Case Report
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MRI Findings of Post-Traumatic Osteomyelitis of Distal Phalanx Following Neglected Open Fracture

방치된 개방성 원위수골 골절 환자의 외상성 골수염의 MRI 소견 증례

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Careful radiologic examination of the osteolytic lesion is important for patients with fracture. Differential diagnosis includes osteonecrosis, neoplasm and infections. In this report, we presented MRI findings of post-traumatic osteomyelitis following neglected open fracture of 3rd distal phalanx with open wound. Early suspicion and imaging of wound or soft tissue inflammation around osteolytic lesion could be helpful for diagnosis of osteomyelitis.

Index terms
Fractures, Open
Osteomyelitis
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INTRODUCTION

Post-traumatic osteomyelitis is inflammation of the bone caused by compound fracture or an open wound to surrounding skin and muscle after trauma. In cases of fracture with osteolytic lesion on plain radiograph of bone in patients with trauma history, differential diagnosis must include post-traumatic osteomyelitis. We presented MRI findings of post-traumatic osteomyelitis in a 15-year-old male who presented with pain in the 3rd finger. Physical examination revealed no definite open wound as a result of trauma 2 weeks earlier. MRI imaging of the fistula tract, a channel between the bone and skin, provided a helpful clue in the diagnosis of post-traumatic osteomyelitis in our case.

CASE REPORT

A 15-year-old male visited our hospital with the complaint of pain in his right 3rd finger. The 3rd distal interphalangeal joint was injured on hyperextension while playing basketball, 10 days prior. At the time of injury, no open wound was present, but bleeding beneath the nailbed had developed with progressive soft tissue swelling in the distal part of the finger. The patient did not seek medical attention until visiting our hospital. On physical examination, soft tissue swelling with internal fluctuation in distal part of the finger and mild tenderness was present. His blood cell count and serum C-reactive protein level were within normal range on the day of admission.

Plain radiographs showed flexion deformity and focal osteolytic lesion with destruction of dorsal cortex in proximal metaphysis of right 3rd distal phalanx (Fig. 1A, B). MRI was performed for further evaluation of the osteolytic lesion (Fig. 1C-F). On fat-saturated proton density images, ill-marginated high signal intensity lesion extending to extraosseous soft tissue was observed in the osteolytic area. The lesion showed low signal intensity on

Fig. 1. Simple radiographs and MRI findings of post-traumatic osteomyelitis of distal phalanx following neglected open fracture in a 15-year-old male.
A, B. Simple radiographs of anteroposterior **(A)** and lateral **(B)** views of 3rd finger show ill-defined osteolytic lesion with cortical defect in dorsal side of 3rd distal phalanx.
C–F. MR images of the 3rd finger. Coronal fat-saturated proton density image **(C)**, sagittal fat-saturated proton density image **(D)**, coronal T1 weighted image **(E)**, and sagittal fat-saturated T1 weighted image with gadopentate dimeglumine enhancement **(F)**. MRI images reveal ill-defined osteolytic lesion in base of 3rd distal phalanx. The lesion was hyperintense on fat-saturated proton density images (**C**, **D**, arrows) and hypointense on fat-saturated T1 weighted images (**E**, arrow). After enhancement, the lesion showed focal peripheral enhancement (**F**, arrow). In skin and subcutaneous layer, linear-shaped dark signal lesion toward the osteolytic lesion was also noted on fat-saturated T1 weighted images with enhancement (**F**, arrowhead).

T1 weighted images. The lesion was approximately 1.1 × 0.4 × 0.6 cm in size and the anteroposterior and transverse diameters were slightly larger than those from plain radiographs, because of the extraosseous extension of the lesion. The lesion showed only focal peripheral enhancement on fat-saturated T1 weighted images after intravenous administration of gadopentate dimeglumine. Bone marrow edema in more proximal and distal parts of the distal phalanx and soft tissue edema around the distal phalanx were observed. External wound in the distal finger did not appear in the patient's medical record, however, thin linear dark signal intensity horizontal line was seen in dorsal skin layer, just superficial to the osteolytic lesion. This line was suggestive of former external wound that had healed 10 days after the injury. Osteomyelitis or osteonecrosis after neglected open fracture were possible differential diagnoses. Primary neoplasm with pathologic fracture was considered in differential diagnosis.

The patient was operated under general anesthesia and yellowish pus was drained from the osteolytic site. Culture from the pus revealed *Staphylococcus epidermidis*. The final diagnosis was post-traumatic osteomyelitis after neglected open fracture.

DISCUSSION

Post-traumatic osteomyelitis is one of the most severe complications that can arise following trauma history. If not examined carefully, acute osteomyelitis after injury can be easily neglected and even lead to chronic osteomyelitis. Radical treatment of chronic osteomyelitis can be extremely difficult.

Tissue damage by fracture manifests clinically as increased body temperature, local swelling, edema and pain, which disappear after 5–7 days. However, in case of bacterial contamination, these symptoms persist and become more severe (1). Increased white blood cell counts and high C-reactive protein indicate the acute inflammation (2).

The most important factors in the pathogenesis of post-traumatic infection are the extent of soft tissue damage and altered blood supply, the inoculation of bacterial flora, instability of the fracture area and general defensive condition of the patient (1). In the present case, subungual hematoma possibly developed from bleeding beneath the nail, was an ideal medium for bacterial growth. MRI revealed linear dark signal in subcutaneous layer and skin of dorsal aspect of 3rd distal phalanx, extending from the osteolytic lesion exteriorly. The lesion was considered as fistula, which was the tract of bacterial invasion.

On plain radiograph, early findings such as regional osteopenia, periosteal reaction, focal bony osteolytic lesion, endosteal scalloping, peripheral sclerotic change and loss of bony trabeculation may be subtle, and changes may not be obvious until 5 to 7 days in children and 10 to 14 days in adults. Although changes occur late, plain radiography usually is the initial imaging examination and may provide important clues (3-5).

Computed tomography (CT) images show soft tissue swelling and bony destruction not seen on plain radiograph, especially in cases of acute osteomyelitis. CT is also an important modality for image-guided biopsy (3-5).

Magnetic resonance (MR) imaging is useful for the early stage of osteomyelitis and differential diagnoses including metabolic, neoplastic, infectious and metastatic disease. MR image findings in osteomyelitis are usually due to the replacement of marrow fat by water secondary to edema, hyperemia, and bone ischemia. Affected bone has hypointense signal on T1-weighted image and hyperintense signal on T2-weighted image. Granulation tissue has hypointense signal on T1-weighted image, hyperintense signal on T2-weighted image and shows gadolinium enhancement. MR image may also help in delineating fistula tract, draining sinus and soft tissue inflammation. Sinus tract has hypointense signal on T1 weighted image and hyperintense signal on fat-saturated fast inversion recovery image (3-6).

In our case, simple radiographs showed dorsal angulation deformity and osteolytic lesion of distal phalanx at 10 days post-trauma. Dorsal angulation deformity can result from fracture. The osteolytic lesion can result from osteolysis of the fracture margin, but other causes such as underlying neoplasm or osteomyelitis should also be considered. Enchondroma or other kinds of tumors were not detected on plain radiographs. Osteomyelitis was ruled out, since on admission, the patient presented only pain and swelling of third finger, without symptoms of acute inflammation such as fever, increased white blood cell counts and high C-reactive protein. On physical examination, possibility of open fracture was overlooked due to non-visualization of open wound. On the MR images, the osteolytic lesion at fracture site showed hypointense signal intensity on T1 weighted image, hyperintense on proton density image and showed no enhancement; in addition, focal extraosseous extension was observed.

Exploratory operation revealed pus-filled lesion. Linear shaped hypointense signal lesion in subcutaneous layer was neglected at the time. At admission, differential diagnosis of osteolytic lesion included other conditions such as osteonecrosis, neoplastic, metabolic and metastatic disease, rather than infections. In conclusion, the radiologist should consider the infectious cause of osteolytic lesion even in cases with insufficient evidence of infection and make efforts to identify the wound in skin and subcutaneous layer. Early detection of open wound on MR image could facilitate prompt and effective treatment such as antibiotic therapy or surgery.

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방치된 개방성 원위수골 골절 환자의 외상성 골수염의 MRI 소견 증례

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골절 환자에서 골용해성 병변이 동반되는 경우 영상의학적인 검사는 매우 중요하다. 감별진단으로는 무혈성 골괴사증, 종양, 감염 등을 들 수 있다. 우리는 이 증례를 통해 세 번째 원위지골의 방치된 개방성 골절 후 외상성 골절염의 MRI 소견을 보고하고자 한다. 영상 검사에서 창상을 조기에 의심하고 발견하는 것과 골용해성 병변 주위의 연부조직 염증소견을 발견하는 것이 외상성 골수염을 진단하는 데 도움이 될 수 있다.

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