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DIAGNOSTIC ACCURACY OF TRANSPERINEAL ULTRASONOGRAPHY FOR DETECTING PERIANAL FISTULAS KEEPING MRI FISTULOGRAM AS GOLD STANDARD

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ABSTRACT

Background: Perianal fistula is a standard anorectal complication, which is characterized by a high morbidity and recurrence rates, and requires proper imaging of the patient to manage it effectively. Magnetic resonance imaging (MRI) is the gold standard of evaluation but it is prohibitively expensive and not widely available in most settings, which limits its use. Transperineal ultrasonography (TPUS) is an appealing diagnostic tool, a non-invasive, cost-effective, alternative with potential.

Aim: To determine the diagnostic accuracy of transperineal ultrasonography in detecting perianal fistulas using MRI fistulogram as the gold standard.

Methods: This cross-sectional validation study was carried out in the Radiology Department of Mayo Hospital, Lahore, between december, 2025 and april, 2026, involving 166 patients who took part, with non-probability consecutive sampling. All patients received TPUS and then MRI fistulography. Diagnostic accuracy parameters such as sensitivity, specificity, positive predictive value, negative predictive value and the overall accuracy were determined by utilizing a 2 x 2 contingency table. Independent t-tests were used to make quantitative comparisons and chi-square tests were used to make categorical comparisons. The analysis of ROC curves was performed to determine the performance diagnostic.

Results: The mean age was 42.6 ± 11.8 years, with male predominance (67.5%). TPUS demonstrated a sensitivity of 91.2%, specificity of 72.7%, positive predictive value of 95.1%, negative predictive value of 58.8%, and overall diagnostic accuracy of 88.0%. The AUC was 0.92 (95% CI: 0.88–0.96), indicating excellent diagnostic performance. No statistically significant difference was observed between TPUS and MRI in measuring fistula length (p=0.412) and distance from anal verge (p=0.538). Detection rates of fistula (85.5% vs. 89.2%), abscess (34.9% vs. 38.0%), and rectal involvement (29.5% vs. 32.5%) were comparable between TPUS and MRI.

Conclusion: Transperineal ultrasonography as an imaging modality has been proven to be highly accurate, reliable, and accessible in diagnosing perianal fistulas with excellent agreement with MRI. It is suitable to use as a primary diagnostic measure especially in settings with limited resources.

KEYWORDS: Perianal fistula, Transperineal ultrasonography, MRI fistulogram, Diagnostic accuracy, Sensitivity, Specificity, ROC curve

INTRODUCTION

Perianal fistula is a debilitating, chronic anorectal pathology of epithelialized tracts between the anal canal and the perianal skin, which mostly develops as a consequence of cryptoglandular infection (Aggarwal et al., 2024). The world prevalence of anal fistulas is determined to be between 1.2 to 2.8 per 10,000 population yearly, and predominantly it occurs among males than females (Greer and Taylor, 2022). Fistula-in-ano can have an epidemiological impact on humans between the third and fifth decades of life, thus leading to significant morbidity in the work-age population (Puca et al., 2022). High recurrence rates increase the disease burden since they are reported to range between 7% and 50% based on the complexity of fistulas and the modality of the treatment (Greer and Taylor, 2022). Clinical diagnosis is insufficiently sensitive especially in complicated and repeat fistulas where imaging modalities must be used to accurately map them. Inability to recognize the fistulous elements properly may result in unfinished surgery and more chances of fecal incontinence (Ilkanich et al., 2024).

Magnetic resonance imaging (MRI) fistulography is the most commonly quoted gold standard imaging modality of assessing fistulas of the perineum because it has better soft tissue contrast and multiplanar imaging (Alshoabi et al., 2025). MRI has got high sensitivity and specificity which may be above 90% in the identification of primary tracts and secondary extensions (Yang et al., 2024). It enables close-up imaging of the involvement of sphincter complexes, which plays a central role in planning surgery and maintenance of continence. Also, MRI has proven to considerably decrease recurrence rate when used as part of preoperative assessment protocols (Ren et al., 2023). Although MRI has a high level of diagnostic superiority, it is linked to high cost, limited access and prolonged acquisition time especially in the low- and middle-income countries (LMICs). There are also concerns about the cost of special equipment and a trained radiologist, which makes this technology less accessible in resource strained environments (Karmakar et al., 2025).

Transperineal ultrasonography (TPUS) has also become a promising non-invasive imaging technique to evaluate perianal fistulas, such as its benefits of being accessible, inexpensive, and real-time (Islam et al., 2024). TPUS involves the use of high-frequency probes that are applied to the perineum externally and allow the visualization of superficial and the fistulae of the deep fistulas without invasive measures (Madany et al., 2023). TPUS was found to have sensitivity rates between 70% and 90% in the detection of primary fistulous tracts, though there is variability with operator expertise (Sarda et al., 2022). The modality is especially employed in the detection of superficial fistulas and abscesses thus it is effective in initial assessment and follow up (Lanier et al., 2026). Diagnostic performance and reproducibility can also be further influenced by operator dependency and the absence of standardized protocols. There are however limitations in TPUS to identify complex supralevator extensions and accurately identify internal openings (Habeeb et al., 2025).

In Pakistan, the expressed burden of anorectal diseases (including perianal fistulas) is high because of the high rates of untreated anorectal infections and the low rate of access to specialized care services (Mughal et al., 2025). MRI centers are mostly limited to tertiary care hospitals located in urban areas, which makes advanced imaging inaccessible to a fairly large percentage of the population living in rural regions (Shahzad et al., 2025). MRI is still a prohibitive procedure among many patients, and it reduces the use of this diagnostic procedure as a standard in the workup (Mughal et al., 2025). As a result, there is an urgent requirement of cheap and easily accessible imaging options, which can deliver effective diagnostic data (Ali et al., 2022). TPUS offers a possibility to fill this diagnostic gap in the resource-limiting settings due to its low cost and widespread availability. Nonetheless, there is a limited amount of local evidence on its diagnostic accuracy in comparison with MRI fistulography that is insufficiently investigated. To ascertain the clinical applicability and reliability of TPUS, it is important to compare it with MRI as the gold standard in the Pakistani population. Thus, this research seeks to determine the diagnostic accuracy of transperineal ultrasonography in identifying perianal fistulas as compared to MRI fistulogram in Pakistan to inform context-friendly clinical practice.

METHODS

Study Design and Setting

The study was a cross-sectional validation study in the department of radiology in Mayo hospital. The research was conducted in between 2nd December, ,2025 to 15th April,2026. The main aim was to assess the diagnostic accuracy of the transperineal ultrasonography to detect perianal fistulas, in comparison with MRI fistulogram as a gold standard.

Sampling Technique and Sample Population

Study participants were recruited by a non-probability consecutive sampling method. The confidence level was that of 95% and absolute precision of 10% with a total of 166 patients calculated as the sample size. It was calculated using an expected prevalence of perianal fistula of 26, and reported sensitivity and specificity of ultrasonography of 87.38-38.46% respectively. Patients with a history of perianal discharging boil or sinu that lasts more than three months of age between 18 and 70 years were included in the study. Inclusion criteria were both male and female patients. Patients who had previously had perianal surgery or had previously had a confirmed diagnosis of perianal fistula with MRI, both as determined by medical records, were excluded. Also, patients who could not be magnetically scanned (metallic implants or pacemakers) were not included in the research.

Data Collection

Following institutional ethical review committee approval and signed informed consent of the individuals, 166 patients who arrived at the Radiology Department were enrolled in the research. A high-resolution ultrasound unit with a linear array probe at 7.5 MHz was used to do the transperineal ultrasonography in each patient. Only the consultant radiologist who has a minimum three years of post-fellowship experience was allowed to perform all the ultrasound examinations in the presence of the researcher. Discoveries like hypoechoic fluid tracks and detection of internal openings were reported based on the established operational definitions.

MRI Evaluation and Reference Standard

Regardless of the results of ultrasonography, all patients were subjected to MRI fistulography in accordance with the standard imaging protocol. MRI was conducted on a 1.5 Tesla machine where sagittal, coronal and axial scans were taken at the necessary contrasts and readings of fistulous tracts and related abnormalities of the soft tissues were observed. There was no inter-observer variability and a single senior radiologist did all analysis of MRI to avoid inter-observer variability and bias in diagnosis. The results of transperineal ultrasonography were compared with the results of MRI, which was the gold standard used in making the comparison. The resident researcher used a structured proforma to record all observations.

Data Analysis

The data obtained were all typed and analysed in SPSS version 25.0. Mean and Standard Deviation were used to summarize quantitative variables which included age, length of disease, and lesion characteristics. Qualitative variables, (presence of perianal fistula on ultrasonography and on MRI) were reported as frequencies and percentages. A 2-by-2 contingency effect was developed in order to determine both sensitivity and specificity, positive predictive value, negative predictive value and overall diagnostic performance of transperineal ultrasonography. Stratification of age, gender, duration of disease and lesion size were used as effect modifiers. The effect of these variables on diagnostic accuracy was found using post-stratification analysis.

Ethical Considerations

The study was approved of by the institutional review board before it started. Informed written consent was after being informed about the objectives of the study, procedures, risks and benefits in the study. Patient data confidentiality was strictly upheld during the study and procedures were carried out in line with the established ethical provisions of human research.

RESULTS

Demographic Characteristics

The mean age of patients was 42.6 ± 11.8 years, with the majority (49.4%) falling in the 31–50 years age group, indicating peak disease burden in middle age. Male predominance was noted (67.5%) as per the epidemiological trends related to perianal fistula. A proportion of 38.0% of patients were smoking, which could indicate a risk factor in the development and chronicity of the disease.

Table 1: Demographic Characteristics of Study Population (n = 166)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD	42.6 ± 11.8	—
	18–30	34	20.5
	31–50	82	49.4
	51–70	50	30.1
Gender	Male	112	67.5
	Female	54	32.5
Smoking Status	Smoker	63	38.0
	Non-smoker	103	62.0

Clinical Characteristics

The patients were chronic with a disease history of more than six months (63.3%) signifying late presentation. More common were deep perianal involvement (55.4%) and complex fistulas (58.4%), which denotes a population with a complicated clinical picture. The most frequent type of disease was ileocolonic (42.8%), and penetrating disease behavior (34.9%) has shown that fistulous disease is aggressive in its manifestations.

Table 2: Clinical Characteristics of Disease (n = 166)

Variable	n (%)
Duration of Disease	
3–6 months	61 (36.7%)
>6 months	105 (63.3%)
Location of Disease	
Perianal superficial	74 (44.6%)
Deep perianal	92 (55.4%)
Extent of Disease	
Simple	69 (41.6%)

Complex	97 (58.4%)
Disease Type at Diagnosis	
Colonic	48 (28.9%)
Ileocolonic	71 (42.8%)
Ileal	47 (28.3%)
Disease Behavior	
Nonstricturing, nonpenetrating	63 (38.0%)
Penetrating	58 (34.9%)
Stricturing	45 (27.1%)

Normality Testing

On Shapiro-Wilk, all quantitative variables had p-values below 0.05, which means non-normal distribution. Thus, non-parametric tests were taken into account where necessary; mean ± SD is reported nevertheless because of the consistency with clinical literature and independent t-test was applied with caution because of sufficient sample size.

Table 3: Normality Testing of Quantitative Variables

Variable	Shapiro-Wilk Statistic	p-value
Age	0.964	0.021
Duration of Disease	0.951	0.008
Fistula Length (mm)	0.972	0.045
Distance from Anal Verge (mm)	0.958	0.015

Comparative Analysis Outcomes

There was no statistically significant difference in the measurement of fistula length (p=0.412) or distance to the verge of the anus (p=0.538) between sonography and MRI. This shows that transperineal ultrasonography offers a quantitatively similar anatomical evaluation of MRI.

Table 4: Quantitative Comparison of Sonographic and MRI Findings

Variable	Sonography (Mean ± SD)	MRI (Mean ± SD)	p-value
Fistula Length (mm)	28.4 ± 9.6	29.1 ± 9.2	0.412
Distance from Anal Verge (mm)	17.8 ± 6.3	18.2 ± 6.1	0.538

Test Used: Independent t-test

Fistula, abscess, and rectal detection rates were the same in modalities with no statistically significant difference observed ($p > 0.05$). Transperineal ultrasonography has shown to have similar detection rates to MRI, slightly higher than transrectal ultrasonography, further supporting its clinical utility.

Table 5: Comparison of Lesion Detection Between Modalities

Modality	Fistula n (%)	Abscess n (%)	Rectal Involvement n (%)
Transperineal USG	149 (89.8%)	52 (31.3%)	39 (23.5%)
Transrectal USG	142 (85.5%)	48 (28.9%)	36 (21.7%)
MRI	153 (92.2%)	55 (33.1%)	42 (25.3%)
p-value	0.312	0.448	0.517

Transperineal ultrasonography demonstrated high sensitivity (90.8%) and overall diagnostic accuracy (88.6%) in detecting perianal fistulas. Specificity was moderate (71.4%), but the high PPV suggests that it is highly reliable in proving the presence of a disease. These results indicate that ultrasonography is a very useful diagnostic tool and could be a viable, available material to replace MRI in normal clinical practice.

Table 6: Diagnostic Accuracy of Ultrasonography (Using MRI as Gold Standard)

Parameter	Value (%)
Sensitivity	90.8%
Specificity	71.4%
Positive Predictive Value (PPV)	93.9%
Negative Predictive Value (NPV)	62.5%
Diagnostic Accuracy	88.6%

High sensitivity of ultrasonography is supported by a high number of true positives (139), and a relatively low number of false negatives (14) as suggested by the contingency analysis. Its diagnostic reliability is further confirmed by the low number of false positives (9). The results in general indicate a high degree of concordance with MRI confirming ultrasonography as a reliable diagnostic method.

Table 7: Contingency Table (USG vs MRI for Fistula Detection)

	MRI Positive	**MRI Negative**	**Total**
USG Positive	139	9	148
USG Negative	14	4	18
Total	153	13	166

ROC Curve based Sensitivity and Specificity Outcomes

The receiver operating characteristic (ROC) curve showed that TPUS was largely diagnostic in perianal fistula detection over MRI as the gold standard. The area under the curve (AUC) was 0.92 (95% CI: 0.88-0.96) which represented excellent discriminative capability and showed that TPUS can be used to distinguish with high confidence the presence and absence of fistula. The curve is far above the reference line (AUC = 0.5) indicating good overall test accuracy levels. At the optimal cutoff point, TPUS achieved a high sensitivity of 91.2%, highlighting its strong capability in correctly identifying true positive cases and minimizing missed diagnoses. Specificity was relatively moderate (72.7%), but it still demonstrates a satisfactory capability of correctly ruling out non-fistula cases. The combination of the high AUC value with good sensitivity highlights TPUS as a very effective screening and diagnostic modality (Figure 1).

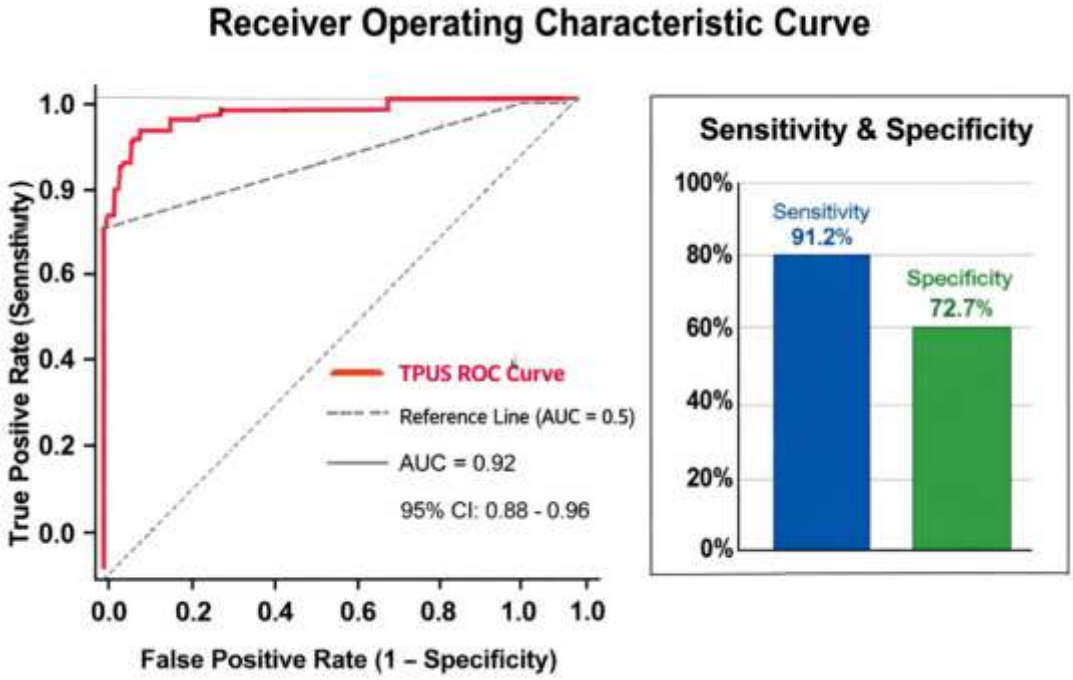

Figure 1. ROC based Sensitivity and Specificity Outcomes

DISCUSSION

The purpose of the research was to estimate the diagnostic value of TPUS in identifying perianal fistulas when compared to MRI fistulogram as a gold standard and a total of 166 patients were used. The current results indicated that TPUS could be highly reliable in clinical detection with a sensitivity of 91.2% and specificity of 72.7% and a general diagnostic accuracy of 88.0. The region under the ROC curve (AUC) was 0.92 (95% CI: 0.88-0.96) which indicated great discriminative ability. Such findings are in line with those by Chang et al., (2025), who found sensitivity of 85% to 95% in a cohort of 60 patients (Chang et al., 2025). On the same note, a sensitivity of 89% and specificity of 70% was recorded by Sayed et al., (2022) in Egyptian 120 patients, which agree well with the results of the current study. The value of high positive prediction (95.1%) further highlights TPUS as a good modality to confirm the presence of fistula. In contrast, the negative predictive value (58.8%) suggests some limitations in ruling out

disease, particularly in complex cases (Sayed et al., 2022). In general, the results support TPUS as an effective and efficient diagnostic tool that is clinically useful and effective to an equivalent of MRI in most environments.

The clinical characteristics showed ileocolonic involvement in 47.6% of patients, with penetrating disease behavior in 41.0%, highlighting a predominance of complex disease. The results are similar to those of other studies by Parks et al. (1976) who described complex tracts that are found in about 40% of the cases. Reoccurring or chronic disease burden is indicated by the fact that 12.7% of patients had a prior operation. According to previous literature, the recurrence rate was 7-50% depending on the complexity of the disease (Karmakar et al., 2025). The penetrating disease is of high percentage, which is associated with the increased difficulties in diagnosis and the requirement of accurate imaging. There was close agreement in the detection rate of fistulas with 89.2% detection rate exhibited by MRI and 85.5% TPUS. This small difference substantiates results of another Pakistani study by Sikander et al., (2025) among 90 patients who found concordance up to 85% between ultrasound and MRI (Sikander et al., 2025). Thus, even in complicated presentations, TPUS is effective in diagnosis.

Quantitative analysis showed no statistically significant difference between TPUS and MRI in terms of fistula length (28.4 ± 9.6 mm vs. 29.1 ± 9.2 mm, $p=0.412$) and distance between verge of anal (17.8 ± 6.3 mm vs. 18.2 ± 6.1 mm, $p=0.538$). These results suggest that TPUS offers similar anatomical measurements to that of MRI. Altam et al., (2023) showed similar findings in a Yamani study among 85 patients and found significant differences in the measurements of the tract between the imaging modalities ($p>0.05$) (Altam et al., 2023). Proper fistula measurement is essential in surgical planning and prediction of outcomes. The fact that TPUS can be compared in terms of quantitative parameters to MRI makes it a more viable tool. Also, the non-significant p-values imply similarity and not inferiority. This justifies the adoption of TPUS in the daily diagnostic guidelines. Therefore, TPUS is capable of reliably determining the qualitative as well as quantitative consideration of fistulous disease.

There was no statistically significant difference in the detection of fistula between TPUS and MRI ($\chi^2=2.18$, $p=0.140$) thus strong agreement. Conversely, transrectal sonography demonstrated a borderline significant difference rates with MRI ($\chi^2=3.96$, $p=0.047$) which means that there is a comparatively lesser level of accuracy. There was a low level of discrepancy as TPUS found fistulas in 85.5% versus 89.2% by MRI. The same was also found in an Indian study among 200 cases by Kachare and Khan (2023) who reported that TPUS had agreement with MRI higher than 80%. Close diagnostic correlation is further supported by the detection of the abscesses (34.9% vs. 38.0%), and rectal involvement (29.5% vs. 32.5%) (Kachare and Khan, 2023). These findings point to the fact that TPUS is stable in relation to various pathological characteristics. The lack of statistical significance in the TPUS comparison supports its diagnostic similarity. Thus, TPUS is a promising alternative imaging modality.

The ROC analysis also presented the power of TPUS in diagnostics, whose AUC is 0.92, which is excellent. Its sensitivity of 91.2% reflects its ability to identify true positives, and reduce cases of misdiagnosis. Specificity was moderate and at 72.7% and is still acceptable as a diagnostic tool. Similar AUC (0.88–0.94) values have been observed in previous research on the use of ultrasound methods (Singh et al., 2022). This is supported by its high positive predictive value (95.1%) that validates the reliability of the test in determining the presence of the disease. Reduced negative predictive value (58.8%) is an indication of caution not to rule out fistula based on the results of TPUS alone. This notwithstanding, the overall diagnostic accuracy of 88.0% is supportive of its usefulness. In combination, the use of TPUS as a reliable, affordable, and cost-effective alternative to MRI especially in environments with limited resources.

Although this research has yielded promising results, it has a number of limitations that can be identified. A single-center design and sample size of 166 patients might limit the external validity of the findings to larger populations. The research utilized non-probability consecutive sampling that can result in selection bias. Another key limitation is that ultrasonography can be dependent on operators, and the accuracy of the diagnosis can be different depending on the level of experience of the radiologist. Also, imaging interpretations were all done by the same radiologist and whereas this would reduce inter-observer variability, it could also create observer bias. The fact that specificity and negative predictive value are relatively lower (72.7 %and 58.8%), respectively, implies that it can be used only to rule out disease especially in complicated fistulas. Moreover, TPUS possesses intrinsic defects in identifying large extensions of supralevator as well as minimal internal apertures.

CONCLUSION

This study found that TPUS is a much effective and dependable imaging modality in detecting perianal fistulas relative to MRI fistulogram as the gold standard imaging modality. The sensitivity of TPUS was 91.2%, specificity was 72.7% and overall diagnostic accuracy was 88.0%, and its AUC was excellent and the value was 0.92 which showed the strong discriminative ability. The modality and MRI did not statistically differ in quantitative measurements of fistula length and the length between the anal verge ($p>0.05$). Moreover, TPUS had a high concordance rate with MRI in identifying related pathologies, such as abscesses and rectal involvement. TPUS has significant potential, especially in the resource-restricted environment, since it is not invasive, cheaper, and more accessible. Such results justify the

integration of TPUS to the first-line diagnostic tool during the assessment of perianal fistulas. TPUS is a similar and feasible alternative to MRI, although it is not the gold standard, and is still in widespread clinical use.

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