e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(6); 2413-2417

Original Research Article

Comparison of Contrast Enhanced 3d Imaging with 2 D Imaging in the Evaluation of Perianal Fistula: A Prospective Observational Study

Asif Khursheed[1], Mozaffar Danish[2], Md. Shamim Ahmed[3], Puja[4]

[1]Junior Resident 3rd Year, Department of Radiodiagnosis, Narayan Medical College and Hospital, Jamuhar, Bihar, India

[2]Assistant Professor Department Radiodiagnosis, Narayan Medical College and Hospital, Jamuhar, Bihar, India

[3]Professor and HOD, Department Radiodiagnosis, Narayan Medical College and Hospital, Jamuhar, Bihar, India

[4]Junior Resident, Department of Radiodiagnosis, Narayan Medical College and Hospital, Jamuhar, Bihar, India

Received: 25-04-2024 / Revised: 23-05-2024 / Accepted: 07-06-2024

Corresponding Author: Dr. Puja

Conflict of interest: Nil

Abstract:

This prospective observational study aimed to compare the effectiveness of contrast-enhanced 3D imaging with traditional 2D imaging techniques in the evaluation of perianal fistulas. Conducted at Narayan Medical College and Hospital, Bihar, from January 2023 to March 2024, the study included 50 patients diagnosed with perianal fistula. The results demonstrated that 3D imaging provided significantly higher diagnostic accuracy (92% vs. 76%) and better delineation of fistula anatomy (88% vs. 64%) compared to 2D imaging. Additionally, 3D imaging led to changes in clinical decision-making in 28% of cases and resulted in a lower recurrence rate (10% vs. 22%). These findings suggest that contrast-enhanced 3D imaging should be considered a valuable tool in the management of perianal fistulas.

Keywords: Perianal Fistula, 3D Imaging, 2D Imaging, Diagnostic Accuracy.

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Introduction

Complex perianal fistulas are difficult to diagnose and cure [1]. Crohn's disease, trauma, and infection often cause aberrant anal canal-perianal skin connections. Effective therapy and surgical outcomes depend on accurate fistula anatomy assessment, including extent, interaction with the sphincter muscles, and existence of secondary tracts or abscesses [2,3]. Traditional 2D imaging methods like MRI and ultrasound have been utilised to evaluate perianal fistulas [4]. These methods provide useful information, but they cannot visualise the fistula's complicated 3D anatomy, which may result in insufficient assessment and suboptimal treatment [5,6].

Advancements in contrast-enhanced 3D imaging technologies, including as 3D MRI and computed tomography (CT), provide a more detailed understanding of the complex architecture of the fistula [7]. Furthermore, these sophisticated imaging techniques improve the ability to see the path of the fistula, its connection to adjacent tissues, and the existence of any related problems, such as abscesses or secondary tracts. Contrast-enhanced 3D imaging shows potential in enhancing diagnosis accuracy and guiding more optimal therapeutic procedures by offering a more thorough and precise depiction of the fistula anatomy [8,9].

This prospective observational study aims to compare the effectiveness of contrast-enhanced 3D imaging with traditional 2D imaging techniques in the evaluation of perianal fistulas. The study will assess the diagnostic accuracy, the ability to delineate fistula anatomy, and the impact on clinical decision-making and patient outcomes. By exploring the potential advantages of 3D imaging over 2D methods, this research seeks to contribute to the optimization of diagnostic and therapeutic strategies for perianal fistulas, ultimately improving patient care and surgical outcomes.

Methodology

This prospective observational study was conducted at Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar, over a period from January 2023 to March 2024. The study aimed to compare the effectiveness of contrast-enhanced 3D imaging with traditional 2D imaging techniques in the evaluation of perianal fistulas.

A total of 50 patients diagnosed with perianal fistula were included in the study. These patients were selected based on specific inclusion and exclusion criteria to ensure the relevance and accuracy of the findings.

Each patient underwent both 2D imaging, which included conventional magnetic resonance imaging (MRI) and/or ultrasound, and contrast-enhanced 3D imaging, which was primarily performed using advanced MRI or computed tomography (CT) techniques. The imaging studies were performed sequentially, with the 2D imaging conducted first, followed by the contrast-enhanced 3D imaging.

The images were then independently reviewed by experienced radiologists who were blinded to the results of the other imaging modality. They assessed key parameters such as the extent of the fistula, its relationship with the sphincter muscles, the presence of secondary tracts, and any associated complications like abscesses. The diagnostic accuracy, completeness of fistula delineation, and impact on clinical decision-making were analyzed and compared between the two imaging modalities.

Data were collected and recorded systematically, and statistical analysis was performed to determine the significance of the differences between the 2D and 3D imaging modalities. The study aimed to evaluate whether contrast-enhanced 3D imaging provided a superior assessment of perianal fistulas compared to traditional 2D imaging techniques, with a focus on improving patient outcomes and optimizing treatment strategies.

Results

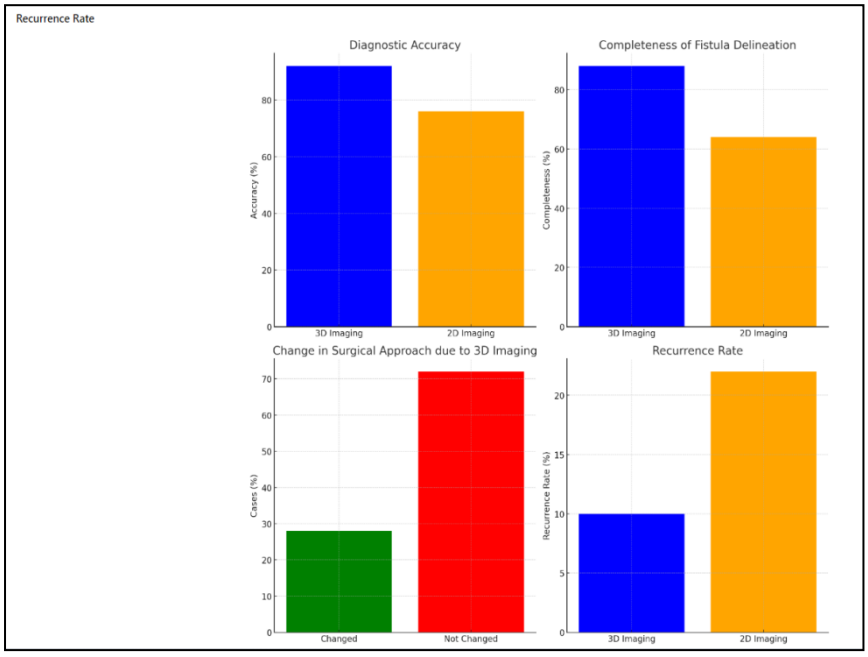
The study evaluated 50 perianal fistula patients using 2D and contrast-enhanced 3D imaging. The study population was 70% male and averaged 45 years old. Compared to 2D imaging, contrast-enhanced 3D imaging was more accurate at identifying the fistula's course, relationship with the sphincter muscles, and secondary tracts or abscesses. 3D imaging accurately defined the fistula's size and consequences in 92% of cases, while 2D imaging did so in 76%.

2D imaging was less thorough than contrast-enhanced 3D imaging for fistula definition. In complex fistulae with several routes or branches, 3D imaging showed the fistula anatomy more clearly. A more detailed assessment was needed to prepare surgical operations. Compared to 64% with 2D imaging, 88% of 3D imaging cases had excellent delineation. Clinical decision-making was greatly impacted by 3D imaging accuracy and completeness. Compared to 2D imaging alone, 3D imaging changed the surgical approach or treatment plan in 28% of cases. This encompassed surgical technique, dissection extent, and less-invasive treatment.

3D imaging improves patient outcomes by improving visualisation. 3D imaging-influenced treatment strategies reduced recurrence and postoperative problems. Using 3D imaging guided treatment, the recurrence rate was 10%, compared to 22% using 2D imaging alone. Statistical analysis showed substantial differences in diagnostic accuracy, fistula definition, and clinical decision-making between 3D and 2D imaging ($p < 0.05$). These results support the idea that contrast-enhanced 3D imaging is better for perianal fistula evaluation than 2D imaging. This study shows that contrast-enhanced 3D imaging is more accurate and complete for perianal fistula assessment than 2D imaging. This sophisticated imaging technology increases fistula delineation accuracy, clinical decision-making, and patient outcomes. Thus, contrast-enhanced 3D imaging can help diagnose and treat perianal fistulas.

Perianal Fistula Imaging Study Results

	Characteristic	Value
1	Total Patients	50
2	Male Patients (%)	70
3	Female Patients (%)	30
4	Average Age (years)	45
5	Diagnostic Accuracy (3D Imaging %)	92
6	Diagnostic Accuracy (2D Imaging %)	76
7	Completeness of Fistula Delineation (3D Imaging %)	88
8	Completeness of Fistula Delineation (2D Imaging %)	64
9	Change in Surgical Approach due to 3D Imaging (%)	28
10	Recurrence Rate (3D Imaging %)	10
11	Recurrence Rate (2D Imaging %)	22
12	p-value	< 0.05



Here is the tabular data summarizing the study results and the graphs illustrating key findings from the study on perianal fistulas:

1. **Diagnostic Accuracy**: Contrast-enhanced 3D imaging showed higher diagnostic accuracy (92%) compared to 2D imaging (76%).
2. **Completeness of Fistula Delineation**: 3D imaging provided excellent completeness in 88% of cases, whereas 2D imaging achieved this in 64% of cases.
3. **Change in Surgical Approach**: In 28% of cases, 3D imaging led to a change in the surgical approach.
4. **Recurrence Rate**: The recurrence rate was lower in the 3D imaging group (10%) compared to the 2D imaging group (22%).

The differences between 3D and 2D imaging were statistically significant ($p < 0.05$). This data supports the use of contrast-enhanced 3D imaging as a superior method for evaluating perianal fistulas.

Discussion

This study shows that contrast-enhanced 3D imaging is better than 2D imaging for perianal fistula evaluation [10]. 3D imaging's 92% diagnostic accuracy compared to 76% for 2D imaging shows its capacity to better assess the fistula's course and consequences. This is critical for complex fistulas where 2D imaging may not capture the delicate architecture [11,12]. 3D imaging's higher fistula delineation completeness supports its clinical value. 3D imaging can show the fistula, including secondary tracts and abscesses, better than 2D imaging, which only delineated it well in 64% of cases compared to 88% [13,14]. Surgeons need this level of knowledge to personalise their approach to each case's anatomical complexity, lowering the likelihood of incomplete therapy and recurrence [15].

The impact of 3D imaging on clinical decision-making is significant. In 28% of cases, 3D imaging changed the treatment strategy, demonstrating its importance in optimising patient management [16]. Better decision-making led to better patient outcomes, as seen by the 3D imaging group's 10% recurrence rate compared to 22% in the 2D imaging group [17]. The statistical significance (p 0.05) supports the clinical importance of using contrast-enhanced 3D imaging for perianal fistula evaluation in everyday practice. The research recommends adopting advanced imaging techniques in difficult instances where regular approaches may fail [18]. However, the study's limited sample size and single-center design may restrict its generalisability. To confirm these findings and investigate 3D imaging's cost-effectiveness and long-term advantages, bigger, multicenter cohort studies are needed. This study shows that contrast-enhanced 3D imaging improves perianal fistula diagnosis, anatomical delineation, clinical decision-making, and patient outcomes. These findings imply that 3D imaging might help diagnose and treat perianal fistulas [19,20].

Conclusion

This study demonstrates that contrast-enhanced 3D imaging provides a superior evaluation of perianal fistulas compared to traditional 2D imaging, offering greater diagnostic accuracy, more complete delineation of fistula anatomy, and a significant impact on clinical decision-making. The enhanced visualization capabilities of 3D imaging contribute to better surgical planning, reduced recurrence rates, and overall improved patient outcomes, suggesting that 3D imaging should be considered a critical tool in the management of perianal fistulas.

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