

Solitary Primary Bone Tumors

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Objectives

- After this activity, the audience should be able to
 - Describe the imaging findings of solitary primary bone tumors.
 - Apply those findings to differentiate primary bone tumors.

Key points

W

- Two MOST important factors in the diagnosis of primary bone tumors :
AGE & LOCATION
- Other factors
 - Matrix – osteoid, cartilagenous, fibrous, etc
 - Aggressiveness – periosteal reaction, tumor margin

2

1

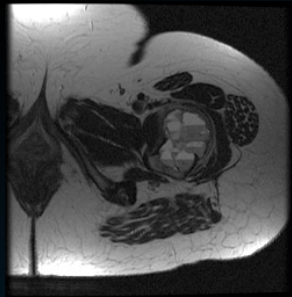
W

3

Which one of the following tumors doesn't demonstrate similar MRI finding?



- A. Lymphoma
- B. Osteosarcoma
- C. GCT
- D. Intraosseous lipoma



47/F

4

ABC

- Age - Most patients are under 20, but the tumor can occur at any age.
- Longitudinal location – metaphysis
- Axial location – eccentric
- Margin of the lesion and periosteal reaction – Geographic, no sclerotic rim, endosteal scalloping, bubbly
- Tumor matrix – Numerous blood-filled arteriovenous communications.

5

D/D Soap bubble lesions : Fegnomashic

W

- Fibrous dysplasia
- Enchondroma/
Eosinophilic granuloma
- Giant cell tumor
- Nonossifying fibroma
- Osteoblastoma
- Metastases/Melanoma
- Aneurysmal bone cyst
- Simple bone cyst
- Hyperparathyroidism
(brown tumor)
- Infection
- Chondroblastoma /
Chondromyxoid fibroma

6

D/D Soap bubble lesions : Fegnomashic

W

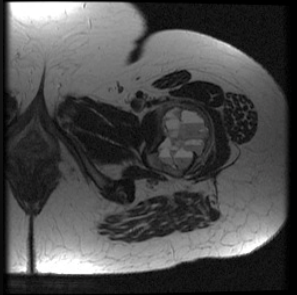
Eccentric metaphyseal soap bubble lesions

- Fibrous dysplasia
- Enchondroma/
Eosinophilic granuloma
- Giant cell tumor
- **Nonossifying fibroma**
- **Osteoblastoma**
- **Metastases/Melanoma**
- **Aneurysmal bone cyst**
- Simple bone cyst
- Hyperparathyroidism
(brown tumor)
- Infection
- Chondroblastoma
- **Chondromyxoid fibroma**

7

ABC

W



- Fluid-fluid levels : Non-specific
- Commonly seen in
 - ABC (m/c)
 - SBC, Intraosseous lipoma (bn, diaph)
 - GCT, CB (bn, epi)
 - Telangiectatic osteosarcoma, MFH (malig, meta)

- *"Bubbly lesions of bone."* Eisenberg R. *AJR* 2009 vol. 193 (2) pp. W79-W94
- *"The prevalence and diagnostic significance of fluid-fluid levels in focal lesions of bone."* O'donnell, P, Saifuddin, A. *Skelet Radiol* 2004 vol. 33 (6) pp. 330-336

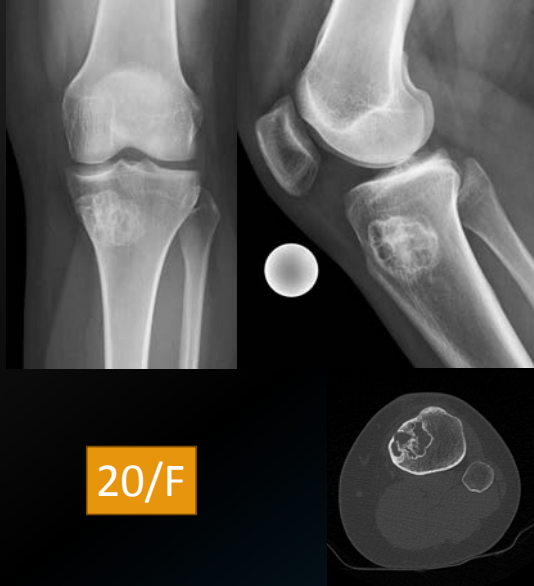
8

2

W

9

What will be the best next appropriate step?



- A. Follow-up radiograph in 3 months.
- B. Leave it alone.
- C. Recommend cross sectional imaging.
- D. Tissue confirmation.

10

Non-ossifying fibroma

- Age – mostly in children with 75% occurring in the second decade.
- Longitudinal location – metaphysis
- Axial location – eccentric cortical
- Margin of the lesion and periosteal reaction – soap bubbly lesion with a sclerotic margin
- Tumor matrix – : Non-neoplastic proliferation of fibrous tissue

11

Non-ossifying fibroma

W

- Differential diagnosis:
 - Benign fibrous cortical defects – small, shallow, cortical lesions
 - NOF – larger, multiloculated lesions
- These lesions regress spontaneously, filling in with bone from the periphery and disappearing.



• *Musculoskeletal Imaging: A Teaching File chapter 7 p. 600-601*

12

3

W

13

Which one of the following descriptions about this lesion is true?

W

46/M



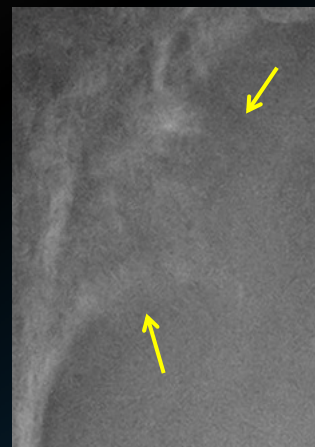
- A. Multilayered periosteal reaction (onion skin)
- B. Osteoid matrix
- C. Geographic lytic lesion with an indistinct margin
- D. Codman's triangle

14

Chondrosarcoma

W

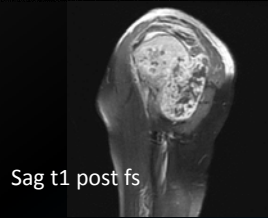
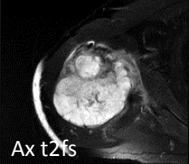
- Age - in adults 30 ~70 years (peak age 40 to 60)
- Longitudinal location – metaphysis/diaphysis
- Axial location – medullary (central)
- Margin of the lesion and periosteal reaction – permeative lesion with scalloping of the inner cortex and aggressive periosteal reaction
 - sunburst (perpendicular)
 - codman's triangle
- Tumor matrix – a malignant tumor that produces cartilage matrix with stippled calcification



15

Chondrosarcoma

W



- D/D Metaphyseal aggressive bone tumors in adults
 - Chondrosarcoma
 - Lymphoma
 - Metastasis
 - Multiple myeloma

• Bonetumors.org

16

4

W

17

W

Which one of the following statements regarding this lesion is true?



- 26/F
- A. It has worse prognosis than intramedullary type.
 - B. It usually involves proximal humerus.
 - C. It usually shows peripherally dense mineralization.
 - D. The cleft sign is differential point from intramedullary type.

18

W

Parosteal osteosarcoma

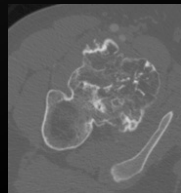
- Age - 20s and 30s are most commonly effected
- Longitudinal location – meta/diaphysis , in particular the posterior aspect of the distal femur.
- Axial location – juxtacortical
- Margin of the lesion and periosteal reaction – dense, pedunculated, mushroom like lesion with a radiolucent cleavage plane between portions of the tumor and cortex
- Tumor matrix – Low grade form of osteosarcoma: long term survival 80-90% in patients receiving appropriate therapy

19

Parosteal osteosarcoma

W

- D/D
 - osteochondroma
 - myositis ossificans
 - osteosarcoma
 - ossifying or calcifying hematoma
 - exuberant callus



Corticomedullary continuation



Zonal phenomenon – peripherally denser

- *Parosteal osteosarcoma: radiologic-pathologic correlation with emphasis on CT. AJR Am J Roentgenol. 1987 Feb;148(2):323-8.*

20

5

W

21

Which of the following tumors does **NOT** typically involve this location (end of bone)?

W



24/F

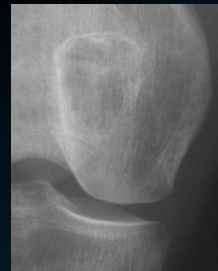
- A. Giant cell tumor
- B. Chondroblastoma
- C. Adamantinoma
- D. Clear cell chondrosarcoma

22

Chondroblastoma

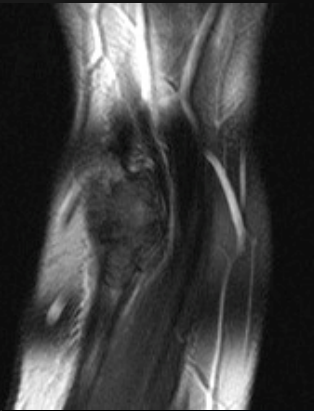
W

- Age - The mean age of presentation is approximately 20 years old.
- Longitudinal location – epiphysis with extension into the metaphysis and subchondral bone.
- Axial location – medullary (central)
- Margin of the lesion – geographic with a sclerotic rim
- Tumor matrix – Benign cartilagenous tumor with ABC component (15%) and multinucleated giant cells. calcification +/-
- Tx - curettage



- *Benign chondroid neoplasms of bone Semin Musculoskelet Radiol 2000 vol. 4 (1) p. 45-58 Robbin MR, Murphey MD.*
- *Musculoskeletal Imaging: A Teaching File chapter 8 p. 678-679*

23



- D/D

Solitary expansile lytic epiphyseal tumors

- GCT
- CB
- CCC

- GCT

- CR - No sclerotic rim
- MR – No surrounding marrow edema and T2 intermediate SI

- Clear cell chondrosarcoma vs CB

- Age- older (30~50's)
- CR - Less periosteal reaction
- MR - Less marrow edema

6

W

What is the most likely diagnosis ?



A. Osteochondroma
B. Parosteal osteosarcoma
C. BPOP
D. Healing stress fracture

21/F

26

W

Bizarre parosteal osteochondromatous proliferation (BPOP)

- Age - Occurs in adults in their 20's and 30's.
- Longitudinal location – metaphysis, occurs most commonly in the hands and feet
- Axial location – juxtacortical, starts from dorsomedial aspect of the bone
- Margin of the lesion– a bony mass with well defined margins to the surface of the bone
- Tumor matrix – Histologically, the lesion contains very cellular cartilage, a proliferation of bizarre fibroblasts, and disorganized bone with spindle shaped fibroblasts in the intertrabecular spaces.

27

BPOP D/D

W

- **Osteochondroma** - BPOPs arise directly from the cortical surface of the underlying bone without the cortex merging at the base of the cortex of the parent bone. Lacks the typical feature of osteochondroma "pointing away from the joint"
- **Parosteal osteosarcoma** – It rarely occurs in the hands and feet.
- **Periosteal chondroma** - It shows matrix calcification



- *MR imaging features of bizarre parosteal osteochondromatous proliferation of bone (Nora's lesion)*, *European Journal of Radiology* 40 (2001) 224–231
- Bonetumors.org

28

7

W

29

Which one of the following tumors does **NOT** demonstrate this finding (sequestrum)?

W



45/M

- A. Langerhans cell histiocytosis
- B. Malignant fibrous histiocytoma
- C. Intraosseous lipoma
- D. Chondrosarcoma

30

Intraosseous lipoma

W

- Age - This tumor presents in their 30s, 40s and 50s.
- Longitudinal location – The most common location is the calcaneus [epiphyseal equivalent]
- Axial location – central
- Margin of the lesion and periosteal reaction – lytic lesion with a geographic margin and rim of sclerosis
- Tumor matrix – fat with sequestrum (about 75%, degenerative ossification)
- Tx -For asymptomatic lesions, no treatment is necessary. Symptomatic lesions may be treated by curettage.

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Intraosseous lipoma

- D/D Calcaneal lucent lesions
 - A. Tumors involve epiphysis (CB, GCT)
 - B. SBC
 - C. IO lipoma
- D/D Tumors with sequestrum
 - Localized LCH
 - IO lipoma
 - Fibrosarcoma
 - MFH
 - Primary lymphoma of bone

Bone tumors and tumorlike conditions: analysis with conventional radiography. Radiology. 2008 Mar;246(3):662-74.

32

8

33

Which one of the following statements regarding this lesion is **NOT** true?

W



- A. It can be associated with soft tissue myxoma.
- B. It can be associated with other endocrine abnormalities.
- C. It can metastasize.
- D. The matrix is usually described as ground-glass opacity.

30/M

34

Fibrous dysplasia

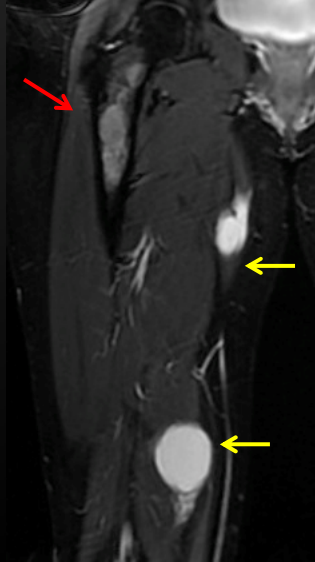
W

- Age - Normally a monostotic (solitary) tumor that arises during periods of bone growth in older children and adolescents and slowly enlarges.
- Longitudinal location – meta, diaphysis
- Axial location – intramedullary
- Margin of the lesion and periosteal reaction – geographic, with a ground glass or hazy appearance of the matrix. No periosteal reaction. Endosteal scalloping (+)
- Tumor matrix – tumor-like proliferation of fibro-osseous tissue.

35

Polyostotic Fibrous dysplasia (15-20%)

W



- Mazabraud syndrome:
Fibrous dysplasia +
Soft tissue myxoma
- McCune - Albright's syndrome
 - polyostotic fibrous dysplasia
 - precocious puberty
 - cafe au lait spots
- Other endocrine abnormalities
; hyperthyroidism, Cushing's
disease, thyromegaly,
hypophosphatemia, and
hyperprolactinemia

Bonetumors.org

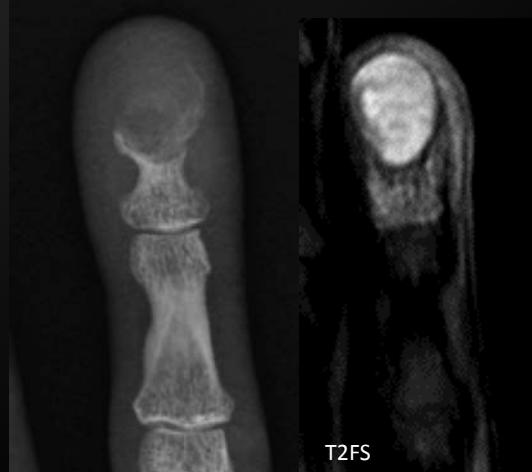
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9

W

37

What is the **LEAST** likely diagnosis?



- A. Subungual exostosis
- B. Glomus tumor
- C. Intraosseous epidermal cyst
- D. Squamous cell carcinoma

36/F

38

Intraosseous epidermal cyst

- Age - 25 to 50 years
- Location – phalangeal tufts of the hands and feet
- Margin of the lesion and periosteal reaction – well defined lytic lesion in the phalangeal tuft with a sclerotic margin
- Tumor matrix – benign cystic lesions caused by proliferation of epidermal cells (T2 low signal can be due to keratin)

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D/D lytic phalangeal tuft lesions

W

- GCT
- Intraosseous epidermal inclusion cyst
- Glomus tumor
- Melanoma
- Squamous cell carcinoma



Subungual exostosis :
A pedunculated or sessile
bone spur in the distal phalanx
extending into the nail bed

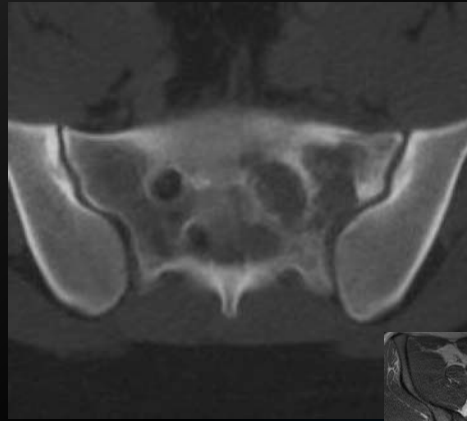
Diagnostic imaging of benign and malignant osseous tumors of the fingers
Radiographics 2014 vol. 34 (7) pp. 1954-67

10

W

What is the most likely diagnosis of this lesion?

W

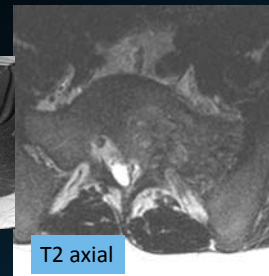


22/M

- A. Chondrosarcoma
- B. Osteoid osteoma
- C. Ewing's sarcoma
- D. ABC



T1 axial



T2 axial

42

Ewing's sarcoma in vertebral column

W

- Age - 10 and 30 years
- Longitudinal location – lumbosacral junction (m/c)
- Axial location – vertebral body
- Margin of the lesion and periosteal reaction –lytic, mixed, or sclerotic lesions. Involvement of paraspinal soft tissues and extradural space
- Tumor matrix – densely packed uniform small cells in sheets

43

D/D SACRAL primary tumors

- Benign
 - GCT (15-40)
 - ABC (in 10's)
 - Osteblastoma
 - Osteoid osteoma
 - Hemangioma (30-50's)
- Malignant
 - Chordoma (mean:50 yr, m/c malig sacral tm)
 - Ewing's sarcoma (in 20's)
 - Chondrosarcoma (mean: 45 yrs,, t-spine m/c)
 - Osteosarcoma (rare, older than conventional osa)

- *Primary Ewing's sarcoma of the vertebral column. Skeletal Radiol. 2004 Sep;33(9):506-13.*
- *Primary tumors of the sacrum: diagnostic imaging. AJR Am J Roentgenol. 2000 Feb;174(2):417-24.*

11

Which one of the following lesions does **NOT** generally demonstrate surrounding edema?



- A. Chondroblastoma
- B. Enchondroma
- C. Osteoblastoma
- D. Eosinophilic granuloma

18/M

46

Osteoblastoma

- Age - young adults. with a peak age of incidence in the 20's.
- Longitudinal location – meta/diaphysis
- Axial location – medullary eccentric, or cortical
- Margin of the lesion and periosteal reaction – geographic lesion with a sclerotic rim, can present with aggressive periosteal reaction or soap bubbly lesion
- Tumor matrix – benign tumor which creates bone and osteoid.

47

D/D bone marrow edema around benign bone tumors

- osteoid osteoma (< 2cm)
- Osteoblastoma (irregular)
- Chondroblastoma (epiphyseal)
- Langerhan's cell histiocytoma (solitary)

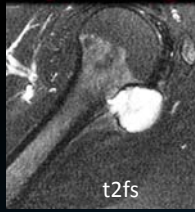
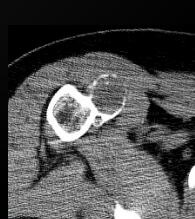


- Bone marrow oedema associated with benign and malignant bone tumours *European Journal of Radiology* 67 (2008) 11–21

12

Which statement regarding this lesion is true?

W



- A. It's a surface lesion.
- B. There is aggressive periosteal reaction.
- C. There is medullary continuation.
- D. Based on MRI features, it's an osteoid lesion.

33/F

50

Juxtacortical (periosteal) chondroma

W

- Age - occur (30's)
- Longitudinal proximal femur
- Axial location involvement
- Margin of the lesion
 - " buttressed"
 - The lesion contains calcification cartilage.
- Tumor matrix on the surface of the bone



51

D/D Cartilagenous surface lesions

W

- Osteochondroma
- Periosteal chondroma
- Paracortical CMF
(typical calcification is not seen)
- BPOP



Surface lesions of bone. Radiology 1998 vol. 206 (1) pp. 17-33

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