphincteric and transsphincteric fistulas. Differentiation of fluid filled tracts from areas of inflammation and enhancement of identification of abscesses were instrumental in the use of post contrast T1 fat saturated images. However, coronal sequences were vital in determining the supralevator extent of the disease, as the levator plate is best seen on coronal images. Although studies have indicated that STIR sequences are highly sensitive and accurate for definition of fistulous tracts[18], we did find that while STIR images do contain extremely useful information, they sometimes give this information too readily. For this reason, they should be interpreted cautiously and in conjunction with T2 and gadolinium enhanced T1WI sequences.

During MRI, the entire perineum should be imaged as fistulous tracts, especially suprasphincteric and extrasphincteric types, can extend several centimeters. The relationship of the fistulous tract to the levator ani muscle and the ischioanal/ischiorectal fossa is particularly well shown by MRI. For example, in our study, we found an extrasphincteric sinus tract that extended to the base of the penis (case number 6) that was fully visualized because of the wide field selected. An intersphincteric fistula was missed on the MRI, possibly because of an abscess with surrounding inflammatory changes, but was found during surgery on the other hand. Chronic fistulas are known to be more difficult to visualize on MRI because of their low contrast uptake due to the presence of fibrous tissue.

Dynamic MRI, which evaluates perianal fistulas across different phases—arterial, venous, and delayed—has emerged as a more effective method than traditional single-phase

post-contrast imaging for staging these conditions[15, 19]. We've recently incorporated this advanced imaging technique into our protocol, and it will take us about one to two years to thoroughly assess its benefits over the conventional single-phase post-contrast MRI approach for perianal fistula assessment.

A second emerging development in MRI technology for perianal fistula assessment is the use of an endo-anal coil, which has been shown to have superior ability to detect sphincter damage and atrophy. This method however is limited by a smaller field of view, higher cost and more patient discomfort for those with acute fistulae[20]. However, tolerability is still a big issue for many patients who undergo this procedure.

One constraint of our study is that our sample size is small and therefore the results are not generalizable. However, our findings clearly demonstrate that preoperative MRI is an accurate roadmap for surgeons to plan surgery and greatly assists in the management of perianal fistulas.

5. CONCLUSION

MRI offers precise anatomical and pathological insights that are crucial for shaping pre-surgical decisions and guiding the treatment strategy for perianal fistulas.

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