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Original Research Article

Surgical management and outcomes of anal fistula with tuberculosis: A retrospective cohort study from South India

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Abstract

Background: Tuberculosis-associated anal fistula presents diagnostic and surgical challenges. Its prevalence and impact on outcomes remain underexplored. This study analysed the prevalence, diagnostic reliability, surgical interventions and treatment outcomes in tuberculosis-associated anal fistula.

Aims & Objectives: The objective of this study was to determine (a) the prevalence of tuberculosis in anal fistula (b) assess diagnostic test concordance (c) evaluate surgical outcomes (d) recurrence rates and (e) analyse the impact of anti-tubercular therapy completion.

Materials and Methods: This study employs a retrospective cohort design to analyse the outcomes of patients surgically treated for anorectal fistula secondary to tuberculosis. A total of 31 patients, treated between December 2021 and January 2025, were included in the analysis. Tuberculosis status was determined via Mantoux, PUS-TB-PCR, PUS-CBNAAT, Fistula-CBNAAT, TB-GOLD. Fistulae were classified into three categories: simple, complicated and horseshoe. Surgical interventions performed included laser-based surgery, fistulectomy and combined procedures. Outcomes were assessed based on the following criteria: disease-free, ongoing antitubercular therapy (ATT), lost to follow-up and persistent disease. Statistical analyses included McNemar's test, Cohen's Kappa, chi-square, Fisher's exact, Mann-Whitney U ($p < 0.05$ significance).

Results: Single openings were observed in 64.5% of cases, multiple openings in 32.3% and absent openings in 3.2% ($p < 0.001$). Regarding fistula complexity, 32.3% were classified as simple, 54.8% as complicated, and 12.9% as horseshoe-shaped ($p = 0.016$). Laser fistulotomy with primary sphincter repair (PSR) was the most common surgical approach performed in 38.7% of patients, with no significant association found between tuberculosis status and choice of surgery ($p = 0.73$). Among diagnostic tests, TB-GOLD showed the highest positivity rate at 22.6%, followed by Mantoux, PUS-TB-PCR, and PUS-CBNAAT, each at 16.1%. Poor agreement was found between Mantoux and TB-GOLD (Kappa = -0.229, $p = 0.12$), while there was slight agreement between PUS-TB-PCR and PUS-CBNAAT (Kappa = 0.044, $p = 0.78$).

The overall disease-free rate was 22.6%. Tuberculosis-positive patients who completed their antitubercular therapy (ATT) achieved a 100% disease-free status ($p = 0.001$). In contrast, those with incomplete ATT had a 53.3% rate of persistent disease. Recurrence rates were 6.7% in tuberculosis-positive patients and 0% in tuberculosis-negative patients ($p = 0.48$).

Conclusion: Tuberculosis plays a significant role in the development of anal fistulae, with a similar prevalence observed within the cohort. The variability in diagnostic tests indicates the importance of a multi-disciplinary approach. Surgical outcomes are primarily influenced by the complexity of the fistula rather than the tuberculosis status of the patient. Complete adherence to antitubercular therapy (ATT) notably improves disease-free rates. These findings emphasize the necessity of preoperative tuberculosis screening and a collaborative, interdisciplinary management approach.

Keywords: Anal fistula, Tuberculosis, Perianal tuberculosis, Anti-tubercular therapy, Surgical outcomes, Recurrence, Fistulotomy, Laser therapy, Diagnostic accuracy, Chronic inflammation

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1. Introduction

Anal fistulae present significant diagnostic and clinical challenges, characterized by the formation of abnormal tracts between the anal canal and perianal skin. Tuberculosis plays a substantial role in the development of anal fistulae, with an estimated prevalence of 0.2% in the general population. However, among cases of anorectal tuberculosis, fistula occurs in 80%-91% of patients. Undiagnosed tuberculosis is often associated with recurrent fistulae, and delayed detection can lead to increased treatment resistance. Garg (2022) identified tuberculosis as a major contributor to persistent disease, highlighting the need for thorough evaluation in recurrent cases.[1] Similarly, Sasahara et al. (2021) emphasized the importance of systematic screening, especially in regions where tuberculosis is endemic.[2]

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2. Epidemiology and Pathophysiology

Hokkanen et al. (2019) emphasized need for heightened clinical awareness of tuberculosis-related anal fistulas.[3] Lao and Mao (2021) emphasized the importance of recognizing tuberculosis association, particularly in endemic regions.[4] Wang et al. (2018) reported nearly 60% of perianal abscesses progress to fistula if untreated and early intervention remains critical for preventing chronic inflammation and fibrosis.[5] Fistula formation occurs due to infection-induced blockage of anal glands, with untreated abscesses advancing into fistulous tracts.[6-7] Chronic inflammatory processes, particularly interleukin-17 (IL-17) activation, play a pivotal role in tissue destruction and fibrosis. Wang et al. (2018) identified IL-17 as potential therapeutic target in managing persistent inflammation.[5] Koizumi et al. (2023) emphasized the need for vigilance in long-standing fistulae due to increased risk of malignant transformation.[8]

3. Risk Factors and Regional Incidence Variability

Risk factors include inflammatory bowel disease, anatomical complexity, prior surgical history and lifestyle influences. He et al. (2020) linked inflammatory bowel disease with increased likelihood of complex fistula formation.[9] Trans-sphincteric and supra-sphincteric fistulae pose higher recurrence risks. Bük et al. (2024) reported extensive sphincter involvement complicates surgical management.[10] Ferreira et al. (2024) and Tassew (2018) highlighted necessity for strategic surgical planning to mitigate recurrence risks.[11-12] Extrinsic factors such as smoking and obesity negatively impact healing outcomes. Tuberculosis-driven fistula formation is linked to granulomatous inflammation and chronic inflammatory response exacerbates tissue destruction. Hokkanen et al. (2019) reported significantly higher anal fistula prevalence among tuberculosis-affected individuals.[3] Lao and Mao (2021) emphasized diagnostic challenges due to clinical overlap with other perianal conditions.[4]

Geographic variability of incidence is influenced by tuberculosis prevalence. Garg et al. (2022) estimated that tuberculosis accounts for 20.3% of complex fistulae, in contrast to just 7.2% of simple cases.[1] A higher incidence is observed in South Asia and Sub-Saharan Africa. LiuS et al. (2024) observed that tuberculosis-associated fistulae are likely under-reported in low-burden regions due to diagnostic limitations.[13] Chaudhry et al. (2023) identified ulcerative presentations as the most common form of tuberculosis-related fistulae, frequently resulting in delayed diagnosis.[14]

4. Diagnostic Challenges and Advancements

Diagnosis is complicated by nonspecific symptoms and the requirement of histological confirmation.[15-16] Morphological presentations that include ulcerative, verrucous and lupoid lesions, frequently mimic Crohn's disease and malignancies. Chaudhry et al. (2023) and Sasahara et al. (2021) emphasized need for differential diagnosis.[2,14] Garg et al. (2022) identified Polymerase Chain Reaction (PCR) as superior to histopathology for tuberculosis confirmation.[1] Gangwar (2014) underscored necessity for molecular diagnostics in identifying tuberculosis-associated cases.[17]

5. Surgical and Medical Management Strategies

Optimal management of tuberculosis-associated anal fistula requires multimodal approach integrating surgical intervention and antitubercular therapy.[18-19] Standard procedures, such as fistulotomy and fistulectomy, are commonly used, but the risk of recurrence and incontinence remains, especially in more complex cases. Studies have reported promising outcomes using biological plugs and sphincter-preserving surgeries. Venara et al. (2022) and Almughamsi et al. (2023) highlighted bioprosthetic plug integration within LIFT (Ligation of the Inter-Sphincteric Fistula Tract) procedure as effective approach for minimizing incontinence risk.[1819] Preoperative tuberculosis treatment is critical for surgical success. Garg et al. (2022) emphasized necessity for antitubercular therapy prior to intervention. Gangwar (2014) reported that failure to address underlying tuberculosis increases recurrence risk and compromises surgical outcomes.[1,17]

Interdisciplinary collaboration is crucial for optimizing treatment, with tuberculosis management requiring close coordination with infectious disease specialists. Garg et al. (2022) emphasized that systemic tuberculosis is a complicating factor, with untreated cases resulting in increased morbidity.[1] In high-prevalence regions, tuberculosis screening is integrated into fistula management protocols, whereas in lower-burden regions, the focus is on surgical techniques without routine infection assessment. Garg et al. (2022) reported disparities in recurrence rates due to inconsistent tuberculosis screening protocols.[1] Advanced imaging techniques, particularly Magnetic Resonance Imaging (MRI), enhance complex fistula assessment and surgical planning. Augustine et al. (2022) reported improved treatment outcomes with MRI-guided diagnosis.[20] Celayir (2020) highlighted resource limitations in low-income settings, impacting access to imaging technology and reliance on clinical examination.[21]

Tuberculosis-associated anal fistulae pose significant diagnostic and therapeutic challenges. High recurrence rates, complex anatomical involvement and inflammatory pathology necessitate multidisciplinary management. Molecular diagnostics that include PCR and Cartridge-Based Nucleic Acid Amplification Test (CBNAAT), offer superior accuracy for tuberculosis detection. Integration of advanced surgical techniques with antitubercular therapy remains critical for optimizing patient outcomes.

6. Materials and Methods

This retrospective cohort study evaluated 31 patients surgically treated for anal fistula at a single centre from December 2021 to January 2025. Data were sourced from clinical records that include demographics, fistula characteristics, tuberculosis (TB) diagnostic tests, surgical procedures, and outcomes. A 45 yr-male had multiple external openings as shown in **Figure 1**.

Figure 1: shows multiple external openings with TB positivity

Routinely, we do PUS for Tuberculosis Polymerase Chain Reaction (TB-PCR), QuantiFERON-TB Gold (TB - GOLD TEST), Erythrocyte Sedimentation Rate (ESR), Mantoux test, excised fistulous tract sent for conventional biopsy and tissue CBNAAT analysis. Moreover, we do sigmoidoscopy and MRI fistulogram for all patients with anal fistula disease. MRI fistulogram of a patient with a long transsphincteric fistulous tract as shown in **Figure 2**.

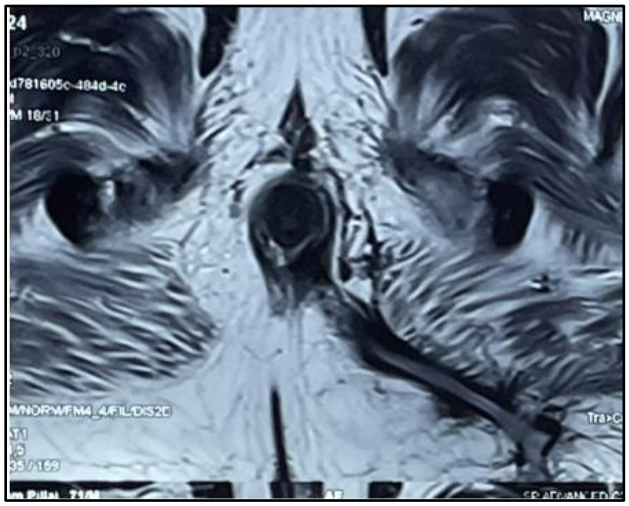

Figure 2: shows MRI Axial view of anal canal T2W image with complex High -Transphincteric fistula type. long tract with internal opening at 6 o'clock

We aimed to characterize the cohort and establish TB prevalence, assess the reliability and concordance of TB diagnostic tests, evaluate surgical interventions by TB status and fistula complexity and determine surgical success and the impact of TB and anti-tubercular therapy (ATT) on outcomes.

Patients were classified as TB-positive if any test (Mantoux, pus-tb-pcr, pus-cbnaat, fistula-cbnaat, tb gold) was positive or tb was noted in the diagnosis. Fistula complexity was categorized as simple, complicated, or horse-shoe. Surgical procedures were grouped into fistulectomy (Fistulotomy with psr), fistulectomy (e.g., fistulectomy +psr) and combined (e.g., fistulectomy, fistulotomy + tropis +psr + curettage). Outcomes were assessed as disease free, on att, lost followup, or refused and "not disease free".

Descriptive statistics determined age (mean, range), sex (% male), fistula features (% single/multiple, complexity), TB prevalence, and co-morbidities to define the cohort. TB diagnostic analysis calculated test positivity rates, using McNemar's test and Cohen's Kappa to evaluate reliability and concordance. Surgical management analysis compared procedure frequencies by TB status and complexity to assess intervention patterns.

Outcome analysis examined DISEASE FREE proportions by TB status, ATT completion (YES vs. incomplete) in TB-positive patients and recurrence rates to gauge success and TB/ATT effects. Statistical significance was tested with Chi-square or Fisher's exact tests for categorical data (e.g., TB vs. outcome) and Mann-Whitney U for age. We used $p<0.05$ as the significance threshold. Analyses were performed with SPSS v29.0 and Excel for precision.

Table 1: Demographic and clinical comparison between TB-Positive and TB-Negative groups.

Variable	Overall	TB-Positive	TB-Negative	p-value
Mean Age	40.45	41.73	39.25	0.66
Age Range	23-71	23-71	26-51	N/A
Male (n, %)	25, 80.6%	12, 80.0	13, 81.3	> 0.05
Female (n, %)	6, 19.4%	3, 20.0	3, 18.7	> 0.05

7. Results

Mean age of cohort indicated similarity between TB-positive and TB-negative groups. No statistically significant difference was observed ($p = 0.66$). Age range analysis showed considerable overlap, indicating that tuberculosis-associated anal fistulae affect a wide age spectrum without any preferential distribution.The following **Table 1** depicts

the results of the tuberculosis anal fistula with positive and negative groups

Gender distribution showed a predominance of males in both groups, with 80.0% of TB-positive and 81.3% of TB-negative patients being male, and 20.0% of TB-positive and 18.7% of TB-negative patients being female. The proportions were comparable, with p-values exceeding 0.05, confirming no significant difference. These findings align with previous studies, which have indicated a higher prevalence of anal fistulas among males due to anatomical and physiological factors.

8. Distribution of TB-Positive and TB-Negative Cases by conventional biopsy

Among 31 patients diagnosed with anal fistula, 48.4% (n = 15) tested positive for tuberculosis by biopsy, while 51.6% (n = 16) were TB-negative for biopsy. Distribution appeared nearly equal, indicating tuberculosis as a significant contributing factor but not the sole determinant in anal fistula development as shown in **Table 2**.

Table 2: Proportion of TB-positive and TB-negative biopsy results

Variable	n	Percentage
TB-Positive Biopsy	15	48.4
TB-Negative Biopsy	16	51.6

The proportion of TB-positive cases closely approximated TB-negative cases. The findings suggested that tuberculosis-associated anal fistula constitutes substantial subset within overall patient population.

Fistula Openings and Types: Among patients diagnosed with anal fistula, single external opening observed in 64.5% (n = 20), multiple openings present in 32.3% (n = 10), absent opening noted in 3.2% (n = 1) with statistically significant difference (p < 0.001) as shown in **Table 3**.

Table 3: Distribution of fistula openings and types with statistical analysis

Category	Characteristic	n	Percentage	P-value
Openings	Single Opening	20	64.5	< 0.001
	Multiple Openings	10	32.3	
	Absent Opening	1	3.2	
Fistula Type	Simple Fistula	10	32.3	0.016
	Complicated Fistula	17	54.8	
	Horseshoe Fistula	4	12.9	

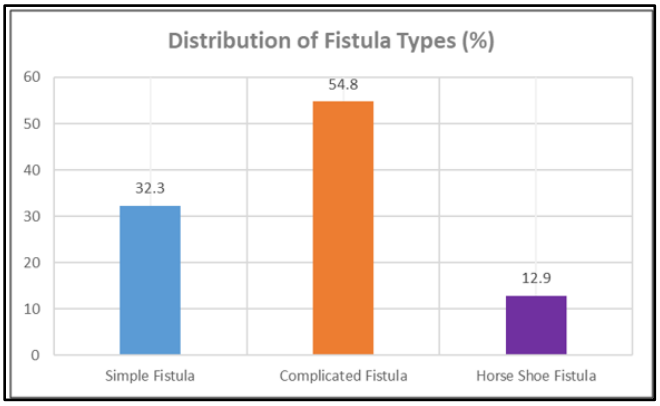

Figure 3: Distribution of fistula types (%)

Regarding fistula classification, simple fistula accounted for 32.3% (n = 10), complicated fistula observed in 54.8% (n = 17), horseshoe fistula identified in 12.9% (n = 4) with statistically significant variation (p = 0.016) as shown in **Figure 3**.

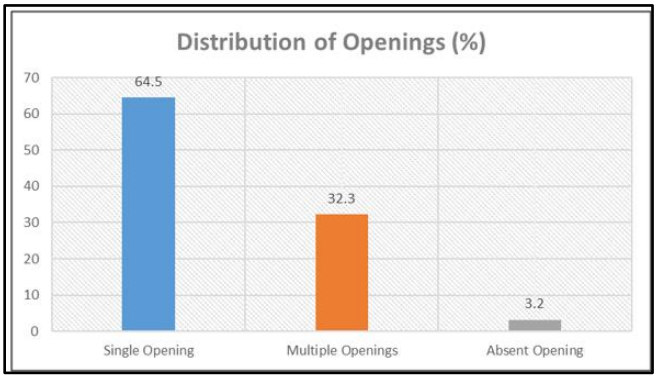

Figure 4: Distribution of openings (%)

The prevalence of a single external opening suggested a common presentation pattern, with a significantly higher occurrence (p < 0.001), indicating that the primary fistulous tract typically manifests as solitary. The presence of multiple openings in one-third of cases pointed to the complexity of disease progression, necessitating advanced surgical approaches. The higher proportion of complicated fistulae (54.8%) compared to simple ones (32.3%) underscored the substantial disease severity within the cohort as shown in **Figure 4**.

9. Co-morbidities Among Patients with Anal Fistula

Among patients diagnosed with anal fistula, 48.4% (n = 15) had no co-morbid conditions. Abscesses were observed in 29% (n = 9), making it the most common co-morbidity. Other conditions included cardiac diseases in 6.5% (n = 2), diabetes mellitus in 3.2% (n = 1), obesity in 3.2% (n = 1), and miscellaneous conditions such as rheumatic heart disease (RHD) and avascular necrosis (AVN) in 9.7% (n = 3).

Table 4: Co-morbidity distribution in the study population

Co-morbidity	n	%
Abscess	9	29
Diabetes (DM)	1	3.2
Obesity	1	3.2
Cardiac Conditions	2	6.5
Other (RHD, AVN, etc.)	3	9.7
None	15	48.4

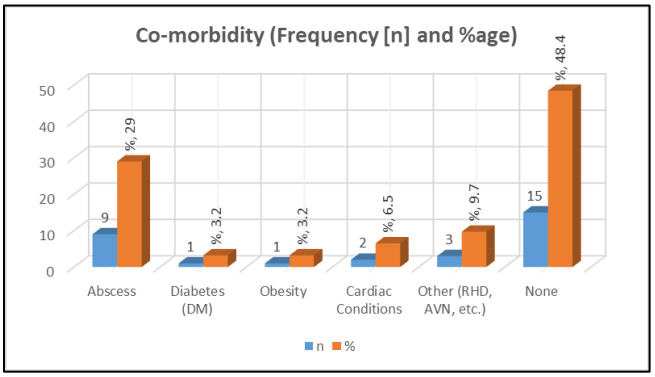

Figure 5: Co-morbidity (Frequency[n] and percentage)

High proportion of patients without co-morbidities (48.4%) suggested anal fistula occurs independent of systemic conditions in nearly half of cases. Abscesses, present in 29% of cases, emerged as the most common associated condition. These findings align with the known pathophysiology, where secondary infections contribute to fistula formation as shown in **Table 4**.

The prevalence of metabolic conditions such as diabetes and obesity remained low (3.2% each), suggesting minimal direct influence on disease occurrence within the cohort. The presence of cardiac conditions and other systemic diseases (9.7%) indicated necessity for multidisciplinary evaluation in selective cases as shown in **Figure 5**.

10. Comparison of Fistula Characteristics Between TB-Positive and TB-Negative Groups

Among TB-positive patients, a single external opening was observed in 60% (n = 9), multiple openings in 33.3% (n = 5), and no opening in 6.7% (n = 1). TB-negative patients showed a similar distribution, with a single opening in 68.8% (n = 11) and multiple openings in 31.3% (n = 5), with no cases of absent openings. The difference between the groups was not statistically significant (p = 0.61) as shown in **Table 5**.

Table 5: Comparison of fistula opening types between TB-positive and TB-negative groups

Characteristics	**TB-Positive n**	**TB-Positive %**	**TB-Negative n**	**TB-Negative %**	**p-value (TB Comparison)**
Single Opening	9	60	11	68.8	0.61
Multiple Openings	5	33.3	5	31.3	
Absent Opening	1	6.7	0	0	

Table 6: Comparison of fistula types between TB-positive and TB-negative groups

Characteristics	**TB-Positive n**	**TB-Positive %**	**TB-Negative n**	**TB-Negative %**	**p-Value (TB Comparison)**
Simple Fistula	3	20	7	43.8	0.31
Complicated Fistula	9	60	8	50	
Horseshoe Fistula	3	20	1	6.3	

Regarding fistula classification, simple fistulae were found in 20% (n = 3) of TB-positive cases, compared to 43.8% (n = 7) in TB-negative cases. Complicated fistulae were more prevalent in the TB-positive group (60%, n = 9) than in the TB-negative group (50%, n = 8). Horseshoe fistulae were observed in 20% (n = 3) of TB-positive cases, versus 6.3% (n = 1) in TB-negative cases. The differences between the groups were not statistically significant (p = 0.31) as shown in **Table 6**.

11. TB Diagnostic Patterns

Among TB-positive patients, diagnostic confirmation was achieved through various methods. TB-GOLD positivity was observed in 22.6% (n = 7), making it the most frequently detected marker. The MANTOUX test, PUS-TB-PCR, and PUS-CBNAAT each yielded positive results in 16.1% (n = 5). FISTULA-CBNAAT positivity was observed in 14.8% (n = 4), while diagnostic data were unavailable for 14.8% (n = 4) as shown in **Table 7**.

Table 7: Distribution of TB diagnostic patterns in the study population

TB Diagnostic Patterns	n	Percentage
MANTOUX Positive	5	16.1
PUS-TB-PCR Positive	5	16.1
PUS-CBNAAT Positive	5	16.1
FISTULA-CBNAAT Positive	4	14.8
TB GOLD Positive	7	22.6
Biopsy	5	14.8

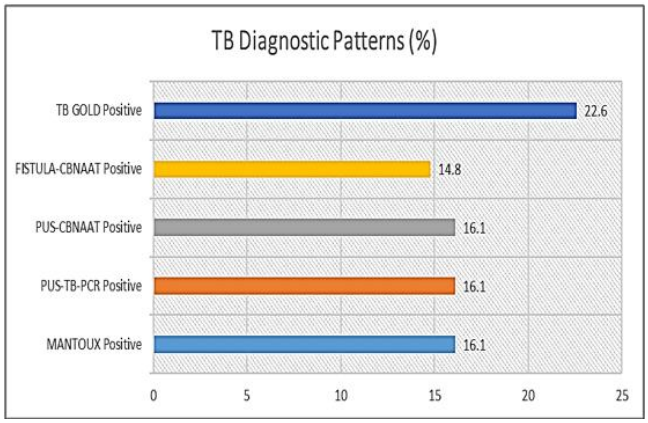

Figure 6: TB diagnostic patterns (%)

The variation in diagnostic modalities highlighted the absence of a single definitive test for tuberculosis in anal fistula cases, highlighting the necessity of using multiple methods for accurate detection. TB-GOLD demonstrated the highest positivity rate (22.6%), indicating its potential utility as a primary screening tool. The MANTOUX test, PUS-TB-PCR, and PUS-CBNAAT each identified tuberculosis in 16.1% of cases, reinforcing the need for microbiological and molecular confirmation. FISTULA-CBNAAT positivity (14.8%) suggests that direct sampling from the fistulous tract may have improved the diagnostic accuracies as shown in **Figure 6**.

12. Agreement between TB Diagnostic Tests

Comparison of diagnostic tests revealed varying levels of agreement. PUS-TB-PCR and PUS-CBNAAT showed an observed agreement (Po) of 0.742, with an expected agreement (Pe) of 0.73. The kappa coefficient of 0.044 indicated slight agreement, and the p-value of 0.78 suggested a non-significant association.

The comparison between MANTOUX and TB-GOLD yielded an observed agreement (Po) of 0.613 and an expected agreement (Pe) of 0.685. The kappa coefficient of -0.229 indicated poor agreement, and the p-value of 0.12 showed no statistical significance as shown in **Table 8**.

The comparison between MANTOUX and TB-GOLD yielded an observed agreement (Po) of 0.613 and an expected agreement (Pe) of 0.685. The kappa coefficient of -0.229 indicated poor agreement, and the p-value of 0.12 showed no statistical significance. The low kappa values across test pairs highlight the inconsistency in tuberculosis detection methods, emphasizing the need for a multi-test approach to improve diagnostic accuracy.

Table 8: Kappa analysis for TB diagnostic tests

Test Pair	n Tested	Observed Agreement (Po)	Expected Agreement (Pe)	Kappa	Interpretation	p-value
PUS-TB-PCR vs. PUS-CBNAAT	31	0.742	0.73	0.044	Slight Agreement	0.78
MANTOUX vs. TB GOLD	31	0.613	0.685	-0.229	Poor Agreement	0.12

Despite targeting similar biological material, PUS-TB-PCR and PUS-CBNAAT exhibited slight agreement, likely due to differences in the sensitivity and specificity of the molecular techniques. The poor agreement between MANTOUX and TB-GOLD suggests that immunological tests may not reliably correlate in detecting tuberculosis in anal fistula cases. Additionally, factors such as prior BCG vaccination, latent TB status, or individual immune responses must be considered.

13. Surgical Interventions for Anal Fistula - Distribution and Association with Tuberculosis and Fistula Complexity

Laser fistulotomy with primary sphincter repair (PSR) was performed in 38.7% of cases overall, with higher utilization in TB-positive patients (46.7%) compared to TB-negative patients (31.3%). The procedure was more prevalent among complicated (47.1%) and horseshoe fistulae (50%) than in simple fistulae (30%). No statistically significant difference was observed regarding tuberculosis association ($p = 0.73$) or fistula complexity ($p = 0.25$). Fistulectomy with PSR was conducted in 9.7% of cases, with 6.7% in TB-positive and 12.5% in TB-negative patients. This procedure was applied exclusively to simple fistulae (20%), with no cases in complicated or horseshoe fistulae. No statistical significance was observed ($p = 0.73$ for tuberculosis; $p = 0.25$ for complexity) as shown in

Table 9.

Table 9: Distribution of surgical procedures by TB status and fistula complexity

Procedure Category	Overall %	TB +ve %	TB -ve %	Simple %	Complicated %	Horse Shoe %	p-value (TB)	p-value (Complexity)
Laser Fistulotomy with PSR	38.7	46.7	31.3	30	47.1	50	0.73	0.25
Laser Fistulectomy with PSR	9.7	6.7	12.5	20	0	0	0.73	0.25
Combined	35.5	33.3	37.5	10	35.3	50	0.73	0.25
Others/Not Done	16.1	13.3	18.8	40	17.6	0	N/A	N/A

Table 10: Treatment outcome based on ATT Status in TB-positive patients

ATT status (TB-Positive)	Disease Free n	Disease Free %	Not Disease-Free n	Not Disease Free %	p-value
ATT Completed (YES)	28	90	0	0	0.001
ATT Incomplete (ON ATT/LOST)	3	9.6	8	53.3	0.001

The combined surgical approach, where the fistula tract was removed with fistulectomy on the lateral component and fistulotomy on the medial component, was used in 35.5% of cases. It was applied in 33.3% of TB-positive and 37.5% of TB-negative patients. This approach was more frequently observed in complicated (35.3%) and horseshoe (50%) fistulae compared to simple (10%) cases. Statistical analysis revealed no significant association with tuberculosis (p = 0.73) or fistula complexity (p = 0.25) as shown in Table 9. The diagrammatic representation of the operative finding as shown in **Figure 7**.

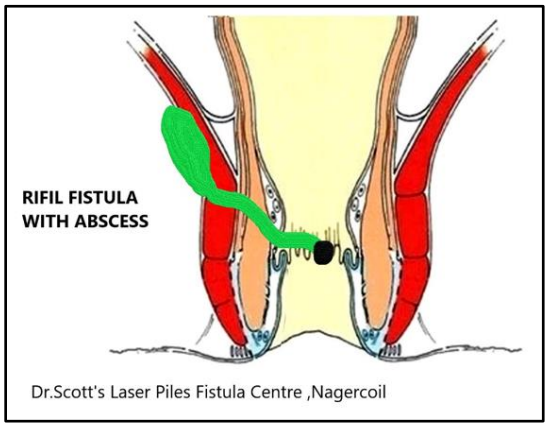

Figure 7: RIFIL abscess with internal opening at 6 o'clock (Roof of The Ischiorectal Fossa Inferior To Levator Ani) description

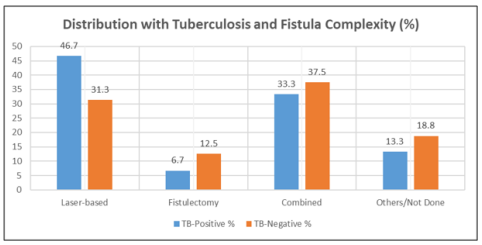

Figure 8: Distribution with tuberculosis and fistula complexity (%)

The similar distribution of surgical approaches across TB-positive and TB-negative groups suggests that tuberculosis status does not significantly influence the choice of intervention. These findings imply that surgical management is primarily guided by anatomical complexity rather than the presence of tuberculosis. Laser-based procedures were the most frequently performed, especially in complicated (47.1%) and horseshoe (50%) fistulae. This preference for minimally invasive techniques in challenging cases likely reflects their reduced morbidity and better healing outcomes.

Fistulectomy was exclusively performed in simple fistulae (20%), with no cases in complicated or horseshoe fistulae, highlighting the preference for more extensive procedures in severe cases. Combined approaches were used in 35.5% of cases, with a higher prevalence in complicated and horseshoe fistulae, underscoring the need for multimodal strategies in managing complex disease presentationsa as shown in **Figure 8**.

14. ATT Completion vs. Outcome (TB-Positive Subgroup)

Among TB-positive patients, disease-free status was achieved in 90% (n = 28) of those who completed ATT, with no cases of persistent disease in this subgroup as shown in **Table 10**.

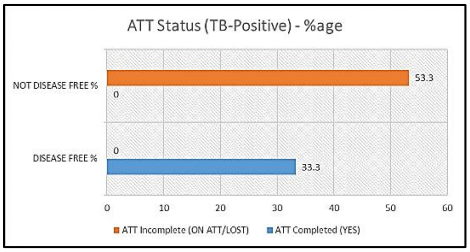

Figure 9: ATT Status (TB-Positive)-Percentage

All patients with incomplete ATT (either ongoing or lost to follow-up) remained disease-positive (9.6%, n = 3). The association between ATT completion and disease outcome was highly significant (p = 0.001). A strong correlation was observed between ATT adherence and disease resolution: completion of ATT resulted in 100% disease-free status, while incomplete treatment led to persistent disease in all cases. The statistically significant association (p = 0.001) emphasized the critical importance of strict adherence to ATT in the management of tuberculosis-associated anal fistulae as shown in **Table 10**. ATT positive percentage is shown in the **Figure 9**.

15. Recurrence Rates by TB Status

Recurrence was observed in 3.2% (n = 1) of TB-positive patients, while 96.3% (n = 27) remained disease-free. Low recurrence rates were noted across both TB-positive (6.7%) and TB-negative patients, suggesting that tuberculosis status may strongly influence these outcomes.

15.1. Abscess and anal fistula

Out of the 31 TB fistula patients, nine patients presented with tubercular (TB) abscesses, two had Roof of Ischiorectal Fossa Inside the Levator Ani Muscle (RIFIL) abscesses, three had supralevator abscesses and four had ischiorectal and superficial perianal space abscesses. The three patients with supralevator abscesses experienced delayed healing. Abscess formation occurred during the course of anti-tubercular therapy (ATT), requiring surgical intervention.

Additionally, patients with RIFIL space abscesses experienced recurrent abscess formation during the course of anti-tubercular therapy (ATT), necessitating redo surgery. These patients underwent a prolonged course of ATT for nine months. Consequently, the presence of abscess formation alongside a TB fistula presents a significant challenge in the treatment process, complicating both management and recovery.

16. Discussion

Surgical management of tuberculosis-associated anal fistula remains a complex effort and requires strategic integration of operative techniques and antitubercular therapy (ATT) to optimize outcomes. This retrospective cohort study of 31 patients aligned with prior observations regarding significant contribution of tuberculosis to anal fistula pathology as noted by Hokkanen et al. (2019). They too reported a heightened prevalence in TB-affected individuals. Our finding of a 48.4% TB-positive rate among anal fistula cases exceeds the 20.3% reported by Garg et al. (2019) for complex fistulas; this emphasized tuberculosis as a substantial factor in our cohort in an endemic setting.

This disparity highlights regional variations in the TB burden and indicated the need for heightened clinical suspicion in high-prevalence areas. Our findings are consistent with those of Garg et al. (2019) and Chaudhry et al. (2023).

Fistula complexity in our study of 54.8% complicated and 12.9% horseshoe mirrors the findings of Bük et al. (2024), who identified Transphincteric and suprasphincteric variants as surgically challenging due to sphincter involvement.[10] Surgical interventions, predominantly laser-based (38.7%) and combined approaches (35.5%), reflected a preference for sphincter-preserving techniques similar to those advocated by Zhao et al. (2019).[22] The lack of significant association between procedure type and TB status (p = 0.73) or complexity (p = 0.25) contrasts with Khan et al. (2024), who highlighted the influence of technique selection on outcomes.[23] This suggests that anatomical complexity, rather than tuberculosis status, drives surgical planning in our cohort, aligning with Schwandner (2011) on the importance of individualized approaches.[24]

Diagnostic challenges persisted as noted by Sasahara et al. (2021) and Maulahela et al. (2022).[2,25] Our TB diagnostic patterns revealed TB-GOLD's higher positivity (22.6%) compared to MANTOUX, PUS-TB-PCR, and PUS-CBNAAT (16.1% each), supporting Lao and Mao (2021) on IGRAs' utility in atypical TB.[4] However, the poor agreement between MANTOUX and TB-GOLD (Kappa = -0.229, p = 0.12) and slight agreement between PUS-TB-PCR and PUS-CBNAAT (Kappa = 0.044, p = 0.78) diverged from Maulahela et al. (2022), who advocated for multi-modal testing. This inconsistency may reflect immune variability or sampling limitations, underscoring the need for PCR and histopathological confirmation, as suggested by Gkegkes et al. (2023).[2,25,26]

Outcomes in our study demonstrated a 22.6% overall disease-free rate, with TB-positive patients achieving 33.3% disease-free status compared to 12.5% in TB-negative cases (p = 0.18). While this trend was not statistically significant, it aligns with Mantefardo et al. (2023), who highlighted TB's complicating role.[27] Notably, ATT completion among TB-

positive patients yielded a 100% disease-free rate (p = 0.001), reinforcing Garg et al. (2022) on the critical role of ATT in reducing recurrence and improving surgical outcomes.[1] Recurrence was observed in 6.7% of TB-positive cases versus 0% in TB-negative (p = 0.48), which is lower than the 12.5% recurrence rate reported by Khan et al. (2024), suggesting effective management despite the presence of TB.[23]

These findings highlight the complex interdependencies between TB management and surgical strategy in the treatment of anal fistulas. Our recurrence rates are better than those reported by Tassew et al. (2018)[12], but the modest disease-free rate indicate the need for preoperative imaging, as suggested by Augustine et al. (2022)20[20], and emphasizes the importance of interdisciplinary coordination, in line with Garg et al. (2022).[1]

17. Conclusion

Tuberculosis is a significant contributor to anal fistula pathology, with a similar prevalence observed in our cohort. The variability in diagnostic tests underscores the necessity for a multi-disciplinary approach. Surgical outcomes are primarily influenced by fistula complexity rather than tuberculosis status. Completion of anti-tubercular therapy (ATT) notably improved disease-free rates. These findings emphasize the importance of preoperative tuberculosis screening and the need for interdisciplinary management in treating these cases.

18. Source of Funding

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19. Conflict of Interest

None.

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