

SKELETAL INVOLVEMENT IN PEDIATRIC TUBERCULOSIS

Radiologic Imaging Manifestations

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Abstract

Skeletal tuberculosis (TB) in childhood remains a considerable source of skeletal infection in developing countries, however the diagnosis is challenging. The common skeletal manifestations are spondylitis, arthritis and osteomyelitis. Recognizing the typical imaging characteristics of skeletal TB in children can help in the diagnosis of these conditions. This article aims to present the imaging features of pediatric skeletal TB.

Key Facts

- Accounts for 10 - 35% of pediatric extra-pulmonary TB
- Systemic symptoms found in only 33% of children
- Less than 50% have concurrent pulmonary TB
- Early diagnosis is crucial to prevent serious bone and joint destruction
- Radiologic evaluation plays an important role in diagnosis and follow up
- Common skeletal manifestations:
 - Spondylitis
 - Arthritis
 - Osteomyelitis

Introduction

Skeletal tuberculosis is not uncommon. It accounts for 10-35% of pediatric extra-pulmonary TB. The lesions can develop more than 10 years after the initial infection and occurs primarily in older children, particularly during the first two decades of life (1, 2). The systemic symptoms are found in only 33% of children and more common in the immunocompromised host with multiple lesions. Early detection is crucial to prevent bone and joint destruction. Radiologic imaging plays an important role in diagnosis, characterization, evaluation of extent, and follow up. Skeletal TB typically presents with solitary bony lesion with local sign of inflammation and less than 50% of patients have concurrent pulmonary TB. Common skeletal manifestations are spondylitis (50%), arthritis and osteomyelitis (11%) (3).

Tuberculous (TB) Spondylitis

The most common manifestation of skeletal tuberculosis is tuberculous spondylitis or Pott's disease, which is found even in children younger than 5 years of age. Lower thoracic and upper lumbar spine are frequently involved. TB spondylitis results from venous spread in the paravertebral Batson's venous plexus and then typically involves anterior vertebral body with anterior longitudinal sub-ligamentous spread (4). It can be difficult to differentiate between pyogenic and TB spondylitis. The intervertebral disc is usually spared in TB until late infection, whereas the intervertebral disc is destroyed in pyogenic spondylitis even in early phase of the disease. Septic embolus may also occur due to thrombosis and bony necrosis (5). Clinical manifestation of TB spondylitis is intermittent, relatively long bouts of fever, with insidious progression, compared to acute onset of high fever in pyogenic etiology. MRI is beneficial to differentiate between pyogenic and TB spondylitis, where TB spondylitis shows multiple body involvement, well - defined paraspinal soft tissue with contrast enhancing walls, vertebral intraosseous abscess with relatively disc preservation, and severe bony destruction resulting in gibbus deformity [Fig. 1]. Pyogenic spondylitis has less than 2 vertebral body involvement, with thick and irregular abscess wall, ill- defined enhanced margin of paraspinal soft tissue, moderate to complete disc destruction, disc abscess, and infrequent bony destruction (4). TB spinal deformity in children can be spontaneously corrected (6). Distinctive clinical manifestations and MRI features between tuberculous and pyogenic spondylitis are shown in Table 1.

Radiologic Clues

• TB Spondylitis

- Most common skeletal TB involvement
- Multi-level involvement
- More severe bone destruction
- Paraspinal abscess is common
- Causes gibbous deformity and can cause spinal cord compression
- Sometimes difficult to differentiate from pyogenic cause

• TB Arthritis

- Second most common skeletal TB involvement
- Typically mono arthritis
- Frequently involves hips and knees
- Pnemister triad
 - Juxta-articular osteoporosis
 - Osseous erosions
 - Joint space narrowing

• TB Osteomyelitis

- Least common skeletal TB involvement
- Lesions can be solitary or multiple
- Transphyseal spread can occur in children age > 1.5 yrs
- Jungling's disease (multifocal bone lesions) is secondary to hematogenous disease
- Four radiographic forms:
 - Cystic
 - Infiltrative
 - Focal erosions
 - Spina ventosa

Table 1. Distinctive Clinical Manifestations and MRI Features of TB and Pyogenic Spondylitis

Variable features	Tuberculous spondylitis	Pyogenic spondylitis
Clinical		
Age	Younger	Older
Clinical symptom	Longer duration and intermittent fever	Shorter duration and high fever
MRI findings		
Spinal level	Thoracic spine	Lumbar spine
Vertebral involvement pattern	Multi-level, more severe destruction and heterogeneous enhancement	≤ 2 levels, mild to moderate destruction and homogenous enhancement
Disc involvement	Normal to mild destruction	Moderate to severe destruction
Abscess	Thin and smooth walled abscess Present para-spinal abscess	Thick and irregular walled abscess Absent para-spinal abscess

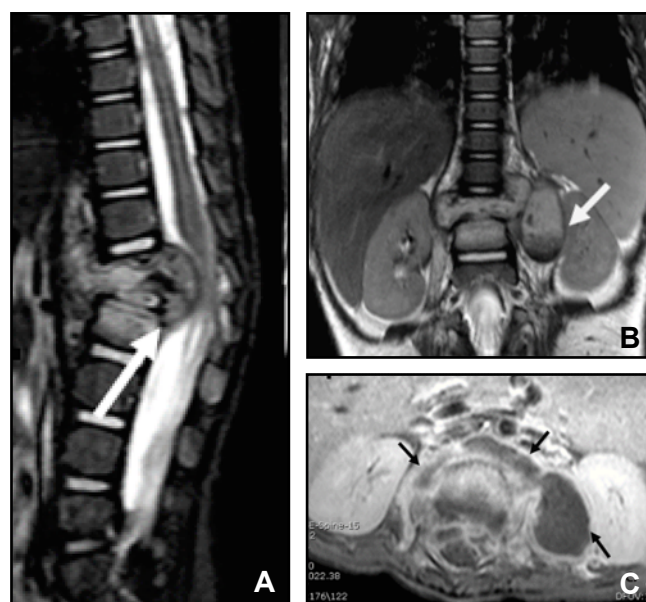


Figure 1. TB spondylitis. A two-year-old boy presented with pain after falling. Sagittal T2 MR image demonstrates spondylodiskitis at T12 and L1 levels with cord compression (arrow). Coronal T2 (B) and contrast-enhanced T1 (C) weighted MR images demonstrate paravertebral abscess (arrows) and epidural phlegmon.

TB Arthritis

The synovial joint is the second most common involvement of skeletal TB. It is typically mono-arthritis with the hip and knee joints frequently affected (3). It can mimic rheumatoid arthritis when hands and feet are involved (7, 8). The sternoclavicular joint accounts for only 1 to 2% of all peripheral TB arthritic cases, less common compared to pyogenic organisms [Fig. 2] (9). Tb arthritis usually results from metaphyseal osteomyelitis with transphyseal spread or the organism can be directly deposited onto the joint synovium. The transphyseal spread is not a characteristic of pyogenic arthritis (4). In children older than 1.5 years of age, transphyseal spread can still occur but it is less common due to disappearance of the transphyseal vessels. Phemister triad, which consists of juxta-articular osteoporosis, peripheral osseous erosions, and gradual tapering of joint space, are typical features of TB arthritis [Fig. 3]. Joint effusion can be present and fluid analysis or synovial biopsy is helpful to differentiate TB arthritis from pyogenic or juvenile idiopathic arthritis.

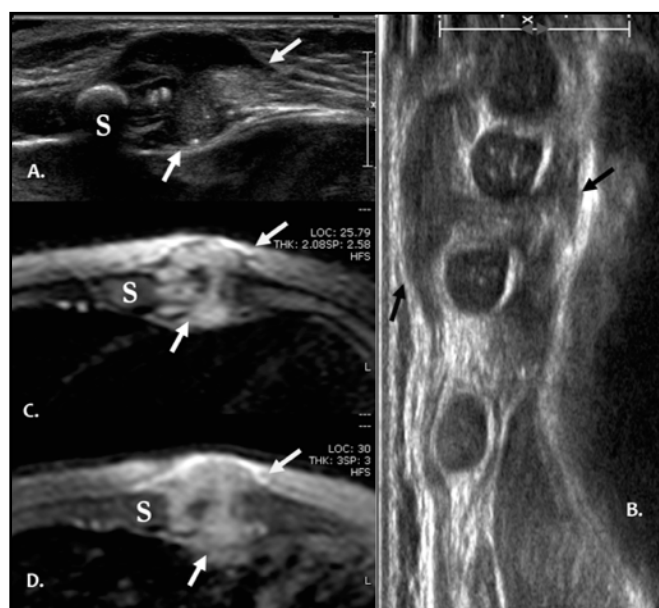


Figure 2. Sterno-clavicular arthritis secondary to TB. A 6 month-old boy presented with chest wall mass for 2 weeks. Ultrasound images in transverse (A) and longitudinal (B) views show hypoechoic lesion of the abscess formation involving left sterno-chondral junction (arrow). Axial T2 weighted with fat suppression MRI (C) and axial T1 weighted contrast enhanced MRI (D) demonstrate abscess formation (arrows) at left sterno-chondral junction with osteomyelitis of adjacent rib and sternum (S).



Figure 3. TB arthritis of the left hip. Frontal radiograph of the hips and pelvic area shows a grossly abnormal left hip joint with deformity and erosions, joint space narrowing, and osteopenia (Phemister triad). Case courtesy of Dr. Bernard F. Laya from Manila, Philippines.

TB Osteomyelitis

Osseous tuberculosis is less common than spinal TB or TB arthritis. In the past, TB osteomyelitis was predominantly multifocal and disseminated type (Jungling's disease) from hematogenous spread, however, the solitary bony involvement are more common in recent years (4, 10). The calvarium, hands, feet, ribs and long tubular bones are most commonly involved (4). Although calcaneal TB is rare in children, if untreated or with delayed treatment, it may lead to functional disability [Fig. 4]. Bony destruction can occur at the metaphysis or epiphyses or it can extend from metaphysis to involve the growth plate through transphyseal spread [Fig. 5]. There are four radiographic findings of TB osteomyelitis: cystic, infiltrative, focal erosions and spina ventosa. TB osteomyelitis demonstrate lack of sclerosis, less sequestra and less periosteal reaction as compared to the pyogenic osteomyelitis (11). Differential diagnoses include Ewing's sarcoma, fungal and subacute pyogenic osteomyelitis, cartilaginous tumors or eosinophilic granuloma.

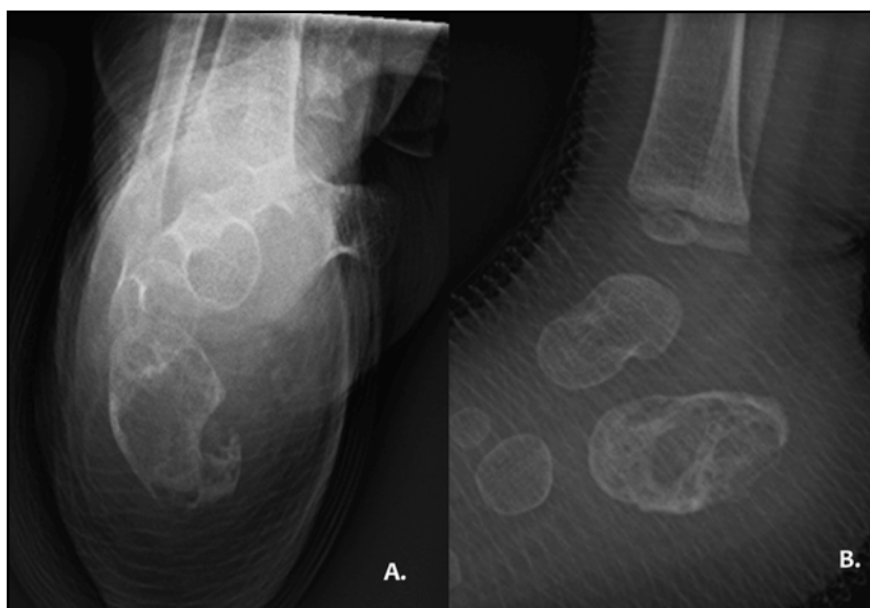


Figure 4. TB osteomyelitis of the calcaneus. A one-year-old girl presented with pain and swelling of right heel for 2 months. Axial (Harris) (A) and lateral (B) views show few well-defined areas of bony destruction with sclerotic rim at the calcaneus which was proven to be TB osteomyelitis.

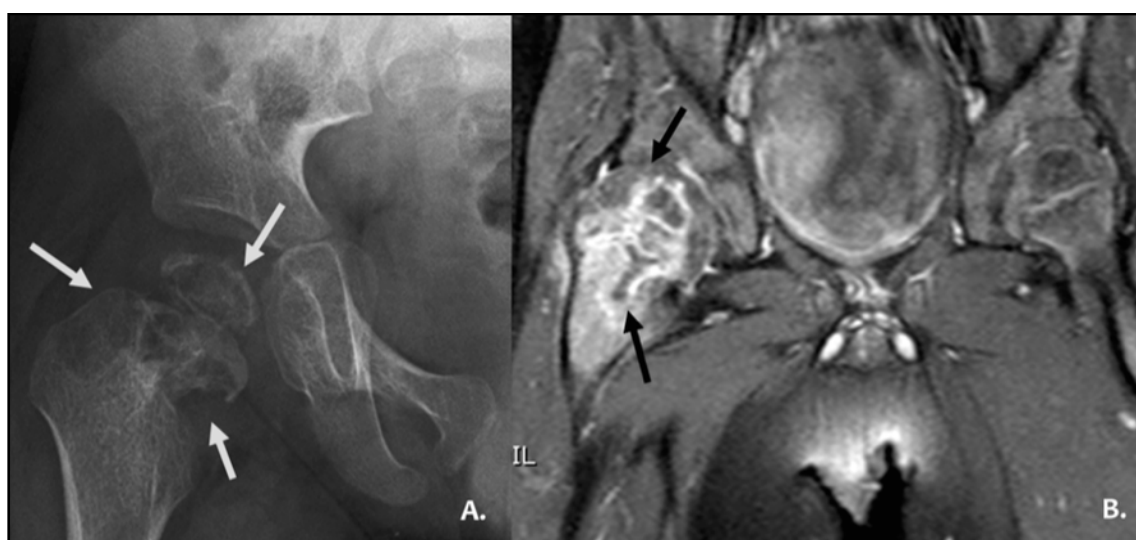


Figure 5. Metaphyseal and epiphyseal TB osteomyelitis via transphyseal spread. A two-year-old boy presented with right hip pain for 5 months. Anteroposterior radiograph of hip (A) demonstrates multifocal cystic bony destruction involving the proximal metaphysis and epiphysis of right femur. Coronal T1 weighted contrast enhanced MRI of the right proximal femur shows rim-enhancing lesion (TB abscess) involving the proximal metaphysis with transphyseal spread to the epiphysis (arrows).

Osteitis tuberculosa multiplex systoles or Jungling's disease is the multifocal musculoskeletal TB and represents about 5%-10% of skeletal TB. It is often found in disseminated disease along with pulmonary infection (12). The lesions generally affect in the peripheral skeleton and metaphyseal long bones.



Figure 6. Multifocal musculoskeletal TB in an 11 year-old boy with HIV infection. Oblique radiograph of both hands (A) and lateral view of the left elbow (B) demonstrate multiple cystic bony destructions involving all long tubular bones and carpal bones.

Children with bone lesions usually present with signs and symptoms such as local pain, swelling, tenderness, muscle wasting, and decreased range of movement. Delay in diagnosis of these bone lesions in children occur because the symptoms are subtle (13).

Conclusion

Musculoskeletal involvement is a very important aspect of TB disease. The patient's clinical manifestations are diverse which can range from subtle pain and discomfort to overt and extensive disease. Histologic diagnosis maybe necessary in some cases, but radiologic imaging studies play a very important role not only in the diagnosis, but also in follow up during and after treatment.

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