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The many faces of Intraosseous Lipomas

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1. Introduction

Learning Objectives

To describe the spectrum of imaging findings of intraosseous lipomas, as seen on radiographs, computed tomography and MRI. The differential diagnosis id also discussed.

Background

Intraosseous lipomas are considered rare benign bone lesions, but with the advent of MR imaging more of these lesions are being recognized.

Intraosseous lipomas are divided into three categories on the basis of their imaging characteristics. The imaging findings of intraosseous lipomas often parallel those of the histologic features of the lesion. Given the variable appearance of intraosseous lipomas in different stages of involution, the radiographic findings can vary from a lucent lesion with a thin sclerotic margin to a radiodense lesion with a thick sclerotic margin.

The main differential diagnosis is broad and includes chondroid tumors, aneurysmal bone cysts, fibrous dysplasia and bone infarcts.

2. Discussion

Intraosseous lipomas are typically solitary.

Frequent locations include:

- intertrochanteric region of the proximal femur (34% of cases),
- tibia (13%),
- fibula (10%),
- calcaneus (8%),
- ilium (8%),
- humerus (5%),
- and ribs (5%).

Long bone lesions typically occur in the metaphysis. Isolated diaphyseal or epiphyseal involvement is unusual.

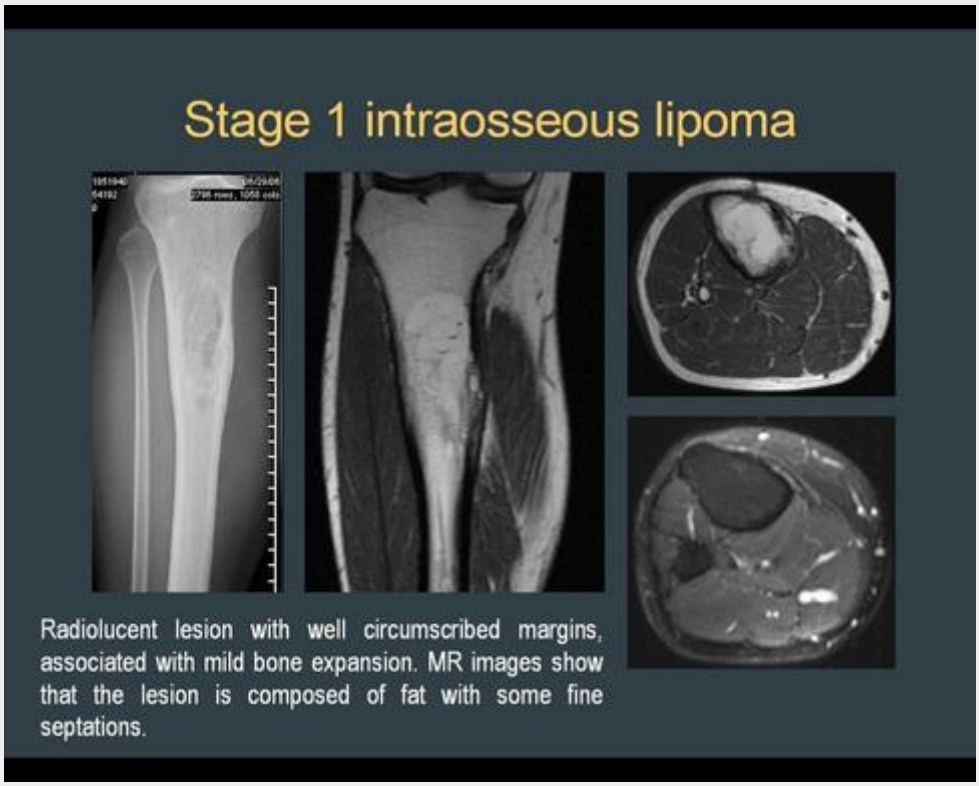
Lesions are usually intramedullary, although rarely they occur in an intracortical location.

Lesion size varies from 2 to 13cm; with most lesions being 5–6 cm.

Milgram divided intraosseous lipomas into three stages:

- In stage 1, lesions contain viable fat without necrosis and cause trabecular resorption.

fig 1 - lipomas 1.jpg



- Stage 2 lesions are transitional cases with partial fat necrosis and focal calcification but also regions of viable lipocytes.

fig 2 - lipomas 2.jpg

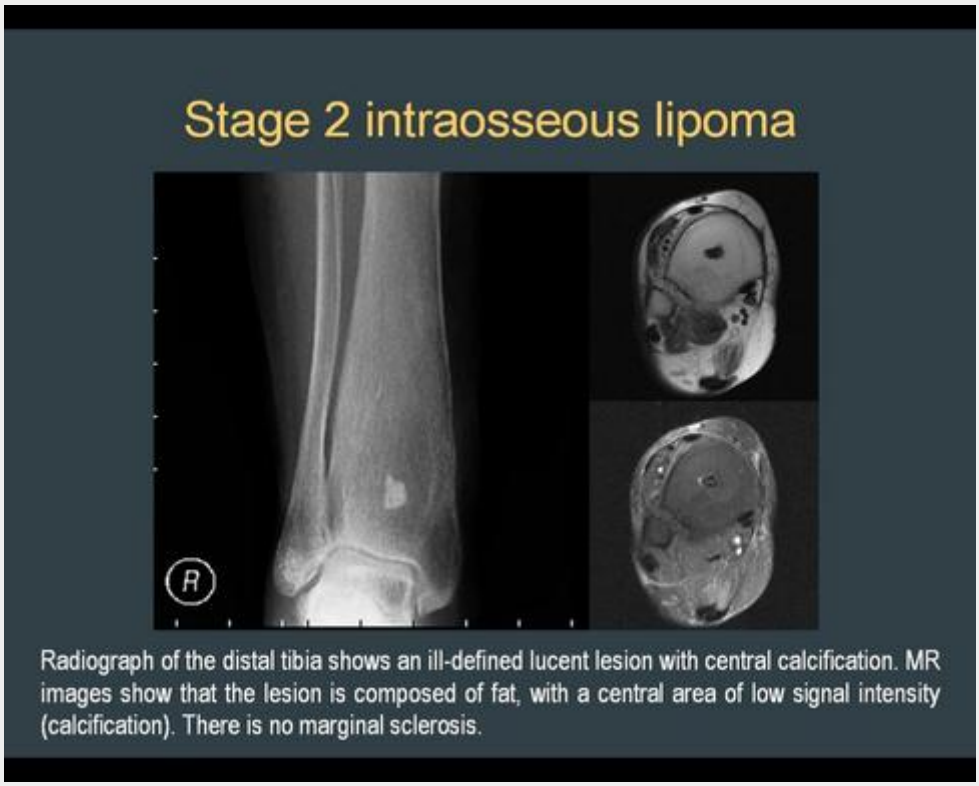
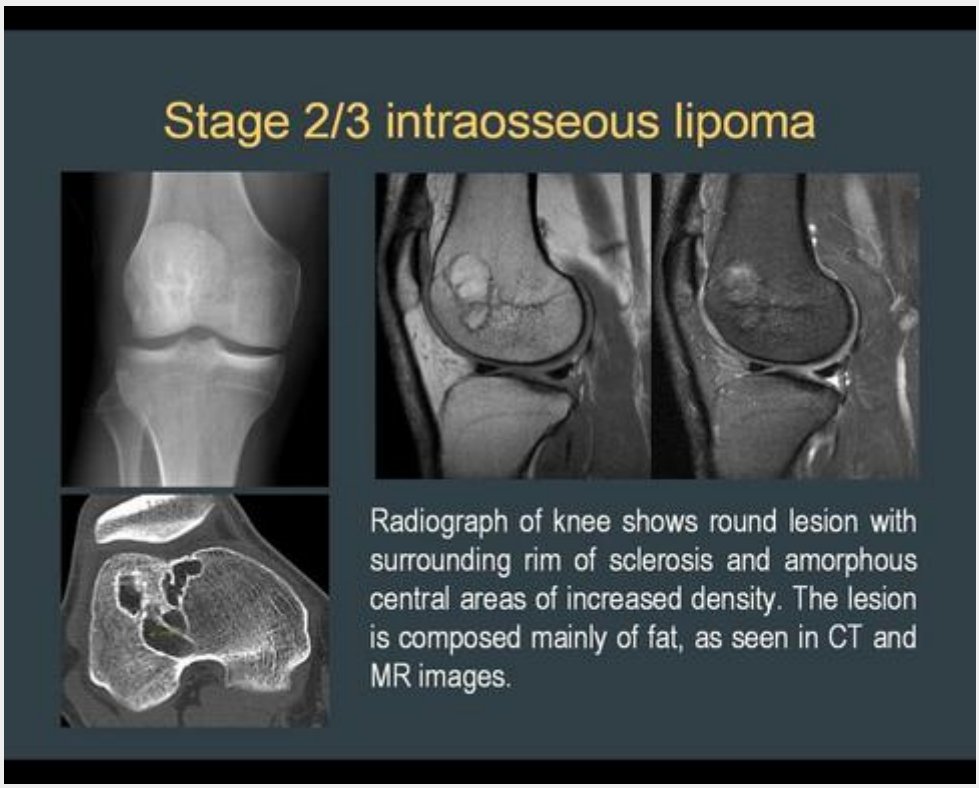
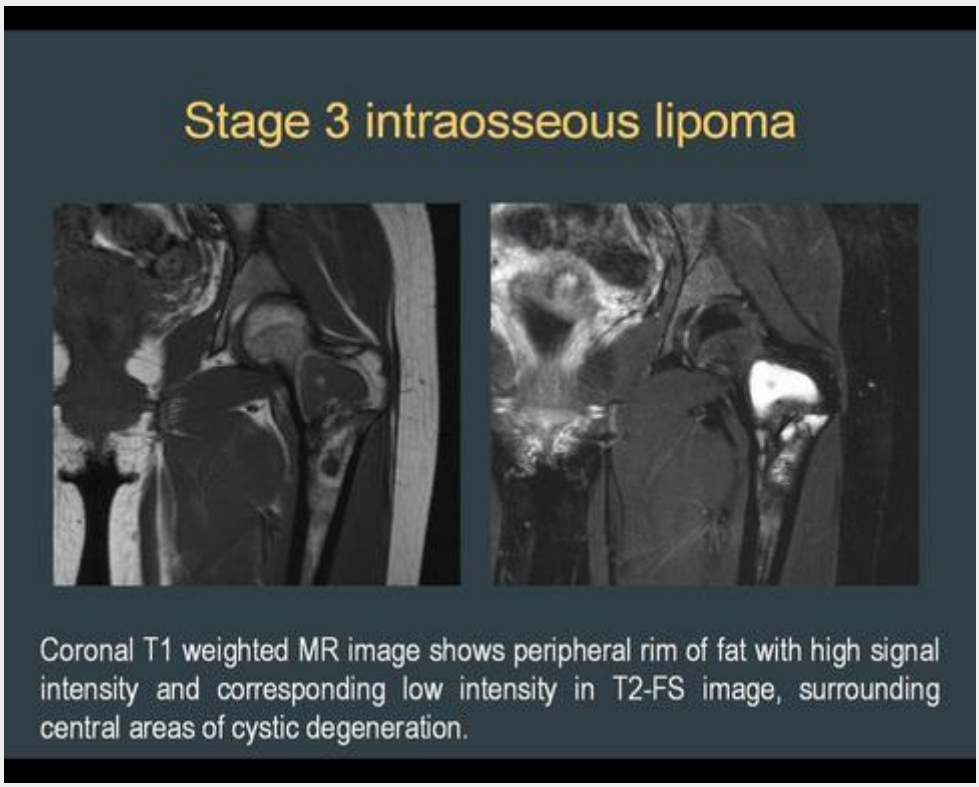


fig 3 - lipomas 2a3.jpg



- Finally, stage 3 intraosseous lipomas demonstrate involutional changes with variable degree of fat necrosis, cyst formation, calcification, and reactive new bone formation.

fig 4 - lipomas 3.jpg



The appearances of lipomas on radiographs, CT and MRI correspond to the pathological staging system.

I. STAGE 1

· The radiographic appearance of intraosseous lipoma containing only fat is nonspecific and shares the same features of unicameral bone cyst, fibrous dysplasia, and plasmacytoma.

· Lesions are radiolucent, with well circumscribed margins, and frequently associated with mild focal expansile remodeling of the affected bone (50% of cases), which is more prominent in thin long bones such as the fibula and ulna.

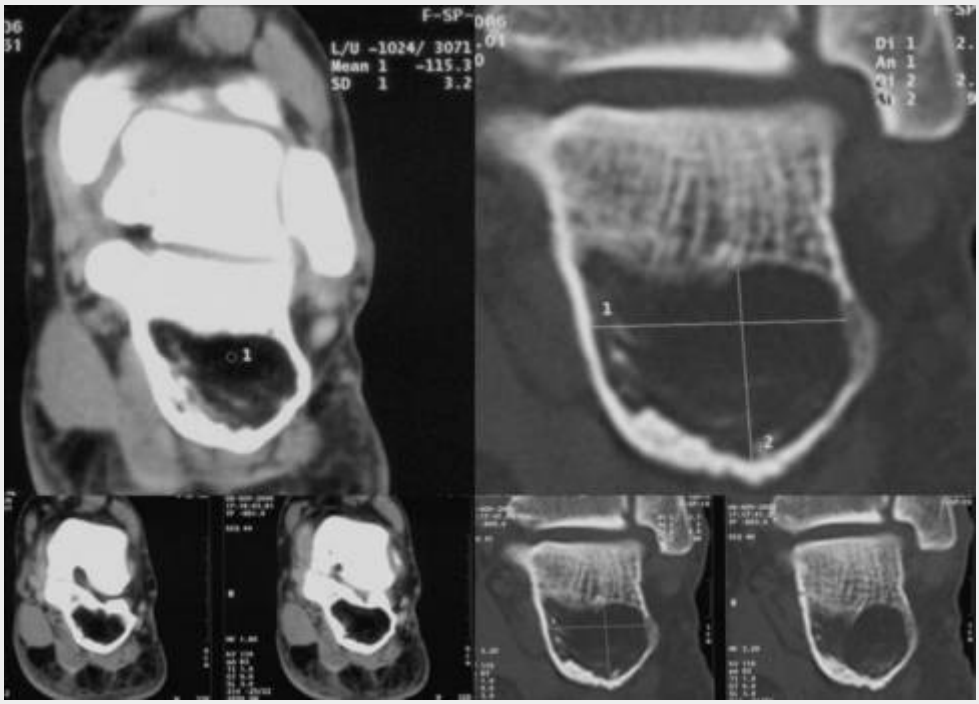
· Thin or occasionally thick trabecular ridges may be present in the periphery of the lesion and produce a septated appearance.

Figure 5

Stage 1 intraosseous lipoma. Lateral radiograph of the feet reveals a lucent lesion with a thin well-defined sclerotic border involving left calcaneous.

· On CT, stage 1 intraosseous lipomas exhibit resorption of bone trabeculae in the lesion and bone expansion. The area of lucency seen on the radiograph corresponds to fat attenuation visible on CT.

Figure 6



Stage 1 intraosseous lipoma. CT scan of the left calcaneous shows a lytic lesion, with well defined margins and fat attenuation.

· MR imaging reveals viable fat in stage 1 intraosseous lipomas. The fat is isointense to subcutaneous fat on T1-weighted sequences and exhibits low signal intensity with fat suppression on T2-weighted images

Figure 7

Stage 1 intraosseous lipoma. Sagital T1 and STIR MR images show in the left calcaneous a homogeneous lesion, surrounded by a thin halo of hypointensity. The lesion is composed of fat (high signal in T1 and low signal intensity in STIR images).

· The lesion may be easily differentiated from surrounding normal fatty marrow by a thin circumferential rim or capsule that separates the lesion from the normal surrounding bone, consistent with reactive sclerosis surrounding the lesion.

· The attenuation/signal intensity on T1-weighted MR images of normal marrow is also often slightly higher than that of lipoma, owing to cellular elements in yellow marrow.

II. STAGE 2

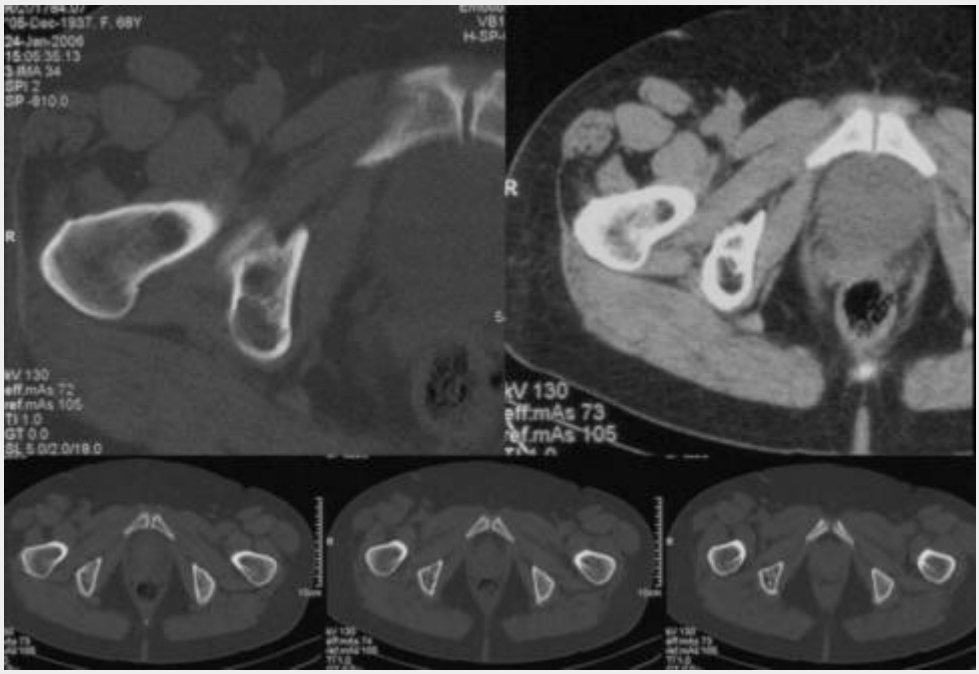
· Stage 2 lesions have lucent areas, which consist of viable fat and radiodense areas that consist of fat necrosis and dystrophic calcification.

Figure 8

Stage 2 intraosseous lipoma. Anteroposterior radiograph of the hip shows a mild expansible bone lesion in the right ischion, with amorphous central areas of increased density.

· Stage 2 lesions have areas of fat attenuation and patchy areas of increased density corresponding to calcification and fat necrosis. Localised areas of calcification are typically central, but may be peripheral.

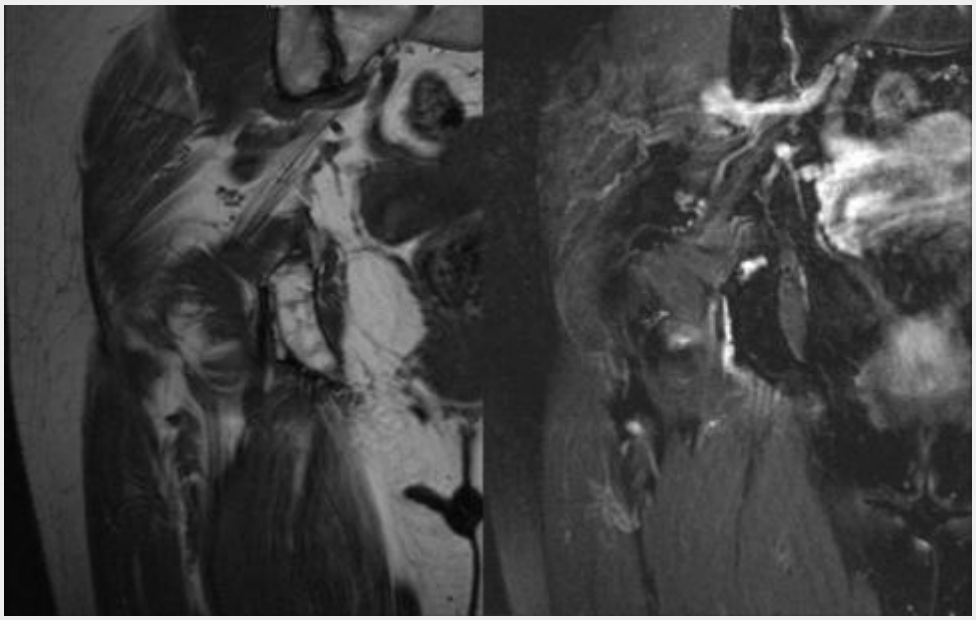
Figure 9



Stage 2 intraosseous lipoma. CT scan of the hip shows that the lesion in the right ischion has mixed attenuation, with central areas of calcification.

· On MRI images, fat can be identified, with the circumferential rim of decreased signal on T1- and T2-weighted images. Low-signal- intensity areas within the central portion of the lesion on T1- and T2-weighted images are consistent with calcifications.

Figure 10



Stage 2 intraosseous lipoma. Coronal T1-weighted MR image shows lesion with high signal intensity with fine internal septation of low signal intensity. Coronal T2-weighted MR image with fat saturation shows low signal intensity in the lesion consistent with suppression of fat. A high signal intensity cyst is also noted in the superior aspect of the lesion.

III. STAGE 3

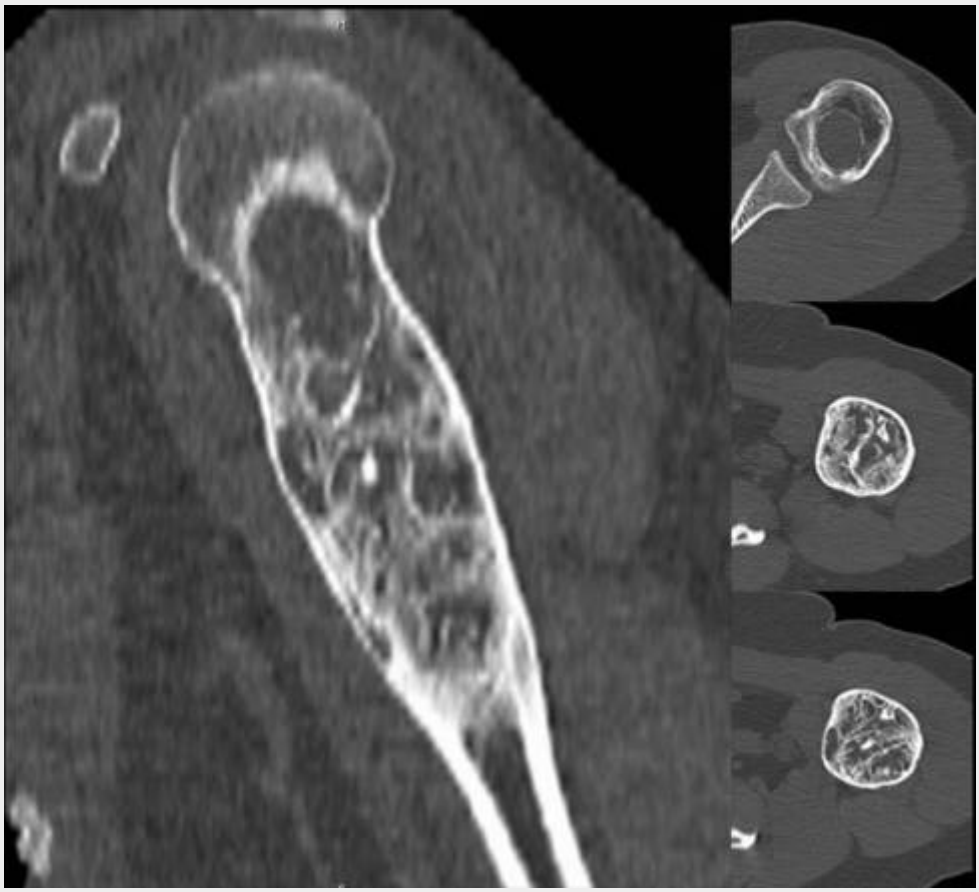
· Stage 3 lesions are more radiodense than stage 1 or 2 lesions. The radiodensity is a result of calcification and extensive fat necrosis. Stage 3 lesions also have thick sclerotic borders, presumably related to involution of these lesions.

Figure 11

Stage 3 intraosseous lipoma. Anteroposterior radiograph of a biopsy-proven lipoma of the proximal humerus in a young adult woman.

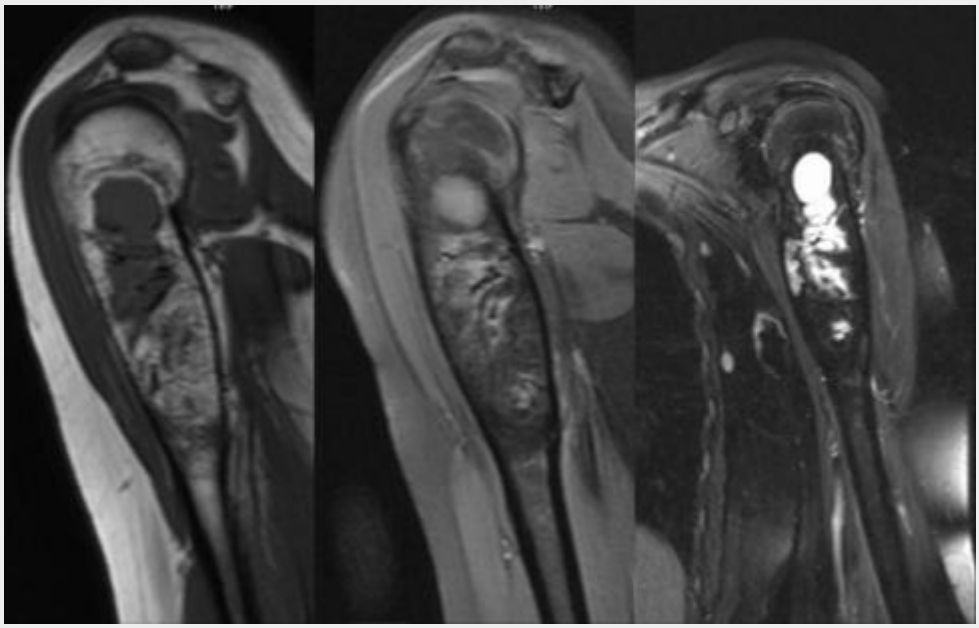
· Cystic degeneration is also present and may be the predominant feature depicted with CT or MR imaging, which may be confusion. Central cystic areas may be surrounded by a rim of ossification. This central ring of ossification may then be surrounded by fat that in turn is surrounded by a rim of ossification or fibrous capsule demarcating the periphery of the lesion. The resulting bull's-eye appearance is distinctive for intraosseous lipoma.

Figure 12



Stage 3 intraosseous lipoma. CT images show a predominantely sclerotic lesion of the proximal humerus, with bone expansion and central areas of calcification.

Figure 13



Stage 3 intraosseous lipoma. MR images show an heterogeneous appearance of the lesion with central calcification (low signal intensity in all images) and central cystic areas. There is also a peripheral area with high signal intensity in sagital T1-weighted MR image and low signal intensity in coronal T2-weighted MR image with fat saturation corresponding to fat.

IV. DIFFERENCIAL DIAGNOSIS

· Radiographic diagnosis of a lipoma may not be straightforward. The differential diagnosis may include non-ossifying fibroma, aneurysmal bone cyst, [fig 14 - quisto ósseo.jpg] simple cyst, [fig 15 - displasia fibrosa.jpg] fibrous dysplasia, [fig 16 - tcg.jpg] giant cell tumour, bone infarct and even chondroid tumours ([fig 17a - encondroma.jpg] enchondroma, [fig 17b - condroblastoma.jpg] chondroblastoma, [fig 17c - condrosarcoma.jpg] chondrosarcoma)

· The ossification and calcification in an intraosseous lipoma (Milgram stage 2 or 3 lesions) may produce a distinctive radiographic appearance. Central or ringlike calcification in a lucent lesion involving the body of the calcaneus is pathognomonic of an intraosseous lipoma and allows it to be distinguished from unicameral bone cyst. However, this same calcification-ossification pattern in other less common locations may cause confusion in diagnosis.

· A predominantly calcified or ossified lesion can be confused with an enostosis. Partially mineralized lesions may be mistaken for a chondroid lesion or osteonecrosis on radiographs.

· CT and MR imaging are extremely useful. If fat is seen in portions of the lesion, it means that the tumor is lipogenic in origin. The fatty composition of the lesion distinguishes the intraosseous lipoma from tumors of chondroid, osteoid, or fibrous origin.

· It may be difficult to differentiate from osteonecrosis at MR imaging and CT because both lesions contain intrinsic fat with a rim of tissue separating the lesion from surrounding marrow. Expansile remodeling of bone, osteolysis, and a rounded rather than irregular serpentine margin are differentiating factors that support the diagnosis of intraosseous lipoma as opposed to osteonecrosis.

· Recognition of a bone lesion as an intraosseous lipoma can usually be regarded as an end point to investigation. Biopsy and surgery can be avoided in the majority of cases.

V. CONCLUSION

· The appearance of these lesions on radiographs, CT scans, and MR images can vary as a result of their degree of involution and necrosis, ranging from lucent to dense sclerotic lesions.

· CT and MR imaging are more definitive examinations because they can accurately visualize fat within these lesions.

3. References

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4. Mediafiles

Figure 5

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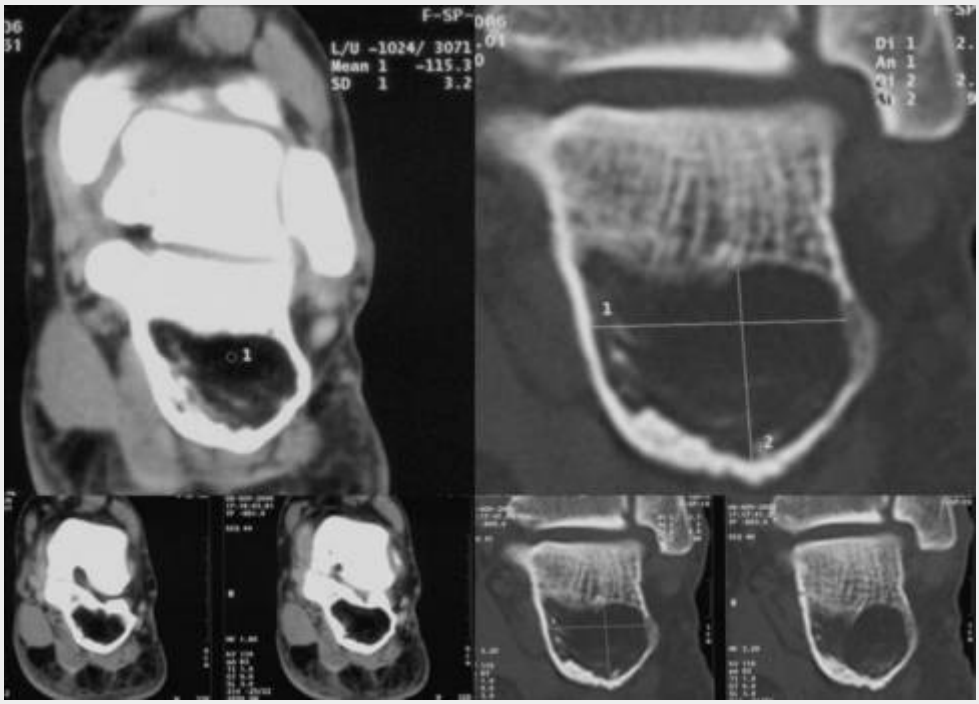

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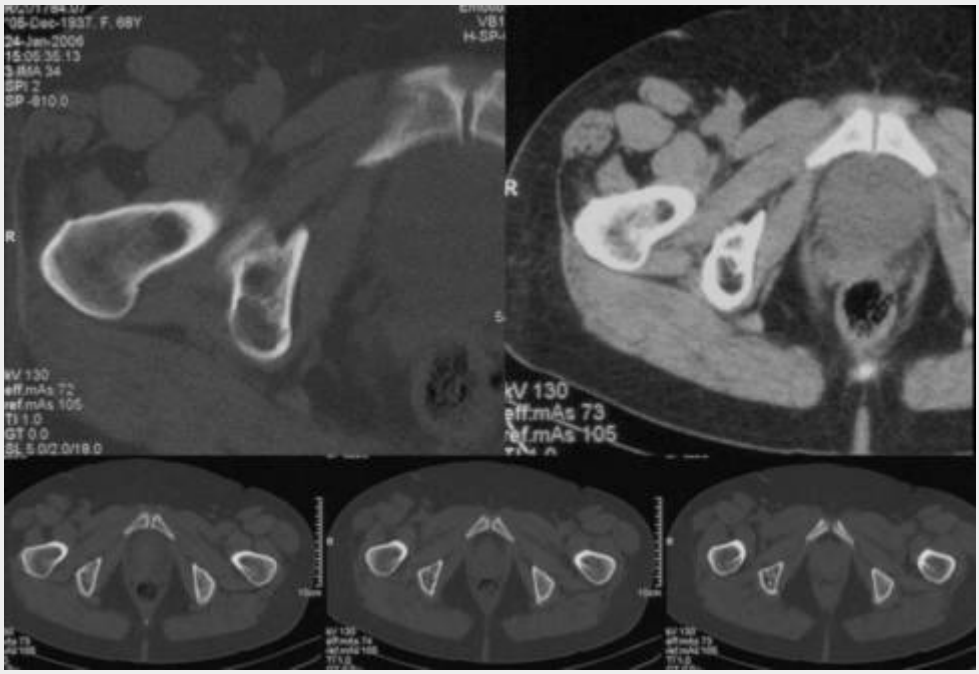

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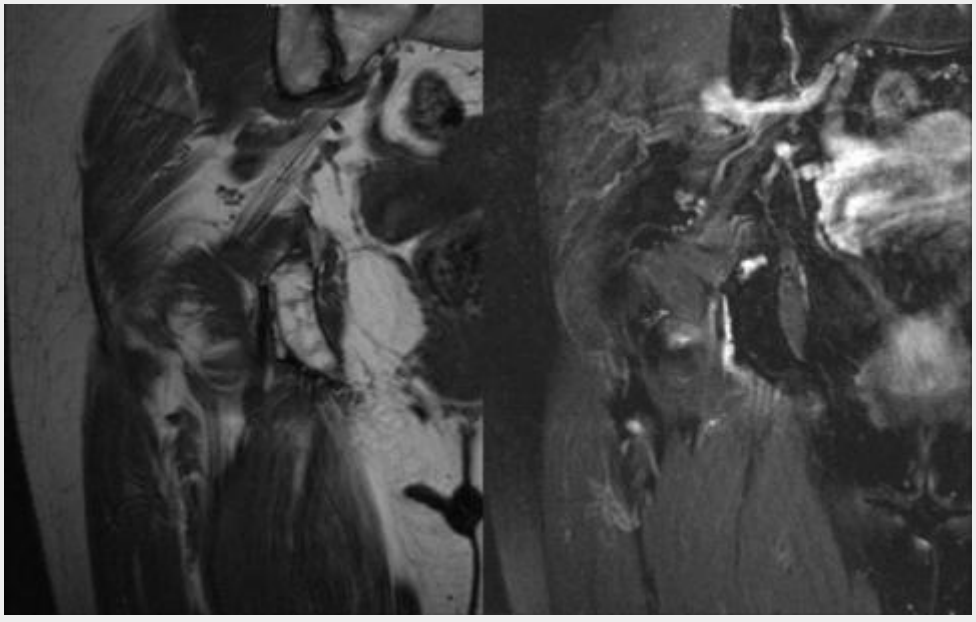

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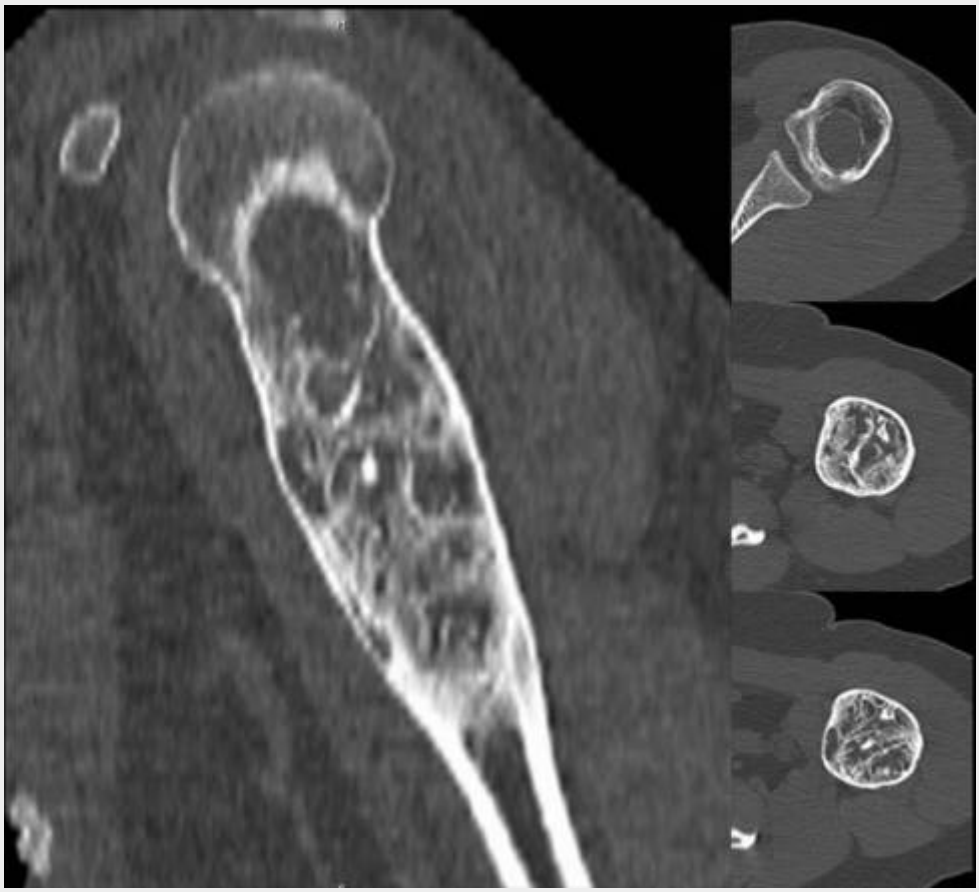

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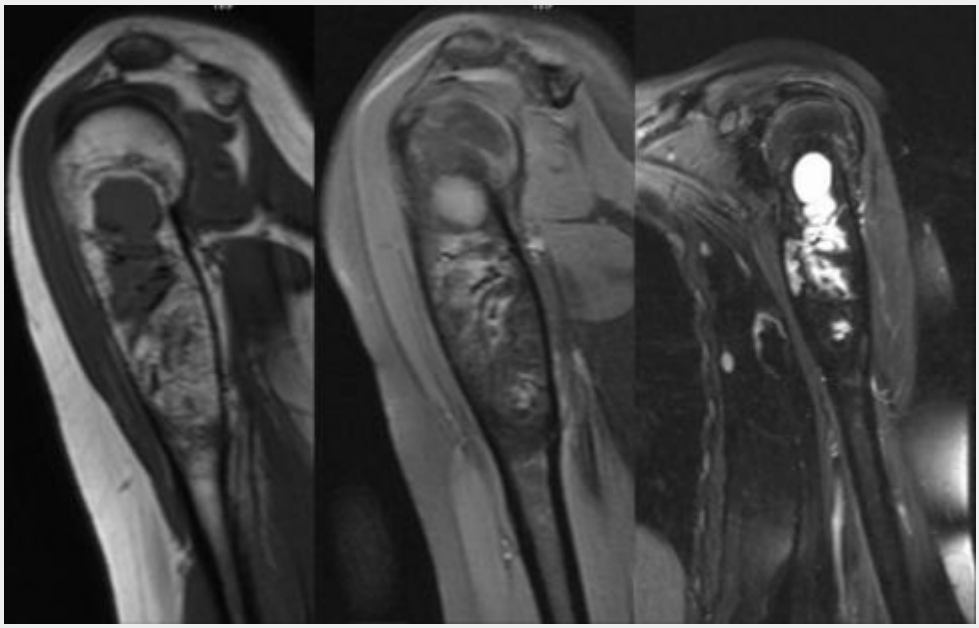

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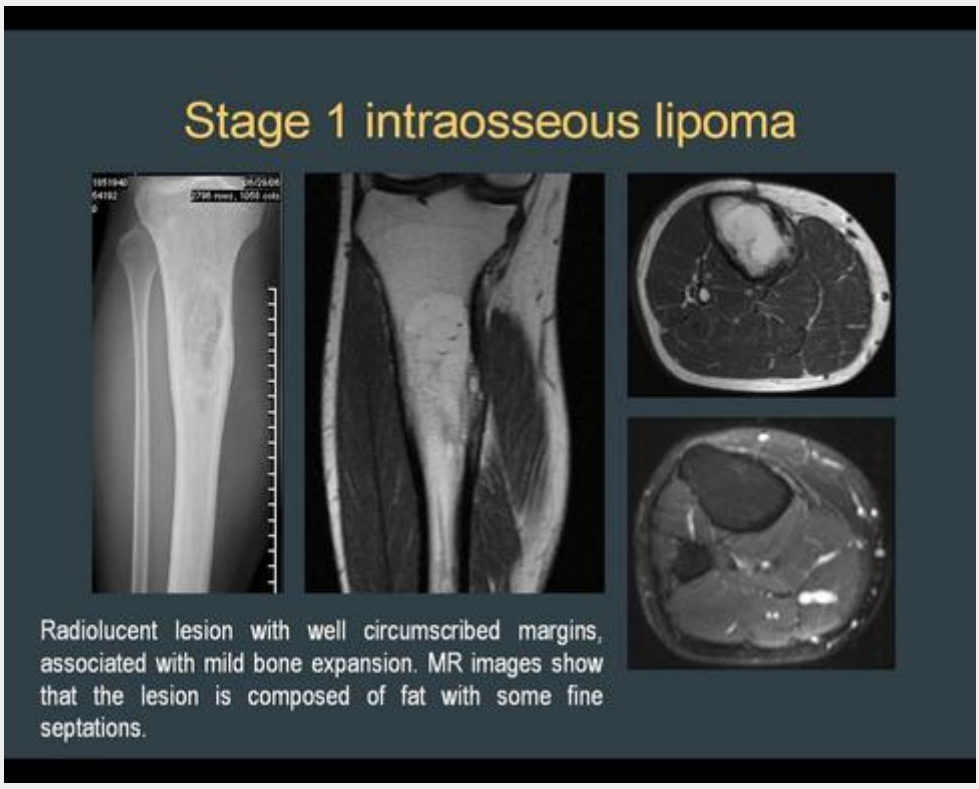

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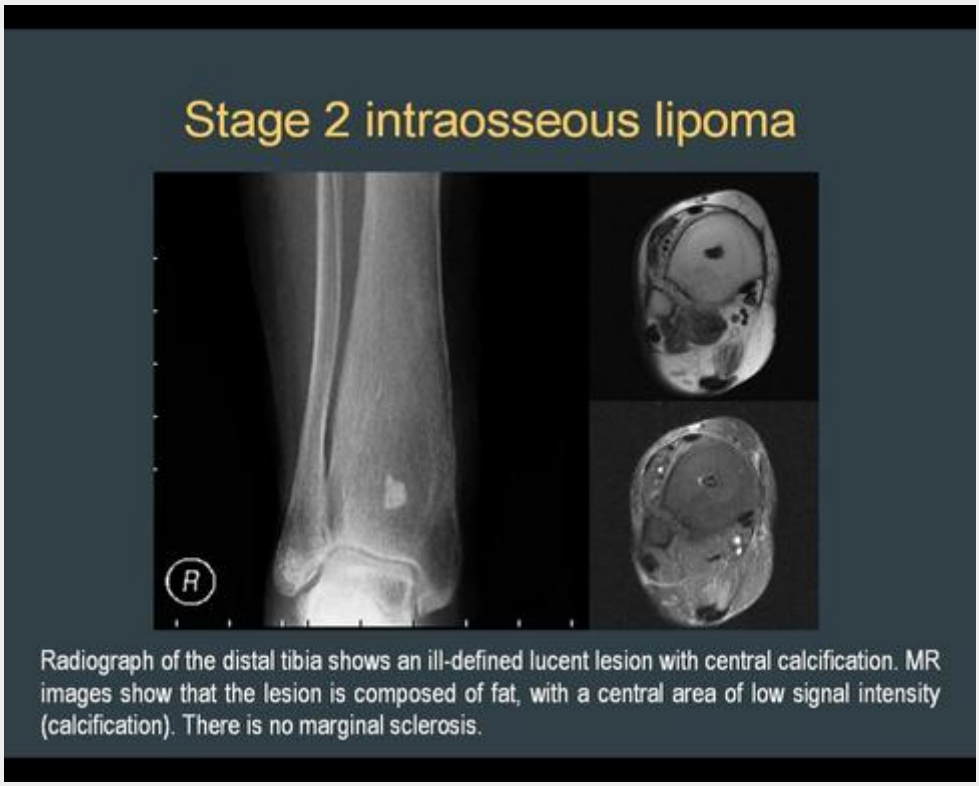


fig 3 - lipomas 2a3.jpg

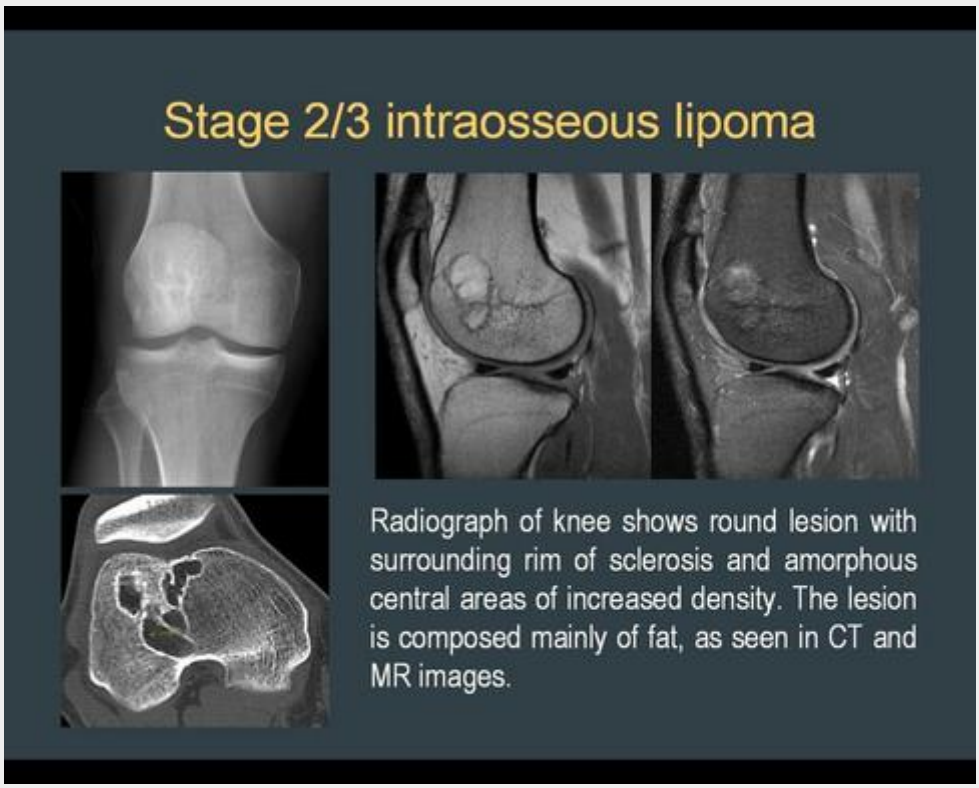
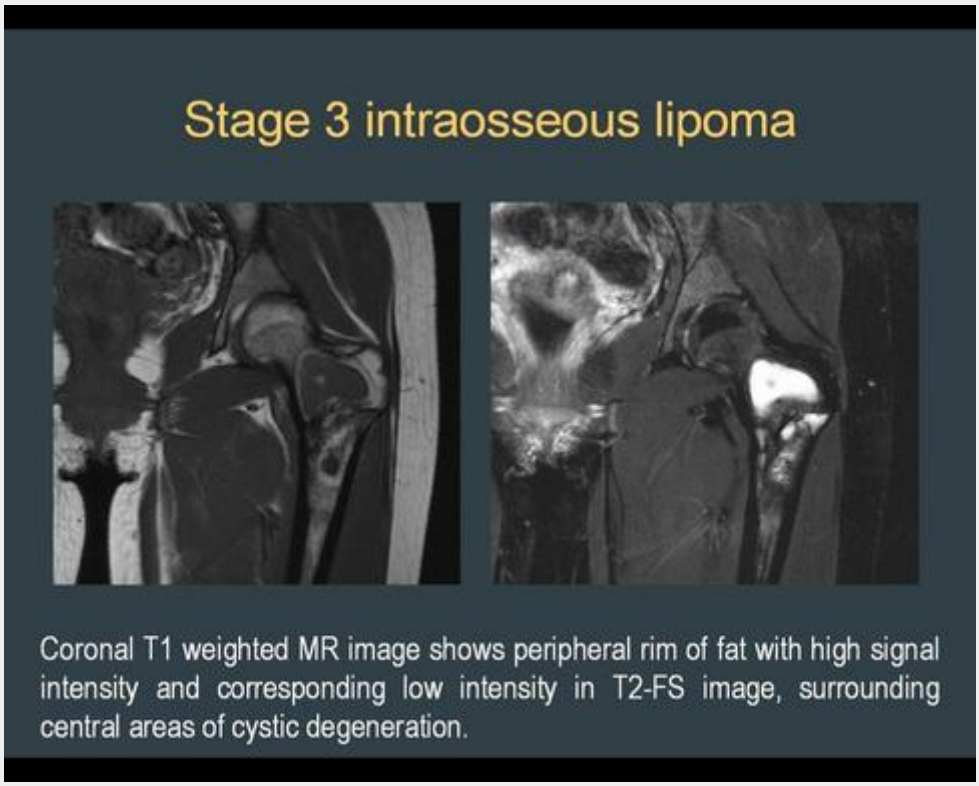


fig 4 - lipomas 3.jpg



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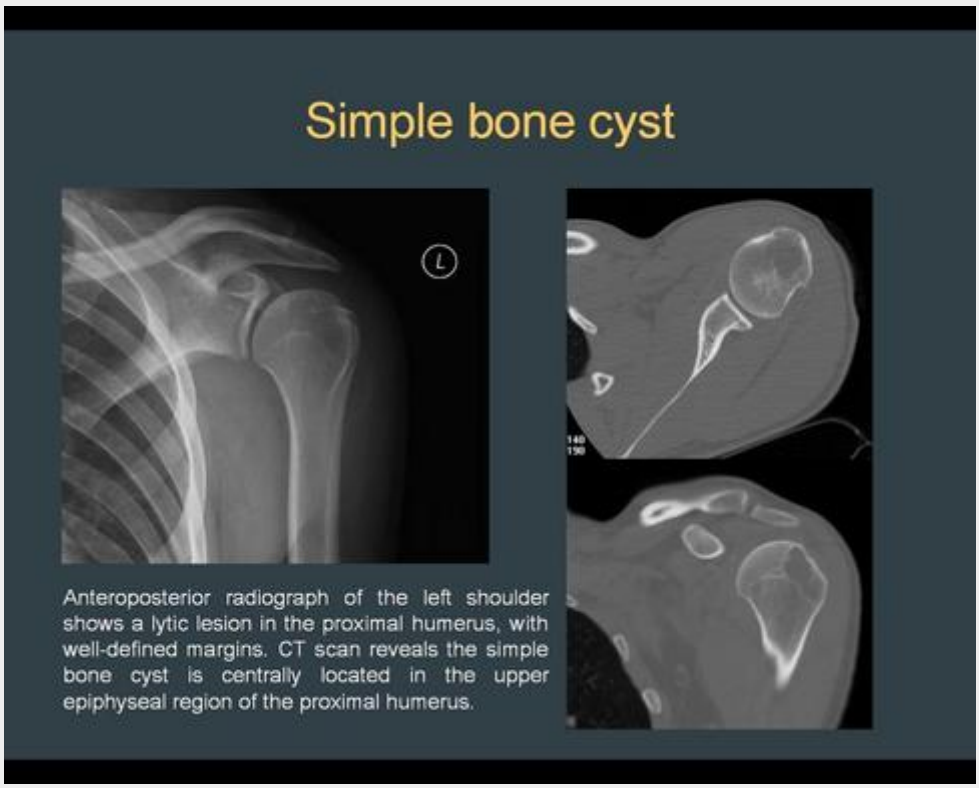

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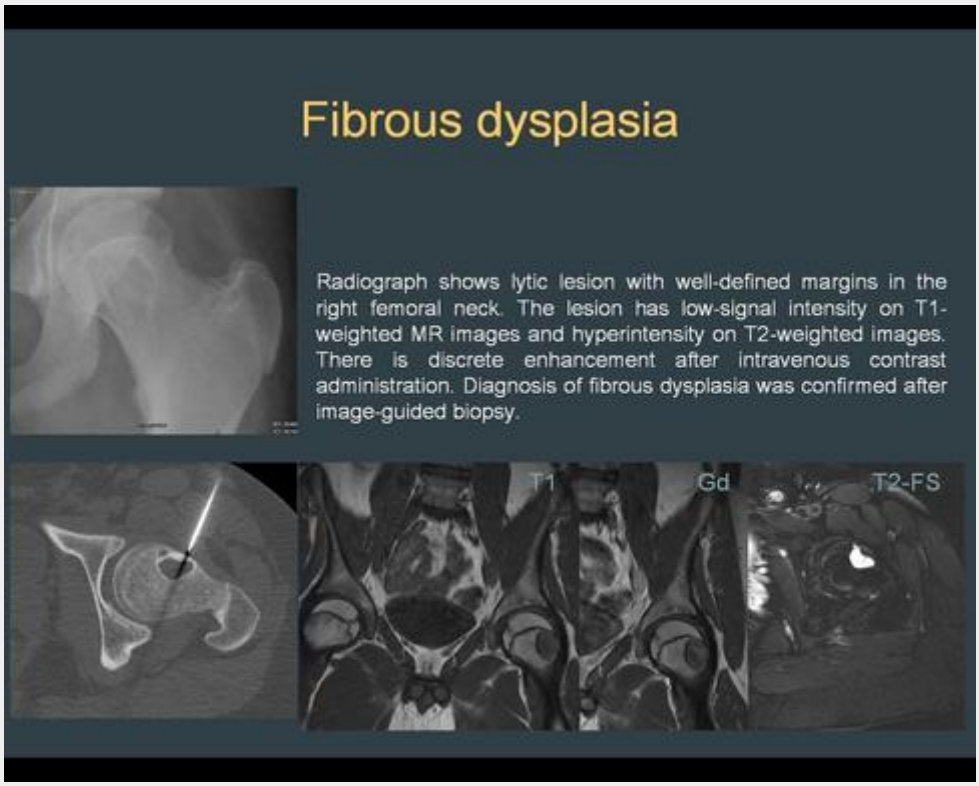

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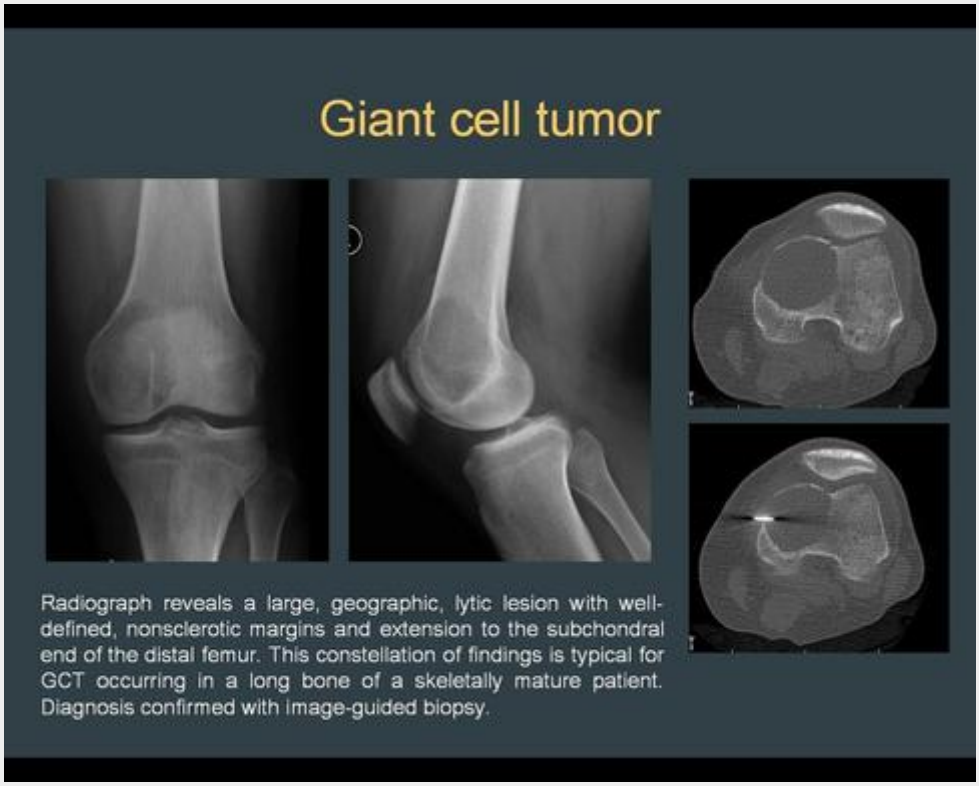
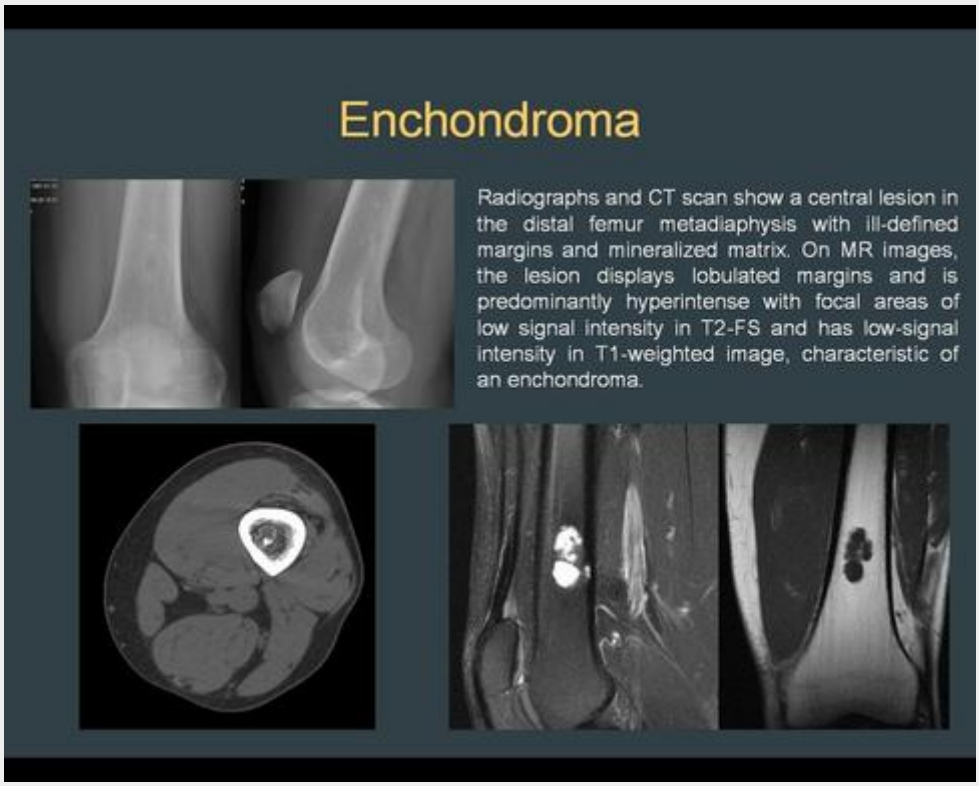


fig 17a - encondroma.jpg



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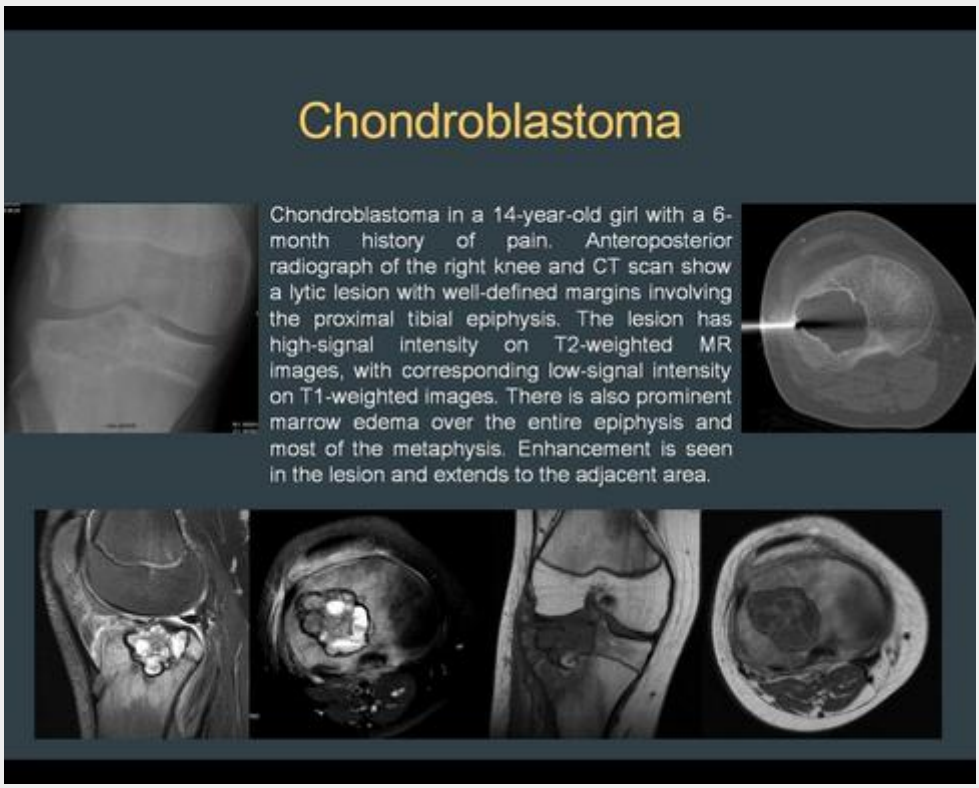

fig 17c - condrosarcoma.jpg