

## Case Series

# Image-guided intervention for targeted management of musculoskeletal infections: A case series

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## ABSTRACT

Musculoskeletal infections (MSKIs), including osteomyelitis, septic arthritis, and soft-tissue infections, can present with non-specific symptoms and overlapping imaging features posing diagnostic and therapeutic challenges. While imaging modalities such as magnetic resonance imaging and computed tomography (CT) are useful for identifying infection, they often cannot determine the specific pathogen or distinguish infection from malignancy. Image-guided biopsy/aspiration allows for accurate, minimally invasive sampling of bone and soft-tissue lesions, leading to definitive microbiological and histopathological diagnosis. This procedure is particularly valuable in cases with non-specific clinical or imaging findings, atypical infections, or when empiric treatment has failed. The use of imaging modalities such as CT, US, and C-arm enhances the precision and safety of interventions. In this case series, we present a spectrum of MSKIs managed through image-guided interventions. The series highlights the clinical utility and how the outcomes of these procedures changed the perspective and management protocols of these cases.

**Keywords:** Image-guided biopsy, Melioidosis, Osteomyelitis, Spondylodiscitis, Tuberculosis

## INTRODUCTION

Musculoskeletal infections (MSKIs) require timely and accurate diagnosis to prevent serious complications such as chronic infection, bone destruction, or sepsis. While clinical evaluation and imaging play a vital role in identifying infection, definitive diagnosis and treatment often depend on obtaining microbiological or histopathological confirmation.<sup>[1]</sup> Image-guided interventions – using ultrasound (US), computed tomography (CT), and C-arm – offer minimally invasive approaches for aspiration and biopsy, particularly in anatomically challenging or deep-seated infections. These procedures have become increasingly important in the management of MSKIs, offering high diagnostic accuracy with reduced patient morbidity.<sup>[1,2]</sup>

## CASE SERIES

### Case 1

A 14-year-old boy presented to the local primary health care with pain and swelling of the right arm following a fall on the ground while playing cricket. Preliminary clinical examination and radiograph of the arm revealed a non-displaced fracture of the mid-humerus. A plaster cast

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immobilization was applied for 4 weeks to reduce edema and advised to follow-up. At 4 weeks, the fracture was non-healing, and suspicion for pathological fracture was raised [Figure 1a]. The patient was referred to a higher center for diagnosis and management.

In our tertiary care center, a magnetic resonance imaging (MRI) of the right arm was done using advanced imaging (diffusion and dynamic scan). The MRI findings revealed an intraosseous and extraosseous mass-like lesion in the mid-humerus with a pathological fracture. The diffusion and dynamic scan demonstrated the aggressive nature of the lesion. The contrast-enhanced MRI revealed peripheral enhancement of the lesion [Figure 1b-d]. Based on the clinico-radiological findings, a sarcoma with underlying necrosis versus infection was considered a differential diagnosis in a multidisciplinary team meeting (MDT) and decided to proceed with image-guided biopsy of the lesion. US-guided biopsy was performed, and histopathological diagnosis of tubercular osteomyelitis with cold abscess was made [Figure 1e and f]. On CBNaat, the lesion was found to be rifampicin sensitive.

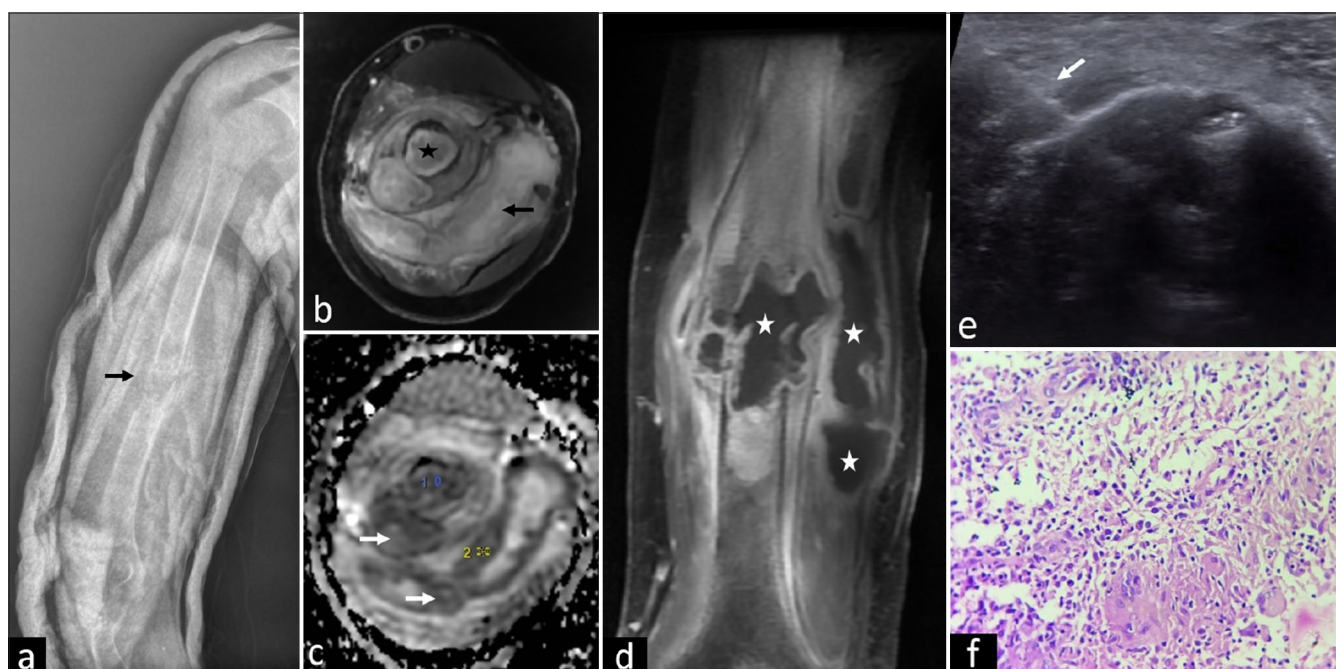
The learning objectives from this case<sup>[3,4]</sup> are:

- Image-guided biopsy is crucial for the differentiation of tumor versus infection

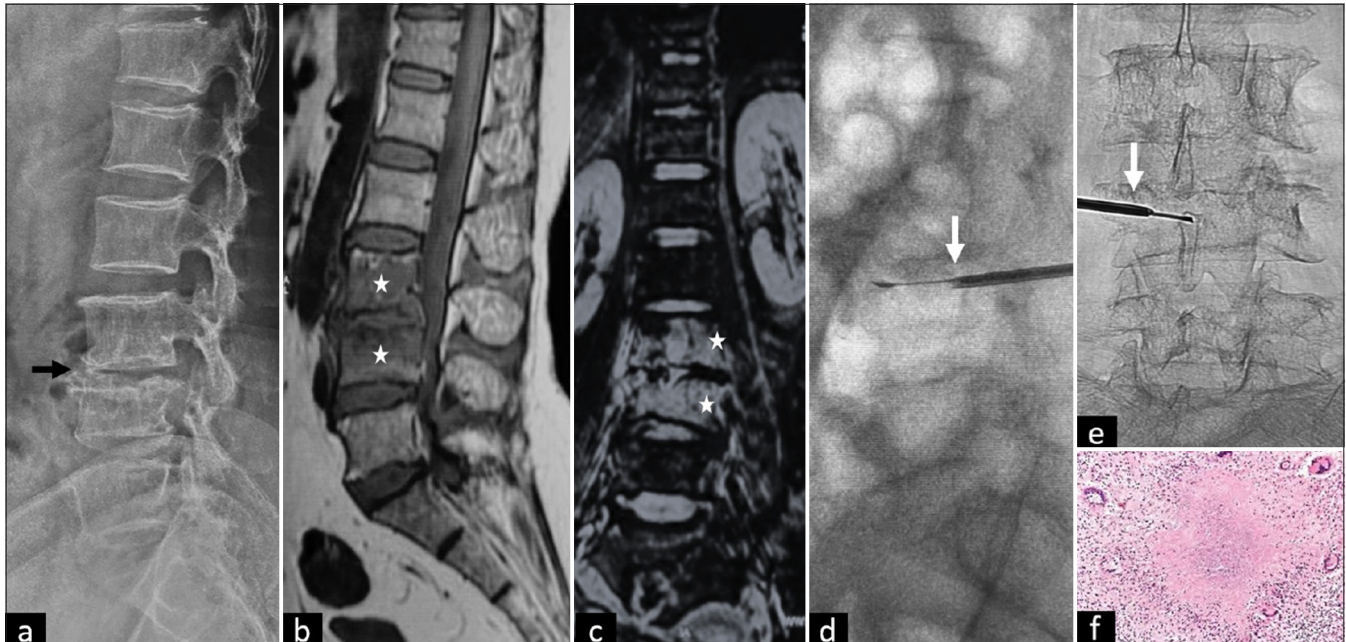
- US is a better modality for biopsy of extremity lesions if the lesion is visible on US and the bone cortex is destructed/paper-thin. It can visualize the neurovascular bundle and avoid its injury along the biopsy tract
- For deeper lesions as in the pelvis, CT is preferable for biopsy than US.

## Case 2

A 52-year-old female, known patient of tubercular osteomyelitis under antitubercular treatment (ATT) for 6 months, presented to the orthopedics outpatient department (OPD) with complaints of severe low backache, difficulty in walking, and presence of constitutional symptoms such as fever and bodyache. The pre-treatment radiograph and MRI were reviewed, and it was noted that the patient was started on ATT without histopathological confirmation and a drug sensitivity test at a local hospital. Fresh radiograph and MRI were done, which revealed features of L3-4 active spondylodiscitis without any radiological signs of healing as compared to prior imaging [Figure 2a-c]. Complete blood count (CBC) revealed lymphocytosis and raised erythrocyte sedimentation rate (ESR) and C-reactive protein. As decided in MDT, the patient underwent C-arm guided biopsy of L4 vertebrae [Figure 2d and e]. Histopathology



**Figure 1:** (a) Frontal radiograph; (b) short tau inversion recovery axial, (c) apparent diffusion coefficient (ADC), (d) post-contrast coronal, magnetic resonance imaging (MRI); (e) ultrasound-guided biopsy, and (f) photomicrograph of histopathological examination (HPE) demonstrate pathological fracture of mid-humerus (black arrow) with plaster cast *in situ*; intraosseous (black asterisk in b) and extraosseous extension of mass/mass like lesion (black arrow in b) with reduced ADC (white arrows in c); on post-contrast MRI (d), peripheral enhancement of the lesion with necrotic component (white asterisks in d). (e) Ultrasound-guided biopsy of the lesion through 16G needle (white arrow in e) was performed, and (f) HPE revealed necrotising granulomatous infection (Hematoxylin and Eosin, 100x). HPE: Histopathological examination



**Figure 2:** (a) Lateral radiograph; (b) T1-weighted (T1W) sagittal, (c) Short tau inversion recovery (STIR) coronal magnetic resonance imaging, (d and e) C-arm-guided L4 vertebral biopsy, and (f) photomicrograph of histopathological examination (HPE) demonstrate endplate erosion of L4 and L3 vertebrae with disc space reduction (black arrow in a); paradiscal marrow changes (hypointense on T1W, asterisk and hyperintense on STIR, (white asterisks in b and c); C-arm-guided transpedicular biopsy of L4 vertebrae (white needle: arrow in d and e); and photomicrograph of HPE, (f) Necrotizing granulomatous infection (Hematoxylin and Eosin, 100X).



**Figure 3:** (a and b) Frontal and lateral radiographs, (c) Short tau inversion recovery coronal magnetic resonance imaging (MRI), (d) C-arm guided biopsy/aspiration, and (e) photograph of aspirate demonstrate unremarkable osseous structures with intact fat planes of soft tissue on radiograph (a and b); A geographical marrow lesion having peripheral T2 hyperintensity in lower femur and upper tibia (black arrows in c) on MRI (c); C-arm-guided biopsy/aspiration (needle: arrow in d); Pus as aspirate (e). Culture of the pus revealed *Burkholderia pseudomallei*.

and CBNaat demonstrated rifampicin-resistant tubercular spondylodiscitis [Figure 2f].

The learning objective from this case<sup>[5]</sup> is:

- a) The practice of starting empirical ATT without the histopathological/microbiological diagnosis of tuberculosis and drug sensitivity must be avoided to prevent rising cases of drug-resistant tuberculosis in Southeast Asia.
- b) For lumbar and lower dorsal vertebrae, both C-arm and CT-guided transpedicular biopsy are technically feasible and safe. However, for cervical, upper- and mid-dorsal vertebrae, CT-guided biopsy is more technically feasible and safer than C-arm guidance.

### Case 3

A 65-year-old male, a chronic smoker and uncontrolled diabetic, presented to the orthopedics OPD with chronic diffuse right lower limb pain, even at rest, and features of polyneuropathy. The patient's blood sugar was 345 mg/dL, hemoglobin A1C: 8.7, CBC: Lymphocytosis, ESR: 25 mm/h. The patient had two episodes of stroke in the past 3 years. On clinical examination, the lower femur and upper tibia were tender. No signs of inflammation were observed.

Radiograph revealed no significant osseous abnormality with intact fat planes [Figure 3a and b]. However, in MRI, a geographical lesion with peripheral T2-hyperintensity was observed [Figure 3c]. Clinico-radiological diagnosis of bone infarct was made. However, in view of lymphocytosis and raised ESR, image-guided biopsy was decided in MDT to rule out any atypical infection mimicking a bone infarct. C-arm-guided biopsy was performed from the lower femur, and surprisingly, pus was aspirated [Figure 3d and e]. In culture, *Burkholderia pseudomallei* was detected (melioidosis). The patient was managed with antibiotics, and significant clinical improvement was observed during the follow-up visit.

The learning objective from this case<sup>[6,7]</sup> is in non-specific and overlapping clinical presentations, image-guided biopsy should be done for definitive diagnosis and to rule out atypical infection.

### DISCUSSION

This case series highlights the critical role of image-guided interventions in the diagnosis and management of MSKIs. The use of imaging modalities has enabled precise localization of infection, safe access to deep or anatomically complex areas, and effective therapeutic interventions with minimal morbidity. Across the presented cases, image-guided procedures provided significant diagnostic and clinical value. In several instances, culture-directed antibiotic therapy could

only be initiated after obtaining microbiological confirmation through percutaneous sampling. This approach not only reduced empirical antibiotic use but also helped in avoiding unnecessary or inappropriate treatments, especially in cases with atypical organisms or partially treated infections.<sup>[1,3,5]</sup>

Despite these advantages, image-guided interventions are not without limitations. False-negative biopsy results can occur, particularly in patients pre-treated with antibiotics or when sampling necrotic or non-representative tissue. Operator expertise and access to advanced imaging equipment also play a significant role in procedural success.<sup>[8]</sup>

Nonetheless, the outcomes of this case series reinforce existing literature supporting image-guided intervention as a cornerstone in the multidisciplinary approach to MSKI management.

### CONCLUSION

Image-guided interventions offer a safe, effective, and minimally invasive alternative to surgical procedures in the diagnosis and treatment of MSKIs. They enhance diagnostic accuracy, allow for targeted therapy, and improve patient outcomes, particularly in complex or deep-seated infections. Based on our case series, such interventions should be considered early in the management algorithm, in collaboration with infectious disease, orthopedic, and radiology teams. Continued refinement of techniques and broader access to imaging resources will further strengthen their role in clinical practice.

**Ethical approval:** Institutional Review Board approval is not required.

**Declaration of patient consent:** The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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