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CASE REPORT

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Epiphyseal osteosarcoma with serial changes of pretreatment imaging findings: a case report

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Abstract

Background Osteosarcoma is not often at the forefront of differential diagnoses for epiphyseal bone tumors because of its rarity; however, more than half of individuals affected by these uncommon cases experience a delay in diagnosis. In such clinical situations, the decision to promptly perform a biopsy of an epiphyseal bone tumor—while considering a potential diagnosis of osteosarcoma —remains unclear, particularly in adolescents. We present herein a case of epiphyseal osteosarcoma in an adolescent, the diagnosis of which was made with minimal delay.

Case presentation A 17-year-old male athlete presented to a previous hospital with knee pain. Radiographs obtained at the initial visit revealed a sclerotic mass in the femoral epiphysis. Computed tomography (CT) and magnetic resonance imaging (MRI) showed a 32-mm lesion adjacent to the remaining epiphyseal scar. When the patient was referred to our hospital 3 weeks later, X-rays showed a circular radiolucent shadow lesion, as well as an enlargement involving the scar on CT. MRI showed altered signal intensities in the cartilage region, with an increase in synovial fluid. These longitudinal changes indicated the need for an incisional biopsy with minimal delay, considering the possibility of malignancy, which resulted in a diagnosis of epiphyseal osteosarcoma. The patient received perioperative chemotherapy followed by a wide resection. The pathological examination of the resected sample validated the initial diagnosis. As of 1 year post-surgery, disease relapse had not been detected.

Conclusions This case highlights the benefit of longitudinal imaging investigations, which assisted in making a crucial diagnosis with minimal delay and enabled timely initiation of treatment before further disease progression.

Keywords Osteosarcoma, Epiphysis, Pretreatment imaging

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Background

Osteosarcoma is the most common malignant tumor, as it occurs in children and adolescents at the sites of rapid growth, mostly around the knee [1, 2]. Specifically, it is frequently seen in the metaphyses of the long bones, where skeletal remodeling and osteoblastic activities primarily occur in adolescents [3, 4]. In fact, it is histologically characterized by the formation of immature bone or osteoids by tumor cells [5, 6].

It may pose a challenge to clinicians when making timely diagnoses of osteosarcoma at sites other than the metaphysis, whereas malignant bone tumors at atypical sites may occasionally be encountered [3, 7–9]. Although efforts to expedite the diagnosis of symptomatic malignant tumors are likely to benefit patients in terms of earlier-stage diagnosis, improved survival, and enhanced quality of life [10], a previous report showed that more than half of patients affected by rare cases experience a delay in diagnosis [11]. In clinical settings, physicians may be faced with the prompt decision to perform a biopsy in epiphyseal bone tumors when considering a diagnosis of osteosarcoma, especially in adolescents. We report herein a case of epiphyseal osteosarcoma in an adolescent male athlete and describe serial changes observed in pretreatment imaging features, including radiography, computed tomography (CT), and magnetic resonance imaging (MRI). The close follow-ups allowed us to perform a biopsy with minimal delay, providing a timely diagnosis and allowing us to start treatment prior to further disease progression. No prior reports have described a case of epiphyseal osteosarcoma with serial changes in pretreatment images.

Case presentation

A 17-year-old male athlete presented to the previous hospital with a chief complaint of knee pain lasting for 1 month. He initially became aware of the pain after sports training, experiencing increased intensity on the lateral aspect of his right knee during sports activities. He also began to notice the pain during daily activity, as well as night pain, 2 weeks before visiting the initial hospital. He underwent multiple imaging studies, which revealed the following: Xray, sclerotic mass at the femoral epiphysis (Fig. 1a and b); CT, a 32-mm lesion adjacent to the remaining epiphyseal scar and trabecular structures at the metaphyseal region (Fig. 2a); and MRI, inhomogeneous signal changes in T2 density-weighted images (Figs. 1a and d and 2d). The patient was prescribed nonsteroidal anti-inflammatory drugs for pain during the initial visit. He was subsequently referred to our hospital 3 weeks after that initial visit, at which time the severity of his primary complaints had not decreased. Follow-up imaging studies showed the following serial changes: X-ray, nearly circular radiolucent shadow lesion with unclear margins and extensive contact with the articular surface on the lateral femoral condyle and a sclerotic lesion within (Fig. 1c and d); CT, increase in the size of the mass over the epiphyseal scar and partial destruction of the trabecular structure in the metaphyseal regions (Fig. 2b); and MRI, change in signal intensity in the cartilage regions with associated joint effusion (Fig. 2e). The laboratory test showed normal ranges of white blood cells, neutrophils, and C-reactive protein.

The serial changes of the imaging studies prompted us to consider osteosarcoma as a differential diagnosis, in addition to chondroblastoma and inflammatory diseases such as osteochondritis dissecans. Soon after the referral, he underwent an incisional biopsy. The histopathological examination of the biopsy specimen confirmed the proliferation of dysmorphic cells accompanied by osteoid formation, resulting in a diagnosis of osteosarcoma. Methotrexate, doxorubicin, and cisplatin (MAP) chemotherapy was immediately initiated based on the diagnosis. Post-chemotherapy radiography, CT, and MRI were performed, with an increase in tumor size and aneurysmal bone cyst-like changes observed on MRI (Figs. 1c and 2f, c and f). The patient underwent an extraarticular knee resection [12, 13], and histopathologic examination of the resected specimen validated the initial diagnosis with an R0 outcome (Figs. 3a–e), showing less than 90% tumor necrosis and no evidence of osteochondritis dissecans. Reconstruction was performed using the Kyocera Modular Limb Salvage system with a thin-mantle titanium stem fixated with cement. As of 1year post-surgery, the patient had survived without experiencing a relapse.

Discussion and conclusions

We have reported herein a case of epiphyseal osteosarcoma with serial changes observed on pretreatment imaging, including radiography, CT, and MRI. These were conducted three times before surgery: at the time of the initial visit to the previous hospital, upon referral to our hospital, and after preoperative chemotherapy. Although prompt decision-making for biopsy in cases of epiphyseal bone tumors considering a diagnosis of osteosarcoma is challenging, the serial changes observed in imaging findings indicated that a biopsy needed to be performed with minimal delay, followed immediately by the initiation of treatment. There was an increase in tumor size after chemotherapy, and the resected sample showed tumor necrosis of less than 90%, which was considered a poor response to chemotherapy [14].

Epiphyseal osteosarcoma was previously described only in case reports [15–17], which provided detailed patient histories but no serial changes on pretreatment imaging. In the clinic setting, it is crucial to promptly manage patients with substantial malignant tumors; however, rare situations, such as the present case, can make this

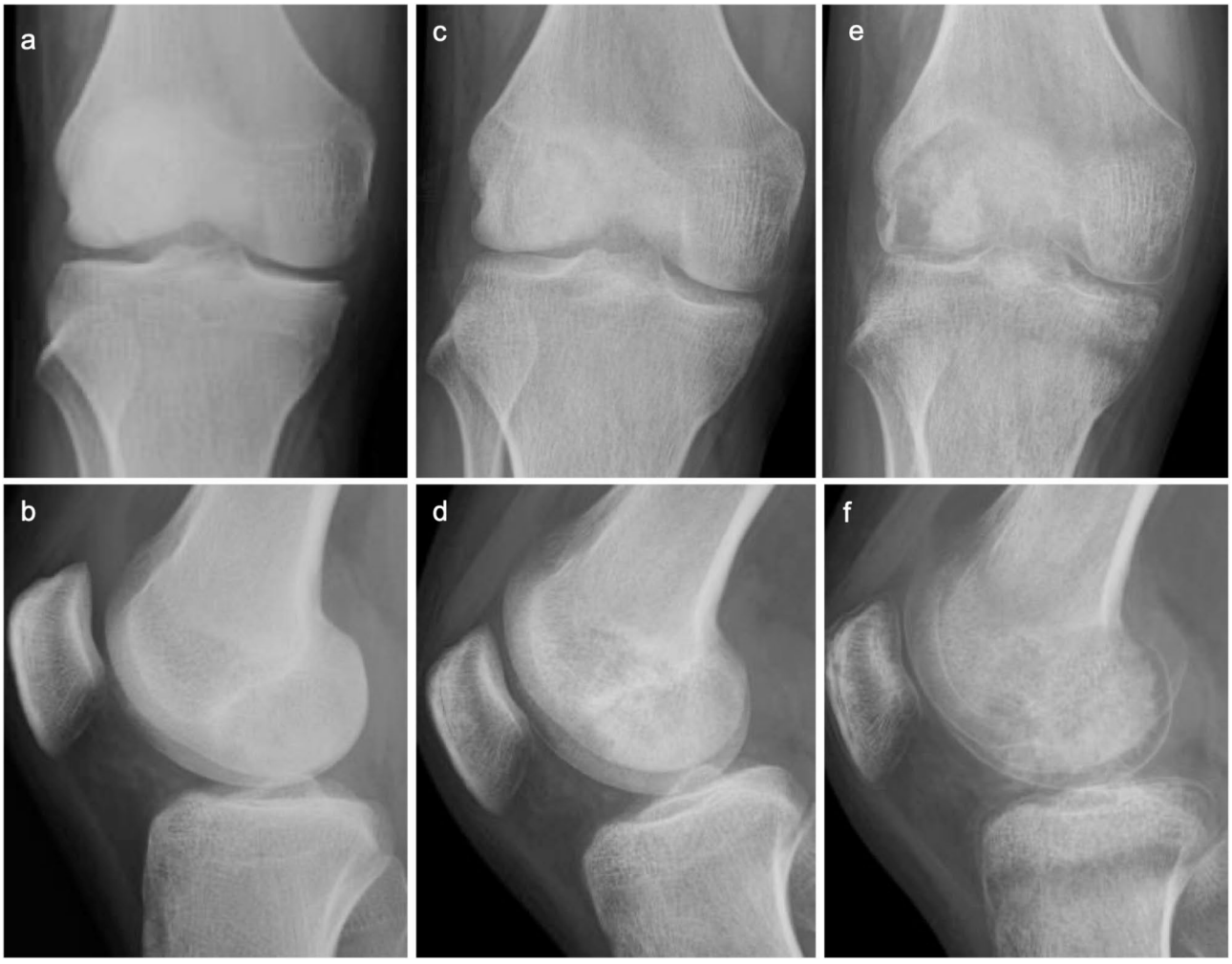

Fig. 1 Longitudinal changes in X-ray findings. **a**, **b** Anteroposterior (AP) and lateral X-rays obtained during the initial visit, showing a sclerotic mass at the femoral epiphysis. **c**, **d** AP and lateral X-rays from the second visit, revealing an almost circular radiolucent shadow lesion with unclear margins and extensive contact with the articular surface on the lateral condyle of the femur, with an internal sclerotic lesion. **e**, **f** AP and lateral X-rays obtained after preoperative chemotherapy

difficult. We consider that serial imaging should be performed in response to increasing symptom severity, as it can reveal evolving imaging features. This approach prompted us to perform further investigations, resulting in a time interval of 1 month between the initial visit to the previous hospital and the biopsy, which was considered a minimal delay.

According to the World Health Organization Classification of Tumors 5th edition and previous reports, osteosarcoma rarely occurs in the epiphysis of long bones (1%) [3, 7, 18]. It is rare to prioritize osteosarcoma in the differential diagnosis of epiphyseal bone tumors. Even in the present case, chondroblastoma was the primary diagnosis considered. Chondroblastoma is primarily diagnosed when patients are in their teens or 20s, with an average age at diagnosis of 19–23 years, and there is a male predominance of approximately 2:1 [19–21]. It primarily occurs in the epiphysis of long tubular bones such as the femur, tibia, and humerus, with an average size of 3–6 cm [21–24]. Although the clinical and radiographic features in this case were not contradictory to those of chondroblastoma, the longitudinal changes in the imaging findings prompted us to consider malignancy.

Osteosarcomas primarily occur in the metaphyses of long bones. Although the exact mechanism is unknown, the metaphysis has a rich blood supply, whereas separate blood circulation is maintained in the epiphysis [25]. As the blood supply orchestrates bone remodeling, which is strongly associated with osteoblastic activity [26], the metaphysis is a primary site of remodeling in adolescents [3]. These findings suggest that the scale of the blood supply may be associated with the occurrence of osteosarcoma, especially in adolescents.

This case of epiphyseal osteosarcoma, evidenced by serial changes on pretreatment imaging, highlights the

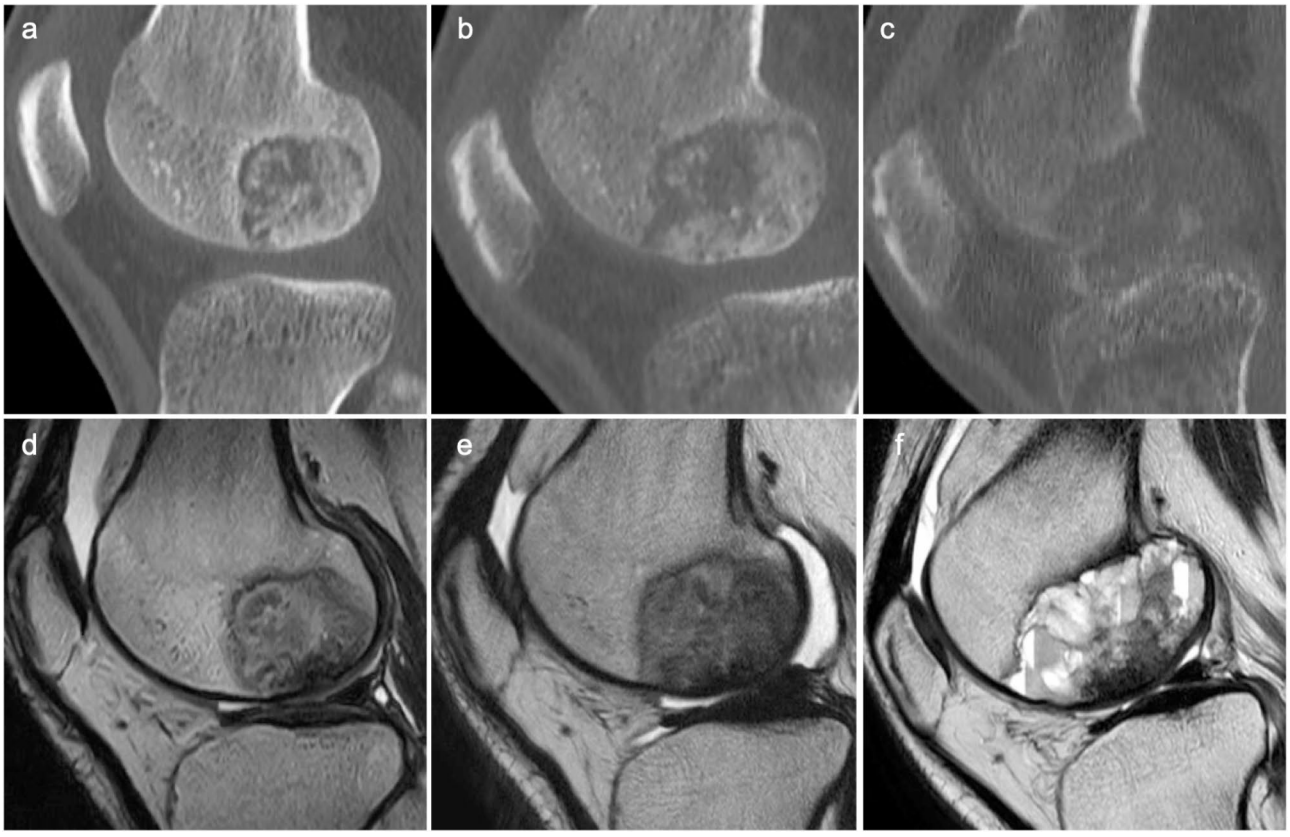

Fig. 2 Longitudinal changes in CT and MRI findings in the sagittal plane. **a** Computed tomography (CT) obtained during the initial visit to the previous hospital, showing a 32-mm lesion adjacent to the remaining epiphyseal scar and trabecular structures in the metaphyseal region. **b** CT obtained after referral to our hospital, showing an increase in the size of the mass over the epiphyseal scar and partial destruction of the trabecular structure in the metaphyseal region. **c** CT obtained after preoperative chemotherapy. **d** T2-weighted image (T2WI) magnetic resonance imaging (MRI) obtained during the initial visit, showing inhomogeneous signal changes. **e** T2WI MRI obtained at the time of referral to our hospital, 3 weeks after the initial visits, showing changes in signal intensities in the cartilage regions with an increase in synovial fluid. **f** T2WI MRI obtained after preoperative chemotherapy, showing aneurysmal bone cyst-like changes

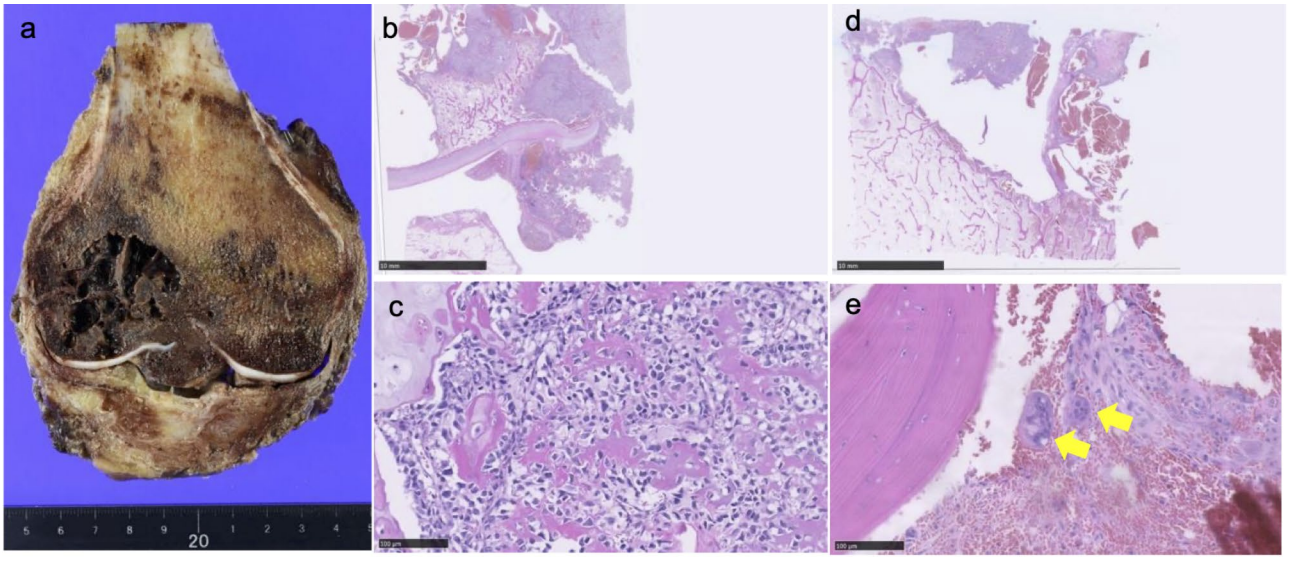

Fig. 3 Pathological findings of the resected sample. **a** Section of the *en bloc* histological sample showing the epiphyseal tumor with disruption of continuity at the articular cartilage. **b** Low magnification of Hematoxylin and eosin (HE) staining, showing the disruption of continuity at the articular cartilage. **c** High magnification of **(b)**, showing spindle and polyhedral cells with hyperchromatic nuclei with calcifying osteoid formation. **d** Low magnification of HE staining, showing the hemorrhagic area. **e** High magnification of **(d)**, showing osteoclastic-like giant cells (arrows)

role these longitudinal changes played in indicating the need for a biopsy with minimal delay.

Abbreviations

CT Computed tomography
MRI Magnetic resonance imaging

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Not applicable.

Author contributions
HS and KW designed the study, suvervised by MM, AI, TS, and NI. HH prepare the references in the manuscript. HS wrote the manuscript. KW illusterated the Figs, supervised by HS. TS performed the surgery, helped by HS. KK reviewed the pathology. All authors have read and approved the final manuscript.

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Data availability
All data concerning the case are presented in the manuscript.

Declarations

Consent for publication
Written informed consent was obtained from the patient for publication of this case report, and the accompanying images.

Competing interests
The authors declare no competing interests.

Ethical approval and consent to participate
Not applicable.

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