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Bone and soft tissue tumors of hip and pelvis

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ABSTRACT

Objective is to identify epidemiologic and radiologic criteria allowing specific diagnoses of tumors and tumor-like lesions in the hip region and pelvis, and to optimize pre-operative staging.

Patients with pelvic tumors are usually older, and their tumors are larger relative to patients with tumors in extremities. The majority of tumors in the pelvis are malignant (metastases, myeloma, chondrosarcoma, Ewing-, osteo-, and MFH/fibrosarcoma), while those in the proximal femur are in majority benign (fibrous dysplasia, solitary bone cyst, and osteoid osteoma). Soft tissue masses in the thigh in the elderly are typically sarcomas without tumor specific signs.

Common tumor-like lesions occurring in the hip and pelvis that can mimic neoplasm are: infections (including tuberculosis), insufficiency/avulsion fractures, cysts, fibrous dysplasia, aneurysmal bone cyst, Langerhans cell histiocytosis, and Paget's disease.

Local MR staging is based on the compartmental anatomy. The psoas and gluteal muscles are easily invaded by sarcoma originating in the ileum. The pectineus muscle protects the neurovascular bundle at the level of the hip. The thigh is separated into three compartments, some structures (Sartorius muscle) cross borders between compartments. Immobile joints (SI-joints, osteoarthritic hip) are relatively easily crossed by sarcoma and giant cell tumor.

1. Introduction

Tumors and tumor-like lesions originating from the bone and soft tissue of the pelvis and hip region share many features and characteristics with those arising in other parts of the body, but there are also specific differences. It is on those discriminating features that we will focus in this review. Clinically the main difference is that pelvic tumors are located deep in the body, while tumors located in the extremities are relatively superficial. Typically pelvic tumors are therefore larger when diagnosed. Clinical presentation is therefore several years later compared to extremity locations of the same tumor type.

Imaging principles are not different in the pelvis. Diagnosis of osseous lesions relies mainly on conventional radiographs, while diagnosis of soft tissue tumors relies mainly on MR, and sometimes on CT. CT plays a more important role in explaining incidental findings, and in characterizing tumor-like lesions such as normal variants and post-traumatic sequelae. MR is the primary pre-operative staging tool of sarcoma [1,2]. Also because of the deep location in the body, the role of MR relative to clinical monitoring in diagnosing recurrence in the pelvis is much more important than in the extremities.

Objective of this review is therefore to stress the imaging findings of sarcoma, benign tumors, and tumor-like lesions that are pertinent to location in the pelvic and hip region.

2. Materials and methods

Data and illustrations used for this review are extracted from 6000 of the 15,000 patient files stored in the data bank of the Netherlands Committee of bone tumors, and on cases presenting at the department of Radiology of Leiden University Medical Center in the period from January 2008 to January 2010.

2.1. Anatomy related pitfalls and staging

General anatomy is discussed elsewhere in this issue of EJR. In the context of osseous pelvic tumors it is important to realize that the building blocks of the pelvic region are the iliac, pubic and ischial bones, the proximal femur with its secondary growth centers and the components of the sacrum.

Because of the complex anatomy there is super position of bone in some parts and thin bone in other parts (especially in the proximal femur and iliac wing) that both can be misleading on conventional radiographs. The normal lucency in the proximal femur (Wards triangle) for example, can be mistaken for osteolysis.

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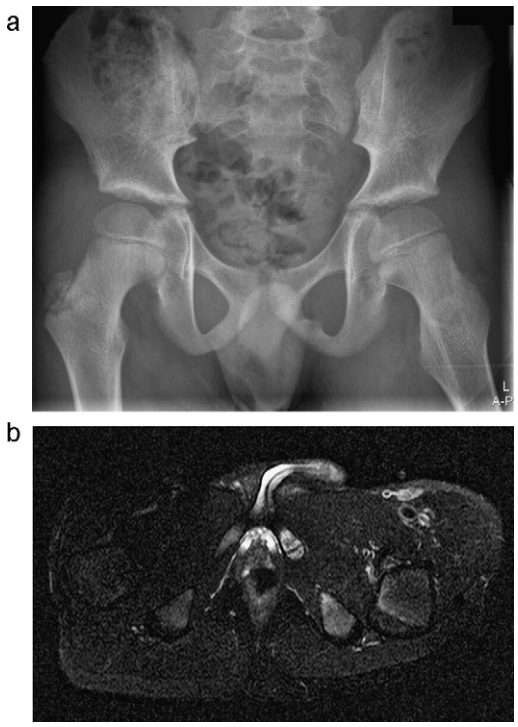

Fig. 1. (a) Conventional radiograph of the pelvis shows the irregularity of the left ischial pubic synchondrosis in a 7 year old boy. (b) The non-fused synchondrosis exhibits a high signal intensity on this fat suppressed T2-weighted axial image.

Also the center of the iliac bone is extremely thin and the resulting lucency can be mistaken for an osteolytic tumor, especially when there is additional bowel gas projecting over the iliac wing. Bowel gas is also an important reason for missed tumors in the sacrum; the best strategy to deal with this is to identify all cortices of the neural foramina. A third commonly encountered lucency is the lobulated well defined multilocular, often bilateral, lucency in the inferior ramus of the ischial bone in adolescents, which is secondary to the origin of the rotator muscles of the hip, in particular the quadratus femoris muscle.

Another common mistake is to diagnose a tumor in a child or adolescent when there is irregularity, more often on the left side, at the ischial-pubic synchondrosis (Fig. 1) [3].

The osseous constituents of the pelvic area all contain hematopoetic bone marrow. The MR signal intensity characteristics of hematopoietic bone marrow (relatively low on T1, and intermediate on fluid sensitive sequences) and the synchondroses between the above mentioned growth centers are a source of normal variants that may mimic tumor. However, at the same time these structures are preferred localizations of tumors.

MR is superior in displaying the relationship between tumors and surgical anatomy, and is thus the preferred staging method. In the pelvis, individual anatomical structures including pelvic content are, in addition to surgical compartments, used to plan surgery. The pectineus muscle is an important barrier between tumors extending anteriorly from the pelvic-hip region on one side, and the neurovascular bundle, which lies superficial to the pectineus muscle, on the other side. Tumors arising from the iliac bone easily extend into, but are often limited to the iliac muscle medially and the gluteal muscle compartment laterally. In the upper thigh three compartments are identified; the anterior (quadriceps, tensor fascia lata, iliopsoas, Sartorius, iliotibial band), posterior (semitendinosis, semimembranosis, and biceps femoris) and medial compartment (adductor longus, brevis, magnus, and gracilis) [1,2]. Special attention has to be paid to structures that cross borders,

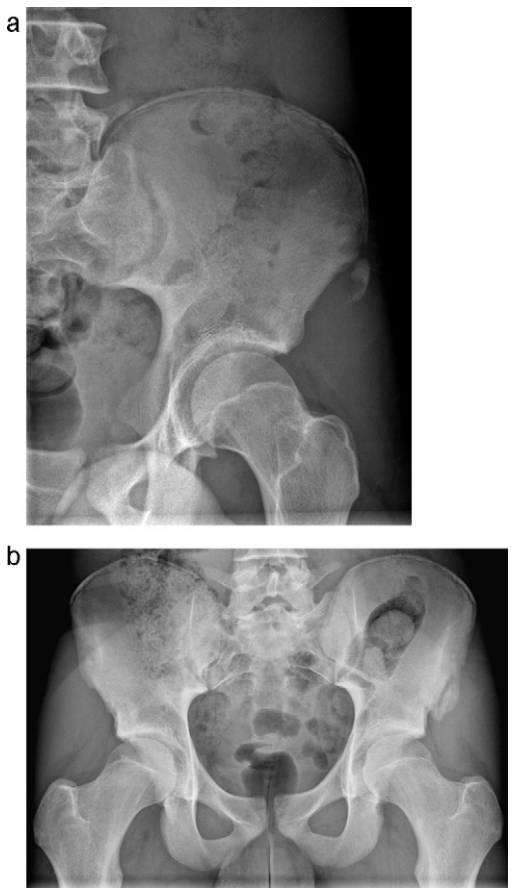

Fig. 2. (a) Conventional radiograph shows an avulsion fracture of the left anterior superior iliac spine in a 16 years old boy after sport related trauma. (b) Two months after trauma there is progressive consolidation.

or are extracompartemental, i.e. arteries, venes, nerves and the Sartorius muscle (lies mainly in anterior compartment).

The SI and hip joints are, because of the fibrous non-cartilaginous part of the SI joint, the teres ligament in the hip, and the frequently present osteoarthritic changes with cartilage destruction and limited motion, more easily crossed by tumors (i.e. osteosarcoma, chondrosarcoma and giant cell tumor) than the joints in the extremities [4].

2.2. Tumor-like lesions

Tumor-like lesions are non-neoplastic tumors, sequelae of trauma, including post biopsy alterations, and infection.

2.2.1. Trauma

Avulsion fractures occur at specific sites in the adolescent patient. The most important ones are the anterior superior iliac spine (Sartorius and tensor fascia latae) (Fig. 2), anterior inferior iliac spine (rectus femoris), and ischial tuberosity (hamstrings). Post-traumatic hematoma, reactive tissue and immature callus may mimic a tumor on MR and radiographs in the acute and subacute phase. In the remodeling phase of healing the distorted anatomy may be mistaken for an osseous tumor on radiographs.

On the other site of the age spectrum (in the elderly) insufficiency fractures secondary to osteoporosis or radiation therapy induced osteonecrosis may mimic tumor, especially metastases. The clue here is the location, most characteristically the sacrum (Fig. 3). Many of these fractures occur bilaterally and at multiple sites. MR may be confusing, but the typical features of fracture on

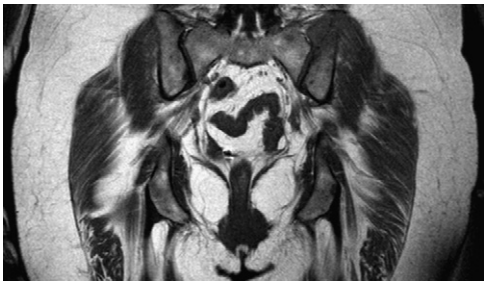

Fig. 3. Coronal T1 weighted image shows a pathologic fracture at the left iliac wing in a 50 year old woman who suffers from metastatic disease from breast cancer.

CT or the so called "Honda sign" on bone scintigraphy allow a confident diagnosis to be made. Osteoporotic insufficiency fractures can occur at many locations including acetabulum, ischial bones, pubic bones and proximal femur. Stress fractures in healthy active adolescents occur mainly medially in the proximal femur.

Small holes are frequently seen in the iliac crest posteriorly in patients who underwent a whole body MR for staging of multiple myeloma. These biopsy holes should not be mistaken for myeloma localisations.

2.2.2. Infection

Usually osteomyelitis, arthritis, and non-infectious inflammatory conditions do not cause diagnostic problems in the pelvic region. The two most important exceptions are sarcoid and tuberculosis. Sarcoid may present as multiple osseous punched out lesions mimicking myeloma, metastases, or multifocal angiosarcoma. In tuberculosis the discrepancy between mild clinical symptoms relative to substantial osseous destruction with marked soft tissue extension, may be the reason to entertain a diagnosis of sarcoma. Abscess formation and arthritis are clues to the diagnosis in these cases (Fig. 4). One should keep in mind, however, that because of absence of cartilage and limited mobility, osteosarcoma, chondrosarcoma and giant cell tumor can relatively easy cross SI joints and osteoarthritic hip joints. [5].

2.2.3. Cysts

Large subchondral cysts or geodes occurring primary or secondary to osteoarthritis or rheumatologic disease may raise suspicion of a neoplasm on conventional radiographs. The hip is a tight-joint, therefore synovial disease may cause marked osseous destruction in femur and acetabulum. The herniation pit or fibrocystic changes may be large occasionally but is easily identified because of its typical location at the femoral head-neck junction.

2.2.4. Fibrous dysplasia

Fibrous dysplasia is a common finding that can be symptomatic, for instance presenting with a pathologic fracture, or asymptomatic. Therefore this lesion is more common than reported. In the pelvic region the lesion is commonly found in the proximal femur (22% of fibrous dysplasia's). The prevalence in pelvic bones in total is only 6%. The radiologic presentation is the same as elsewhere in the body, has been described extensively, and normally allows a confident radiologic diagnosis to be made (Fig. 5). Cystic components seen on MR may be quite prominent. The lesion may be multifocal. It's most characteristic features are the ground glass appearance, and the shepherds crook deformity of the proximal femur. Poly-ostotic fibrous dysplasia is associated with soft tissue myxoma (Mazabroud's syndrome), so diagnosis of these myxoma's on CT or MR support the diagnosis.

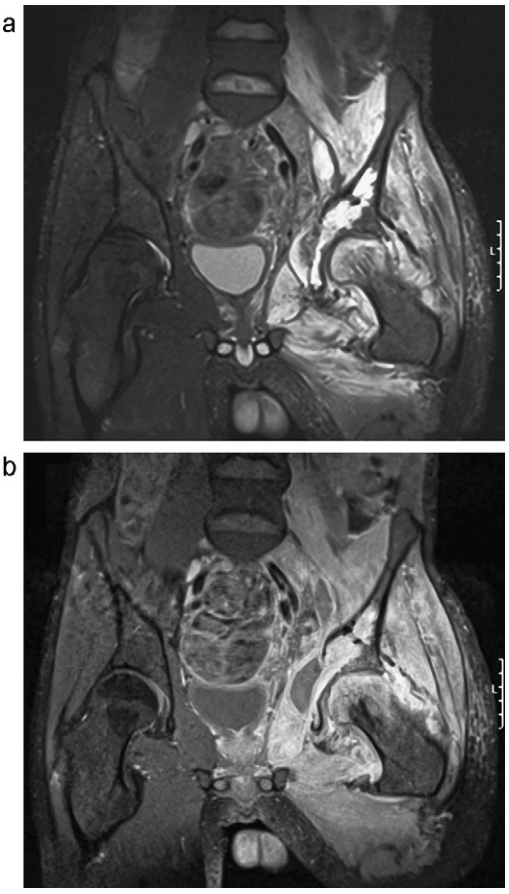

Fig. 4. (a) A 27 years old man diagnosed with tuberculosis. Coronal STIR and Fig. 4b. Gd-chelate enhanced, fat suppressed MR images show arthritis of the left hip joint with marked soft tissue extension, abscesses, joint effusion, osseous destruction and high signal intensity secondary to osteomyelitis.

2.2.5. Aneurysmal bone cyst

Aneurysmal bone cysts do not have a preference for the pelvis, in all three pelvic bones combined the occurrence is 7%, but 9% of them are found in the proximal femur. The radiologic features are the same as those described in more common locations in the peripheral skeleton. In the iliac bone the intra-osseous hematoma (pseudotumor) seen in patients suffering from hemophilia may have a similar appearance. The hemophiliac pseudotumor has a preference for the iliac bone.

2.2.6. Langerhans cell histiocytosis

Langerhans cell histiocytosis has a modest preference for the pelvic region, 13% of them are found in iliac bone, 13% in proximal femur, but only 3% in pubic and ischial bones combined (Fig. 6). The most important differential diagnoses are Ewing sarcoma (see below) and infection [6].

2.2.7. Solitary bone cyst

Although the typical location of solitary bone cyst is the proximal humerus, up to 21% are found in the proximal femur. The prevalence is much lower in the iliac bone (7%), and ischial and pubic bones combined (2%). In the proximal femur it may be challenging both for the radiologist and pathologist to differentiate solitary bone cyst from the cystic variant of fibrous dysplasia. Both lesions may present with pathological fractures.

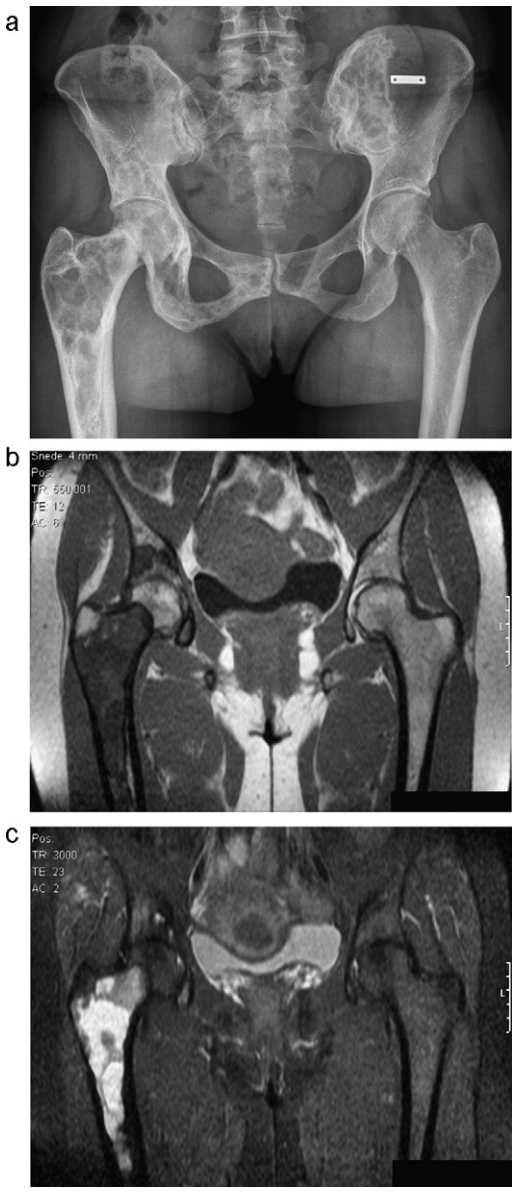

Fig. 5. Poly-ostotic fibrous dysplasia in a 48 years old woman. (a) Lesions in the right proximal femur and pelvis with mixed lysis and sclerosis in combination with a shepherd's crook deformity of the femur. (b) Coronal T1-weighted image shows low signal intensity. (c) Cystic components are seen on coronal fluid sensitive MR image.

2.2.8. *Paget's disease*

Paget's disease occurs anywhere in the skeleton, but the pelvic bones and proximal femur are among the preferential sites (Fig. 7). Although Paget's disease is not a neoplastic condition, it may be confused with tumors or tumor-like lesions. Diffuse metastatic disease is the most important diagnosis to rule out. The lytic phase may mimic an osteolytic tumor, but especially the mixed lytic and blastic phases may be confused with metastases from prostate cancer, or the regional metastases from tumors arising from the urogenital system. Other differential diagnostic considerations may be lymphoma, chronic osteomyelitis, osteoblastoma, and osteoid osteoma. Complications that occur predominantly in the pelvic region are osteoarthritis, fractures (proximal femur) and Paget sarcoma (usually osteosarcoma in iliac bone and proximal femur) [7–9].

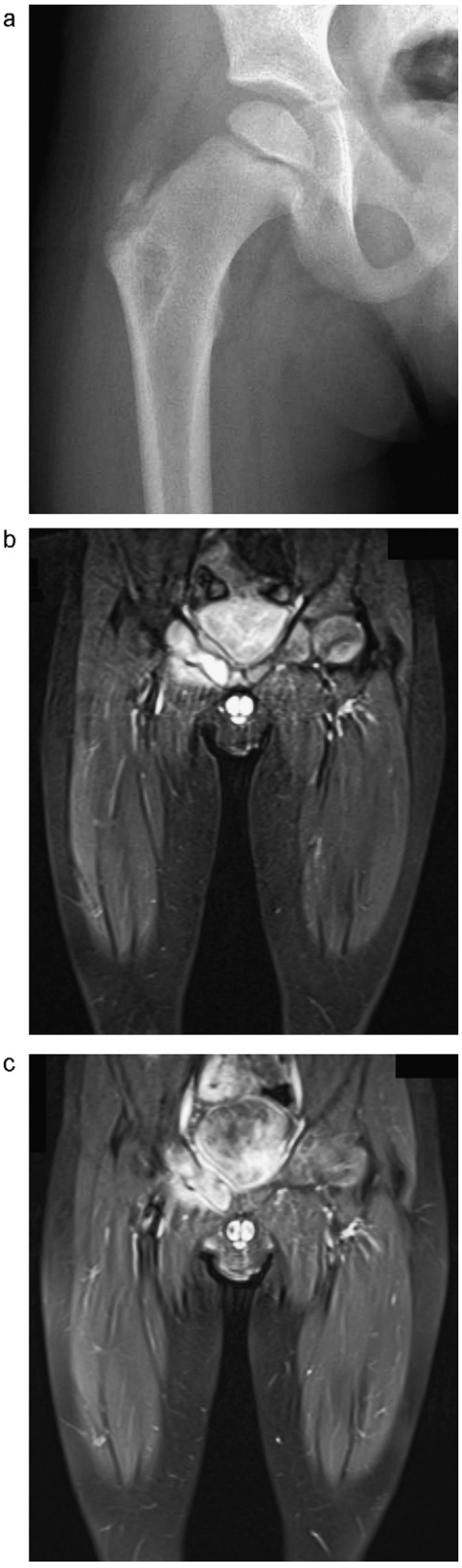

Fig. 6. Multifocal Langerhans cell histiocytosis in a 4y old boy. (a) Conventional radiograph shows an old lesion in the femur, and a new subtle lesion with cortical irregularity in the superior part of the pubic bone. (b) The pubic lesion is easily seen as a high signal intensity lesion on this coronal STIR image. The high signal represents the lesion and reactive inflammatory response. (c) Both the lesion and reactive changes enhance after Gd-chelate injection. A pathologic fracture is seen.

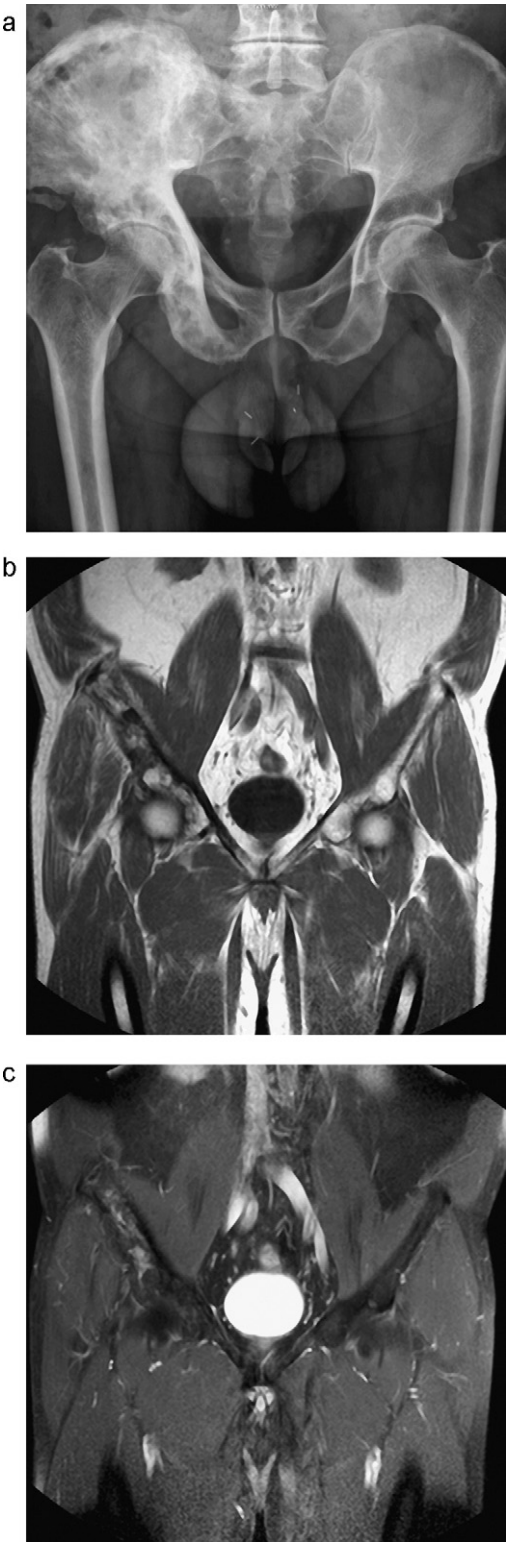

Fig. 7. Paget's disease of the right iliac wing. (a) Conventional radiograph; Mixed phase; note the increased bone size. (b) heterogeneous low signal intensity on the T1 weighted image. (c) Little enhancement is appreciated on this coronal fat suppressed GD- chelate enhanced image.

2.3. Osseous tumors

Although any bone tumor may occur in the pelvis, there are some preferential tumors, and some rules of thumb. Most bone tumors in the pelvis are malignant (62%, Table 1), while most tumors in the proximal femur are benign (68% Tables 2, 3). Most tumors in pelvic region in children are also benign. In children younger than 14 years, 42% of tumors and tumor-like lesions in the hip region are solitary bone cyst or osteoid osteoma [10]. When looking at incidence data, one should keep in mind that common tumors in rare locations usually are encountered more frequently than rare tumors in common locations. In Tables 1 and 2 frequency distribution of tumor type per location is given.

Table 1
primary osseous tumors of the pelvis in decreasing order of frequency.

Chondrosarcoma	24%
Ewing	16%
Osteosarcoma	9%
Fibrosarcoma/MFH	5%
Langerhans cell histiocytosis	5%
Aneurysmal bone cyst	4%
Fibrous dysplasia	4%
Miscellaneous benign*	25%
Miscellaneous malignant	8%

*Each type of lesion < 4%, in decreasing order of frequency: osteomyelitis, osteochondroma, SBC, GCT, OO, OB, Lymphoma, etc.

Table 2
Primary benign osseous tumors and pseudo-tumors of the proximal femur in decreasing order of frequency.

Fibrous dysplasia
Solitary bone cyst
Osteoid osteoma
Chondroblastoma
Giant cell tumor
Osteochondroma
Aneurysmal bone cyst
Langerhans cell histiocytosis

Myeloma and metastases are not included in the frequency data, but are a common cause of tumors found in the pelvic region in patients older than 40 years of age. The hematopoetic bone marrow of pelvic bones and proximal femur are predeliction sites for both myeloma and metastases.

In children, especially young children, under 2 years of age, a diagnosis of neuroblastoma should be entertained when seeing an aggressive lesion in the pelvis or proximal femur (Fig. 8). These are typically multifocal and may resemble osteomyelitis [11].

The sacrum belongs, with respect to osseous tumors, more to the spine than the pelvis. Tumors and tumor-like lesions found most frequently are: chordoma (25%), giant cell tumor (15%), aneurysmal bone cyst (13%), chondrosarcoma (12%), osteosarcoma (8%), Ewing sarcoma (8%), and miscellaneous (29%). Other tumors including osteoid osteoma do occur in the sacrum, but at a much lower frequency.

2.4. Osteosarcoma

Osteosarcoma, especially the conventional type, occurs not infrequently in the proximal femur (5%) and iliac bone (3%) (Fig. 9). Other types are rare in the pelvic region. Osteosarcoma is very rare in sacrum, pubic, and ischial bones (<1%). Radiographic features are similar to that of osteosarcoma in the extremities. Its hallmark is osteoid formation, which is seen in association with asymmetric destruction of bone, and asymmetric soft tissue extension. Tumors

Table 3
Sarcoma in the proximal femur, in decreasing order of frequency.

Chondrosarcoma
Osteosarcoma
Ewing sarcoma
Fibrosarcoma/MFH

Fig. 8. A 4 year old boy with osseous localizations of neuroblastoma. The right femoral localization with lamellar periosteal reaction is well seen on the. conventional radiograph (a) and. fat suppressed Gd-chelate enhanced sagittal image (b). The biopsy hole is seen on the radiograph. (a) Coronal T1 shows multiple low signal intensity lesions in both femora.

are larger than those in the extremity and more often contain large cartilaginous components (conventional or chondroblastic type of osteosarcoma depending on the fraction of tumor consisting of cartilage). The cartilaginous components are identified when ring and arc type of enhancement is seen on Gd-chelate enhanced MR. Most important differential considerations are chondrosarcoma, especially when there is a large cartilaginous component, and Ewing sarcoma. Ewing sarcoma has a more symmetric destruction and soft tissue extension.

2.5. Osteoid osteoma

Although osteoid osteoma is a rare finding in the pelvis, it is relatively common in the proximal femur (20% of all osteoid osteoma's). Radiologic diagnosis of osteoid osteoma is of particular importance because of the successful radio frequency ablation therapy that is performed without histologic diagnosis, also in the hip region [12,13]. The radiologic signs are not different from that of osteoid osteoma in the extremities or spine. Reactive inflammation, including synovitis, seen as high signal intensity on fluid sensitive sequences and Gd-chelate enhanced images, is marked on MR. The nidus is best seen on CT [14]. CT is also used to guide the radiofrequency needle.

2.6. Osteoblastoma

Only 4% of osteoblastoma's occur in the pelvis, mainly pubic and ischial bones, but 11% occur in the proximal femur. Osteoblastoma is the main differential consideration of osteoid osteoma. Osteoblastoma's are larger than the mean 1.5 cm diameter of

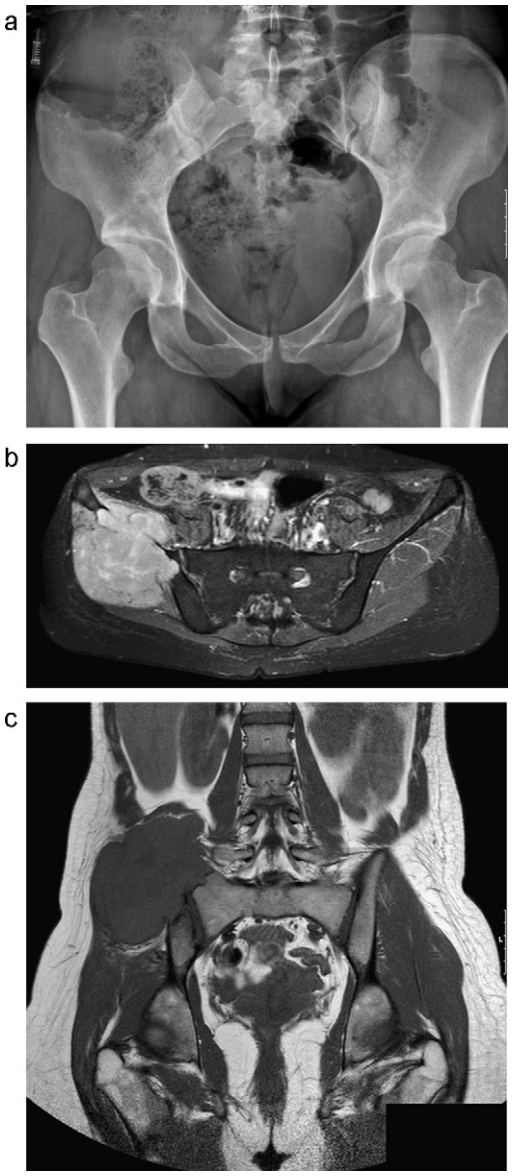

Fig. 9. A 27 years old woman with an osteosarcoma of the right iliac wing. (a) Large lytic lesion is seen on the conventional radiograph. (b) Axial fat suppressed Gd-chelate enhanced image with asymmetric soft tissue extension. (c) Tumor is seen to cross the SI joint on this coronal T1-weighted image.

osteoid osteoma. Other radiologic features typically resemble that of osteoid osteoma. Ossification can be marked. In these cases differentiation from osteosarcoma may be challenging both radiologically, and on histology. Absence of cortical destruction in these cases is an important sign in favour of osteoblastoma.

2.6.1. Chondrosarcoma, enchondroma and osteochondroma

In decreasing order of frequency central chondrosarcoma's occur in the proximal femur (11%), iliac bone (10%), pubic bone (5%), sacrum (2%), and ischial bone (1%). For peripheral chondrosarcoma the frequency distribution is: iliac bone (14%), pubic bone (11%), and proximal femur (7%). Chondrosarcoma is the osseous tumor in the pelvis causing the vast majority of the clinical problems. The main reason is that chondrosarcomas are usually large when detected. Furthermore the tumors are very fragile and break easily during surgical manipulation, leading to tumor spill in the surgical bed. This often results in multiple soft tissue recurrences (Fig. 10). Another problem is that higher grades of conventional

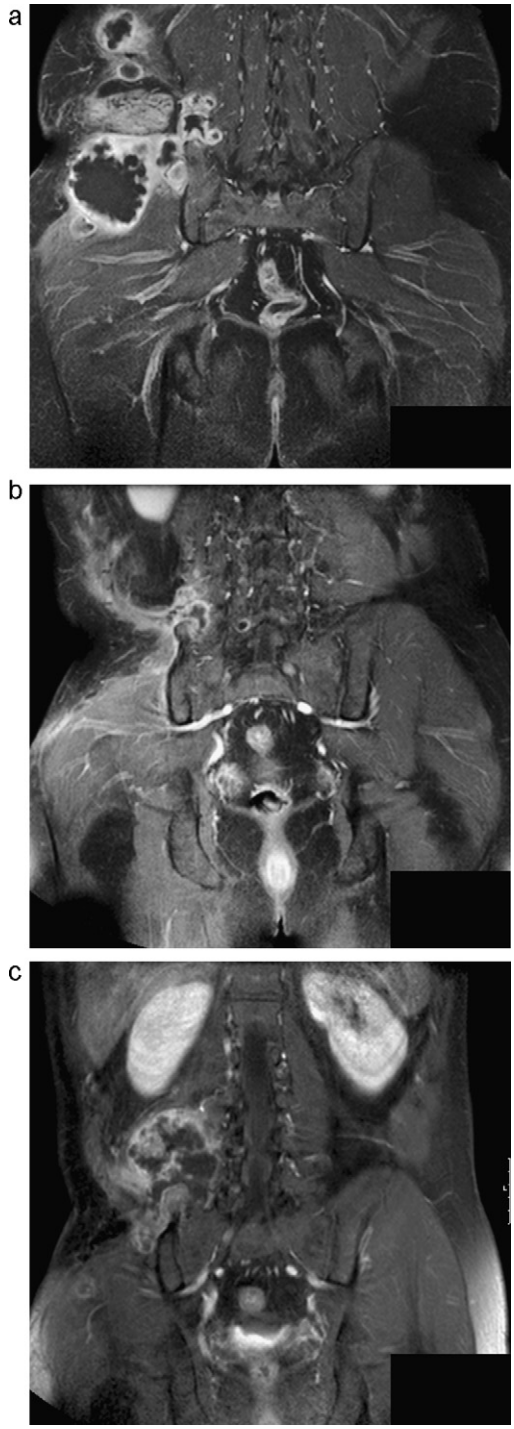

Fig. 10. (a) Recurrent multifocal chondrosarcoma with the typical ring and arc enhancement at the level of the right iliac wing. (b) Second recurrence 6 month's after second resection. Progressive disease of the second recurrence 1 year later (c).

chondrosarcoma are more frequent than in the peripheral skeleton. The prevalence of grade 2 and 3 chondrosarcoma in the entire femur is 45%, compared to 70% in the iliac bone. Diagnosis is straightforward because of the characteristic cartilaginous popcorn calcifications seen on radiographs, and the ring and arc enhancement pattern on MR.

The dilemma of differentiating, in the extremities, enchondroma from chondrosarcoma grade 1, is not an issue in the pelvis. Cartilaginous tumors in the pelvis and axial skeleton larger than 5 cm are malignant [15]. Therefore virtually all cartilaginous tumors in

the pelvis are chondrosarcomas. Only in the proximal femur do we encounter the same dilemma as elsewhere in the peripheral skeleton [16].

Although osteochondroma is not rare in the three pelvic bones (7%), they are more frequently found in the proximal femur (11%). In the iliac bone, osteochondroma occurs almost as frequently as peripheral chondrosarcoma. However, peripheral chondrosarcoma is three times as common as benign osteochondroma when we look at the pubic bone and proximal femur. The criteria to differentiate the two are the same as elsewhere in the body. In favour of malignancy are size (> 5 cm), thick cartilaginous cap (> 2 cm), and rapid enhancement on dynamic Gd-enhanced MR images (less than 10 seconds after arterial enhancement). An additional feature of osteochondroma in the proximal femur, may be a large bursa. Such a bursa causes mechanical symptoms, may be mistaken for cartilaginous cap, may contain cartilaginous particles that look malignant on histology, and is often associated with rapid enhancing osteochondroma, which is secondary to mechanical friction. Osteochondroma's in children also enhance rapidly, this should not be mistaken as a sign of malignancy.

A typical location of clear cell chondrosarcoma (only 2% of all chondrosarcomas) is the proximal epiphysis of the femur (Fig. 11). There is some overlap in ages, but typically an epiphyseal tumor in the proximal femur in a patient less than 25 years of age, displaying marked reactive changes is a chondroblastoma. When the patient is somewhat older, and reactive changes are less pronounced, the diagnosis of clear cell chondrosarcoma should be entertained. Chondroblastomas are not rare in the proximal femur (15%), but are rare in the three bones of the pelvis (1%).

2.6.2. Ewing sarcoma and lymphoma

Ewing sarcoma is relatively common in the iliac bone (14%), proximal femur (9%), and less common in ischial (3%), and pubic bones (3%). Although the radiographic features are the same as in extremity locations, reactive sclerosis is often more prominent in the iliac bone than in the extremities. Most important differential diagnosis is osteosarcoma. In contrast to osteosarcoma, Ewing sarcoma easily penetrates cortical bone without gross destruction, and extends in a concentric fashion. When located in the iliac bone it extends easily both in the gluteal and iliac muscle compartments (Fig. 12).

Langerhans cell histiocytosis is also a differential consideration, but the soft tissue mass is much smaller in this condition. In addition the marked reactive soft tissue and osseous reaction seen as high signal intensity on fluid sensitive and Gd-chelate enhanced images is typically seen in Langerhans cell histiocytosis, and less striking or even absent in Ewing sarcoma. Non-Hodgkin lymphoma is a differential consideration as well. Being also a round cell tumor it exhibits similar radiologic features as Ewing sarcoma. However, it is rare with approximately 10% of these lesions occurring in the pelvic region, mainly the iliac bone. The soft tissue mass is smaller in lymphoma than in Ewing sarcoma, but the radiographic features may be very similar to those of Ewing sarcoma. Sclerosis may be more prominent in lymphoma.

2.6.3. Malignant fibrous histiocytoma (MFH) and fibrosarcoma

Fibrosarcoma is not uncommon in the iliac bone (9%), proximal femur (9%), but uncommon in ischial and pubic bones (3%). MFH is also not uncommon in the proximal femur (12%), but rare in other components of the pelvis. Fibrosarcoma and MFH share the same radiologic features, and these are clearly malignant, but not discriminative towards other types of sarcoma.

2.6.4. Giant cell tumor

The proximal femur is, following the three bones around the knee joint (patella excluded) and the proximal humerus, the next most common location of giant cell tumor (6%). It is less commonly found in the three pelvic bones (4% combined for all three bones). Although only 6% of giant cell tumors occur in the sacrum, it is the second most common primary tumor found in the sacral bones. Large volume, with secondary aneurysmal bone cyst occurs more common in the pelvic region than in the extremities [17].

Most important differential considerations are chondroblastoma, clear cell chondrosarcoma and aneurysmal bone cyst (proximal femur). The lesion is eccentric, which is helpful in differentiating it from chordoma (for the sacral location). Other tumors that should be included in the differential diagnosis are osteosarcoma and malignant fibrous histiocytoma. For the older age group, plasmacytoma and metastasic carcinoma should also be considered [18].

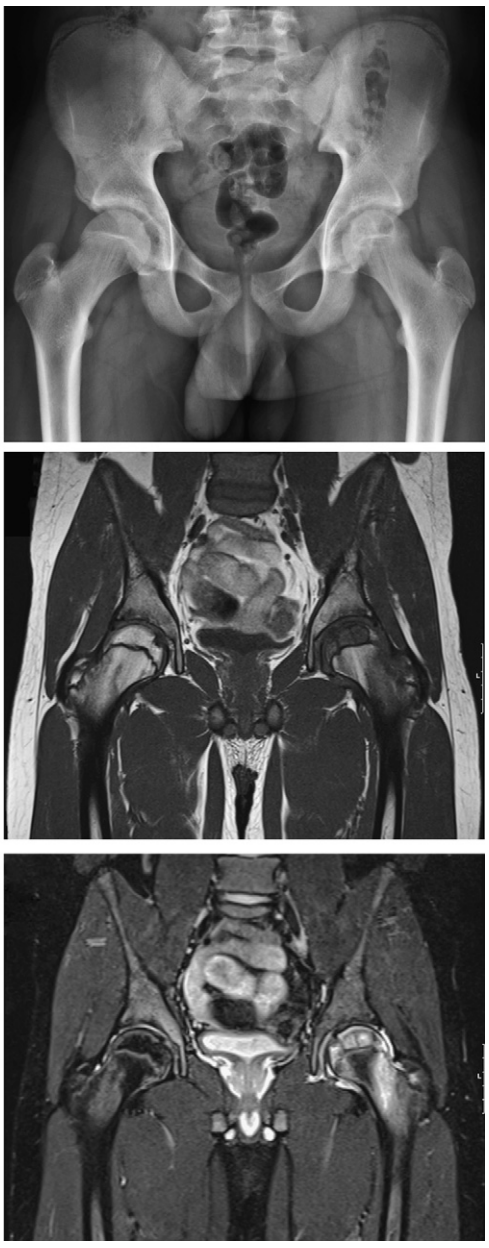

Fig. 11. Clear cell chondrosarcoma diagnosed in a 14 years old boy. (a) Conventional radiograph shows a well-defined lytic lesion in the proximal femoral epiphysis. (b) Low signal of the lesion and reactive inflammation in epiphysis on the T1-weighted image. (c) Heterogeneous high signal of the lesion, and inflammatory reaction in bone marrow and synovium on the STIR image. This lesion was first diagnosed as a chondroblastoma because of the age, location and marked reactive changes.

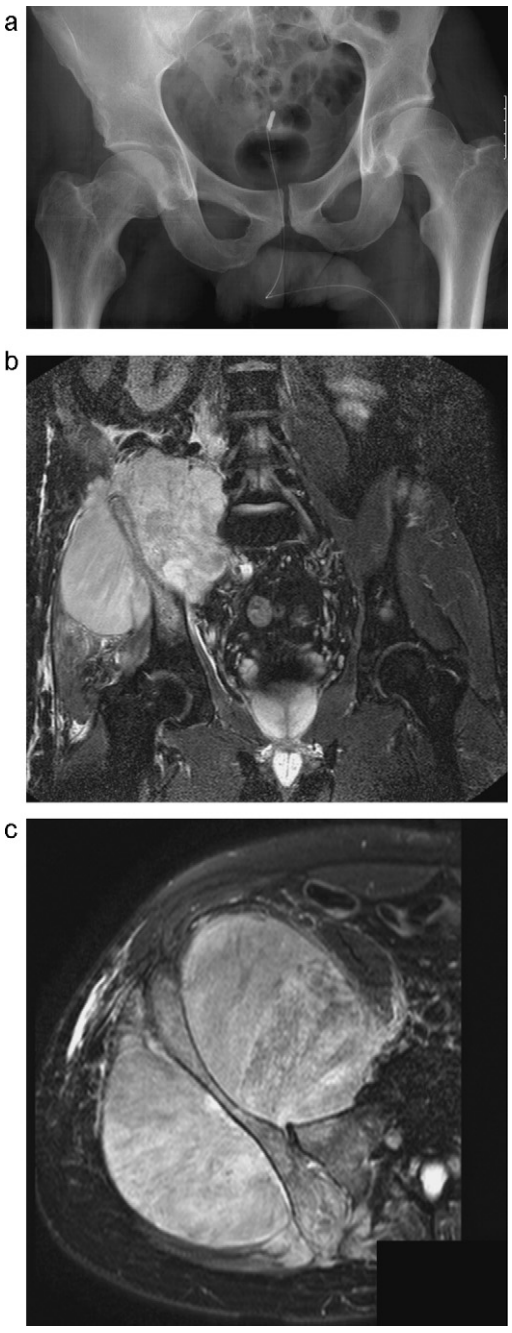

Fig. 12. Ewing sarcoma of the right iliac wing in a 35 years old man. (a) A conventional radiograph shows increased density projecting over iliac wing secondary to soft tissue mass, and a sclerotic area with cortical irregularity superiorly. Coronal T2 fat saturated (b) and. axial GD- chelate enhanced (c) images showing a large symmetric soft tissue extension in the gluteal- and iliac muscle compartments without gross cortical destruction.

2.7. Soft tissue tumors

A detailed discussion of soft tissue tumors is beyond the scope of this review. The number of benign and malignant soft tissue tumors is much larger than the number of osseous lesions, and virtually all of them can occur in the pelvic and especially hip region. Synovial disease like osteoarthritis, rheumatoid, and pigmented villonodular synovitis are common in the hip and may mimic a tumor. They present as intra-articular masses and can cause massive destruction simultaneously in femur and acetabulum. A peri-articular non-neoplastic condition that is found in the hip region with a specific appearance is tumoral calcinosis. It is familial in 30% of cases, is typically found in children, or adolescents at multiple sites surrounding larger joints. Calcifications are seen on radiographs and CT (may be septal, so called chicken wire, sometimes fluid levels are seen), and it often has low signal intensity on T2-weighted images.

Most large soft tissue tumors of the thigh and hip region, presenting in the elderly are malignant. Most commonly these are high grade sarcoma, fibrosarcoma, liposarcoma, or myxofibrosarcoma. The MR appearance is malignant, but not tumor specific. Large volume, liquefaction and cellular components are features on MR shared by these sarcomas.

Myositis ossificans is not infrequently found in adolescents around the hip and gluteal muscles. The marked reactive soft tissue and intraosseous abnormalities seen on MR are an important feature in distinguishing myositis ossificans from sarcoma. Neurofibromatosis has a typical often symmetric distribution in the pelvis.

3. Conclusions

Tumors and tumor-like lesions are difficult to detect on radiographs, and there should be a low threshold to go to CT or MR. When the lesion is visualized on radiographs, a short differential list can usually be given, based on morphology and epidemiology. MR is the most powerful tool, and is used for diagnosis, monitoring therapy, and detecting recurrence.

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