

# Correlation of Plain Radiography and MRI Spine Evaluation in Spinal Tuberculosis

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**Abstract:** ***Objective:** To evaluate the sensitivity, specificity and correlational efficiency of plain radiography with MRI findings in clinically suspected/proven cases of spinal tuberculosis. **Methods:** This was a descriptive study conducted at Department of Radiodiagnosis & Imaging, Vydehi Institute of Medical Sciences & Research Centre, Bangalore, from January 2018 to June 2019. This study was carried out on 30 clinically suspected patients of Spinal tuberculosis. Plain radiograph of the spine and chest was done followed by MRI of spine were done in all the patients. Various MRI features were observed on non-contrast STIR, T1W and T2W-sagittal and axial, T1W and T2W-sagittal and axial post gadolinium contrast, ADC and diffusion weighted sequences. MRI examination and radiographic features of the patients were compared. **Result:** With the cross-sectional study, we evaluated the changes of Pott's spine in 30 patients on plain radiography and MRI. Plain radiography was useful in detecting bony changes, vertebra involved, deformities of the bone and Para spinal densities if any. MRI helped in evaluating the bony changes, soft tissue involvement and abscess formation if present. With the additional sequences we used to evaluate Pott's spine we used ADC and DWI. ADC and DWI were taken from the involved vertebra and also if there was surrounding collection, normal vertebra values were taken for normal reference values. DWI showed restriction in most of the cases and the ADC values were in the range of  $1.47 \pm 0.42 \times 10^{-3} \text{ mm}^2/\text{sec}$ . **Conclusion:** MRI is the much more valuable, far more superior, accurate and more sensitive radiological diagnostic modality from x-ray, for the patients having suspected spine tuberculosis or Pott's disease. MRI findings provide the benefits of earlier detection and treatment.*

**Keywords:** Spinal tuberculosis (Pott's spine), Magnetic resonance imaging, Plain radiograph, Spinal cord compression.

## 1. Introduction

Tuberculosis is an ancient infection that has plagued humans throughout recorded history. It is still very much prevalent today. This infection remains the cause of a higher morbidity and mortality than any other infection in the world especially in the densely populated developing countries. (1) It is the most common disease in the third world countries. Tuberculosis is the ninth leading cause of death worldwide and the leading cause from a single infectious agent, ranking above HIV/AIDS (As per WHO sources).

According to world Health Organization (WHO), nearly two billion people about 1/3rd of world population have tuberculosis. (2) Annually 6 million become ill with tuberculosis and two million die from disease worldwide (Data from the WHO 2006). This rise has been associated with concomitant rise in bone and joint tuberculosis. (3) In developing countries, TB spine remains a major health problem. This is most common and dangerous form of musculoskeletal tuberculosis. (4-6) Tuberculosis of spine is a most common condition in the developing countries as compared to the developed countries. (7) The reason for differences are illiteracy, poverty, poor hygienic conditions, unbalanced diet, overcrowding, low budget for health and high prevalence of pulmonary tuberculosis. (1)

The infection reaches the spine via respiratory tract or intestine by blood stream. The infection begins from the anterior part of vertebral body, spreads to the disc and causes bone destruction and formation of abscess. Culture and sensitivity is positive in 80% of cases. (8)

Pott's disease is the extra pulmonary manifestation of tuberculosis essentially involving spine and intervertebral

joints. The disease derived its name from Percivall Pott (1714-1788), who first in elaborately described it. The most common affected areas include lower thoracic and lumber vertebrae. The diseases spread haematogenously and infection reaches to adjoining vertebrae involving the disc space, which being avascular eventually collapses. Four sites of infection involve paradiscal, central, anterior subligamentous and appendiceal. Through the process of caseous necrosis, there is a death of the tissue and finally vertebral collapse and spinal damage. Spinal tuberculosis, as one of its manifestations, too has acquired greater magnitude and has a noticeable presence even in the developed countries.

The most extra-pulmonary location of tuberculosis is spine, accounting for more than 50% musculoskeletal tuberculosis. (9) The first, Percival Pott initially depicted spine tuberculosis traditionally in 1778. Spine tuberculosis is the commonest type of skeletal tuberculosis and constitutes about 50 % of all cases of TB of bones and joints. Tuberculous spondylitis now represents 6% of new extra pulmonary tuberculous cases. (10) In developing nations, tuberculous spondylitis is an illness of kids, though in North America and Europe it is most common in moderately aged grown-ups. The disease is similarly conveyed between both (Male and females). (8) Tuberculosis can influence diverse parts of vertebra. The organism responsible is Mycobacterium tuberculosis. The usual root of spread is haematogenous.

The most common clinical features of spinal tuberculosis are backache, localized tenderness, stiffness, spasm of muscles and even spinal deformities.

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Plain radiography has been used as the basic primary imaging investigation of choice in every patient of TB spine in developing countries due to its cost effectiveness as well as its easy availability. But it is usually helpful only in the late stage of the disease. Newer diagnostic modalities like-CT, MRI and PET are currently being utilized more frequently and are seen to be replacing plain radiography wherever possible.

MRI is the ideal imaging modality for evaluation of spinal tuberculosis. MRI is the most valuable method for detecting early disease and is preferred technique to define the activity and extent of infection. In addition to the high contrast resolution and multi-planar images, it also helps in the assessment of spinal cord and neural elements. It shows not only bony involvement but also the edema and soft tissue swelling. Abscess may be detected or excluded. Early diagnosis of spinal tuberculosis is of paramount importance as it helps in limiting the bone deformities and complications arising out of cord compression. Findings are very useful in the management of multilevel infection. Serial MRI examinations can be used to assess the response to treatment. (11, 12)

#### Objective:

To evaluate the sensitivity, specificity and correlational efficiency of plain radiography with MRI findings in clinically suspected/proven cases of spinal tuberculosis

## 2. Materials and Methods

All patients who are clinically suspected/proven cases of spinal tuberculosis, which are referred to the Department of Diagnostic Radiology at VIMS and RC, Bangalore from January 2018 to June 2019. Total 30 Patients of both sexes are included, age range was 11 to 72 years, and only diagnosed cases of tuberculosis spondylitis were included. Patients with non-tuberculous spondylitis were excluded.

Diagnosis was based on history, clinical examination and investigations. All clinically suspected patients of Spinal tuberculosis, who are being referred to the department of Diagnostic Radiology in VIMS and RC will initially undergo an X-ray examination following an MRI examination of the spine and results will be compared respectively to evaluate the different radiological features of tuberculosis. A proforma was designed for the study. Diagnosis was based on history, clinical examination and investigations. Plain X-Ray was done in all cases as primary imaging modality. All diagnosed patients of Spinal tuberculosis will undergo MRI examination and their previous radiographic features will be compared. Clinical features of the patients were noted.

For cervical and thoracolumbar spine antero-posterior and lateral projections X-ray images are taken for evaluation of spine. Multi-planar and multi-sequential scan of the spine in a 1.5 Tesla. The following pulse sequences are acquired non contrast: STIR, T1W and T2W-sagittal and axial T2W. T1W sagittal and axial post gadolinium contrast, ADC and diffusion weighted sequences.

## 3. Discussion

Tuberculosis of the spine has been common orthopedic and neurological problem until the middle of last century for the developing world. It showed a steady decline in its prevalence in developed countries in 60s and 70s due to effectiveness of public health program and advances in chemotherapy. (13)

Male dominance and clinical pattern of onset shown in this study is in accordance with observation of other studies. (11) The regional distribution of vertebra is similar to the findings of Bikha Ram, (14) Tulsi S. M. (5) Plain radiography plays an important role in diagnosis of most cases of TB spine. MRI was found to be most valuable investigation for assessment and treatment of TB spine. It gives following information to the clinician in patients with TB spine.

- 1) Site of involvement
- 2) Paravertebral soft tissue swelling/abscess/disc sequestration
- 3) Number of vertebra involved
- 4) Angle of Kyphosis
- 5) Size of vertebral canal
- 6) Degree of cord compression
- 7) Severity of bone disease – wedge collapse/compression fracture.

Although MRI is costly investigation but it gives more information about soft tissue involvement and degree of spinal cord or root compression as compared to plain X-Ray, CT scan. (15, 16) It gives information about extent of disease and hence gives guide to treatment. It is helpful in monitoring response to treatment by serial MRI scans.

In early diagnosed cases, conservative treatment by chemotherapy gives good results. Anti-tuberculous drugs can reach the tuberculous caseous material and cavities in spine. (17) However if there is severe bone involvement along with cord or root compression, surgical treatment is the only remedy. (18-20)

With the cross sectional study based on 30 subjects, plain radiography has been successful in evaluating the bony changes of the involved vertebra. The vertebra involved, disc space involvement, spinal deformities are the main changes seen on the plain radiography as evaluated by this study. Para spinal soft tissue shadow is another feature seen in plain radiography that correlates with MRI finding as abscess/collection.

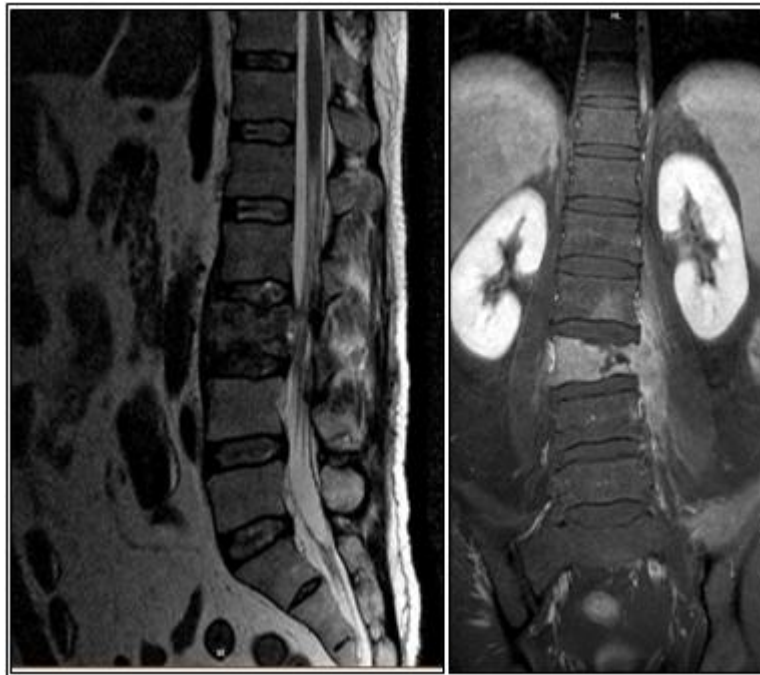
X-rays finding showed the Pott's disease was found to affect all the segments of the vertebral column. The most common vertebra involved in this study was thoracic (43%) followed by lumbar vertebra (26.6%) and cervical vertebra (10%). Few cases had both lumbar and sacral involvement (10%), thoracic and lumbar involvement (6.6%), while one patient recorded involvement of Cervical, Thoracic, and lumbar vertebrae.

The entire lot of patients in study were found to show sclerotic lesions affecting all the segments of vertebral column and the disc space was reduced in most of the cases

(96.7 per cent), while only in one subject showed normal disc space (Figure-1 & 2).



**Figure 1:** reveals reduced disc space at L3-L4 vertebral level with osteophytes, bony erosions with surrounding sclerosis in the body of L3 vertebra and reduced disc space at L3-L4 vertebral level



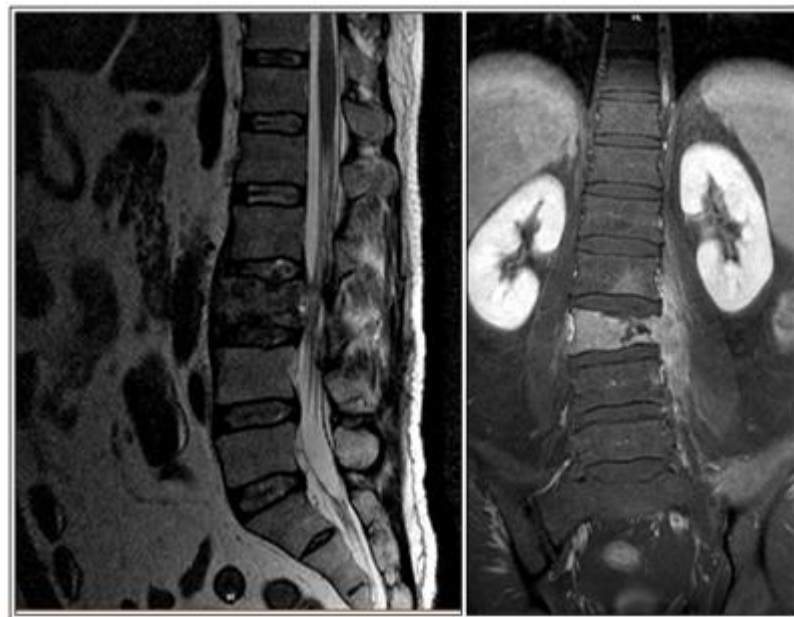
**Figure 2:** T2W hyper intensity noted in the body & posterior elements of L2 & L3 vertebrae and in the intervertebral discs of L2-3 and L3-4 vertebra. On post-contrast study, heterogeneous enhancement in L2 and L3 vertebrae noted. As compared to X-ray images reveals decreased vertebral body height of L3 vertebral body with mild scoliotic deformity to right and sclerosis involving the body of L3 vertebra.

Vertebral body height was reduced in 90 per cent of the cases, while 10 per cent showed no change in the vertebral body height (Figure-3 & 4). Associated deformities due to Pott's disease in the study were kyphosis, scoliosis, and loss

of thoracic and lumbar curvature. The spinal deformities were present in 76.7 per cent of the cases and the rest 23.3 per cent of the subjects were found normal.



**Figure 3:** X-ray AP and Lateral view of lumbar spine shows decreased vertebral body height of L3 vertebral body with mild scoliotic deformity to right and sclerosis involving the body of L3 vertebra.



**Figure 4:** T2W hyperintensity noted in the body & posterior elements of L2 & L3 vertebrae and in the intervertebral discs of L2-3 and L3-4 vertebra. On post-contrast study, heterogeneous enhancement in L2 and L3 vertebrae noted. As compared to X-ray images reveals decreased vertebral body height of L3 vertebral body with mild scoliotic deformity to right and sclerosis involving the body of L3 vertebra.

MRI shows particular signal intensity changes in patients with Pott's spine with T1, T2 and FLAIR sequences. On T1 sequence the signal intensity changes was Hypo intense and Hyper intense on T2 and FLAIR sequences. Following post contrast studies using T1 weighted sequence there was enhancement in most of the subjects and also the collection/abscess showed wall enhancement. MRI was helpful in evaluating the spinal cord and the nerve involvement, 60 % of the subjects had spine/nerve involvement.

The sequences used for preliminary MRI examination include T1, T2 and Flair. On T1 the signal intensity change was hypo intense in 93.3 per cent of the cases. On T2 the signal intensity change was hyper intense in 93.3 per cent of the cases. On Flair the signal intensity change was hyper intense in 96.7 per cent of the cases.

The mean ADC value of tubercular vertebrae was found out to be  $1.47 \pm 0.42 \times 10^{-3} \text{ mm}^2/\text{sec}$ . ADC value of the patient under treatment for the affected vertebrae decreased and came down to  $0.42 \times 10^{-3} \text{ mm}^2/\text{sec}$ . DWI sequence showed restriction in all the cases except one. The correlation between ADC and DWI showed very high positive relation with the R value of 0.98.

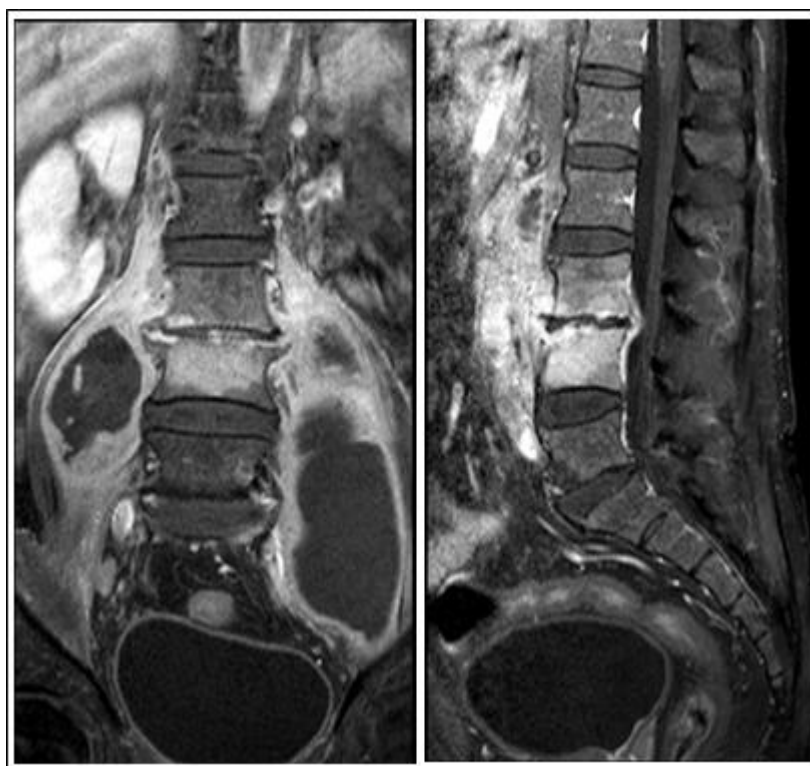
Collection/Abscess was easily seen on MRI studies, which showed peripheral enhancement following post contrast T1 weighted sequences. 27 subjects (90 per cent) had collection/abscess while rest 3 subjects (10 per cent) had no visible collection/abscess. Following contrast administration using T1 sequence, 29 subjects (96.7 per cent) showed enhancement. Out of 30 subjects, 18 (60 per cent) showed visible spinal cord and nerve root involvement, while rest 12 subjects (40 per cent) had no visible involvement. On

comparison with X-Ray and MRI findings for evaluation of abscess/collection. X-ray showed Para spinal soft tissue shadow in 10 subjects (33.3%) and MRI showed 27 subjects (90%) positive with abscess/collection, suggesting MRI is

superior in evaluating abscess or collection in Pott's spine (Fig.-5 &6)



**Figure 5:** Reveals reduced disc space at L3-L4 vertebral level with osteophytes, bony erosions with surrounding sclerosis in the body of L3 vertebra and reduced disc space at L3-L4 vertebral level



**Figure 6:** Spondylodiscitis involving the L3-L4 vertebral bodies with erosion of inferior end plate of L3 and superior end plate of L4 involvement of the intervening intervertebral disc space. Bilateral psoas abscesses seen extending from L3 to L5 lumbar vertebrae on the right and L3 to S3 vertebra on the left with sub-ligamentous extension of collection along the anterior and posterior longitudinal ligaments from superior end plate of L3 to inferior end plate of L4 vertebral body causing thecal sac compression. As compared to x-ray it shows reduced disc space at L3-L4 vertebral level with osteophytes and bony erosions with surrounding sclerosis in the body of L3 vertebra and reduced disc space at L3-L4 vertebral level

#### 4. Conclusion

MRI is the much more valuable, far more superior and accurate radiological diagnostic modality from x-ray, for the patients having suspected spine tuberculosis or Pott's disease. MRI is found to be more sensitive than plain radiography to know the status, extent and severity of the

disease. It provides early diagnosis and detection of spinal tuberculosis as compared to conventional radiography (x-ray). MRI also helps in early detection of neurological involvement thus, helping in the line of treatment. Bone and soft tissues lesions are also well detected and distinguished by MRI. Hence, MRI is overall far more superior to conventional radiography in early detection, demonstrating

in various pathological facets of Pott's disease, its treatment, progress and follow up. Several other studies also showed that Magnetic resonance imaging (MRI) has proven to be the most accurate radiologic investigation to diagnose and classify spinal tuberculous, identifying early spinal cord changes.

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