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ORIGINAL PAPER

Benign bone tumours of tibial tuberosity clinically mimicking Osgood-Schlatter disease: a case series

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Abstract

Introduction Osgood-Schlatter disease (OSD) is a traction apophysitis of the tibial tubercle and a common cause of anterior knee pain in growing adolescents. A variety of benign neoplasms can also cause bony prominence over the tibial tubercle in adolescents that might clinically imitate OSD. Therefore, the differential diagnosis of tumours mimicking OSD is critical and considered the primary goal of this study.

Methods Eleven patients who were referred to our orthopaedic oncology department with clinical suspicions of OSD and obscure radiographic presentation were identified. The final diagnosis was OSD in three cases. The demographic, clinical, and radiologic characteristics of the remaining eight patients in whom a tumour mimicked OSD were evaluated. The diagnosis was confirmed by pathologic examination.

Results The final diagnosis was periosteal chondroma in four cases, osteochondroma in three cases, and dysplasia epiphysealis hemimelica (DEH) in one case. The average age of the patients was 10.5 ± 3.1 years. In the majority of patients (62.5%), the lesion was painless. The mean size of the bump was 6.5 ± 1.2 cm^2. In patients with a painful knee, the pain was constant and activity-independent. At history taking, the pain and bump size were progressive.

Conclusion Lack of pain, progressive pain and bump, activity-independent pain, a bump size larger than 5 cm^2 at presentation, and age fewer than ten years could be considered in favour of tumours and against OSD.

Keywords Osgood-Schlatter disease · Differential diagnosis · Clinical mimicking · Periosteal chondroma · Osteochondroma · Dysplasia epiphysealis hemimelica

Introduction

Osgood-Schlatter disease (OSD) is a traction apophysitis of the tibial tubercle resulting from repetitive quadriceps contraction through the patellar tendon on unfused tibial tubercle apophysis [1]. It is a common cause of anterior knee pain in growing adolescents [1]. The prevalence of OSD is 9.8% between the age of 12 and 15 years. It is more frequent in males (11.4% in males, 8.3% in females) and athletes. In 20 to 30% of patients, bilateral involvement occurs [2].

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The diagnosis is mainly based on clinical symptoms that include subtle anterior knee pain, with tenderness and prominence over the tibial tubercle. The pain usually gets worse during activities and is relieved with rest [3]. Radiographic evaluation is only used to rule out other diagnoses. Classically, plain radiographs reveal fragmentation and elevation of the tibial tubercle, as well as calcification and oedema of the distal insertion of the patellar tendon [1, 3]. MRI and sonography can potentially be helpful when the radiography does not yield sufficient information for a definite diagnosis of the atypical cases [4].

OSD is generally a self-limiting disease. Even so, the symptoms may persist for more than two years, until the fusion of the tibial tubercle apophysis. Activity restriction and the local application of ice and NSAIDs can be used for symptom relief. In prolonged cases with severe pain, a short period of knee immobilization could be implemented. In rare cases in which the conservative management fails to improve symptoms, surgical intervention through the excision of the ossicle

and/or free cartilaginous material can be helpful, which is considered after skeletal maturity [1].

Fracture, infection, and a variety of neoplasms can cause anterior knee pain in adolescents [1]. Although these conditions usually present with symptoms not associated with OSD such as night pain, pain at rest, erythaema, and fever, they might mimic OSD, particularly if their presentation is atypical [5].

To the best of our knowledge, only two case reports have discussed tumors of tibial tuberosity mimicking OSD (one case of periosteal chondroma and one case of solitary osteochondroma) [6, 7]. Thus, more awareness is required regarding the differential diagnoses of tumours mimicking OSD.

The aim of this study was to report a series of tumours involving the tibial tuberosity in paediatric patients, which clinically mimicked OSD. We also discuss the diagnostic challenge of these entities and propose some differentiating features.

Patients and methods

This study was approved by the review board of our institute, and informed consent was obtained from the patients' parents to use their medical data for publication. Using the electronic database of our hospital, patients who were referred to our orthopaedic oncology department between 2001 and 2015 with clinical suspicions of OSD and obscure radiographic presentation were identified. From a total of 11 patients, the final diagnosis was OSD in three cases. These cases were excluded from the study. Finally, a total of eight patients in whom a tumor clinically mimicked OSD were included in this series.

For the differential diagnosis, a combination of clinical, radiologic, and pathologic criteria was implemented. The definitive diagnosis was made by our hospital tumour board composed of an orthopaedic oncologist, a radiologist, and a pathologist. Clinical examination included the evaluation of the characteristics of pain and bump. The bump size was recorded as a multiplication of length in width. The radiologic evaluation included plain radiograph to inspect the appearance of the proximal tibia adjacent to the tibial tuberosity, fragmentation, and calcification; MRI to assess the presence of tumoral mass; and CT scans for better visualization of bony projection or erosion of the proximal tibia.

Surgical techniques

We used medial or lateral parapatellar tendon incision depending on maximum subcutaneous prominence, from 2 cm above the inferior pole of the patella to the distal of the tuberosity. The patella tendon attachment was identified and usually protected by a retractor. The mass of osteochondroma and DEH was excised with a cartilaginous cap. For periosteal chondroma, curettage of the tumor and burring of the adjacent cortex were performed. In the case of patellar tendon disruption, the edges of the torn tendon were turned back together or attached to the bone after constructing bone tunnels with No. 2 non-absorbable sutures. In the end, the knee was flexed to evaluate the tracing and tensioning of the patellar tendon.

Post-operative protocol

The patients were asked to have full-weight bearing ambulation the day after surgery. Range of motion exercises was started after two weeks. An extension knee brace was applied for three weeks for patients whom their patellar tendon was repaired. Range of motion exercises was started after three weeks in this group. Follow-up for all patients was every three months in the first two years, every six months for the third year, and annually thereafter. In each follow-up, clinical examination was performed, and anteroposterior and lateral radiographs of the surgical site were obtained.

Results

The final diagnosis was periosteal chondroma in four cases, osteochondroma in three cases, and dysplasia epiphysealis hemimelica (DEH) in one case. In total, six males and two females with the average age of 10.5 ± 3.1 years, ranging from seven to14 years, were included in this study. The mean disease duration was 24.1 ± 11.2 months, ranging from 12 to 48 months. The mean follow-up period of patients was 67.5 ± 41.2 months, ranging from 24 to 120 months. At the time of referral, leg length discrepancy, muscle atrophy, deformity, and motion constraint were not present in any of the cases. The lesion was unilateral in all cases. The only clinical symptom was a relatively large mass in the anterior part of the tibial tuberosity. The mean size of the bump was 6.5 ± 1.2 cm^2, ranging from 5 to 8.3 cm^2. The laboratory tests were normal, and there were no signs of fever or weight loss. The history of trauma was not present in any cases. The demographic and clinical characteristics of the patients are demonstrated in Table 1.

Periosteal chondroma mimicking OSD

Three males and one female were finally diagnosed with periosteal chondroma. The average age of this group was 10.75 ± 3.3 years, ranging from seven to14 years. Three cases had pain and local tenderness. The average duration of symptoms was 22.5 ± 9.8 months, ranging from 12 to 36 months. At history taking, the pain and bump size were progressive. At clinical examination, the bump size was larger than what is generally

Table 1 Demographic and clinical characteristics of patients with lesions mimicking Osgood-Schlatter disease

ID	Age (years)	Gender	Diagnosis	Pain	Mass size (cm^2)	Symptom duration (months)	Follow-up (months)
1	7	Male	Periosteal chondroma	Positive	2.6 × 2.4 (6.2)	36	120
2	14	Male	Periosteal chondroma	Positive	2.7 × 2.1 (5.7)	24	60
3	12	Male	Periosteal chondroma	Positive	2.5 × 2 (5)	18	48
4	10	Female	Periosteal chondroma	Negative	2.6 × 1.9 (5)	12	72
5	8	Male	DEH	Negative	2.8 × 2.6 (7.3)	48	24
6	13	Female	Osteochondroma	Negative	3 × 2.6 (7.8)	12	36
7	9	Male	Osteochondroma	Negative	3 × 2.2 (6.6)	18	96
8	11	Male	Osteochondroma	Negative	3.2 × 2.6 (8.3)	25	84

DEH dysplasia epiphysealis hemimelica

seen in OSD. The mean size of the bump was 5.5 ± 0.6 cm^2 at presentation, ranging from 5 to 6.2 cm^2.

In the plain radiographs, soft tissue swelling and intralesional calcifications were present. Other radiologic presentations included cortical remodeling distal to the tibial tuberosity, along with cortical scalloping, endosteal sclerosis, and in two cases with intraregional cartilaginous calcifications (Fig. 1a). Thickening of the cortex at distal margins of the lesion was also noticed, which was consistent with the "cortical buttress sign." MRI was ordered for the inspection of the internal characteristic of the mass, which revealed a juxtacortical mass with the high-intensity signal on T2-weighted images and intermediate-intensity signal on T1-weighted images (Fig. 1b, c). As the radiologic findings were suggestive of periosteal chondroma, the lesion was extracted with curettage and burring, and the diagnosis was confirmed histologically. The mean follow-up of 75 months was event-free in all patients.

Osteochondroma mimicking OSD

Three patients that were initially suspected as OSD finally were diagnosed with osteochondroma (two males and one female). The mean age of these patients was 11 ± two years, ranging from nine to 13 years. All patients were presented with a mass in the proximal tibia. The mass was painless. At history taking, the bump size was progressive. The bump size was also larger than the general size of the OSD (Fig. 2a). The mean size of the bump was 7.6 ± 0.9 cm^2 at presentation, ranging from 6.6 to 8.3 cm^2. The mean duration of symptoms was 18.3 ± 5.6 months, ranging from 12 to 25 months.

In the plain radiographs, a protruded bone lesion of the tibial tuberosity with medullary and cortical continuity with the underlying bone was observed (Fig. 2b). Considering the patients' age and location of the lesion, OSD was initially suspected. However, due to the lack of pain and obscure radiographic findings, MRI was

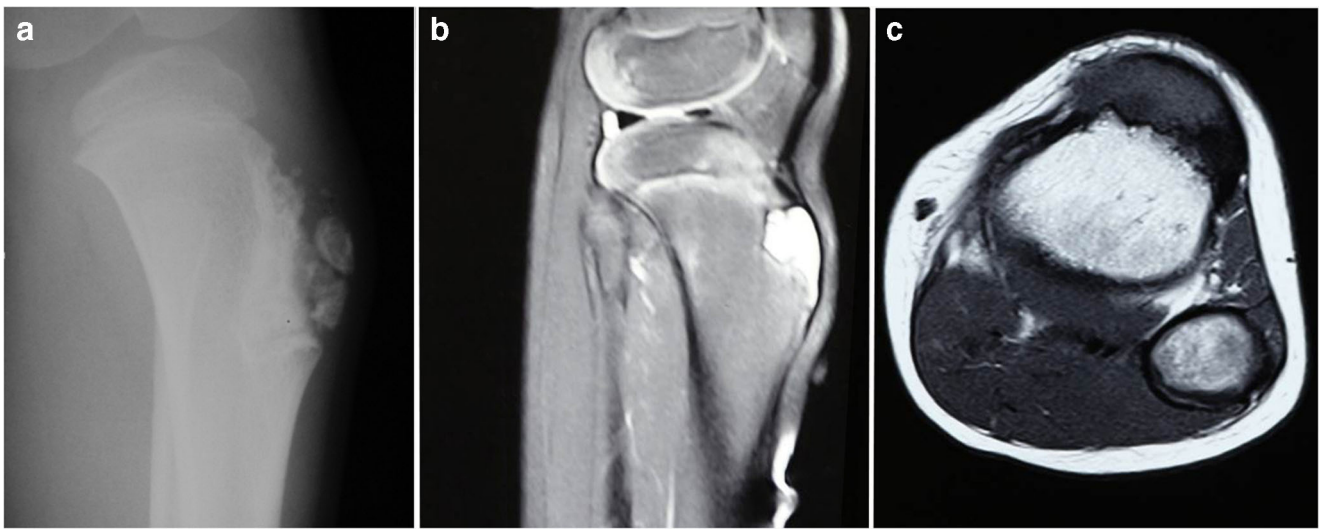

Fig. 1 Periosteal chondroma mimicking Osgood-Schlatter's disease. **a** Lateral radiograph showing the features of periosteal chondroma including cortical remodeling and intralesional calcification distal to the tibial tuberosity (case 3). **b** Sagittal T2-wighted MRI showing a juxtacortical mass with the high-intensity signal (case 1). **c** Axial T1-wighted MRI showing a juxtacortical mass with intermediate-intensity signal (case 1)

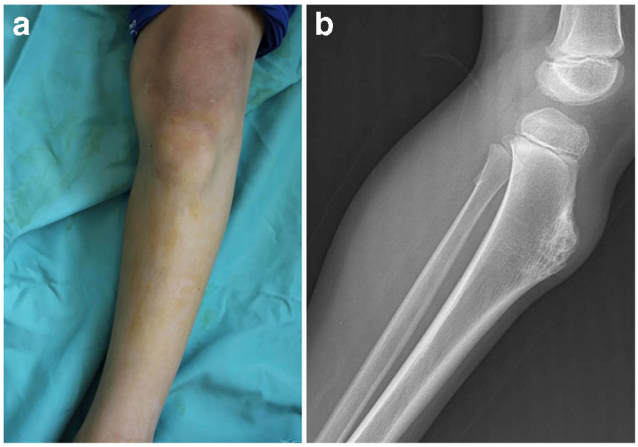

Fig. 2 Osteochondroma mimicking Osgood-Schlatter's disease in a 9-year-old male (case 7). **a** Photography of the involved knee showing a bump larger than general size in Osgood-Schlatter's disease. **b** Lateral radiograph of the lesion showing a protruded bone mass with cortical and medullary continuity with the tibial tuberosity consistent with broad-based osteochondroma

performed for further evaluation of the case. The MRI revealed an obvious cartilage cup on the bone lesion with no calcification. Accordingly, the diagnosis of osteochondroma was made. Although the tumour was painless, the lesion was resected surgically, as the masses of the anterior shin were highly exposed to trauma while the kids were playing, and the patients reported frequent pain caused by repetitive direct trauma. The diagnosis of osteochondroma was confirmed with histologic evaluations. The mean 72-month follow-up of the patients was event-free.

DEH mimicking OSD

An -eight year-old boy was referred with 48 months of history of mass and no pain. The bump size was 2.8 × 2.6 cm (7.3 cm^2) at presentation. At history taking, the bump size was progressive. An irregular ossification mass originated from the epiphysis of the proximal tibia was found in the plain radiograph (Fig. 3a). Considering the bony prominence over the proximal tibia and the age of the patient, OSD was initially suspected. However, the lack of pain and progressive size of the bump indicated further radiologic evaluation. MRI and 3D reconstruction CT scan of the lesion were used for better visualization of the lesion which revealed an osteocartilaginous mass originated from the proximal tibial epiphysis that was suggestive of intra-articular osteochondroma (Fig. 3b, c). The patient underwent surgery afterward. The lesion was extracted and sent to the pathology department. Pathologic examination revealed a grayish-white spongy lesion with firm consistency, covered with a whitish cartilaginous cap that was consistent with the diagnosis of DEH. Twenty-four months follow-up of the patient was event-free.

Discussion

Differential diagnosis of benign bone tumours could be challenging [8–10]. In this study, we reported a series of benign tumuor, which clinically mimicked OSD, including four cases of periosteal chondroma, three cases of osteochondroma, and one case of DEH. The demographic and clinical imitation of these cases with OSD, as well as the obscure finding on plain radiographs, resulted in the delayed definitive diagnosis of the lesion. Based on the results of this investigation, the age of the patients, as well as the pain and mass characteristics, could help the differentiation of benign tumours from OSD. Accordingly, a diagnostic algorithm could be suggested, as shown in Fig. 4. Based on this algorithm, if the lesion characteristics favour the tumour diagnosis, further radiologic evaluations with CT of MRI could be helpful.

Vancauwenberghe et al. reported a case of a periosteal chondroma of the proximal tibia in an 11-year-old girl, which was misdiagnosed as OSD in the initial evaluation. The patient had no pain. A plain radiograph revealed a subtle soft tissue swelling and intralesional calcifications adjacent to the tibial tuberosity. The obscure clinical and radiographic symptoms led to the nine months delay in the definitive diagnosis of the lesion. In later radiographs, cortical remodeling, cortical scalloping, endosteal sclerosis, abundant superficial cartilaginous calcifications, and cortical buttress sign were presented that were suggestive of a tumoral lesion of the bone. MRI revealed a juxtacortical cartilaginous mass located adjacent to the growth plate of the tibial tuberosity. The lesion was extracted with curettage, and diagnosis of periosteal chondroma was confirmed histopathologically. Vancauwenberghe et al. noticed the absence of pain as an indication against the diagnosis of OSD, as periosteal chondromas often present as a painless swelling with progressive onset [6]. However, three out of four cases of the current series were presented with pain. By contrast to the OSD, the pain was activity-independent. Moreover, the bump size at presentation was generally larger than the size in OSD. In addition, both pain and bump size were progressive in the periosteal chondromas, while they are generally non-progressive in OSD. Therefore, the pain and bump characteristics could be used to differentiate periosteal chondroma from OSD.

Balaji et al. reported a rare case of osteochondroma arising in the tibial tuberosity of a 12-year-old boy presented with swelling from one year ago and associated pain in the last three months. The mass size was 4 × 2 cm (8 cm^2) at presentation. The pain was aggravated during prolonged activities such as walking and playing. Clinically the lesion mimicked OSD. As the plain radiographs did not help the diagnosis of the lesion, CT scan and MRI revealed a well-defined broad-based, eccentric, osseous protruding mass arising from proximal tibial containing a cartilage cap. Accordingly, the

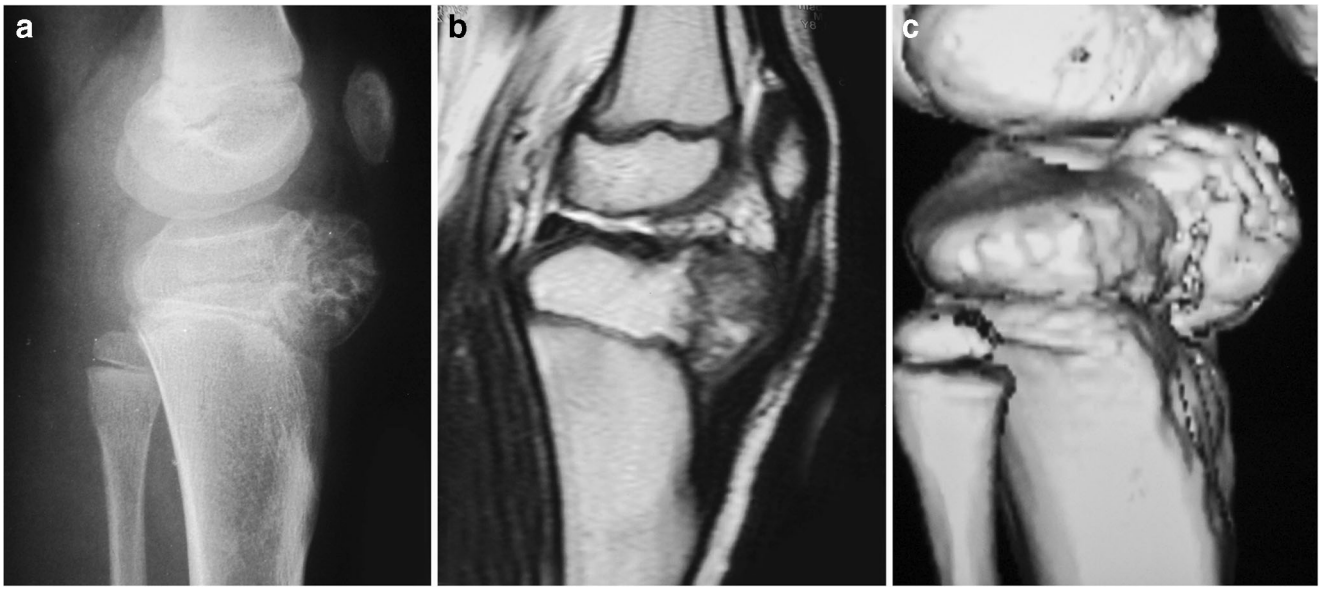

Fig. 3 Dysplasia epiphysealis hemimelica mimicking Osgood-Schlatter's disease in an 8-year-old female. **a** Lateral radiograph of the lesion showing an irregular ossification and enlargement of the proximal tibia. **b** Sagittal T1-wighted MRI. **c** 3D reconstruction CT scan of the case showing an osteocartilaginous mass originated from the proximal tibial epiphysis that was suggestive of dysplasia epiphysealis hemimelica

diagnosis of osteochondroma was suggested and confirmed by histopathologic evaluation of the lesion [7]. While the case of Balaji et al. presented with pain, all three cases of the current series that were finally diagnosed with osteochondroma were painless.

Although Balaji et al. recommended keeping in mind DEH in the differential diagnosis of OSD, no case of DEH mimicking OSD has been reported earlier. To the best of our knowledge, the present study is the only report highlighting the importance of the differentiation of DEH with OSD. DEH is a rare developmental disorder caused by asymmetric epiphyseal cartilage growth. This condition is commonly seen in adolescents and presents as a bony mass around the joint and no pain [11, 12]. Similar to osteochondroma, the absence of pain, progressive swelling, and age of the patients could be helpful in the differentiation of DEH and OSD.

The present study also affirms that OSD is not always presented with typical radiographic symptoms such as fragmentation and classification. In two cases of OSD that were excluded from the study after definitive diagnosis, no calcification and fragmentation were seen in plain radiographs. Although radiographic evaluation is generally not necessary for OSD, it is required to rule out additional diagnoses if the presentation is severe or atypical [13].

While this study provides some hints for the differentiation of benign tumours clinically mimicking OSD, it should be noted that these hints cannot be taken for granted. OSD typically involves boys at ages 12–14 years and girls at ages the to 13 years. Even so, an age range ofeight to 15 years has been reported as well [13]. Moreover, atypical age of 30 years has also been reported [14].

OSD has been defined as an overuse condition in highly active children, and specific sports such as long jump could increase the risk of OSD [5]. Surgical excision of ossicle through a variety of procedures such as arthroscopy could be used to satisfactorily treat unresolved OSD, particularly in professional athletes with persisting symptoms which adversely impact their athletic performance [15]. Although the

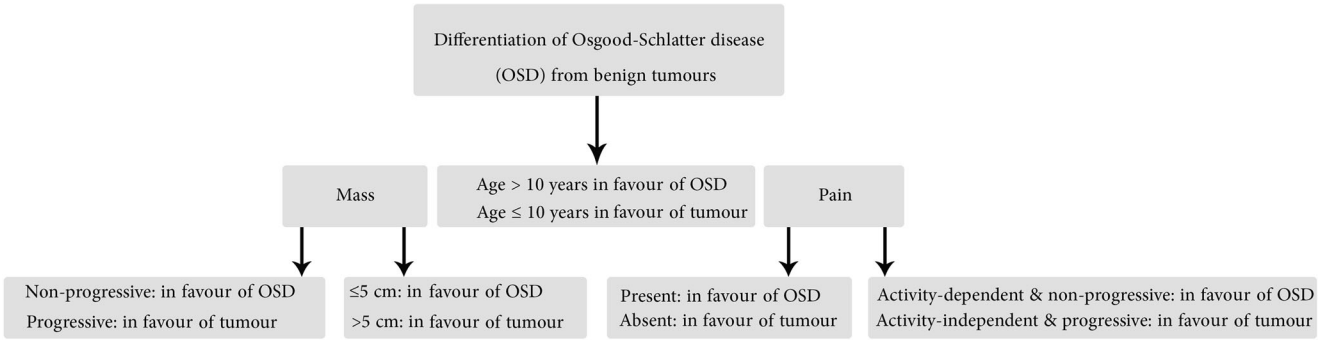

Fig. 4 A diagnostic algorithm to help the differentiation of Osgood-Schlatter's disease from benign tumors

pain in OSD is activity-dependent in the beginning, it becomes permanent and steady over time [16]. Therefore, not all activity-independent pains could be against OSD.

Some investigations suggest that anatomic characteristics of the patella could be responsible for the emergence of OSD [17, 18]. If so, these characteristics could be used in the differential diagnosis of OSD. However, there is still no consensus regarding the role of these factors in the aetiology of OSD [19].

The main limitation of this study was the small number of cases which did not allow the statistical analysis of the data. Considering the importance of the differentiation of OSD and neoplasms, further studies with a larger patient number are required for the codification of discriminating factors between these entities.

Conclusion

The characteristics of pain and bump, as well as the age of the patients, could be regarded as the factors helping the differentiation of OSD from benign tumors when their clinical presentation is mimicked. In this respect, lack of pain, a constant and increasing pain, progressive size of the bump, a bump size larger than 5 cm^2 at presentation, and age fewer than ten years could be considered factors against OSD.

Compliance with ethical standards

This study was approved by the review board of our institute, and informed consent was obtained from the patients' parents to use their medical data for publication.

Conflict of interest The authors declare that they have no conflict of interest.

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