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# MUSCULOSKELETAL TUBERCULOSIS: CLINIC RADIOLOGICAL SPECTRUM AND DIAGNOSTIC CHALLENGES

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ABSTRACT

**Background: Objective**: To find out the clinical manifestations and radiological features of patients having musculoskeletal tuberculosis.
**Materials and Methods:** The data collection period of this hospital based observational study was from March, 2025 to March, 2026. In all, there were 60 cases of clinically and/or radiologically suspected or confirmed musculoskeletal tuberculosis included. Patients' clinical history, examination, lab and radiology data were used to assess them. Anatomical site and clinical presentation determined the use of plain X-ray, computed tomography (CT) scan, magnetic resonance imaging (MRI), and ultrasonography. Data obtained were tabulated and statistically analysed and reported as frequencies and percentages.
**Results:** The mean age for the study population was 38.6 ± 15.4 years, and majority was males (56.7%). The most prevalent presenting symptom was pain (86.7%) and this was followed by swelling (40.0%) and restriction of movement (35.0%). Anatomical site most commonly involved was spine (53.3%), and the thoracolumbar area most commonly involved in the spines. Radiological changes most often noted were bone destruction (68.3%), destruction of the soft tissue collection/abscess (33.3%), narrowing of joint space (30.0%) and collapse in the vertebrae (25.0%). 21.7% of patients had paravertebral abscess and 13.3% had epidural extension. In 75.0% of patients, the ESR was raised and in 61.7% of patients, the CRP was raised.
**Conclusion:** There is a wide clinic radiological spectrum in musculoskeletal tuberculosis and the most common area of involvement is in the spine. Clinical findings that were most common were pain while radiological findings that were most common were destructive osseous changes. The key to early diagnosis, to assessing how far the disease has spread and to seeing complications is the high index of suspicion, and the appropriate use of imaging (especially MRI in spinal disease).
**Keywords:** Musculoskeletal tuberculosis, Spinal tuberculosis, extrapulmonary tuberculosis, MRI, radiology, bone destruction and Clinicoradiological spectrum.

## INTRODUCTION

Tuberculosis (TB) is still a tremendous disease problem in the world and is responsible for considerable morbidity and mortality, especially in the developing countries. Pulmonary tuberculosis is the most common tuberculosis but extrapulmonary tuberculosis is also present in a significant number and usually affects almost any organ system.[1] The musculoskeletal tuberculosis related to the bones, joints and spinal column is a significant extrapulmonary tuberculosis seen in the adjacent soft tissues. Although significant progresses have been achieved in the field of diagnostic imaging and microbiological techniques, musculoskeletal tuberculosis has proven to be a diagnostics

challenge due to its clinical variability, slow clinical evolution, and its unmistakable resemblance to other infectious, inflammatory, degenerative and neoplastic diseases.[2]

MTB can spread hematogenous or through the lymphatic system to a primary site of MTB (pulmonary or extrapulmonary) to form MTB muscle tissue involvement or MSTBI. The disease may involve axial or appendicular skeleton and the spine is among the most common sites of disease involvement. Other skeletal structures, long bones and peripheral joints are also involved.[3] Disease distribution and extent are variable; some patients may have simple lesions on bones while others may have extensive lesions of the joints and surrounding soft tissues. Spinal tuberculosis being significant is the progressive destruction and deformity of the vertebrae can lead to paravertebral/epidural abscess, compression of spinal cord and neurological deficits.[4]

Clinical signs of musculoskeletal tuberculosis are non specific, insidious. Common symptoms include pain, swelling, tenderness, stiffness, and/or limited motion. Back pain can be the main clinical problem in spinal disease and neurologic symptoms can happen when the disease is very advanced. Constitutional symptoms could be present and include fever, weight loss, anorexia and night sweats, but these are not observed on all children. Rare are signs and symptoms of an ordinary constellations case.[5] In addition, clinical symptoms can mimic those of pyogenic osteomyelitis, septic arthritis, rheumatoid arthritis, degenerative disease or malignant disease and may lead to delayed diagnosis or treatment. A radiological workup is an essential and crucial part of a musculoskeletal tuberculosis diagnosis and assessment.[6]

Traditional x-radiography is commonly used as a preliminary imaging investigation and may show osteolytic lesions, sclerosis, destruction of the cortex, narrowing of the joints, collapse and/or deformity of the vertebra. When disease occurs early, however, subtle or nonspecific radiological changes can occur. Ultrasonography may aid in areas of fluid collection and joint effusions, in outlining superficial soft tissue abnormalities, and in guiding aspiration and/or biopsy.[7]

Computed tomography (CT) is a useful modality for assessing the destruction of the cortex and osseous components of the SWK and is especially helpful with the identification of sequestra, calcification, vertebral involvement and paravertebral collections. CT can also help to guide biopsy or aspiration to microbiological or histopathological confirmation.[8]

However magnetic resonance imaging (MRI) has a special value in the assessment of the extent of musculoskeletal tuberculosis as it can provide excellent soft tissue contrast and show bone marrow abnormalities, joint involvement, abscesses, epidural extension, compression of the spine, involving of adjacent structures. MRI is, in particular, useful in spinal tuberculosis to assess the level and extent of disease and to detect any complications, which could affect treatment planning. The radiological features of musculoskeletal tuberculosis are variable and can vary depending on the anatomical location, the stage and the extent of the disease.[9]

Early stages of the disease may present with minimal or only a few bones impacted or involve the joints; later disease may progress to abscess, bone loss, affect joints, abnormal gait, or neurologic signs and effects. In some instances, the diagnosis, the imaging findings may closely resemble malignancy or other infective and inflammatory lesions. Thus, it is important to carefully correlate imaging with clinical history, laboratory, microbiological and, when available, histopathological evaluation. With its consequences of irreversible fixation of the bones and joints, deformity, functional disability and neurological impairment, early diagnosis of musculoskeletal tuberculosis is a must.[10,11]

A detailed knowledge of the clinical and radiological spectrum can aid in the development of diagnostic suspicion and prompt investigation and management when indicated. It is important for both clinicians and radiologists to be aware of atypical presentations especially in the endemic areas of the world. Musculoskeletal tuberculosis (MS-TB) is a relatively uncommon condition which can be under diagnosed, due to its low prevalence and the lack of specificity in its clinical presentation. The literature review on the clinic spectrum of evaluation might be helpful to understand the common sites of involvement, presenting symptoms and typical clinic radiological tumour findings in the affected patients. So, the present study was conducted to assess the clinic radiological picture of musculoskeletal tuberculosis especially related to the clinical picture, distribution and characteristic of the disease radiologically.

**Aim**

To assess the clinic X-ray spectrum of Muscles Tuberculosis.

**Objective**

To analyse clinical and radiological features of the patients with musculoskeletal tuberculosis.

## MATERIALS AND METHODS

The present study was carried out as an observational study in an hospital setting to assess the spectrum of diseases in paramedical radiology of musculoskeletal tuberculosis. This study centered on the description of the clinical features, anatomical distribution and radiologic features of the patients who were diagnosed and/or suspected to have musculoskeletal tuberculosis. The study was started after getting ethical approval from the Institutional Review/Ethical Committee.

The study was carried out in the Department of Radiology, retrospectively with the cooperation of the related clinical departments. During the study

period (March 2025 to March 2026), patients with clinical characteristics suspicious of musculoskeletal tuberculosis and referred for radiological evaluation were evaluated. 60 patients were studied in all. The study population consisted of patients suffering from musculoskeletal tuberculosis of spine, bones, joints or the surrounding soft tissues. Clinical, physical, laboratory and radiologic examinations were all used to evaluate patients. Available microbiological, histopathological, clinical, radiological evidence was used for the diagnosis.

**Inclusion Criteria**

Patients were enrolled into the study who had a clinical and/or radiological probability of a musculoskeletal tuberculosis lesion of the spine, bones, joints or soft tissues. To include the male and female patients and of all age groups. The patients who had undergone the relevant radiological investigations as part of their diagnostic evaluation and sufficient clinical and imaging information to properly assess the patients were included. Where microbiological or histopathological confirmation had been given then patients with confirmed TB were also included.

**Exclusion Criteria**

The following patients were excluded:

- Patients with insufficient clinical or radiological records.
- Patients with isolated pulmonary tuberculosis without musculoskeletal involvement.
- Patients who had undergone previous major surgery at the affected site when postoperative changes significantly interfered with radiological assessment.
- Patients with incomplete imaging studies.
- Patients who did not provide consent for participation, where applicable.

**Clinical Assessment**

An extensive clinical history was taken of each patient. Demographic data (age and sex) was obtained. Medical history, presenting complaints and length of symptoms were recorded. Specific symptoms similar to those of musculoskeletal tuberculosis (pain, swelling, tenderness, stiffness, decreased range of motion, fever, weight loss, loss of appetite and night sweats or neurological symptoms) were given special attention. Anyone with involvement of the spine complained of back ache, weakness of arms and/or legs, sensory symptoms and bladder or bowel problems were addressed. Pulmonary tuberculosis history and contact with known tuberculosis patients, antitubercular treatment history and comorbidities were also documented, if present.

**Laboratory Investigations**

Laboratory tests, which were required for routine clinical assessments performed as part of the investigation were documented. These encompassed full blood counts, the C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) measurements, as well as other investigations which were deemed clinically suitable. In cases tested, microbiological tests comprised examination of the tissue or aspirate for the presence of Mycobacterium tuberculosis. If available, molecular testing (e.g., cartridge-based nucleic acid amplification testing) and culture were documented. Necropsies and biopsies or surgical procedures were also documented (if performed) and submitted to documentation based on histopathological findings. Laboratory findings were not used alone to interpret the findings, but made together with the clinical and radiological findings.

**Radiological Evaluation**

All available radiological examinations were reviewed systematically. The imaging modality used depended on the anatomical site and clinical indication.

**Plain Radiography**

Conventional radiographs were evaluated for:

- Osteolytic or sclerotic lesions
- Cortical destruction
- Joint-space narrowing
- Articular surface irregularity
- Bone deformity
- Vertebral body destruction
- Vertebral collapse
- Alignment abnormalities
- Soft-tissue swelling
- Calcification where present

**Ultrasonography**

Where applicable, ultrasonography was performed on the superficial lesions and peripheral joints. Diagnostic abnormalities recorded included joint effusion, synovial thickening, collections of soft tissue, and/or soft tissue involvement, including abscess. Various value of ultrasound aspiration or biopsy results were noted if used.

**Computed Tomography**

CT examination was analysed for the amount and distribution of osseus involvement. Special focus was placed on the following abnormalities: Cortical destruction, lytic lesions, sclerotic effect on the vertebrae, sequestration, pathological fracture, paravertebral collections, calcification and related abnormalities. The level of spinal disease achieved, as well as paravertebral involvement / epidural disease, was recorded in severe disease cases.

**Magnetic Resonance Imaging**

The presence and extent of the bone marrow involvement, vertebral destruction, disc involvement, joint abnormalities, synovial changes, soft tissue collections, the presence of abscess and presence of epidural extension and compression of the neural elements was evaluated by MRI. Along with the features above, the following characteristics were assessed specifically for spinal tuberculosis:

- Number and level of vertebrae involved
- Vertebral body destruction
- Intervertebral disc involvement
- Vertebral collapse
- Kyphotic deformity
- Paravertebral abscess

- Epidural abscess
- Spinal canal involvement
- Spinal cord compression
- Neural foraminal involvement
- Associated neurological complications

For peripheral skeletal and joint involvement, the affected bone or joint, pattern of destruction, joint-space changes, marrow involvement, synovial abnormalities, and surrounding soft-tissue extension were recorded.

**Assessment of Anatomical Distribution**

The anatomical distribution of disease was documented for each patient. Musculoskeletal involvement was categorised according to the principal site, including:

- Spine
- Hip
- Knee
- Shoulder
- Ankle and foot
- Elbow
- Wrist and hand
- Long bones
- Other skeletal sites

Patients with multiple sites of involvement were recorded separately to determine the frequency of multifocal disease.

**Diagnostic Criteria**

The diagnosis of musculoskeletal tuberculosis was accepted if there were microbiological/histopathological evidence and/or a combination of clinical features and/or radiologic features supportive of the diagnosis and antitubercular therapy (ATT) had been started. Histopathological changes consistent with histopathological diagnosis were established, partly only indicative of tuberculosis, which were found in areas where tissue was available (granulomatous inflammation with caseous necrosis). Definitive microbiological evidence (as provided by molecular testing or culture) was considered in the absence of clinical history to be a substitute for clinical history.

**Data Collection**

A proforma structured data collection form was used to collect the data. The demographical characteristics, the presentation symptom, duration of illness, the past or recent exposure to tuberculosis, laboratory results, site of involvement, imaging modality, radiological findings, complications, and diagnostic confirmation, were included in the proforma. Patients were anonymized by assigning each patient a study ID. For the study, there were no names included.

**Data Analysis**

The data collected were entered and analyzed in SPSS version 26.0 or appropriate statistical software. The data was summarised using descriptive statistics. Frequencies and percent were used to express interest for categorical variables like sex, anatomical site, presenting symptoms and individual radiological finding. For continuous variables, which included measures of age and number of symptoms, the mean, standard deviation or median and interquartile range (IQR) was used depending on the distribution of the data. The clinical and radiological variables were compared where appropriate with appropriate statistical tests. Categorical variables were analyzed by chi-square test or Fisher's exact test and continuous variables were analyzed by independent-samples t-test or Mann–Whitney U test depending on the distribution of the data. Statistically significant was defined as having a p-value $<0.05$.

**Study Outcome**

The major aim of the study was to summarize the muscle bone tuberculosis clinic radiological spectrum including the clinical features, distribution and the typical radiological findings. Secondary observations conducted were the frequency of various imaging findings, any complications that occurred and any relationship between the clinical presentation and the radiologic manifestations.

# RESULTS

**Table 1: Demographic Characteristics of the Study Population**

| Variable | Frequency (n=60) | Percentage (%) |
|---|---|---|
| **Age group** | | |
| ≤20 years | 8 | 13.3 |
| 21–40 years | 25 | 41.7 |
| 41–60 years | 19 | 31.7 |
| >60 years | 8 | 13.3 |
| **Sex** | | |
| Male | 34 | 56.7 |
| Female | 26 | 43.3 |

The demographic data of 60 patients are given in Table 1. The majority of patients were aged 21–40 years (41.7%), followed by those aged 41–60 years (31.7%). Of all patients: there were 13.3% ≤20 years and 13.3%>60 years. The slight gender imbalance was in favour of males (34 or 56.7% versus 26 or 43.3%). The average age of the subjects in the study was 38.6 ±15.4 years.

**Table 2: Clinical Presentation of Patients**

| Clinical presentation | Frequency (n=60) | Percentage (%) |
|---|---|---|
| Pain | 52 | 86.7 |
| Swelling | 24 | 40.0 |
| Restricted movement | 21 | 35.0 |
| Fever | 17 | 28.3 |
| Weight loss | 14 | 23.3 |
| Neurological symptoms | 11 | 18.3 |
| Night sweats | 9 | 15.0 |

The clinical presentation of cases of musculoskeletal tuberculosis is listed in Table 2. The most prevalent complaint was pain (52 (86.7%) patients). In 24 (40.0%) patients there was swelling and in 21 (35.0%) restricted movement was observed. Fever was reported in 17 (28.3%) patients, followed by weight loss in 14 (23.3%). Eleven (18.3%) patients had neurological symptoms and nine (15.0%) patients had night sweats.

**Table 3: Anatomical Distribution of Musculoskeletal Tuberculosis**

| Site of involvement | Frequency (n=60) | Percentage (%) |
|---|---|---|
| Spine | 32 | 53.3 |
| Peripheral joints | 16 | 26.7 |
| Isolated bones | 9 | 15.0 |
| Multifocal involvement | 3 | 5.0 |
| **Total** | **60** | **100** |

This anatomical distribution of musculoskeletal tuberculosis is shown in Table 3. The most common pattern was that of spinal involvement seen in 32 (53.3%) patients. 16 (26.7%) patients had involvement of the peripheral joints and 9 (15.0%) had osseous involvement alone. 3 (5.0%) patients had a multifocal musculoskeletal involvement.

**Table 4: Distribution of Spinal Tuberculosis**

| Spinal region | Frequency (n=32) | Percentage (%) |
|---|---|---|
| Thoracolumbar | 13 | 40.6 |
| Lumbar | 10 | 31.3 |
| Thoracic | 7 | 21.9 |
| Cervical | 2 | 6.2 |
| **Total** | **32** | **100** |

The distribution of spinal tuberculosis as per region of spine is shown in table 4. Thoracolumbar region (13 (40.6%)) was the most frequent area of involvement followed by the lumbar region with 10 (31.3%) cases. Thoracic involvement was seen in 7 (21.9%) patients, and cervical involvement was the least, seen in 2 (6.2%) patients.

**Table 5: Radiological Findings**

| Radiological finding | Frequency (n=60) | Percentage (%) |
|---|---|---|
| Bone destruction | 41 | 68.3 |
| Soft-tissue collection/abscess | 20 | 33.3 |
| Joint-space narrowing | 18 | 30.0 |
| Vertebral collapse | 15 | 25.0 |
| Paravertebral abscess | 13 | 21.7 |
| Epidural extension | 8 | 13.3 |

Overall, the main radiological findings found in the group studied is reported in table 5. Bone destruction was the most common radiological abnormality with 41 (68.3%) patients. Twenty (33.3%) patients had soft tissue collection/abscess and 18 (30.0%) had joint space narrowing. 15 patients (25.0%) had vertebral collapse. Paravertebral abscesses were seen during the evaluation in 13 (21.7%) patients and 8 (13.3%) patients had evidence for an extension of the epidural space.

**Table 6: Imaging Modalities Used**

| Imaging modality | Frequency (n=60) | Percentage (%) |
|---|---|---|
| Plain radiography | 42 | 70.0 |
| CT | 35 | 58.3 |
| MRI | 39 | 65.0 |
| Ultrasound | 18 | 30.0 |

The different imaging modalities used for identifying musculoskeletal tuberculosis are included in Table 6. In 42 (70.0%) patients, plain radiological examination was the most common imaging modality, followed by MRI in 31 (51.7%) patients and computed tomography (CT) scan in 13 (21.7%) patients. MRI was performed in 39 (65.0%) patients, while CT was used in 35 (58.3%). There were 18 (30.0%) patients that underwent ultrasonography. The percentages do not sum to 100% for the individual with repeat imaging as the patients did not have multiple types of imaging performed.

**Table 7: Laboratory and Diagnostic Findings**

| Finding | Frequency (n=60) | Percentage (%) |
|---|---|---|
| Raised ESR | 45 | 75.0 |
| Raised CRP | 37 | 61.7 |
| Microbiological/molecular confirmation | 22 | 36.7 |
| Histopathological confirmation | 19 | 31.7 |

The laboratory and diagnostic results of the participants studied are displayed in table 7. The most common laboratory abnormality (seen in 75.0% of patients) was an elevated ESR. In 37 of the patients (61.7%) a raised CRP was detected. Of the patients, 22 (36.7%) were confirmed on the basis of microbiological or molecular confirmation of tuberculosis and 19 (31.7%) patients had histopathological confirmation.

**Table 8: Major Clinic radiological Findings According to Anatomical Site**

| Finding | Spinal (n=32) | Peripheral/osseous (n=25) | Multifocal (n=3) |
|---|---|---|---|
| Bone destruction | 27 (84.4%) | 12 (48.0%) | 2 (66.7%) |
| Soft-tissue collection | 16 (50.0%) | 4 (16.0%) | 1 (33.3%) |
| Joint-space narrowing | 2 (6.3%) | 15 (60.0%) | 1 (33.3%) |
| Vertebral collapse | 15 (46.9%) | — | — |
| Paravertebral abscess | 13 (40.6%) | — | — |
| Epidural extension | 8 (25.0%) | — | — |
| Neurological symptoms | 11 (34.4%) | 0 | 0 |

The major clinicoradiological findings in the different anatomical locations are compared in table 8. Spinal involvement of the disease was found in 27 (84.4%) patients and was associated with bone destruction. There were additionally more soft-tissue collections in people with spinal disease, with 16 (50.0%) patients having soft-tissues. Joint space narrowing was more frequently seen in those with peripheral/osseous involvement:15 (60.0%) patients. In 46.9% of the patients, the spine was above (vertebral collapse), in 40.6% there was an extension to paravertebral areas, and in 25.0% of the patients an extension to the epidural area was found in patients with spinal tuberculosis. 11 (34.4%) patients who had involvement of the spine had neurological symptoms.

## DISCUSSION

Musculoskeletal tuberculosis is an important extrapulmonary TB which may affect the spine, bones, joints and adjacent soft tissue. The diagnosis is often difficult, due to its insidious clinical course, non-specific symptoms and variable radiological manifestations. SPILL was the most common radiological pattern (present in 60 patients in the present study), bone destruction was the most common radiological abnormality (in 50 patients in this study), and the most common presenting symptom was pain (in 20 of these 60 patients). This is seen to be broadly similar to previous studies describing the wide range of clinicoradiological features of musculoskeletal tuberculosis which includes Mudgal et al., and Rajasekar et al.[5,12]

The average age of the patients was 38.6 ± 15.4 years with the majority of patients (22.5%) being 21–40 years old. There was a slight male predominance with males accounting for 56.7%. Past studies have shown that MS-TB can develop in a wide age group and that there is no uniform age distribution of MS-TB cases across the different studies performed, and that there may be no consistent sex distribution of MS-TB across the population is shown in the previous study by Ning et al.[13] Peer et al., studied microbiologically confirmed S.T.B. in which they found the median aged to be 42 years, with skeletal involvement seen in both males and females.[14] However, the slight predominance of males in our study may be attributable to differences in the study population and/or in patterns of accessing health care services due to sex differences.

The most frequent clinical presentation was pain in 86.7% followed by swelling and restricted mobility. This is consistent with previously described musculoskeletal tuberculosis as clinical features are most frequently local pain, swelling, tenderness, and functional limitation.[15] Constitutional symptoms occurred at a lower frequency in the patient group in this study: fever, 28.3% and weight loss, 23.3%, and night sweats, 15.0%. It is clinically significant that systemic symptoms occur less frequently, in that musculoskeletal tuberculosis can be insidious and compatible constitutional symptoms of pulmonary

tuberculosis may not be evident. Similarly, Gupta and Bhatnagar emphasized on the non-specific clinical presentation of musculoskeletal tuberculosis and the possibility of the disease simulating other musculoskeletal diseases.[15]

The most common mode of involvement in this study was the spinal pattern involving 53.3% of all cases. This finding is in line with former studies which found spinal tuberculosis to be one of the most prevalent presentations of musculoskeletal tuberculosis. Tobin and Rausch-Phung indicated spinal tuberculosis as a significant factor in musculoskeletal TB and Al Salam and St-Amant provided that musculoskeletal TB most frequently presents as tuberculous spondylitis, arthritis, osteomyelitis and soft tissue infection.[16,17] The fact that the majority of the patients had spinal disease in our study reinforces the fact that spine tuberculosis is a significant entity within the spectrum of musculoskeletal diseases.

The thoracolumbar region was the most common site of spinal involvement followed by the lumbar and thoracic regions amongst those with spinal involvement. In previous clinicoradiological studies similar involvement of the thoracolumbar spine has been described. Kubihal et al., found vertebral collapse, soft-tissue masses, disc narrowing and endplate erosions as important radiological features in a study of 50 patients with spinal tuberculosis.[18] The spectrum we observed in our study also further highlights the need to assess the thoracolumbar region properly in those with suspected tuberculosis of the spine.

Neurological signs and symptoms were found in 18.3% of all of the animals in the study, with most of those being related to spinal disease. Neurologic complications can result from spinal tuberculosis; the result of vertebral collapse, epidural abscess, inflammatory involvement, or spinal cord and nerve root compression can all lead to neurologic sequelae in spinal tuberculosis. In a large study of 274 patients who had spinal tuberculosis, Marais et al., found a wide variety of neurological and MRI findings including radiculomyelitis, spondylitis, subdural abscess and intramedullary tuberculoma was seen. Neurological involvement in our study was different to that of Marais et al., but both are illustrative of the potential for neurosurgical complication of Spinal tuberculosis.[19]

In the present study, the most frequent radiological finding was bone destruction valued in 68.3% of them. It conforms to the untoward effect of musculoskeletal tuberculosis. Tuberculous infection has the potential to cause vertebral body and endplate destruction and collapse, and deformity if spinal disease is present. Endplate erosions were found in 89 of 107 endplates and vertebral wedge/collapse reported in 23 of 50 patients of spinal tuberculosis by Kubihal et al.[18] In a like manner, Sinan et al., have reported vertebral destruction, endplate changes, disc involvement and associated soft tissue changes as crucial imaging features of spinal TB.[8]

In our study, 33.3% showed the presence of soft tissue collections and/or abscesses, and 21.7% showed paravertebral abscess. The results bear congruence with the previous findings that showed soft-tissue involvement is essential in spinal tuberculosis. Kubihal et al., reported soft tissues mass in 29 out of 50 cases and Sinan et al., emphasised that paravertebral or epidural mass is an important imaging finding. When a paravertebral abscess is large and associated with destruction of the vertebrae, the possibility of tuberculosis should be suspected, but the abscess itself is not pathognomonic and should be correlated with the clinical and laboratory findings.[8,18]

The presence of joint-space narrowing (JSN) was noted in the 30.0% of patients, and was more common for patients with peripheral disease. In TB arthritis, the initial destruction of the articular cartilage slows down causing progressive narrowing of the joint space. Garbin Savarese et al., reported that extra-spinal (peripheral) tuberculosis can affect bones and joints in the extremities and can present with imaging findings similar to inflammatory, degenerative and neoplastic processes.[20] Hence, the findings of narrowing joint space should be used in conjunction with other clinical and radiological features when evaluating a patient with TB from a TB-endemic country.

MRI was available in 65.0 % of the patients in the present study and was able to supply useful information on the degree of other spinal involvement and was important in soft-tissue involvement. The use of MRI is widely recognised as the imaging modality of choice for the evaluation of spinal tuberculosis due to its ability to show bone marrow abnormalities, vertebral destruction, disc involvement, paravertebral and epidural collections and neural compression. Pattamapaspong et al., highlighted writings that the radiographs and MRI are important imaging modalities in musculoskeletal tuberculosis while Abid et al., noted that MRI should be the preferred imaging modality for diagnosis and evaluation of disease burden in musculoskeletal tuberculosis.[21,22] Similarly, previous reports by Vanta et al., showed the importance of MRI, in revealing the marrow involvement and the soft-tissue density changes and to differentiate tuberculous spondylitis from pyogenic infection.[23]

In this study plain radiographic imaging was the most common method applied, followed by patients in 70.0%. If a condition is known to have osseous changes and/or joint changes, standard radiography is still a good starting point because radiology is readily available and it can show the osseous/articular changes. But it may be hard to make an early diagnosis with only ordinary X-rays. Conventional radiography is still of value in tuberculous arthritis and osteomyelitis, while MRI is particularly useful for identifying marrow, soft

tissue abnormalities, and is superior to other imaging techniques in some areas.[23] An important complementary aspect of CT is its ability to provide excellent image of cortical destruction and calcification in chronic tuberculous abscesses.[21,22] Of these, the raised ESR and CRP levels were observed in 75.0% and 61.7% of patients, respectively. These results are nonspecific, and do not by themselves confirm the diagnosis of TB.

Microbiological or molecular characterization was available for 36.7% of the patients and histopathological characterization for 31.7% of the patients in the present study. The authors of a recent study by Che et al., highlighted importance of microbiological confirmation in skeletal tuberculosis and showed the variety of the involved skeletal site.[24] If possible, tissue sampling is still important especially if there is an overlap between imaging and malignancy and other infective conditions.

Clinically and radiologically tumour locations showed differences, as compared to the planification of clinic radiological parameters. Bone destruction and soft tissue collections were more common in t.b of the spine while peripheral involvement had more joint space narrowing. These findings are supportive of the concept of the radiological spectrum of musculoskeletal tuberculosis being different for different sites. As is done by Abid et al., various imaging patterns of spinal, articular, osseous and soft tissue tuberculosis were described, with particular focus on the extra-spinal lesions that might have an atypical appearance.[22]

One of the problems that arise in diagnosis is the similarity of musculoskeletal tuberculosis with other diseases. The radiological picture can be similar to that seen in pyogenic osteomyelitis, septic arthritis, inflammatory arthritis, degenerative arthritis and malignancy. It has been mentioned by Pattamapaspong et al. (2024) that musculoskeletal tuberculosis is usually not associated with specific clinical characteristics and can often resemble many other diseases.[21] Similarly, Abid et al. (2024) pointed out that the radiographical profile of a case of extra-spinal musculoskeletal tuberculosis is often non-specific.[22] Hence, radiological data should always be used along with clinical history, biochemical parameters, microbiological data and histopathological finding when necessary.

Results of the current study have clinical significance. In endemic countries, persistent musculoskeletal pain, swelling, difficulty moving or back pain needs to be investigated for tuberculosis. Even when there are no constitutional symptoms, fever, or weight's loss, this should not rule out the diagnosis. A systematic radiological assessment is vital in establishing bone destruction, joint space abnormalities, soft tissue collections, vertebral collapse, paravertebral abscesses and extension into the epidural space. In suspected spinal tuberculosis, MRI can be used to show the main disease area and any complications of the disease, which often cannot be seen using other imaging techniques such as X-rays or MRIs (MRI).[21,22]

There are a few problems with the present study. There are a small number of patients (60), so that the study results are limited in generalisation. Selection bias may also be introduced into the design as radiological assessment was performed after referral for a patient. Moreover, not every patient received all the imaging modalities and microbiologic or histopathologic confirmation was not available in all patients. Moreover, this study emphasised the clinicoradiological spectrum and didn't analyze the outcome of the treatment in terms of long-term follow-up or in terms of functional outcome.

Notwithstanding these drawbacks, this study clearly illustrates the wide clinicoradiological clinical spectrum of tuberculosis of musculoskeletal system. Overall findings of spinal involvement, high prevalence of pain, destructive bone changes and associated soft tissue abnormalities are similar to that reported in previous studies.[25-27] The findings further highlight the important role the MRI plays in identifying the extent of spinal and soft-tissue disease and complications.

In general, musculoskeletal tuberculosis should be a significant differential diagnosis for patients who present with chronic musculoskeletal symptoms, especially in the areas of countries where the disease is endemic. Taking a multifactorial approach, combining clinical assessment, laboratory work-up, microbiology/histopathology and/or appropriate imaging can enhance the accuracy of diagnosis. Prompt diagnosis in the specific clinico-radiological patterns can prove beneficial in the timely treatment and preventing any permanent skeletal destruction and deformity as well as neurological damages.

## CONCLUSION

The clinicoradiological presentations of musculoskeletal tuberculosis are very variable including spinous involvement which was seen most often in the present series. The most common clinical symptoms were pain, and the main radiological findings were bone destruction, collections of soft tissue, narrowing of the joint spaces, vertebral collapse, and paravertebral abscesses. The relatively low prevalence of constitutional symptoms underlines the sneaky and non-specific features of the disease. In patients with a suspicion of spinal involvement, radiological assessment is important to determine extent of disease and neurological compromise and complications such as extension into the epidural space. It is essential to have an integrated approach combining the clinical, lab, microbiological, histopathologic and radiological features to arrive at an accurate diagnosis. The early diagnosis of the clinico-radiological signs of musculoskeletal tuberculosis will help to start timely treatment and

avoid irreversible bone destruction, deformity and neurological complications.

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