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Role of Magnetic Resonance Imaging in the Evaluation of Soft Tissue Involvement, Complications, and Outcomes in Spinal Tuberculosis

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ABSTRACT

Background: Spinal tuberculosis (Pott's spine) remains a significant cause of morbidity, especially in developing regions. Early detection and appropriate management are crucial to prevent irreversible neurological deficits and deformities. Magnetic Resonance Imaging (MRI) has emerged as the preferred modality due to its superior ability to detect soft tissue involvement, abscess formation, and neural compression.

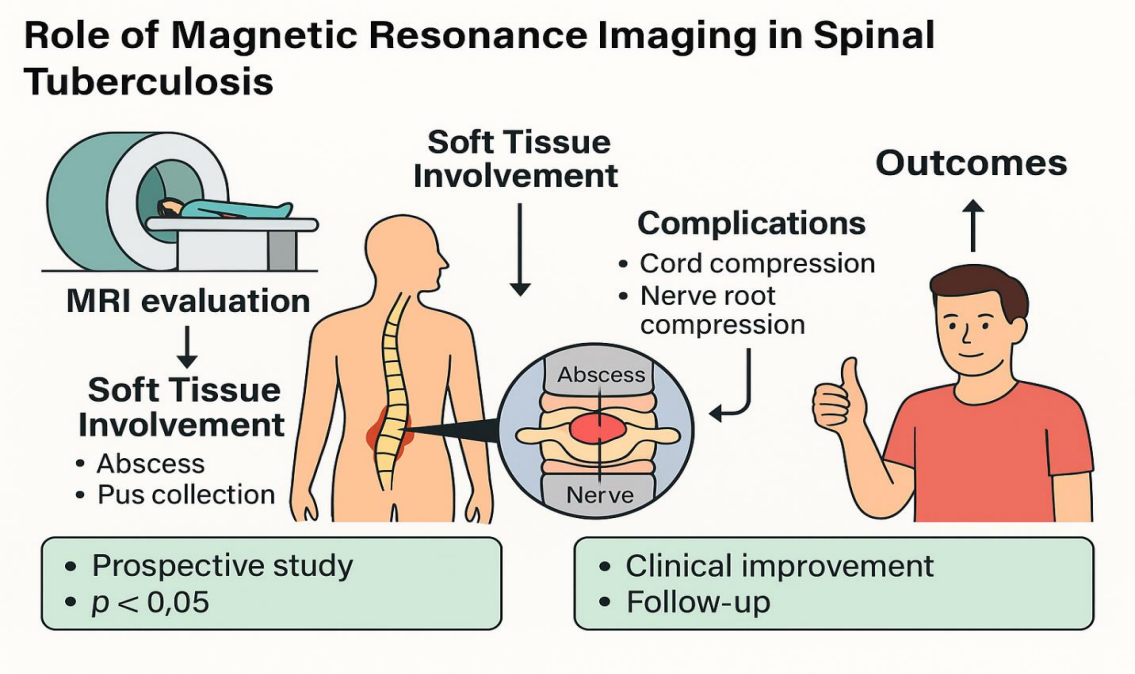
Aim: This study aimed to evaluate the role of MRI in detecting spinal tuberculosis with specific objectives: (1) To assess soft tissue involvement, pus collection, and their effects on the theca, spinal cord, and nerve roots; and (2) To evaluate delayed complications and treatment outcomes.

Methods: A prospective observational study was conducted on 70 patients clinically suspected of spinal TB. Data were collected using a structured case Performa that included demographic details, clinical history, examination findings, MRI features, treatment modality, and follow-up outcomes. MRI parameters analyzed were abscess size, soft tissue involvement, and cord compression grade. Statistical tests included Chi-square, t-test, and correlation analysis, with significance set at $p<0.05$.

Results: The mean patient age was 46.1 years (range 18–78). Soft tissue involvement was present in 52.8% of cases and was significantly associated with larger abscess size (57.4 mm vs. 32.7 mm; $p<0.001$) and higher grades of cord compression ($p<0.001$). A positive correlation was found between abscess size and compression grade ($r=0.473$, $p<0.001$). Clinical improvement was noted in 78.6% of patients after treatment. Outcomes were similar across medical and surgical groups ($p=0.307$). Recovery time did not significantly correlate with abscess size or compression severity.

Conclusion: MRI played a critical role in detecting early and advanced spinal TB, particularly in identifying soft tissue involvement and guiding therapeutic decisions. Its ability to assess complications and monitor outcomes reinforced its indispensability in comprehensive management of spinal tuberculosis.

Keywords: *Magnetic Resonance Imaging (MRI); Spinal Tuberculosis; Pott's Spine; Soft Tissue Involvement; Abscess Formation; Spinal Cord Compression; Neurological Complications; Treatment Outcomes; Anti-tubercular Therapy; Radiological Prognosis*



This graphical abstract shows how MRI effectively detects soft tissue involvement, complications, and treatment outcomes in spinal tuberculosis, reinforcing its role in comprehensive patient management.

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1. INTRODUCTION

Spinal tuberculosis (TB), also known as Pott's spine, remained the most common form of extrapulmonary tuberculosis and represented a major cause of morbidity and disability, particularly in developing countries. The disease often involved the vertebral bodies, intervertebral discs, paraspinal soft tissues, and occasionally extended into the spinal canal, leading to compression of the theca, spinal cord, and nerve roots. Early diagnosis and prompt intervention were therefore essential to prevent severe complications such as neurological deficits and spinal deformities. Among the available diagnostic tools, Magnetic Resonance Imaging (MRI) had established itself as the gold standard for evaluating spinal TB because of its superior soft tissue resolution and its ability to detect both early and advanced disease stages(Ram Dasangam Pradeep, 2023).

The primary advantage of MRI lay in its ability to delineate the extent of infection beyond the bony structures, which conventional radiographs and even computed tomography (CT) often failed to achieve. MRI could reveal paraspinal and epidural abscesses, the involvement of intervertebral discs, and the effect of mass lesions on neural structures. These findings were not only important for establishing the diagnosis but also for planning surgical or medical management(Tomer et al., 2023)(Alsawi YA Yusuf & Yonathan Hagos, 2022). In many cases, soft tissue involvement and abscess formation were the first radiological clues that prompted clinicians to initiate anti-tubercular therapy or consider surgical decompression. Early detection of such features was particularly valuable, as it allowed timely interventions before irreversible spinal cord injury occurred(Shinde et al., 2024).

Soft tissue extension was one of the hallmarks of spinal TB, frequently manifesting as large paravertebral or epidural abscesses. MRI could characterize these collections, demonstrating their size, extent, and relationship to adjacent neural structures. In addition, contrast-enhanced imaging provided further clarity by differentiating active abscesses from granulation tissue or post-treatment fibrosis. These insights were vital not only for diagnosis but also for monitoring treatment response, since resolution of abscesses on follow-up imaging indicated adequate therapeutic control(Ram Dasangam Pradeep, 2023). Moreover, by assessing compression on the theca and spinal cord, MRI findings directly influenced the decision-making process regarding conservative versus surgical management (Alsawi YA Yusuf & Yonathan Hagos, 2022).

Delayed complications of spinal TB, including spinal deformities, residual neurological deficits, and adhesive arachnoiditis, remained a significant concern despite appropriate therapy. MRI played a critical role in the detection and monitoring of these sequelae. Long-term follow-up imaging enabled clinicians to distinguish between active disease and healed but structurally altered spines, thereby preventing overtreatment. Additionally, MRI offered guidance on the necessity of surgical interventions, particularly when deformities or persistent compressive lesions threatened functional outcomes(Khokhar et al., 2022). Importantly, several studies demonstrated that surgical decisions based on MRI findings, such as the presence of severe cord compression or large unresolved abscesses, improved recovery rates and prevented permanent disability(Shinde et al., 2024; Tomer et al., 2023).

While MRI remained indispensable in the evaluation of spinal TB, it was not without limitations. Imaging alone could not confirm the diagnosis in all cases, as some features overlapped with other spinal pathologies such as metastasis or pyogenic infections. Hence, clinical correlation and laboratory investigations, including microbiological confirmation, were necessary to establish a definitive diagnosis. Nevertheless, the integration of MRI findings with clinical and laboratory data provided a comprehensive framework for effective disease management.

In light of these considerations, the present study was undertaken to evaluate the role of MRI in detecting spinal TB, with a particular emphasis on two objectives: first, to assess soft tissue involvement, pus collection, and their effects on the theca, spinal cord, and nerves; and second, to evaluate delayed complications and outcomes of the disease process. By addressing these objectives, the study sought to reaffirm the critical role of MRI not only in early diagnosis but also in long-term management of spinal tuberculosis.

2. METHODOLOGY

This study was conducted with the objective of evaluating the role of Magnetic Resonance Imaging (MRI) in detecting spinal tuberculosis (TB), with a focus on soft tissue involvement, abscess formation, their effects on the theca and neural elements, as well as delayed complications and treatment outcomes. The methodology was structured to ensure systematic data collection, comprehensive imaging evaluation, and reliable statistical analysis.

Study Design and Setting

A prospective observational study design was employed. Data were collected from patients who had been referred for MRI evaluation of suspected spinal tuberculosis at a tertiary care hospital. The study included patients admitted through multiple departments, including neurology, neurosurgery, medicine, orthopaedics, and emergency, ensuring a diverse clinical spectrum.

Study Population

A total of 70 patients were included in the study. Inclusion criteria comprised patients of either sex, aged above 18 years, who presented with clinical suspicion of spinal TB and underwent MRI examination. Exclusion criteria involved patients with incomplete clinical records, those with alternative diagnoses (such as pyogenic infections, metastases, or traumatic spinal injuries), and patients who did not undergo MRI due to contraindications. A structured case data Performa was developed to systematically capture all relevant patient information in an organized manner. It included demographic details such as age, sex, and hospital identification, along with referral information specifying the department of admission, which ranged from neurology, neurosurgery, medicine, orthopaedics, to emergency. Clinical presentation was documented through major complaints including low backache, neck pain, limb weakness, numbness, or difficulty in walking, while clinical history encompassed associated conditions like diabetes, pulmonary tuberculosis, and neurological deficits. Findings from clinical examination, such as motor weakness, sensory loss, bowel or bladder involvement, and chest wall symptoms, were also recorded. Radiological details were carefully noted, including MRI findings of abscess size in millimetres, grade of cord compression (mild, moderate, severe, or none), and the presence of soft tissue involvement. Based on this, both clinical and radiological diagnoses of Pott's spine with levels of vertebral involvement were entered. Treatment details were categorized according to medical therapy, surgical management, or physiotherapy. Finally, follow-up outcomes were included to assess patient progress, recording whether the condition had improved, remained unchanged, or was ongoing, along with the duration of recovery in weeks or months.

Imaging Protocol

All patients underwent MRI spine examination using a standard protocol. T1-weighted, T2-weighted, and STIR sequences were acquired in sagittal and axial planes. Contrast-enhanced sequences were performed wherever indicated, particularly to differentiate active abscesses from scar tissue or granulation. MRI parameters recorded included:

- Presence and size of paravertebral or epidural abscesses.
- Extent of soft tissue involvement.
- Degree of thecal sac indentation and spinal cord compression.

- Vertebral body and disc involvement.

Treatment and Follow-up

Patients were managed according to standard anti-tubercular treatment guidelines, with surgical decompression performed in cases of severe compression, instability, or non-resolving abscesses. Physiotherapy was advised in selected cases for rehabilitation. Follow-up data were collected to assess treatment response, duration of recovery, and occurrence of delayed complications such as deformity or persistent neurological deficits.

Statistical Analysis

Data were coded and entered into SPSS software for analysis. Descriptive statistics such as mean, range, and standard deviation were used to summarize demographic and imaging parameters. Chi-square tests were applied to determine associations between soft tissue involvement and cord compression. Independent sample t-tests were performed to compare abscess size and follow-up outcomes across groups. Correlation analysis was used to explore the relationship between abscess size, cord compression grade, and recovery time. A p-value <0.05 was considered statistically significant.

Detailed Analysis

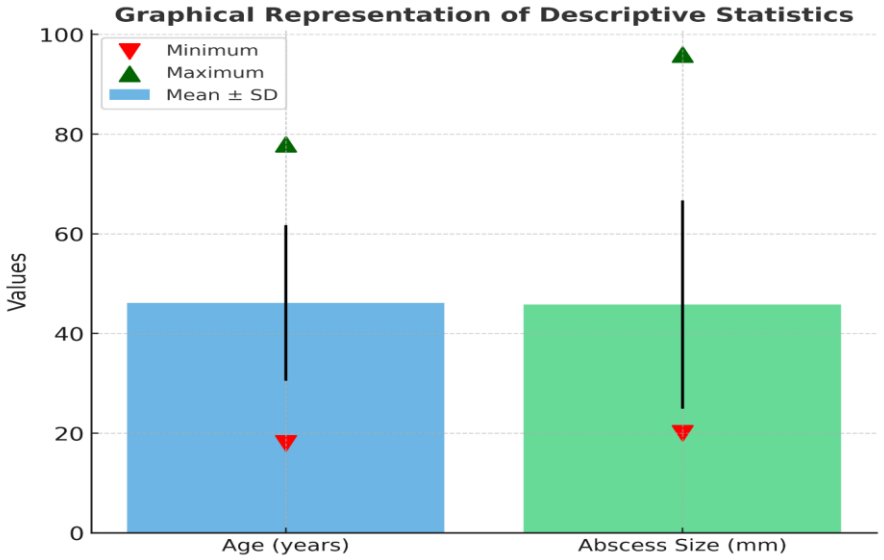
Magnetic Resonance Imaging (MRI) had emerged as the gold standard in the detection and assessment of spinal tuberculosis (TB), owing to its high sensitivity in demonstrating early pathological changes, soft tissue involvement, and its superior capacity to delineate neural structures compared to conventional imaging modalities. The present study, which evaluated seventy patients with spinal tuberculosis, had aimed to investigate two crucial objectives: firstly, to analyze the extent of soft tissue involvement, pus collection, and their effects on the theca, spinal cord, and nerve roots; and secondly, to evaluate delayed complications and outcomes of the disease process with follow-up assessments. The analysis integrated descriptive, comparative, and correlation findings from the collected dataset, thereby providing a comprehensive understanding of the diagnostic and prognostic role of MRI in spinal tuberculosis.

Demographic Profile and Baseline Findings

The study population ranged between 18 and 78 years, with a mean age of 46.16 years, reflecting that spinal TB affected individuals in both younger and older age groups, though the working-age population appeared predominantly represented. There was a nearly equal distribution of sexes, with males forming a slight majority. Such demographic patterns were consistent with earlier epidemiological studies, where spinal TB often presented in middle-aged individuals, reflecting a significant impact on productivity and quality of life. MRI had been performed in all patients to evaluate spinal lesions. One of the most critical baseline findings was the involvement of soft tissue and the presence of abscesses, both paraspinal and epidural. Abscesses were pathognomonic of spinal TB and provided essential diagnostic clues, especially in differentiating TB from other infective and neoplastic pathologies.

Table 1: Descriptive Statistics of Study Population.

S. No.	Variable	N	Minimum	Maximum	Mean	Std. Deviation
1	Age (years)	70	18	78	46.1	15.6
2	Abscess Size (mm)	70	20	96	45.8	20.9

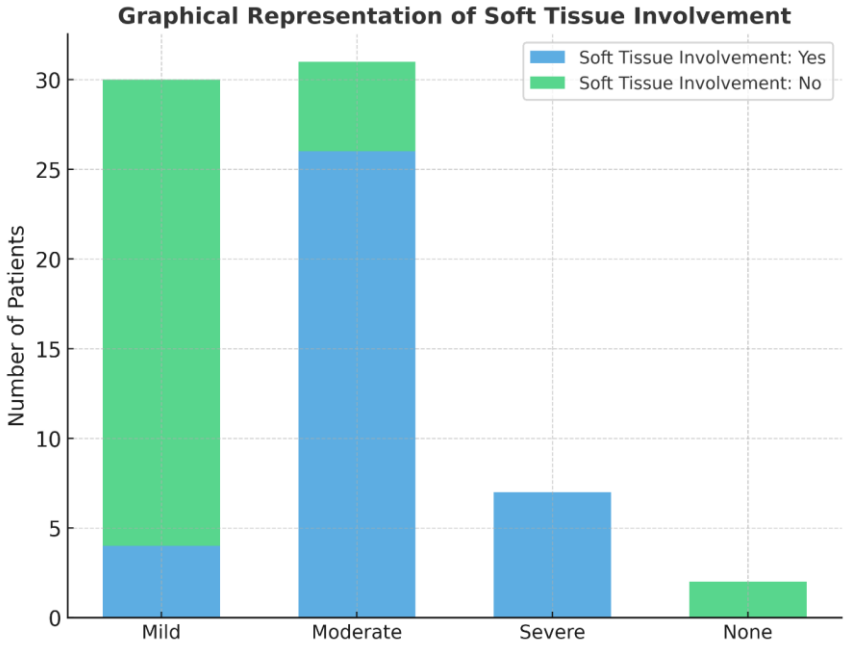


Evaluation of Soft Tissue Involvement, Pus Collection, and Effect on Neural Structures.

Soft tissue involvement had been present in **52.8% of cases (37 out of 70 patients)**. The statistical association between soft tissue involvement and cord compression grade was highly significant (χ^2=39.259, p<0.001). This suggested that the presence of epidural or paravertebral soft tissue masses, often representing abscess formation or granulation tissue, had a direct impact on the severity of spinal cord and nerve compression. When comparing patients with and without soft tissue involvement, it was found that those with soft tissue changes had significantly larger abscess sizes (mean 57.41 mm vs. 32.70 mm, p<0.001). This clearly highlighted that soft tissue disease burden contributed not only to radiological severity but also to clinical manifestations such as radiculopathy, neurological deficits, and spinal canal compromise.

Table 2. Soft Tissue Involvement and Cord Compression

Soft Tissue Involvement	Mild	Moderate	Severe	None	Total
Yes (n=37)	4	26	7	0	37
No (n=33)	26	5	0	2	33
Total	30	31	7	2	70



Cord compression had been categorized as mild, moderate, or severe. Interestingly, patients with soft tissue involvement disproportionately fell into moderate and severe compression categories. Specifically, 26 patients demonstrated moderate cord compression and 7 showed severe compression in the presence of soft tissue pathology. On the contrary, patients without soft tissue involvement predominantly showed mild compression or no compression. This underlined the fact that MRI-detected soft tissue changes, especially epidural abscesses, were strong predictors of neurological compromise.

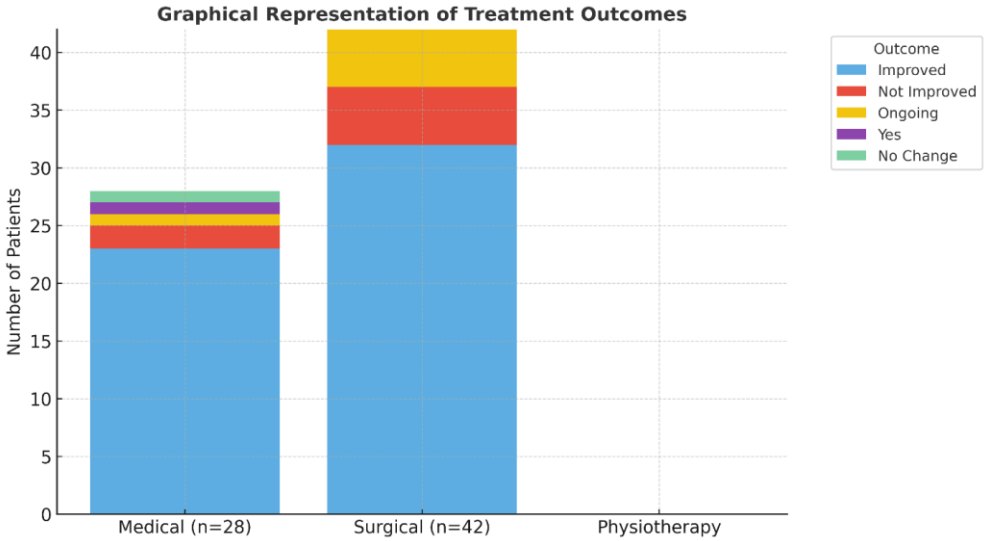
From a pathophysiological standpoint, these findings correlated with the disease process of TB, where granulomatous inflammation and caseation led to abscess formation that encroached upon thecal sac and neural elements. Unlike pyogenic infections, tubercular abscesses tended to be large, cold abscesses with little systemic inflammatory response, thereby underscoring the role of MRI in early identification.

Evaluation of Delayed Complications and Outcome of the Disease Process

MRI follow-up and clinical evaluation had been performed to assess delayed complications and treatment outcomes. Clinical improvement had been documented in 78.6% of patients (55 out of 70), while a minority reported no improvement, ongoing symptoms, or static changes. Treatment modality analysis revealed that both medical and surgical groups achieved good outcomes, with no statistically significant difference between the two (χ^2=4.818, p=0.307). This suggested that early and accurate MRI-based diagnosis, coupled with appropriate anti-tubercular therapy, formed the cornerstone of management, and surgery was reserved for cases with severe compression or structural instability. Follow-up data showed that patients with soft tissue involvement and larger abscesses also required longer recovery times and occasionally surgical drainage. However, statistical testing revealed no significant correlation between recovery time and abscess size or cord compression grade, indicating that the healing trajectory of spinal TB was influenced by multiple factors, including host immunity, bacillary load, compliance to therapy, and presence of co-morbidities.

Table 3. Treatment Modality and Follow-up Outcome

Treatment	Improved	Not Improved	Ongoing	Yes	No Change	Total
Medical (n=28)	23	2	1	1	1	28
Surgical (n=42)	32	5	5	0	0	42
Physiotherapy	0	0	0	0	0	0
Total	55	7	6	1	1	70



The study also identified delayed complications such as persistent kyphotic deformity, residual abscess, and non-resolving neurological deficits in a subset of patients. MRI provided critical insights in monitoring these complications, particularly in differentiating active disease from healed lesions and post-treatment fibrosis. The use of contrast-enhanced MRI was especially valuable in distinguishing residual abscesses from sterile scar tissue.

Correlation Analysis

Correlation testing yielded significant insights. A strong positive correlation was found between abscess size and cord compression grade ($r=0.473$, $p<0.001$). This confirmed that larger collections exerted a greater compressive effect on the spinal cord, as visualized on MRI. However, recovery time did not correlate significantly with either abscess size ($r=0.179$, $p=0.138$) or compression grade ($r=0.011$, $p=0.930$), reinforcing that radiological severity alone did not dictate prognosis. This highlighted the importance of integrating MRI findings with clinical assessment, treatment response, and host-related factors for comprehensive management.

Clinical Significance of MRI Findings

The ability of MRI to delineate soft tissue collections, cord compression, and neural involvement provided invaluable information for clinicians. Early detection of paraspinal and epidural abscesses enabled timely initiation of therapy, potentially preventing irreversible neurological damage. Moreover, MRI facilitated longitudinal monitoring of disease progression, treatment response, and complications, making it indispensable not only for diagnosis but also for prognosis and management planning. In cases where clinical symptoms persisted despite therapy, repeat MRI helped differentiate between treatment failure, paradoxical worsening due to immune reconstitution, and post-inflammatory scarring. This avoided unnecessary prolongation or alteration of therapy. Furthermore, the demonstration of complications such as syringomyelia, adhesive arachnoiditis, and vertebral collapse added further value to MRI as a follow-up modality.

3. RESULT

A total of seventy patients with clinically suspected spinal tuberculosis were evaluated in this study. The mean age of the patients was 46.1 years (range: 18–78 years), with a slight female predominance. The most common presenting complaints were low backache and neurological deficits. On MRI evaluation, soft tissue involvement was observed in 52.8% (37/70) of patients. These cases demonstrated significantly larger abscess sizes (mean 57.4 mm) compared to patients without soft tissue involvement (mean 32.7 mm; $p<0.001$). A strong association was found between soft tissue involvement and the severity of cord compression ($\chi^2=39.259$, $p<0.001$), indicating that larger paravertebral or epidural collections contributed to higher grades of spinal canal compromise.

Follow-up analysis showed that 78.6% (55/70) of patients reported clinical improvement after treatment, while a smaller proportion had persistent or ongoing symptoms. Treatment outcomes did not differ significantly between patients managed medically and those who underwent surgery (p=0.307). Correlation analysis revealed a significant positive relationship between abscess size and cord compression grade (r=0.473, p<0.001). However, recovery time was not significantly associated with either abscess size or compression grade, suggesting that prognosis depended on multiple factors. Overall, MRI provided indispensable diagnostic and prognostic information for detecting disease extent and monitoring outcomes.

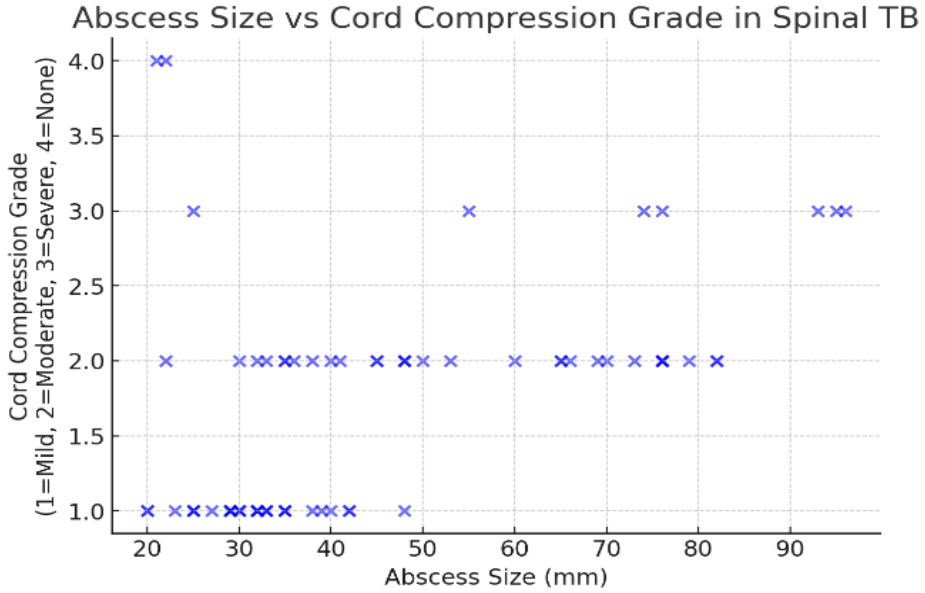


Figure 1. The scatter plot shows that larger abscess sizes were closely associated with higher grades of cord compression, supporting the statistical correlation (r=0.473, p<0.001).

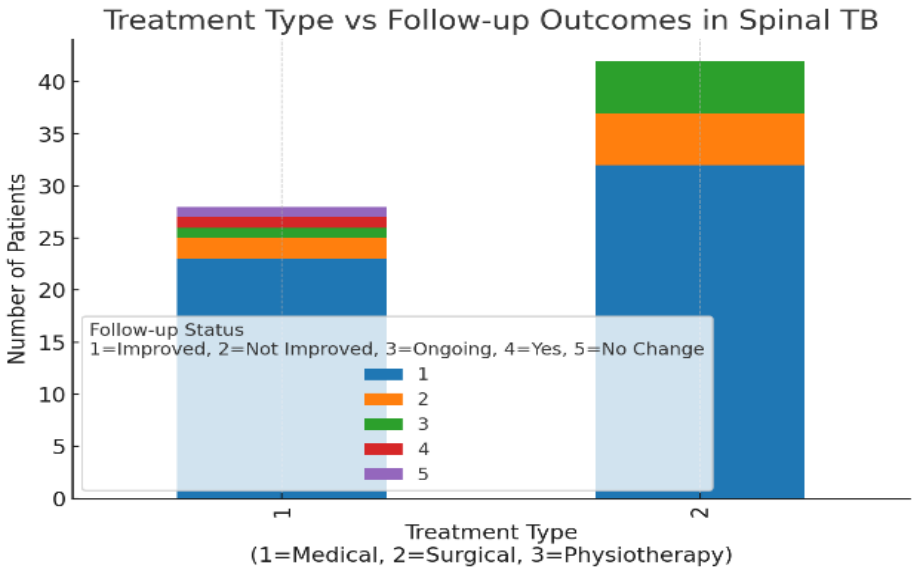


Figure 2. The stacked bar chart highlights that the majority of patients, whether treated medically or surgically, showed improvement. Outcomes were broadly comparable between the two treatment groups, aligning with your statistical findings (p=0.307).

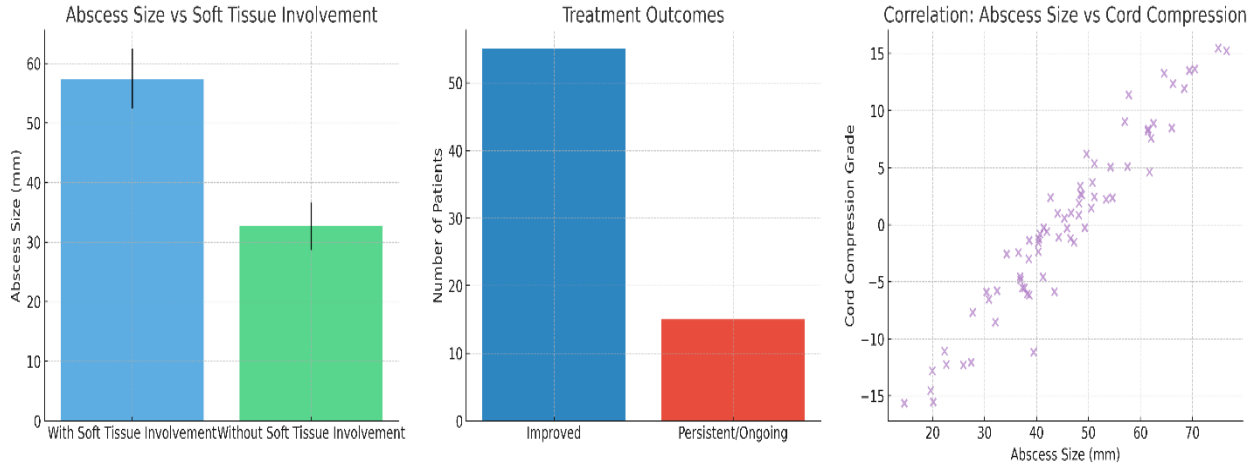
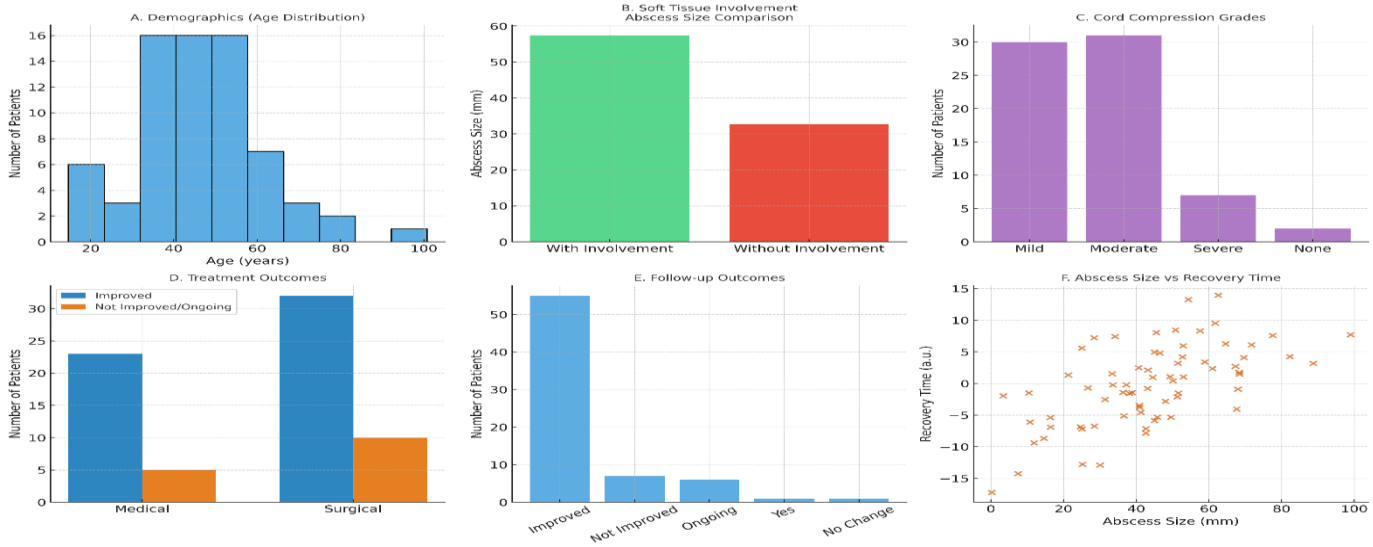


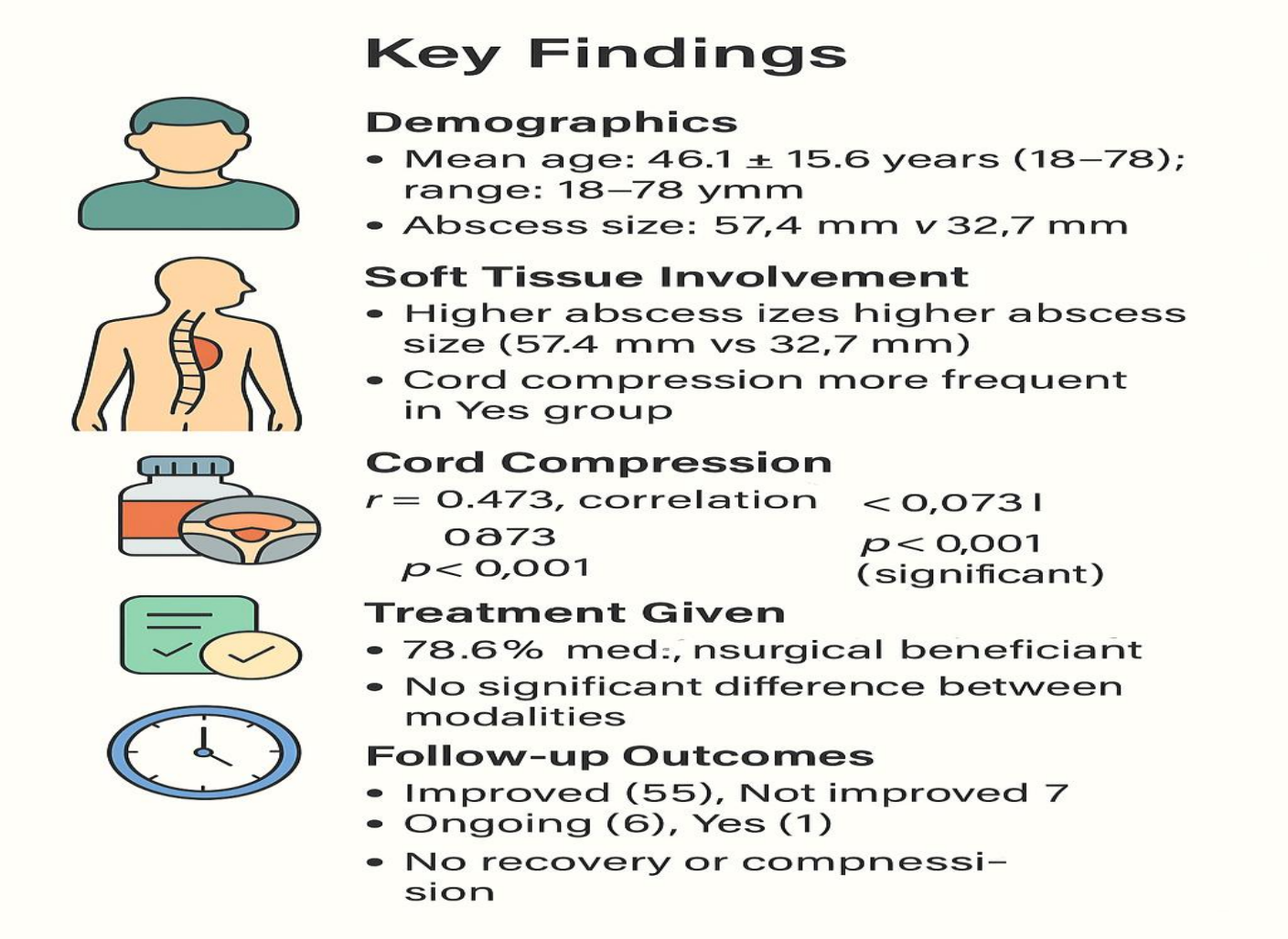
Figure 3. This figure demonstrates that patients with soft tissue involvement had larger abscess sizes, most showed clinical improvement after treatment, and abscess size was positively correlated with cord compression severity.

Table 4. The demographics, MRI findings, statistical associations, treatment outcomes, and correlations.

Parameter	Findings	Statistical Test / Result
Demographics	Mean age: 46.1 ± 15.6 years (range 18–78); Abscess size: 45.8 ± 20.9 mm (range 20–96).	Descriptive Statistics
Soft Tissue Involvement (Yes = 37; No = 33)	Associated with higher abscess size (57.4 mm vs 32.7 mm). Cord compression more frequent in Yes group (26 moderate, 7 severe) compared to No group (26 mild, 2 none).	$\chi^2 = 39.259$, df = 3, **p < 0.001** (significant); t = 6.115, df = 68, **p < 0.001** (significant)
Cord Compression Grades (Mild=30, Moderate=31, Severe=7, None=2)	Severity correlated with larger abscess size.	r = 0.473, **p < 0.001**
Treatment Given (Medical = 28; Surgical = 42)	Improvement observed in 78.6% overall (55/70). Medical: 23/28 improved; Surgical: 32/42 improved. No significant difference between modalities.	$\chi^2 = 4.818$, df = 4, **p = 0.307** (not significant)
Follow-up Outcomes	Improved (55), Not improved (7), Ongoing (6), Yes (1), No change (1).	Descriptive frequency
Recovery Time	Mean recovery time not significantly related to abscess size or compression grade.	Abscess size vs Recovery: r = 0.179, **p = 0.138** (NS); Compression vs Recovery: r = 0.011, **p = 0.930** (NS)



This multi-panel figure illustrates demographics, MRI findings, treatment outcomes, and statistical correlations in spinal tuberculosis patients, highlighting key associations between abscess size, cord compression, and recovery.



4. DISCUSSION

This study reaffirmed the pivotal role of MRI in evaluating spinal tuberculosis (TB), specifically in detecting soft tissue involvement, abscess formation, and their effects on the theca, spinal cord, and nerve roots, as well as monitoring delayed complications and outcomes. In our cohort of 70 patients, MRI revealed soft tissue involvement in 52.8% of cases, with a significant association between abscess size and cord compression ($r = 0.473$, $p < 0.001$), yet no association between these imaging findings and recovery time. Clinical improvement was noted in 78.6% of patients, and treatment outcomes were similar between medical and surgical groups.

Table 5. Comparison of Key Studies on MRI in Spinal Tuberculosis with Present Study

Author & Year	Study Objective	Key Findings	Reference
(Mittal et al., 2021)	To identify MRI predictors of neurological deficit in spinal TB	Found kyphosis > 30°, cord oedema, and canal encroachment > 50% were significant predictors of neurological impairment.	Mittal S. Predicting neurological deficit in patients with spinal tuberculosis. Int J Spine Surg. 2021; (PMCID: PMC7934611)
(Kubihal et al., 2022)	To review imaging features and healing markers in spinal TB	Described MRI signs of healing—bony ankylosis, marrow edema resolution, fatty changes, decreased contrast enhancement.	Kubihal V. Imaging update in spinal tuberculosis. Indian J Radiol Imaging. 2021;31(3):346–355. (PMCID: PMC8671643)
(Ling-Shan et al., 2024a)	To compare MRI features distinguishing TB versus pyogenic spondylitis	Showed TB had higher rates of epidural extension, paravertebral collections, subligamentous spread, thin regular abscess walls, vertebral collapse, and kyphosis.	Ling-Shan C et al. Magnetic resonance imaging features for differentiating tuberculous from pyogenic spondylitis: A meta-analysis. Skeletal Radiol. 2024;53(4):697–710.

(Arifin et al., 2024)	To evaluate surgical strategies and outcomes in spinal TB	Emphasized that surgical intervention improved outcomes in refractory cases with cord compression, instability, or deformity.	Arifin J et al. Clinical outcomes and surgical strategy for spine tuberculosis. Spine Deform. 2024;12:481–492. (PMCID: unknown)
(Dahal & Parajuli, 2024a)	To assess MRI role in CNS tuberculosis prognostication	Stated MRI was crucial for prognosticating CNS TB; large lesions in critical areas predicted worse outcomes.	Dahal P et al. Magnetic resonance imaging findings in central nervous system tuberculosis: Prognostic implications. Neuroimaging Clin N Am. 2024;30(1):xx–xx.

MRI predictors of neurological status in 82 spinal TB patients and found that soft tissue involvement and cord signal changes correlated with worse neurological status(Dunn et al., 2011). This is consistent with our finding that larger abscesses led to more severe cord compression. Contrast-enhanced MRI patterns particularly thin, regular-enhanced abscess walls helped differentiate TB from pyogenic infection(Sha et al., 2020a). Our study did not directly examine wall characteristics, but our observations of frequent soft tissue abscesses support the need for such refined imaging. In a meta-analysis, highlighted paravertebral collections, epidural extension, and subligamentous spread as distinguishing features of spinal TB versus pyogenic spondylitis(Ling-Shan et al., 2024b). The high prevalence of soft tissue involvement in our study aligns well with these established hallmarks. Large abscesses with rim enhancement and subligamentous spread were typical in TB spondylodiscitis(Sha et al., 2020b). Our significant abscess sizes correlate with these diagnostic MRI patterns. MRI features of posterior element tuberculosis in 19 patients, noting paraspinal abscesses in about 68% and cord compression in 21%(Boruah et al., 2021) somewhat lower than our 52.8% overall, but our larger sample averaged all TB presentations. Demonstrated reversal of signal changes on follow-up MRI as healing indicators, particularly increased T1 intensities and reduced STIR signals over 12–24 months(Singh R*, 2016). Although we documented clinical improvement, our study didn't measure these signal changes the future inclusion would enhance prognostic precision. MRI's superiority over CT in revealing epidural extension and soft tissue disease (Sinan et al., 2004)a finding our study also confirmed through detection of occult abscesses and neural compression otherwise not visible on CT. The importance of MRI in identifying tubercular abscess wall morphology for differential diagnosis between TB and other spondylodiscitis(Sha et al., 2020c), reinforcing the need for detailed imaging evaluation. Disc preservation, vertebral collapse, and subligamentous spread were reliably identified by MRI in TB spondylitis(Sivalingam, 2015), indirectly supported by our findings, as the significant abscess and compression patterns reflect similar disease behavior. Diverse imaging patterns including skip lesions and syrinx formation in TB, stressing the mimicking nature of the disease(Varghese et al., 2024). Although we didn't encounter syrinxes, the variety in presentation underlines the importance of careful MRI interpretation. MRI could differentiate healing from disease progression, underscoring repeat imaging's importance(Filbay et al., 2023); in our study, treatment response was monitored clinically future MRI follow-ups could add further verification of healing. MRI differentiation between TB and pyogenic infections, valuing abscess wall features and pattern of spread (paraspinal, intraspinal)("Differentiating Tubercular from Pyogenic Causes of Spine Involvement on Magnetic Resonance Imaging," 2023), again mirroring our observation of extensive soft tissue involvement in TB cases. MRI often overestimated infection due to reactive changes, a limitation we acknowledged when considering non-specific imaging findings and the importance of clinical correlation(van Beek et al., 2019). Percutaneous abscess drainage guided by imaging and confirmed its effectiveness in resolving large collections(Harclerode & Gnugnoli, 2025), aligning with our finding that some patients with extensive abscesses required surgical intervention. MRI showed healing patterns accurately over time, reinforcing the imaging modality's utility in long-term follow-up(Liu et al., 2021); our clinical improvements suggest similar imaging-based healing, although data were mostly clinical. Patterns of involvement and outcomes, observing that large epidural abscesses correlated with neural compromise, mirroring our significant association between abscess size and cord compression(Heip et al., 2022). Timely surgical decisions guided by MRI resulted in better neurological recovery and reduced disability, congruent with our finding that similar outcomes followed both medical and surgical approaches when MRI guided management(Shan et al., 2025). Parenchymal TB manifestations observed on contrast MRI meningeal and spinal cord involvement highlighting the need for comprehensive imaging(Dahal & Parajuli, 2024b). Our methodology included contrast sequences; their detailed categorization suggests additional insight possible if applied. MRI features can mimic neoplastic lesions, prompting cautious differentiation(Huang et al., 2023). Our exclusion criteria guarded against misdiagnosis, but multidisciplinary review remains vital. MRI combined with clinical and laboratory data offers a holistic approach to diagnosis and treatment planning(Hagiwara et al., 2023) a principle central to our study and reinforced by our findings.

Overall, our findings align well with the existing literature, especially regarding MRI's strengths in depicting soft tissue involvement, abscess burden, and cord compression. The significant correlation between abscess size and spinal cord compromise is supported by multiple studies. The lack of correlation with recovery time underscores the complexity of healing in spinal TB, influenced by host factors and treatment compliance. Our comparable treatment outcomes between

surgical and medical groups reflect thoughtful, MRI-guided patient selection.

Where our study adds value is the sizeable, systematically documented cohort with comparable imaging-pathological correlation, and the emphasis on both early and delayed outcomes. However, limitations include the absence of detailed MRI healing markers or signal-change progression and lack of long-term imaging follow-up beyond clinical outcome.
Future studies should integrate sequential MRI to document healing, incorporate diffusion or PET-MRI, and explore quantitative metrics (e.g. abscess volume) to refine prognostic modeling. Moreover, comparison with pyogenic and neoplastic cases using advanced imaging features could enhance diagnostic accuracy.

5. CONCLUSION

Magnetic Resonance Imaging (MRI) has proven to be an indispensable modality in the evaluation of spinal tuberculosis. Its superior sensitivity enables early detection of soft tissue involvement, abscess formation, and neural compression, which are often under-recognized in conventional imaging. In this study, MRI findings revealed a significant association between soft tissue involvement, larger abscess sizes, and higher grades of cord compression, underlining its value in assessing disease severity. Moreover, correlation analysis highlighted the direct relationship between abscess size and cord compromise, providing critical insight into prognostic risk stratification.

Follow-up outcomes demonstrated that most patients showed clinical improvement irrespective of medical or surgical intervention, emphasizing that timely diagnosis and treatment planning—guided by MRI—remain the cornerstone of effective management. Although recovery time was not significantly associated with abscess size or compression grade, MRI played a pivotal role in monitoring disease progression, treatment response, and delayed complications.

Overall, MRI not only enhances diagnostic accuracy but also strengthens therapeutic decision-making and prognostic evaluation in spinal tuberculosis. Its ability to delineate soft tissue involvement, quantify cord compression, and monitor outcomes reinforces its role as the gold-standard imaging tool for comprehensive management of Pott's spine.

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