Imaging diagnosis of intraarticular osteoid osteoma

Osteoid osteoma is a benign osteoblastic tumor that accounts for 10-12% of all benign bone tumors[1,2]. It usually develops in males between ages 10 and 25-30[1-3]. This lesion can be classified according to its location. Cortical, medullary and subperiosteal[4], osteomas have been described, the fist being the most common and the last the most rare. The femur is the most frequently involved bone, followed by the tibia and by the bones in the hand, the foot and the elbow.

CASE REPORT

The patient is a 17-year old athlete that had been complaining for the last 6 months of continuous pain of mild intensity in the left hip, at the level of the trochanter, which increased with exercise. The pain eased slightly with ibuprofen. On examination, the patient reported pain on hip rotations. A plain film of both hips was taken, whose result was normal (fig. 1A). A hip magnetic resonance (MRi) was requested (fig. 1B), which was performed on a 0.5 tesla unit with a pelvic surface coil and a broad field of view that made it possible to visualize both hips in coronal T1-weighted, STIR (*short time inversion recovery*) and axial T2-weighted sequences with fat saturation. In this way, an area of altered signal intensity with the characteristics of an unspecific medullary bone edema affecting the superolateral portion of the left femoral neck. A suspected diagnosis of osteoid osteoma was made. However, since the *nidus* could not be clearly identified, a second high-resolution study was carried out of the left hip on a 1.5 tesla unit with a smaller pelvic surface coil, of the kind used in shoulder studies, in order to identify a potential focal lesion, using sagittal T2-weighted, axial fat saturated proton density, and coronal T1 and T2-weighted sequences. The bone medullary edema was found in the superolateral portion of the junction between the femoral head and the left femoral neck, with an image suggesting the presence of a *nidus* about 8 mm in diameter that disrupted the external aspect of the cortex. There were also signs of adjacent synovitis. An ultrasound was also performed of the left hip, which also revealed a cortical irregularity, in addition to synovitis. Finally a computerized tomography (CT) was performed (fig. 1C), which showed a cortical irregularity with surrounding sclerosis and a small calcification of the *nidus,* which confirmed the initial diagnosis.

DISCUSSION

In 1947, Sherman was the first to describe the intracapsular (intraarticular) osteoid osteoma. Clinical presentation is unspecific, which means that diagnosis tends to be made rather late[1,4]. The most frequently affected joint is the hip, specifically the proximal portion of the femur, with the most common location being the medial cortex of the femoral neck[2]. Synovitis associated to the intraarticular osteoid osteoma tends to be hyperplastic, with prominent lymphoid aggregates (lymphofollicular or lymphoproliferative synovitis).

Very few Studies have evaluated osteoid osteomas located in the femur by means of MR[2]. When an osteoid osteoma is located intraarticularly, the *nidus* Could go undetected on a plain film since the degree of reactive sclerosis could be minimal or even inexistent. This is due to the absence of periostium inside the joint capsule, although the formation of endosteal bone is normally apparent[1-3]. Some authors have described a periosteal reaction[3] distal to the lesion or in adjacent bones not involved with the tumor. Most subchondral or subperiosteal lesions are not accompanied by a surrounding sclerotic reaction[4]. In he hip, the formation of abundant new endosteal bone, as in the case of well-developed intraarticular osteoid osteomas located in the femoral neck, could result in the thickening of the medial cortex (in the lesser trochanter area) and endosteal sclerosis. In the early stages, periarticular osteopenia and joint space widening are not uncommon occurrences[3]. The natural evolution of the osteoid osteoma could lead to the development of growth abnormalities, such as the narrowing of the femoral neck, resulting from the premature closing of the epiphysis, the narrowing of the joint space, the formation of osteophytes on the periphery of the joint, the flattening of the epiphysis and the development of intraarticular bone and soft tissue masses.

CT is the most sensitive Imaging technique for the detection of the *nidus*[4,5], whereas MR is the best technique for identifying changes in the intramedullary area and in the soft tissues adjacent to the lesion[5]. A low-enhancement *nidus* with central internal calcifications is characteristic. Calcifications reflect the maturity of the tumor, denser tumors being usually the longest.-standing. CT makes it possible to accurately select the surgical approach to be used and is also a useful guide for the carrying out of percutaneous techniques.

Ebrahim et al[1] reported the ultrasound findings of the intraarticular osteoid osteoma in 3 patients and found a cortical irregularity, associated with a hypoechoic focal synovitis.

RM poses a series of difficulties when it comes to identifying the *nidus*, since these are in general rather small[3,4] and there may be a large peritumoral edema hindering visu-

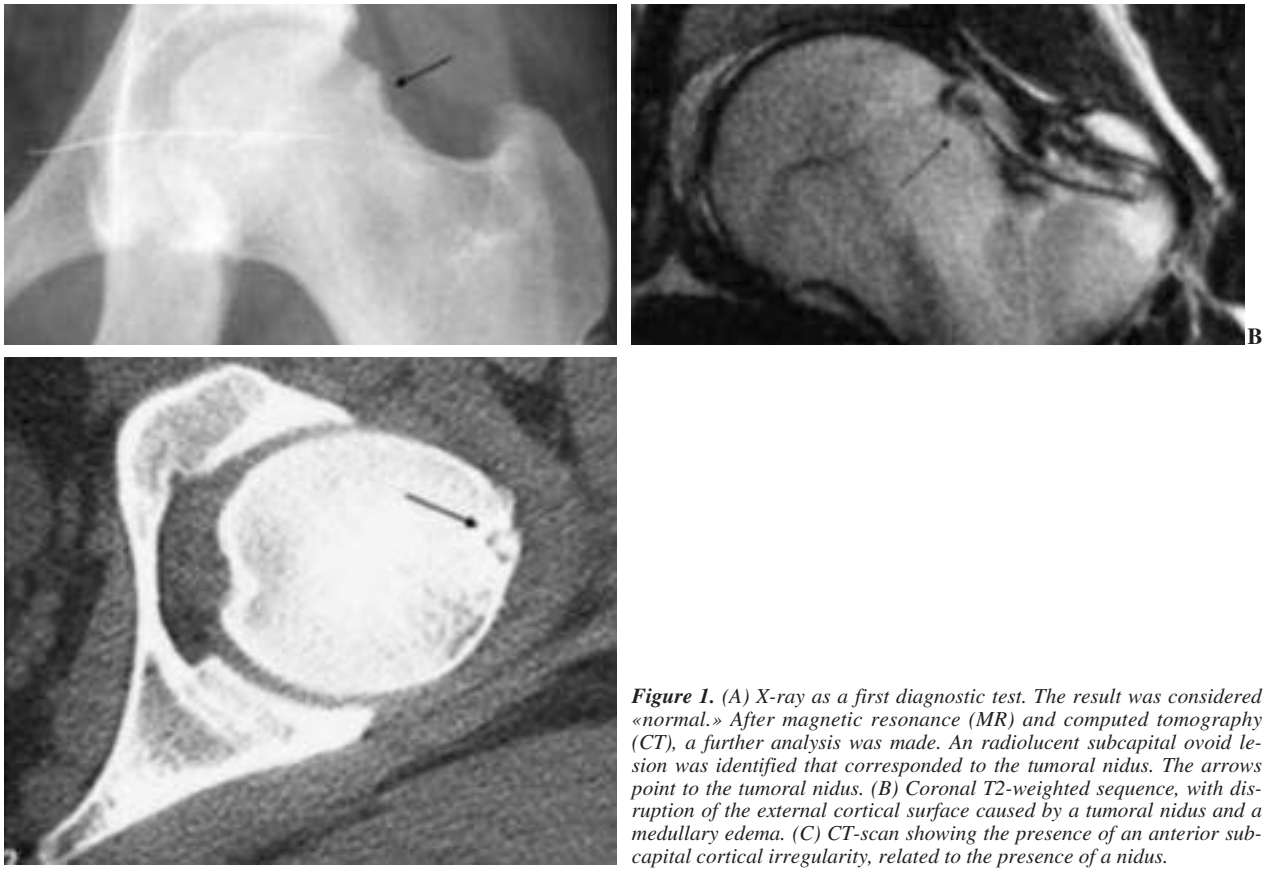

Figure 1. *(A) X-ray as a first diagnostic test. The result was considered «normal.» After magnetic resonance (MR) and computed tomography (CT), a further analysis was made. An radiolucent subcapital ovoid lesion was identified that corresponded to the tumoral nidus. The arrows point to the tumoral nidus. (B) Coronal T2-weighted sequence, with disruption of the external cortical surface caused by a tumoral nidus and a medullary edema. (C) CT-scan showing the presence of an anterior subcapital cortical irregularity, related to the presence of a nidus.*

alization. When it can be visualized, the degree of enhancement of the *nidus* varies according to the tumor's age, size, vascularization and calcification. It tends to have low to intermediate signal intensity (isointense to surrounding muscle) in spin-echo T1-weighted (SET1) sequences, while in spin-echo T2-weighted (SET2) sequences its appearance is variable: it can be hyper-, hypo-, isointense or even heterogeneous. Osteoid calcifications are identified on MR as a lack of signal intensity inside the *nidus*[2].

Intraarticular tumors are frequently associated to a yuxtanidal edema affecting the bone marrow and adjacent soft tissues. This normally brings about changes in the signal intensity of these entities consisting in a hyperintense area in STIR and SET2-weighted sequences, especially with fat saturation, and a hypointense area in SET1-weighted images, with variable enhancement after an IV gadolinium injection[2,3]. The medullary edema can extend to the femoral head, the intertrochanteric region and the proximal shaft[2]. The characteristics edema found in the bone marrow have been related with the age of the lesion, larger edema being found in the more recent tumors and in younger patients[3]. Hyperintense signal areas correspond to increased vascularization, inflammatory cell infiltration and mixomatotic changes[2]. Fat replacement can be developed in the neighboring muscles[2]. Greater or lesser degrees of articular effusion and of synovitis are characteristically seen on MR[2,3,5].

The literature contains few series of osteoid osteomas located in the proximal femur evaluated by means of MR. In addition, these cases have been studied with low spatial resolution sequences, which make it impossible to identify the *nidus*. The use of an optimized RM technique, with small surface coils for the unilateral study of the hip, afford better visualization of osteoid osteomas, especially with small fields[5].

Several Studies consider that MR should only be used in cases in which x-rays are not diagnostic and symptoms persist. A CT-scan should be carried out if x-ray/MR studies awaken any suspicions in order to confirm or dispel them. In our opinion, MR can be a very useful tool in the diagnosis of intraarticular osteoid osteoma if small fields of view are used together with surface coils in order to obtain a high resolution image.

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CT-guided percutaneous resection of osteoid osteoma

Osteoid osteoma is one of the most frequent benign osteogenic tumors in children and young adults. It is located in the lower limb (femur and tibia) in 50-60% of cases. Clinically, it is characterized by (preferentially) nocturnal pain that in most cases eases with anti-inflammatory drugs. Diagnosis is pretty straightforward by means of imaging techniques. X-rays tend to show a *nidus* of 6-10 mm in diameter surrounded by sclerosis. Histologically it is characterized by the presence of highly vascular connective tissue, fibrous bone trabeculae, osteoid substance and numerous osteoclasts and osteoblasts. Disappearance of pain has been reported following years of conservative treatment with aspirin or other antiinflammatory drugs, although most patients do not accept such a long-term treatment.

Treatment consists in the resection or complete destruction of the *nidus*. Since most osteoid osteomas are small, accurate intraoperative identification of the *nidus* can be challenging. In these cases, the surgeon may be forced to resect a significant amount of bone to guarantee full excision, which in the context of the long bones of the lower limb often results in the use of internal fixation and bone grafting if a large-scale resection is needed.

New percutaneous treatment alternatives have recently been developed, under computed tomography (CT) control: resection by means of trephines[1,2]; percutaneous ethanol injection into the *nidus*; *nidus* destruction by means of radiofrequency electrodes[3,4;] and the use of the laser beam[5]. Advantages of percutaneous treatment are manifest: these are minimally invasive low-morbidity techniques that can be performed as outpatient procedures and that make it possible to accurately control de location of the lesion.

CASE REPORT

This was a 9-year-old girl who, 4 months prior to consultation, developed pain and a limp in the right lower limb. Pain was moderate without pain-killers being required. Physical examination revealed pain and a some numbness at the level of the medial aspect of the proximal third of the right tibial shaft. Plain films (fig. 1) showed a periosteal reaction at the level of the medial tibial aspect. CT showed periosteal thickening, confirming the existence of a radiolucency that corresponded to the *nidus* of an osteoid osteoma.

With a presumptive diagnosis of osteoid osteoma, it was suggested to the girl's family that a resection of the lesion should be carried out percutaneously, with a 4 mm trephine and CT control, under local anesthesia and sedation (fig. 2).

At 24 hours the patient had no pain. The tibia was protected by means of a short leg cast for 3 weeks. The pathological study of the cylinder extracted confirmed the presence of an osteoid osteoma and its full resection. A 1-year post-op x-ray showed the complete of the perforation made. Six years later the patient had no discomfort.

Figure 1. *Anteroposterior radiograph of both tibias. The right tibia shows the periosteal reaction.*