# MRI IN TUBERCULAR SPINE- TELESCOPING THE EVIL

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**ABSTRACT**

**BACKGROUND**

Magnetic Resonance Imaging (MRI) is a non-invasive and highly sensitive modality capable of mutliplanar imaging. It helps us to diagnose tubercular spondylitis, where plain radiographs are normal with added advantage of detecting extramedullary tuberculosis, arachnoiditis and intramedullary tuberculosis.

**MATERIALS AND METHODS**

MRI Spine was done in 60 clinically and radiographically suspected cases of spinal tuberculosis to establish diagnosis and evaluate extent and neural involvement. Statistical analysis was done using percentages and proportions.

**RESULTS**

On MR imaging, a total of 195 vertebrae were found to be involved. The number of vertebral involvement range from 1 to maximum of 10. Contiguous vertebral involvement was seen in 86.67%. Single vertebral involvement was noted in 13.33% patients and 6.67% patients showed skip lesions. Out of 82 involved intervertebral discs, 34.14% discs showed total collapse, 31.4% (26/28) showed partial collapse and 31.14% (28/82) showed intact disc height. 83.33% had paraspinal abscesses on MR imaging. Spinal cord compression was seen in 34 (56.7%) patients, out of which 27/34(79.4%) patients had spinal cord signal alteration. Meningeal involvement and intramedullary granuloma were seen in 1/60 patients.

**CONCLUSION**

This study highlights the contribution of MRI in early identification, exact extent of disease, non-radiographically accessible lesions and in atypical presentations like isolated posterior element involvement.

**KEYWORDS**

MRI Spine, Tuberculosis, Pott's Spine.

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## BACKGROUND

Since the earliest days of history, tuberculosis has ravaged the human race with its protean forms, diverse complications and enormous morbidity and mortality. The primary focus of disease is usually visceral (lungs, lymph nodes and gastrointestinal tract).[1]Of the extra pulmonary sites, skeletal tuberculosis constitutes a major segment. Within the osseous form, the most common site is vertebral column, which accounts for 50% of patients with skeletal tuberculosis.[2]The disease occurs with equal frequency in both the sexes.[3]

Most common sites of involvement are thoracic and thoracolumbar spine. The commonest radiological presentation involves destruction adjacent to the endplates of two or more vertebral bodies (Paradiscal type). Other common patterns of involvement are Anterior/ Subligamentous, Central type and Neural arch involvement. Atypical presentations include circumferential involvement, lateral vertebral translation and involvement of single or multiple vertebrae. Immunocompromised patients present with more extensive involvement, multiple contiguous vertebral involvement and poor treatment response.

Effective imaging evaluation of spine demands not only the capacity to visualise complex bony structure of the vertebral column but also ability to visualise spinal cord, exiting nerve roots and thecal sac that are surrounded and protected by bony canal.[4] Many imaging techniques have been applied to spine starting with plain radiographs, CT to MRI.[5]

Radiographic findings manifest late, requiring minimum of 50% destruction of trabecular bone.[3] CT provides higher contrast resolution which allows superb details of bony elements and clearly outlines soft tissue/fat planes.[6] Due to difficulty in differentiating spinal cord from surrounding structures on CT, in cases of narrow subarachnoid space, MRI is investigation of choice now-a-days.[4,5] MR imaging is able to detect changes in vertebral marrow, intervertebral

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discs, neural structures and endplate irregularity; earlier than radiograph, bone scintigraphy and CT due to its high soft tissue and contrast resolution and multiplanar capabilities. MRI has an additional advantage of non-radiation exposure. Limitations of MRI include high cost, contraindication in patients with implants and claustrophobia. MR imaging also has a useful role in followup of spinal tuberculosis.[1]

The differentials for spinal tuberculosis include degenerative changes, infections (Pyogenic, Brucella, fungal and syphilis), benign lesions (haemangioma, giant cell tumor, aneurysmal bone cyst, Histiocytosis X) and malignant lesions (Ewing's sarcoma, osteosarcoma, multiple myeloma and metastasis).

This study aims at analysing the spectrum of spinal tuberculosis, atypical vivid presentations, extent of disease and neural involvement which are precisely diagnosed by MRI, thereby facilitating treatment and determining prognosis.

## MATERIALS AND METHODS

A prospective study was carried out in the Department of Radiodiagnosis in our institute.

### Patient Selection

A total of 60 patients with suspected spinal tuberculosis on basis of clinical history, laboratory data and radiological signs indicative of spinal tuberculosis or patients with established extra-spinous tuberculosis and features indicative of spinal tuberculosis or patients with either a bacteriological, cytological or histopathological diagnosis of spinal tuberculosis.

Patients unable to undergo MRI due to aneurysmal clips, metallic foreign bodies in body or any other contraindication or claustrophobia were excluded from study.

### Imaging Protocol

Plain radiographs of regional spine (both Antero-posterior (AP) and lateral view) and chest (Postero-anterior (PA) view) of all patients were taken.

MRI spine was done on 1.5 Tesla Philips AchievaMRI system using a spinal array coil. T1 W sagittal images, T2W axial and sagittal images, STIR sagittal and coronal images and Post-contrast images in all three planes.

### Assessment

On MRI scans, note was made of any abnormality of spinal curvature, vertebral alignment, number and pattern of vertebral involvement, posterior elements involvement, marrow signal alteration, intervertebral disc and end plate involvement, para-vertebral soft tissues or collection, intra-spinal extension of disease and signal intensity changes in spinal cord and evidence of cord compression.

### Statistical Evaluation

The obtained data was statistically evaluated using appropriate statistical tools with respect to the demographic profile, complaints, physical signs, and MR imaging signs.

The prevalence of pulmonary disease in spinal tuberculosis was also determined based on chest radiographic findings and/or sputum examination.

## RESULTS

All the patients included in this study were subjected to detailed clinical history and physical examination. Relevant investigations like Hb, TLC, DLC, ESR, Chest Skiagram, etc. were done.

### Demographic Profile

We evaluated 60 patients from 2 to 70 years of age. Mean age of presentation was 28.08 years. Most patients presented in the 3rd decade. Out of all, 38 (63.33%) patients were male and 22(36.67%) patients were female.

### Symptomatology

The most common symptom in this series was backache (98.33%), followed by fever (53.33%) and neurological involvement in the form of paresis/paraplegia (48.33%). Weakness of lower limbs was present in 19/60(31.67%) and complete paraplegia was seen in 8/60 (13.33%) patients. Quadriplegia was seen in 2/60(3.33%) patients. Paraspinal mass/Tenderness (41.67%) and Urinary and bowel disturbances (18.33%) were also seen.

### Radiographic Findings

#### Chest Skiagram

Chest Skiagram PA view was taken for all the patients. Findings suggestive of tuberculosis were seen in 19/60(31.67%). Other relevant findings are tabulated in Table 1.

### Radiographs of Spine

Anteroposterior and lateral radiographs of relevant part of the spine were done in all cases. Positive findings were seen in 52/60 (86.6%) patients. Involvement of body was present in 46/52 patients. Disc involvement was seen in 30 patients as narrowing or loss of disc space between vertebrae. The associated soft tissue component was present in 12/52 cases. Radiographs were normal in 8/60 cases. In patients with cervical spine involvement, 2 cases showed increased atlantoaxial distance.

### MR Imaging Findings

#### Signal Intensity

Signals were observed on T1, T2 and STIR sequence in all patients and results are tabulated in Table 2.

### Pattern of vertebral Involvement

On MR imaging, a total of 195 vertebrae were found to be involved in 60 patients. The average number of vertebrae involved per patient was 3.2. 52 out of 60(86.67%) patients showed contiguous involvement of two or more vertebrae. 4 of these patients had skip lesions also. Only 8 out of 60(13.33%) patients showed single vertebral

involvement. Maximum number of vertebrae involved in a single patient was 10.Rest of findings are shown in table 3.

**Site of Involvement**

Dorsal spine (33.33%) was the most common site of involvement in the present study followed by lumbar spine (28.33%) patients. Other sites of involvement in decreasing order of frequency were dorso-lumbar 7(11.67%), lumbo-sacral 7 (11.67%), cervical 7 (11.67%), sacral 3(3.33%). and cervico-dorsal 2 (3.33%).

**Type of Involvement**

Rest of 56 patients showed varying types of tubercular involvement excluding Cranio-vertebral junction. Classification is shown in bar diagram (Figure 1). Paradiscal involvement is more common (Figure 2). Isolated posterior vertebral involvement was seen in 3/60 patients (Figure 3). Isolated vertebral involvement was seen in 4 patients (Figure 4). Cranio-Vertebral Junction (CVJ) involvement was seen in 4/60(6.67%) patients (Figure 5).

**Intra-canalicular Involvement (Fig. 6)**

Out of 60 patients, 40 patients showed epidural collection. Meningeal enhancement was seen in one patient out of 60 patients on contrast administration. Intramedullary tuberculoma was seen in one out of 60 patients. Spinal cord signal alteration was seen on T2. Out of 34/60(56.67%) showing compression of spinal cord, 27 patients showed oedema of spinal cord. Out of 34, 7 patients showed compression but normal signal intensity of spinal cord. 4 patients showed development of syrinx.

**Pre- & Para-vertebral Soft Tissues**

Out of the 60, 46 (76.66%) patients had prevertebral abscess and 50 out of 60 (83.33%) patients had para-vertebral abscess. 18 out of 60 patients (30%) showed sub-ligamentous spread. Focal collection within the vertebral body was seen in 26 patients. 24 patients had collections in posterior paraspinal or psoas muscles (Figure 7).

**Intervertebral disc changes**

A total of 82 intervertebral discs were involved. 28 out of 82(34.14%) intervertebral discs showed complete destruction of intervertebral disc. 26 out of 82(31.7%) showed partial destruction of intervertebral disc. 28 out of 82(34.14%) intervertebral discs showed preserved disc height. Visualised part of involved discs were hypointense on T1 W sequence and was hyperintense on T2 W sequence and showed contrast enhancement.

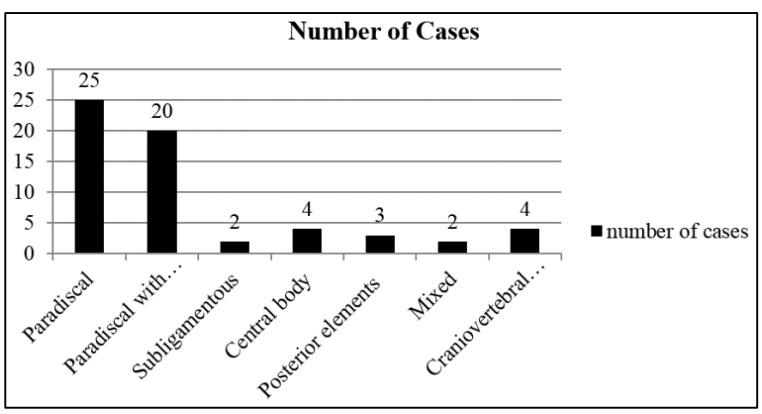


***Figure 1. Bar Diagram showing type of vertebral involvement. Most common subtype of involvement was para-discal followed by para-discal with subligamentous variety. Isolated posterior elements and central body involvement were seen in fewer number of cases.***

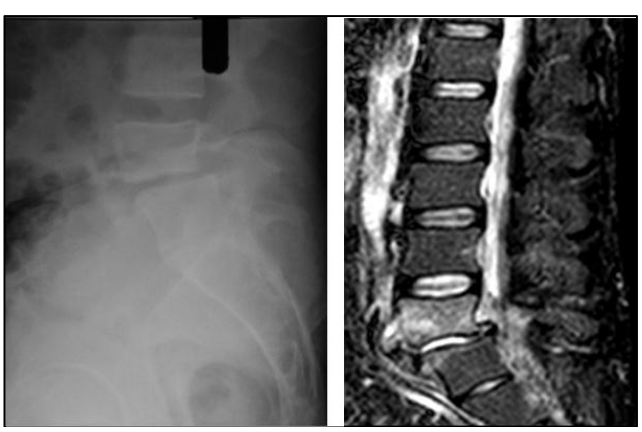

***Figure 2. Para-discal tuberculosis. (A): Lateral radiograph of LS Spine showing grade I anterolisthesis of L4 over L5 with reduction of intervening disc space. (B) STIR sagittal showing in vertebral body of L4 and superior end plate of L5.***

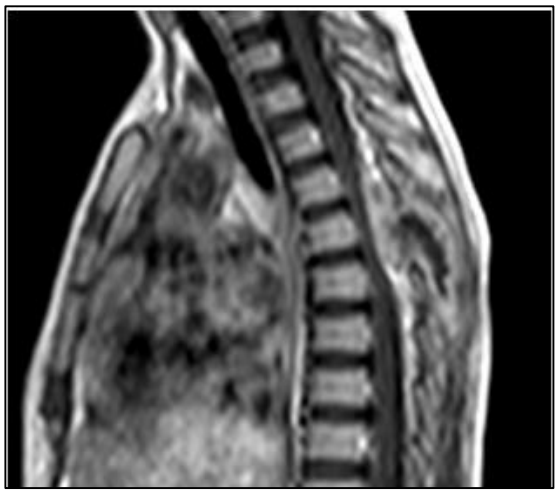

***Figure 3. Isolated posterior element tuberculosis: T1W CE sagittal sequence shows altered signal intensity in posterior element of D5 vertebra with associated epidural collection causing compression of spinal cord.***

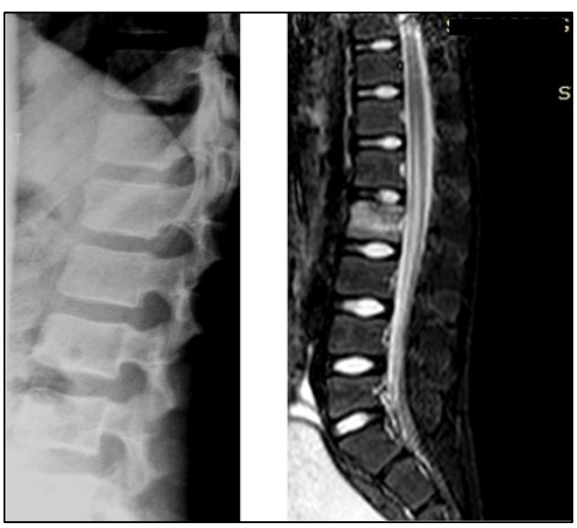

***Figure 4. Central type of tuberculosis (Isolated single vertebral involvement). (A): Plain radiograph of Lumbo-sacral (LS) Spine Lateral view showed no abnormality. (B): Sagittal T1W CE MRI. L2 vertebral body shows altered signal intensity with mild contrast enhancement. Visualised discs are normal in height and signal intensity.***

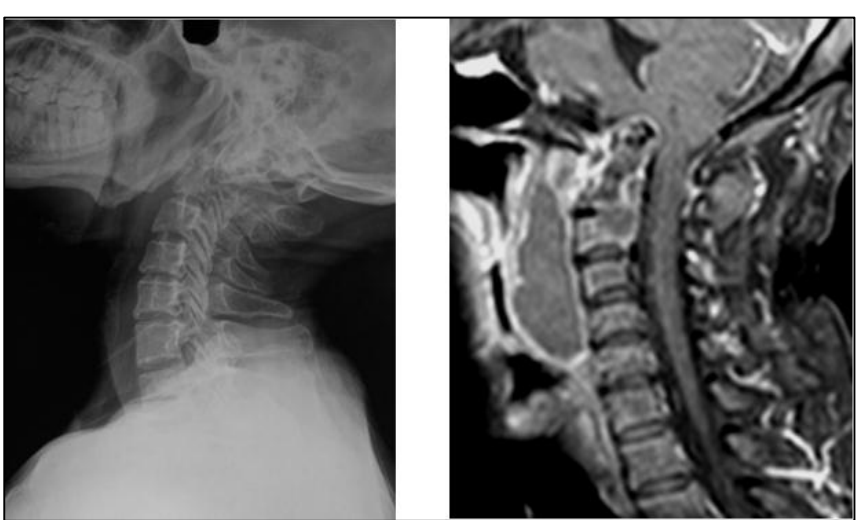

***Figure 5. Cranio-vertebral junction (CVJ) tuberculosis. (A): Lateral radiograph of cervical spine showing increased prevertebral soft tissue. (B): Sagittal TIW FS CE MRI sequence shows altered signal intensity of C2 odontoid process and body which shows contrast enhancement. There is associated prevertebral collection with increased atlantoaxial distance and with basilar invagination. Kinking and compression at cervico-medullary junction is seen.***

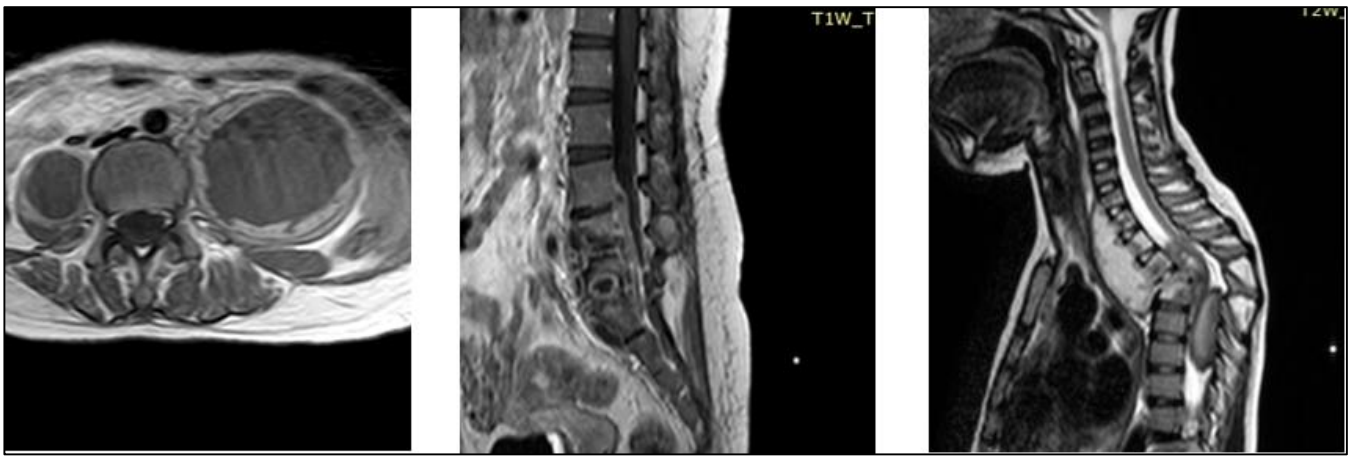


***Figure 6. Multiple site abscesses: (A) Bilateral psoas abscesses. (B) Intraosseous and anterior subligamentous collection. (C) Subligamentous and large epidural collections with associated gibbus formation.***


***Figure 7. Spinal cord abnormalities: (A) Sag T2W image shows intramedullary hypointense lesion at level of D5 vertebral level with development of syrinx in spinal cord. (B) Axial T1W CE MR Image showing rim enhancing intramedullary hypointense lesion.***

| | **Number of Patients (n=60)** | **Percentage of Patients** |
|---|---|---|
| Normal | 41 | 68.33% |
| Active pulmonary T.B. (A) | 15 | 25% |
| Old healed T.B. (O) | 4 | 6.66% |

***Table 1: Chest radiographic finding. Chest radiograph is normal in maximum number of patients. Chest radiograph is used as screening for pulmonary tuberculosis which can be primary focus for spinal involvement of tuberculosis***

| | **Signal Intensity** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Isointense** | | **Hypointense** | | **Hyperintense** | | **Heterointense** | |
| | **Number** | **Percentage** | **Number** | **Percentage** | **Number** | **Percentage** | **Number** | **Percentage** |
| T1W | 0 | **0%** | 58 | **96.67%** | 2 | 3.33% | 0 | 0% |
| T2W | 4 | 6.67% | 2 | 3.33% | 52 | **86.67%** | 2 | **3.33%** |
| T2W | 4 | 6.67% | 2 | 3.33% | 52 | **86.67%** | 2 | **3.33%** |
| STIR | 0 | 0% | 2 | 3.33% | 55 | **91.67%** | 3 | **5%** |
| STIR | 0 | 0% | 2 | 3.33% | 55 | **91.66%** | 3 | **5%** |

***Table 2. Signal intensity patterns of osteitis (n=60). Table depicts most of tubercular lesions appear hypointense on T1W sequence and hyperintense on T2W and STIR sequence. Healing lesions and immunocompromised patients can show heterogeneous signal intensity***

| Number of Vertebrae Involved | Number of Patients (n=60) | Percentage of Patients |
|---|---|---|
| 1 | 08 | 13.33% |
| 2 | 20 | 33.33% |
| 3 | 17 | 28.33% |
| 4 | 5 | 8.33% |
| 5 | 3 | 5% |
| 6 | 1 | 1.67% |
| >6 | 6 | 10% |

***Table 3. Number of Vertebral Involvement in 60 Patients of Study***

**DISCUSSION**

MRI of spine is investigation of choice in patients with suspected tuberculosis of spine. Characteristic findings on MRI include low signal intensity on T1W images and high signal intensity T2W and STIR images. Other findings usually are destruction of vertebral body with loss of cortical definition and irregularity of end plates, well-defined paraspinal collection with irregular thick rim of enhancement, enhancing epidural soft tissues/collections and spinal cord signal alteration.

MRI confirms the diagnosis in cases where plain radiographs show findings suggestive of the disease. In addition, MR is useful in diagnosis of early disease where only marrow changes are seen, atypical lesions like posterior element involvement and single vertebral involvement and radiographically inaccessible lesions like cranio-vertebral junction, cervico-dorsal region, posterior elements and sacrum. In addition, MRI has an additional advantage of detecting intradural extra-medullary tuberculosis, tubercular arachnoiditis and intramedullary tuberculosis.

After obtaining plain radiographs of the chest and spine for 60 patients studied, MRI of area of interest was carried out. Sagittal T1W TSE, Sagittal T2W TSE and STIR images of the spine were obtained. Then, supplementary axial T1 and T2 weighted spin echo images were obtained at the site of pathology. In all cases, post-contrast coronal, sagittal and axial T1W spin echo images were obtained. In few patients, SPIR sequence was also done.

The age group of patients ranged from 2 years to 70 years with mean age of 28.2. The study population comprised of 63.33% males and 36.67% females showing male preponderance with male: female ratio = 1.7:1. Similar observations were made by Kim et al[7] and Al-Mulhim et al.[8] 25% (15/60) patients in the present study were between 21-30 years of age. This reflects the fact that tuberculosis affects primarily the young age groups.

The most common symptom in this series was backache, which was present in 98.33% patients. Neurological involvement in the form of paresis/paraplegia was present in 48.33% (29/60) patients. Chest symptoms were seen in 13.33% (8/60). 35% (21/60) patients complained of bowel and bladder disturbances. Earlier studies conducted by Desai et al[9] and Kim et al[7] also reported backache as the most common symptom present in 96% and 100% of their patients respectively.

Routine laboratory investigations were performed in all subjects. Erythrocyte sedimentation rate (ESR) was found to be raised in 88.33% (53/60) patients. Lolge S et al[10] made similar observations. Monteux test was performed in all patients; it was positive in the 30% (18/60) cases and was indeterminate in 20% (12/60) cases.

Chest Skiagram PA view revealed evidence of tuberculosis in 31.67% (19/60) patients. Out of these, radiologically active disease was seen in 78.9% (15/19) patients while 21.1% (4/19) patients seemed to have old healed lesions. Desai et al[9] found associated pulmonary tuberculosis on chest skiagram in 26% of his patients.

Focal areas of erosion and osseous destruction in the anterior corners of the vertebral body are typical plain film findings for tuberculous spondylitis with further subligamentous extension causing contiguous involvement of adjacent intervertebral disc or vertebral body.[11]The posterior elements of the spine are usually secondarily involved by spread of infection from the vertebral body. Paraspinal abscess formation may be detected on plain radiographs as areas of fusiform soft-tissue swelling around the spine.[11]Soft tissue masses can be missed in early involvement and in cases of posterior element tuberculosis.[12,13]

On MR imaging, 195 vertebrae were involved in the study population comprising of 60 patients. The average number of vertebrae affected per patient was 3.2. In earlier studies conducted by Mukhopadhyay et al[14] and Martin et al,[15] average number of affected vertebrae were 3.8 and 3.4 respectively. Vertebral involvement was more in immunocompromised patients.

Single vertebral involvement was seen in 13.33% (8/60) patients. Liu et al,[16]Loke et al[17] and Lolge et al[10] found single vertebral involvement in 7%, 7.3% and 1.7% of patients respectively. Single vertebral affection without involvement of disc is not a well-recognised entity and is often misdiagnosed and mistreated due to varied differentials.[18] Multifocal disease was seen in 6.67% (4/60) of our patients in present study as was also seen in study by Loke et al.[17]

Dorsal spine was the most commonly affected region seen in 33.33% (20/60) of cases. Several earlier studies have reported different sites. Sharif et al,[13] Liu et al[16] and Al-Mulhim et al[8] have reported lumbar spine as the second common site of affection. Our study is in agreement with them.

Because of the risk of upper spinal cord involvement, tuberculosis of the cervical spine is considered the most dangerous form of spinal tuberculosis and symptoms may range from no symptoms to quadriplegia.[19] In the present

study, 11.67% (7/60) patients suffered from cervical spine tuberculosis. Lokeet al[17] had also similar incidence of cervical tuberculosis as 13.3%.

Cranio-vertebral junction is the least common site of presentation for spinal tuberculosis accounting for less than 1% of cases according to some authors.[7]In the present study, 4 such cases were found accounting for 6.67% (4/60) of all cases.

Osteitis is defined as low signal intensity on T1W images and high signal intensity on T2W images due to oedema in the marrow space (Desai SS 1994). It was seen in all patients in the present series.

Total body destruction with preservation of intervertebral disc space and minimal para-vertebral involvement constitutes the central type of lesion.[13] Central type of lesion was seen in 10% (6/60) cases. In absence of para-vertebral shadow, this type of lesion is very difficult to differentiate radiologically from Calve's disease and neoplastic conditions.[20]

The neural arch or posterior elements include spinous processes, laminae, transverse processes, articular processes and pedicles.[21] Recognition of posterior element involvement is important in tuberculosis because successful treatment requires laminectomy and fixation in addition to chemotherapy. Posterior elements were involved in 56.67% (34/60) of cases in the present study. Desai et al,[9] Al-Mulhim et al[8] and Loke et al[17] reported posterior element involvement as 8%, 68% and 40% respectively in their study.

6.67% (4/60) patients of isolated posterior element involvement were found in the present study. In our study, pedicle was most commonly involved. Kumar K (1985) suggested that nearly 5% of spinal tuberculosis could be located in the posterior elements.[21]

Discitis is seen as increased signal intensity on T2 weighted images.[22]In our study, disc involvement was seen in 75% (45/60) cases. The reported incidence of disc involvement varies from 30% to 80%.

Extension of infection to adjacent ligament and soft tissue is frequent. The reported incidence of paraspinal abscess was 100% by Kim et al,[7] 71% by Al-Mulhim et al,[8] 73.3% by Loke et al[17] and 83.33% in present study. Presence of paraspinal abscess out of proportion to destruction of vertebral body is strongly suggestive of tuberculosis. If there is air fluid level with in paraspinal abscess, this is said to exclude tuberculosis.

Epidural collection was present in 66.67% (40/60) of patients in the present study. Al-Mulhimet al[8] reported an incidence of 60.7% in his study while Loke et al[17] found epidural collection to be present in 53.3% of their patients.

The extent of epidural collection correlated well with clinical features. Out of 40 patients with epidural lesions, 29 presented with weakness (paresis/paraplegia/quadriplegia). Bowel and bladder symptoms were present in 11/60 patients in which epidural lesion was found to cause compression of the conusme dullaris.

Subligamentous spread occurs when infection spreads beneath anterior longitudinal ligament and periosteum. There is relative preservation of intervertebral disc space. Radiologically, it manifests as erosions of anterior surface of vertebral body.[13] In present study, subligamentous spread was seen in 30% (18/60) patients. Out of these, 2 had pure subligamentous extension and 16 patients had paradiscal involvement with subligamentous extension. In study of Loke et al (1997),subligamentous spread was reported in 66.6% of cases.[17]

Spinal cord involvement appears as high signal intensity on T2W which could be either cord oedema or myelomalacia. Cord is compressed by epidural soft tissues.[13] Epidural soft tissue was seen in 66.67% (40/60). However, clinically 48.33% (29/60) had weakness. This is because deficit occurs only when there is 60% or more encroachment of spinal cord above the level of conus.[13]Oedema due to spinal cord compression is reversible, but unfortunately myelomalacia is not. Both these findings can be differentiated on basis of T2 signal intensity.[23]

In the present study, in 8 patients who showed normal radiographs and MRI showed changes suggestive of tuberculosis, 2 patients had isolated paradiscal involvement, 4 patients had isolated posterior elements involvement and 2 patients had sacral involvement, which cannot be generally evaluated well by plain radiography.

Up to 76% canal encroachment is compatible with intact neural status, if all other causes of neural complications such as instability (pathological subluxation/dislocation) or vascular cause, exists. The explanation suggested was that the cord compression in the tubercular spine is gradual, hence the spinal cord adapts to slowly progressing cord compression. However, neural complications may present at lesser canal compromise, if there is an associated evidence/element of spinal instability.[24]

## CONCLUSION

MRI is only imaging modality which allows us to directly visualise the cord and vertebral marrow facilitating early detection and reducing bone destruction and deformity and diminish the need for surgical intervention. MRI provides a reliable guide to the level and extent of surgical treatment needed and further prognostication of outcome of therapeutic measures.

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