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CASE REPORT

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Apophysitis of the ischial tuberosity mimicking a neoplasm on magnetic resonance imaging

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Abstract We present multimodality imaging features of an ischial tuberosity apophysitis in a 13-year-old boy who was an active baseball pitcher. Roentgenography of the pelvis and computed tomography showed mild irregularity in the inferior margin of the left ischial tuberosity. T1-weighted MRI showed a wide area with low signal intensity in the left ischial body; T2-weighted fat-suppression images showed areas with markedly high signal intensity in the ischial apophysis and body and the surrounding periosteum; contrast-enhanced T1-weighted fat-suppression MRI showed that the ischial body, surrounding periosteum, and origin of the hamstring muscles strongly enhanced; technetium-99m scintigraphic scans showed increased isotope uptake in the entire ischial body. Histological specimens obtained from the bone showed increased osteoblastic activity, edema, and proliferation of benign spindle cells and small vessels in the bone marrow spaces. In the present case, because MR imaging demonstrated extensive signal abnormalities involving the apophysis, periosteum, and intramedullary portion of bone, a neoplasm could not be excluded, and a biopsy was undertaken.

Keywords Ischial tuberosity · Apophysitis · Pseudoneoplasm · Magnetic resonance imaging

Introduction

Causes of acute and chronic buttock pain in young athletes include avulsion fractures of the ischial tuberosity, ruptures of the proximal hamstring tendons, and apophysitis of the ischial tuberosity [1, 2, 3, 4]. Of these conditions avulsion fracture of the ischial tuberosity is the most common, and ischial tuberosity apophysitis is relatively rare [1]. Roentgenography of ischial tuberosity apophysitis usually shows mild irregularity in the inferior margin of the affected ischial tuberosity, with minimal or no bone marrow changes in the early stage of the condition [1, 2]. We demonstrate magnetic resonance imaging (MRI), computed tomography (CT), and scintigraphic findings of ischial tuberosity apophysitis in a young athlete, mimicking a malignant bone tumor. Significant bone marrow and periosteal changes were detected by MRI. The multimodality imaging features of the condition have rarely been reported previously in the English-language literature [1].

Case Report

A 13-year-old boy presented with an approximately 2-month history of gradually increasing left buttock pain. The patient had no history of major trauma to the buttock. He had actively been playing baseball as a pitcher for several years. Physical examination showed no swelling, local warmth or redness in his left buttock. Local tenderness was noted on the left ischial tuberosity, and the patient complained of left buttock pain when he anteriorly flexed his lumber spine. Range of motion of the left hip joint was normal. Neurological examination of the lower extremities was normal. Laboratory data showed no abnormalities.

Anteroposterior roentgenography of the pelvis showed mild irregularity in the inferior margin of the left ischial tuberosity (Fig. 1). A bone tumor in the pelvis was suspected, and the patient was referred to our institution. The patient subsequently underwent MRI, CT, and scintigraphy. T1-weighted MRI showed a wide area

Fig. 1 Anteroposterior roentgenography of the pelvis at the initial presentation shows mild irregularity in the inferior margin of the left ischial tuberosity

with low signal intensity in the intramedullary space of the left ischial body (Fig. 2A). T2-weighted fat-suppression images showed areas with markedly high signal intensity in the intramedullary space of the ischial body and the surrounding periosteum (Fig. 2B). Contrast-enhanced T1-weighted fat-suppression images showed that the ischial apophysis and body, the surrounding periosteum, and the origin of the hamstring muscles were significantly enhanced (Fig. 2C). Multiplanar reconstruction CT showed mild irregularity in the inferior margin of the left ischial body (Fig. 3). Technetium-99m scintigraphy showed increased isotope uptake in the entire left ischial body (Fig. 4). The differential diagnoses included osteosarcoma, Ewing sarcoma, osteomyelitis, and ischial tuberosity apophysitis. The patient underwent an open biopsy to establish the diagnosis. At biopsy the ischial tuberosity was posteriorly approached by splitting the gluteus maximus muscle. The sciatic nerve was laterally retracted. Histological specimens obtained from the ischium consisted of fibrous tissues containing lymphocytes, osteoclast-type multinucleated giant cells, and numerous small vessels between newly formed bone trabeculae. Cartilaginous foci were occasionally observed. There were wide edematous areas in the matrix, admixed with a small number of inflammatory cells (Fig. 5). At the hamstring tendinous insertion onto the apophysis an increased number of small vessels were observed. No neoplastic components were identified. Thus the patient was diagnosed with apophysitis of the ischial tuberosity.

The patient was conservatively treated with modification in sports activity and administration of anti-inflammatory agents. The patient's symptoms completely disappeared within 5 months postoperatively. At follow-up examination 8 months postoperatively roentgenography of the pelvis showed that the involved apophyseal area was sclerotic and slightly wider than on the right side (Fig. 6).

Discussion

Ischial apophyseal injuries include acute avulsion fracture and apophysitis of the ischial tuberosity [1, 2, 4]. Patients with an ischial tuberosity avulsion fracture usually have a history of acute trauma with symptoms, and roentgenography may show an avulsed bone fragment immediately after injury or later [1]. In children the fragment may not be seen on roentgenography [2].

Ischial tuberosity apophysitis typically occurs in active adolescent athletes in the second decade who are skeletally immature and is most common in distance runners and dancers [1, 2, 5, 6]. Ischial tuberosity apophysitis is caused either by chronic repetitive minor trauma to the site of hamstring origin or following acute major trauma to the apophysis which is followed by inflammation [5]. Muscle-tendon imbalance is another factor in the occurrence of ischial tuberosity apophysitis [5, 7]. In young athletes who are going through a growth spurt muscle development lags bony development. Muscle-tendon imbalance manifests as tight hamstring muscle groups. The imbalance can affect the ischial apophysis by increasing the traction force on this site [5, 7].

Most cases of ischial tuberosity apophysitis have previously usually been evaluated and diagnosed by roentgenography. Typical roentgenographic features of the condition include irregularity of the inferior margin of

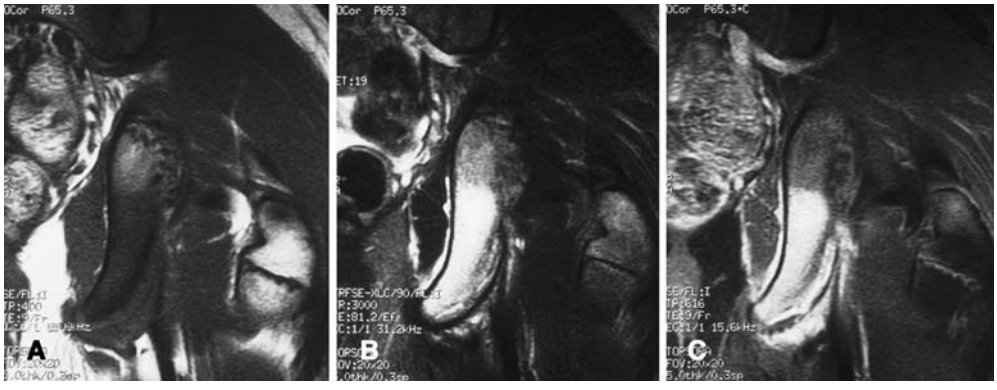

Fig. 2 MR appearance of ischial tuberosity apophysitis. **A** Coronal T1-weighted image (400/9; TR/TE) shows a wide hypointense area in the left ischial body. **B** T2-weighted fat-suppression image (3000/81.2; TR/TE) shows areas with markedly high signal intensity in the ischial body and the superior periosteum. **C** Contrast-enhanced T1-weighted fat-suppression image (616/9; TR/TE) shows that the ischial apophysis and body, the superior periosteum and the origin of the hamstring muscles are intensely enhanced

Fig. 3 Coronally reconstructed CT shows mild irregularity in the inferior margin of the left ischial body. The lateral wall of the left ischial body seems to have an avulsion fracture, but this was in retrospect not a fracture fragment because subsequent examinations did not show any changes at this site and that the changes were only noted in the apophyseal area

Fig. 4 Technetium-99m scintigraphic scan shows increased isotope uptake in the left ischial body (posterior view)

the ischial tuberosity, osteoporotic patches, sclerosis, and widening of the involved apophyseal area [1, 2, 8, 9].

To our knowledge there have been only a few reports describing the MRI appearance of ischial tuberosity apophysitis in the English-language literature [1, 9]. Watanabe et al. [9] reported MRI findings in two patients with the condition. In one case both ischial apophyses and bodies showed slightly decreased signal intensity on T1-weighted images and markedly increased signal intensity on T2-weighted images. In another case T1-weighted images showed slightly decreased signal intensity in both ischial apophyses and bodies, and T2-weighted images showed markedly increased signal intensity only in the apophyses. Kujala et al. [1] illustrated MRI features in a 17-year-old female runner with ischial tuberosity apophysitis. They reported that in the acute phase inflammatory reaction was detected as a high signal intensity change in

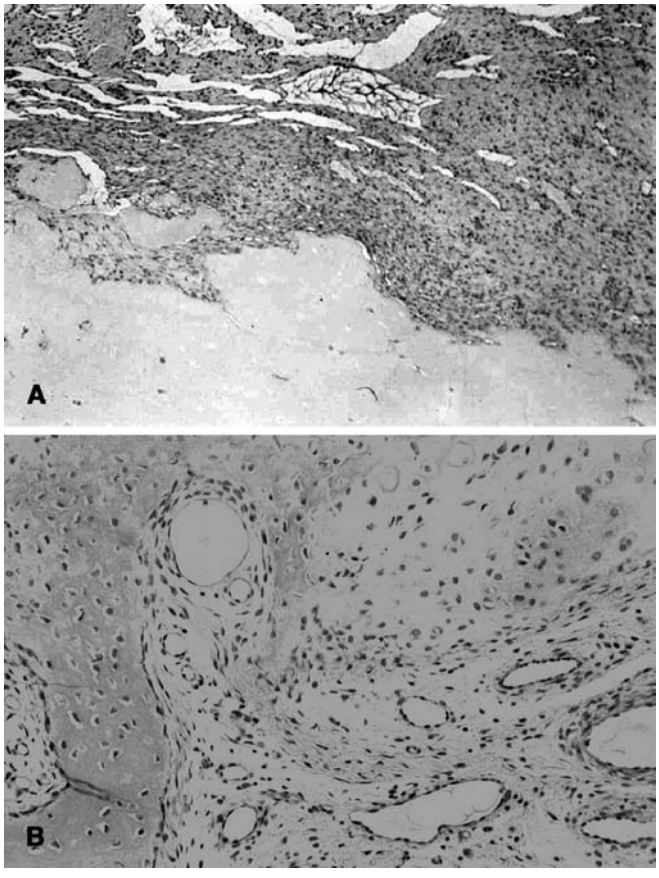

Fig. 5 Histological specimens obtained from the ischium show granulation tissue adjacent to the apophysis (**A**) and newly formed bone, cartilaginous foci, and wide edematous areas containing numerous small vessels in the medullary portion (**B**). Hematoxylin and eosin, **A** ×100, **B** ×200

Fig. 6 Roentgenography of the pelvis 8 months after biopsy shows that the involved apophyseal area is sclerotic and slightly wider than on the healthy side

the affected ischial body on T2-weighted images, whereas the signal intensity was decreased on T1-weighted images due to edema. Follow-up MRI performed 6 months later, however, showed on both T1- and T2-weighted images low signal intensity areas in the ischial body, suggesting sclerosis associated with healing.

In our patient a wide intramedullary area in the involved ischial body showed diffuse low signal intensity on T1-weighted images, and the intramedullary area, apophysis, and periosteum showed markedly high signal intensity on T2-weighted images. On contrast-enhanced T1-weighted images the ischial body, apophysis, periosteum, and hamstring tendinous origin were significantly enhanced. These findings suggest that inflammation and edema were not limited to the apophysis but extended into the bone marrow and the superior periosteum. Scintigraphic findings in our patient also support this consideration by showing diffuse, increased isotope uptake in the affected ischium. Barnes and Hinds [10] reported that ischial tuberosity injuries can be mistaken for bone tumor. In the present case it was difficult to differentiate ischial tuberosity apophysitis from a malignant bone tumor only by imaging. Clinical history regarding sports activity and previous trauma would be helpful in establishing the correct diagnosis.

Characteristic histological findings in our case include increased osteoblastic activity, edema, and proliferation of benign spindle cells and small vessels in the intertrabecular spaces. Inflammatory cell infiltration, however, was minimal. These histological features are in accord with the MRI findings, such as intralesional, markedly high signal intensity on T2-weighted images due to edema, and intense enhancement on contrast-enhanced T1-weighted images. There have been no reports describing histological features of ischial tuberosity apophysitis, to our knowledge. Previously some investigators believed that irregularity of the ischial tuberosity is caused by osteonecrosis [11]. However, our histological study revealed no evidence of osteonecrosis.

Conservative treatment including modification of activities and anti-inflammatory medication is adequate for ischial tuberosity apophysitis [1, 2, 5, 6, 8, 9]. The prognosis of the condition is reported to be excellent. After 2–6 months rest the symptoms usually disappear, and the involved apophysis becomes sclerotic and wider than on the healthy side. It is speculated that persistent, increased osteoblastic activity in the affected apophyseal area in the healing process might result in the bone sclerosis and widening.

In summary, we present roentgenographic, MRI, CT, scintigraphic, and histological findings of ischial tuberosity apophysitis. Although roentgenographic abnormalities were minimal, MRI clearly demonstrated the intraosseous, periosteal, and apophyseal pathologies. One should be aware that radiological features of ischial tuberosity apophysitis may mimic those of a malignant bone tumor, especially on MRI, because of the profound edema.

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