Cystic Lesions of Bone

FIBROUS LESIONS OF BONE

Fibrous dysplasia - NO periosteal rxn or pain unless fx
Fx frequent but no pseudoarthrosis, no ST component
Elongated Diaphyseal lesion w "Ground Glass" matrix
centered in medullary cav, "alphabet soup" of woven bone
lucent, sclerotic, expasnsile, patchy, etc... MRI high T2
Monostotic - #1 presentation, prox femur 78%, ribs, skull
if in pelvis it will also be in ipsilat prox femur
Diaphyseal if mild case, rarely affects spine
Polyostotic - lesions usually larger, freq Cafe-Au-Lait
"Sheperds Crook" femur & cystic pelvic lesions assoc
Skull base thickening, CN encroachment, asym orbits
involvement of spine & soft tissue myxoma more common
#1 cause of Rib lesions, mostly lytic, well circuscribed
slowly expanding & assoc w extrapleural mass
Regress w puberty
Malignant degeneration reported in <1%
MRI - Hyper T2 unlike most fibrous processes
Malig degen to Osteosarc poss, esp w polyostotic form

McCune-Albright syn - polyostotic fibrous dysplasia
Florid disseminated form, usually unilat, female>male
assoc w cafe au lait spots and precocious puberty

Adamantinoma - appears similar, mid tibia and jaw only
can appear aggressive, 30+ yrs, trauma often assoc
may be assoc w osteofibrous dysplasia, 15% met to lungs

Ossifying Fibroma - most in face
Cortical based fibrous dysplasia w same ground glass appearance
homogeneous 1-5cm lesions, maxilla & frontal #1
assoc w loosening of the teeth in mandible
Pt <10yrs, vascularized fibrous stroma like FD
No alphabet soup of woven bone

Osteofibrous Dysplasia - fibrous lesion of tibia & fibula in child <5yrs
present w unilat bowing & painless enlargement of the leg
trabecula surrounded by osteoblasts, mixed lytic Diaphyseal lesion
no osteoclasts as in fibrous dysplasia
Juvenile Adamantinoma - possible assoc

Congenital Multiple Fibromatosis - Infantile Fibromatosis
ST fibromas diagnosed at birth, stabalize by 4mo, regress by 2yrs
forms lytic lesion along metaphysis of long bones, variable size

Juvenile Fibroma - benign fibrous tumors, cause pressure erosions
can be aggressive, high T2 intensity, freq recur after resection
Juvenile Aponeurotic Fibroma - subset w fibrochondral matrix
occurs in deep palmar facia of young males
ST mass over wrist w stippled calc, bone errosion poss

Cortical Desmoid - Reactive repair at site of musc insertion
freq at adductor tubercle, "Don't Touch" lesion.

Desmoplastic Fibroma - aggressive expansile con tis lesion
Tibia #1, 10-20y/o, most benign or low grade malignancy
resembles soft tissue desmoid, 50% recur P resection
NO ST mass, never metastisize
DDx Giant Cell, ABC or Fibrosarc
Very vascular, not easily distinguished from FD

ENCHONDROMA
Lucent defect w Ring & arc chondroid, 40-50
Metaphyseal, unilat & solitary, never epiphyseal
NO periostitis, central, eccentric & expansile
Cartilage formed bones only, NO skull lesions
#1 cystic lesion of phalanges, but no calc here
Sim bone infarct but not well defined or serpiginous
Chondrosarcoma differs only in its clinical pres - pain
50% can degenerate to chondrosarcoma, histo identical
Diaphyseal long bone lesions more likely to deg
Surgically excise, Bx is not a reliable way to DDx

Ollier's Dz - mult enchondromas, NO inc in malig deg
Predominate Unilat, punctate calc remain distinctive
Bizzarre bulbous expansions of tubular bones early
Columnar growth of cartilagenous tissue from epi
Become more rounded w older Pts, Pathog
Longitudinal striation - poss in long bone metaphysis

Maffucci's syn - mult enchondromas, Inc malig deg
Hemangiomas assoc, phleboliths seen.

LANGERHANS CELL HISTIOCYTOSIS - HISTIOCYTOSIS X

Birbeck Bodies - inclusions seen in cells on EM
Penilaminar Organnels also assoc
50% have skin, eye, respiratory & fever w enlarged nodes
pts >2yrs w no organ dysfxn have 90% 5yr survival
with organ dysfxn about 40% 5yr survival
Tx - chemo reserved only for most severe cases

Eosinophilic Granuloma - Non-disseminated form, Bone only
90% occur from 5-15yrs, 95% white, 2:1 male, 70% in flat bones,
femur & humerus #1 long bones, 60% diaphyseal, rare in hands
central bony sequestrum like osteomylitis & fibrosarc poss
Monostotic usually but #1 cause of benign polyostotic
Periostitis freq, usually thick, wavy, & uniform
Fever poss similating osteomyelits
Skull #1, Beveled NONSCLEROTIC edges
Calverial in 40%, often isolated parietal, mandible 20%
present as painful enlarging skull mass, rarely into dura
hearing loss & otitis type sx if temporal bone involved
Vertebra Plana - often effect post elements as well, neuro sx rare

Hand-schuller - Chronic Disseminated Histiocytosis, <5y/o
Triad of destructive lesions, exophthalmos & diabetes insipidus
D. Insipidus II' to hypothalmus involvement, hyper T2 in pit stalk
90% have cranial involvement, 15% have classic triad
NO osteopenia or erosions, Reticular nodular in lungs

Letterer-Siwe - Acute Disseminated Histiocytosis, <1y/o
Fulminate - 95% die, often bone lesions don't form
Permeative pattern sim to Ewings sarc possible.

OTHER CAUSES OF BENIGN CYSTIC LESIONS

Osteoblastoma - rare, Giant osteiod osteoma, >2cm
Expansile bubbly lesion, Sclerotic margins poss, sim ABC
can have speckled calc or even blastic in long bones
freq in post spine, predominatly lytic here
30% are vertebral, may cause cord compression
Appendicular are lytic w NO soft tissue mass

Osteoid Osteoma - not tumor or infection, unkown etiology

Cortically based sclerotic lesion w nidus <2cm, pt under 30
Metaphyseal 75%, 2/3 around knee
Medulary - nidus in medula or joint less sclerosis seen, 20%
Intrarticular - mimics synovitis, Sclerotic, joint eff seen
Periosteal - minimal sclerosis, cortical scalloping & ST swelling
Spine - prefers appendages, freq cause of Scoliosis
unilat pars Fx still a more freq cause though
Spontaneous regression, NEVER seen over age 30
Resection curative, recurrance due to incomplete resection
Pain at night releived by aspirin
NUCS - Double Density sign caused by hot nidus
Angio - Nidus is hypervascular, rapid washout
MRI - shows nidus lying in region of marrow edema
nidus enhances on both MRI & CT, very vascular
DDx - Osteomyelitis is always #1 in sclerotic lesion w nidus
may resemble sequestrum, can also mimic stress Fx

Aneurysmal Bone Cyst - must be expansile in pt under 30
Tibia #1, 30% occur in assoc w a primary neoplasm
Diaphyseal but usually near end, extend to metaphysis
Markedly destructive esp in pelvic bones
can have densly sclerotic border, Fx freq
Can sim Osteoblastoma
Spine appendages often involved, lg soft tissue mass
Present w pain, may follow truama
CT - can show multiple compartments, fluid-fluid levels in 30%
Can show rim enhancement w cent low atten

Solitary Bone Cyst - Must be central in a pt under 30
simple or unicamiral cyst, excluded if not central
2/3 occur prox humerus, prox femur #2, any bone poss
NOT most commonly seen around knee unlike others
Metaphyseal, grows in from physis, rarely epiphyseal
Fallen fragment sign is pathagnomonic
Asymptomatic unless fx, triangular in calcaneus Recur if packed too early

Hyperparathyroidism - HYPERcalemia, HYPOphosphatemia
Subperiosteal Resorbtion - radial aspect of dist phalanx
dist clavicles, med prox tibia, & sacroilliac joints
osteopenia & cortical resorb of long bones late

Brown Tumors - flat bones & ribs
#1, sim ABC, giant cell
most assoc w I' form, must have other HPT Sx as well
Parathyroid Adenoma may cause tracheal deviation
Tx of HPT - all sx resolve, brown tumors scleros, resorb
Calcitonin - has opposite effect as Parathyroid Hormone
decreases bone resorbtion, inc renal Ca+ clearance
causes Hypophosphatemia & Hypocalcemia

II' Hyperparathyroidism - Renal Osteodystrophy, more common
Soft tissue calc, Chondrocalcinosis & Osteosclerosis MORE common
kidney can't hydroxylate 25-hydroxy to 1,25-dihydroxycholecalciferol
causes compensatory elev in parathyroid hormone
Freq cause of "Super Scan" w MDP, only seen w 50% in I' HPT
Phosphate retained, Ca+ low (Normal Ca+ 8.4-10.2, phos 2.2-4.5)

Chondroblastoma - must be Epiphyseal in a pt under 30
Most occur at Knee, Calc frequently seen
50% will have sm extention across the epi to metaphy
70% assoc w periostitis in diaphymetaphyseal region adjacent
Lytic & epiphyseal: 1) infection, 2) this, 3) giant cell
EG and ABC also but very rare, mets & myeloma over 40
consider subchondral cyst if joint DJD assoc
carpal, tarsal bones, and patella behave like epihysis
Apophysis (ligamentous attachment) is similar
MRI - often low T2 in child due to cellular nature

Chondromyxoid fibroma - mention w nonossifying fibroma
can present w pain in any age, most in dist toe phalange
Diaphyseal w subendosteal thickening & scalloping
Usually NO chondroid matrix, NO malig degen
Difficult to distinguish from chondroblastoma histologically

Cystic Angiomatosis - rare, assoc w Osler-Weber-Rendu, asym when isolated
mult complex cystic lesions anywhere, may spontaneously regress
70% w viceral involvement have bad prognosis.

RARE CAUSES OF BENIGN LYTIC LESIONS

1.Inclusion Cyst - follows trauma to dist digits mostly
Epidermoid lines cyst walls

2.Glomus Tumor - ST mass w destructive lesion, sharp margins
Dist phalanges #1 esp in female, elsewhere in male
Arise from glomeruli or pericytes in vessel wall

3. Hydatid Cyst - Dog tapeworm larvae, Pelvis & Spine #1 bone
Sharply demarcated & sclerotic margin, "bunch of grapes"
can simulate an aggresive lytic process
75% in liver, 15% lungs, freq calc in ST, 2% in bone
Sheep & human intermediate to dog (definitive host)

4. Primary Amyloidosis - can cause mult lytic bone lesions seen in 15% w multiple myeloma, preserves joint space
osteopenia & rib lesions common, NO subperiosteal resorb
Course trabeculation in hands poss, sim SLE
Protenacious deposits in heart & GI #1, bone rare
may calc in lung & kidney
plaque like deposits may be seen in synovium
II' Amyloidosis assoc w RA, ank spondylitis & others

5. Hemangioma - lytic w sclerotic marg, esp in long bone head
Spine or Calvaria #1, asym & solitary, pt >40y/o
Vertebral body - vertical lines
Calvaria - honeycomb or sunburst pattern
Soft tissue hemangiomas can cause errosions

6. Pigmented Villonodular Synovitis -benign synovial swelling
Subarticular erosions poss w joint pain & swelling
Lg subchondral cysts w NO joint space narrowing typical
CALC NEVER SEEN, no osteoperosis
see section on benign joint processes

7. Sarcoid - 10%, lace-like destruction in metaphsis of phal
Periosteal rxn & endosteal sclerosis, NO errosions, penia

8. Intraosseus Ganglion - subchondral cytic lesion
Sharply defined sclerotic border, NO calc, NO ST portion
Dist Tibia #1, Talus #2, presents w pain in ankle
Simulates a Geode, but no degenerative changes
mucoid center, fibrous capsule in both

9. Acroosteolysis - dist phalanges erroded away
Scleroderma, frost-bite, burn, Hadju-Cheney.

MALIGNANT CAUSES OF WELL DEFINED LYTIC BONE LESIONS

Giant Cell Tumor - 15% malignant, may recur even if not
1. Epiphyses must be closed, but rare in elderly >50y/o
2. Must abut the articular surface, knee #1, spine rare
3. A sharp zone of trans w a nonsclerotic margin
4. Must be eccentric, NO matrix calc, pathologic fx freq

Nonossifying Fibroma - must be under 30, Metaphyseal

Fibroxanthoma - AFIP name, Whorls of fibrous tiss & Xanthoma Cells
Occur in long bones, emanate from cortex
Knee #1, expansile w NO periostitis
lytic w thin sclerotic border, slight scalloping
Fx poss esp if >2cm or occupy more than 50% of dia
MRI - low T2 due to fibrous matrix
20% of children, spont regression w calc of matrix late
synonymous w fibrous cortical defect & Fibroxanthoma
Involute by age 30, may be hot during this time
Multiple NOF - freq assoc w Neurofibromatosis

Metastatic disease - consider w any lesion IF pt over 40
Hemopoetic marrow first, no X-ray evidence initially
NO soft tissue mass, less periosteal Rxn than I' mass
#1 site is lesser trochanter of femur
any ca can be lytic, usually thyroid or renal
Renal cell ca said to always be lytic
Skull mets often lytic due to slow healing
Sclerosis results from slow growth allowing bone Rxn
Carcinoid & Hodgkins frequently sclerotic
Breast Mets - often imitate mult myeloma

Myeloma - Aggressive, bubbly lytic pattern esp in ribs
#1 cause of extraplueral masses @40
Plasmacytoma can occur in younger pt (over 35)
Pelvis, thoracic & lumbar spine freq, skull rare
collapses vert body, appendages not involved
preceed mult mye by 3-5 y

Childhood Mets - Horizontal radiolucent bands freq
Neuroblastoma - freq lytic lesions esp in skull
Sutures spread from Inc intracranial pres
Pulm mets only late, Retinoblastoma sim
Leukemia - 50% w Metaphyseal bands, less freq lytic
Bands probably II' to nutritional deficiet, not infiltation
Diffuse periosteal Rxn & demineralization
DDx w blood: inc lymphoblasts vs inc catacholeamines
Wilms does NOT met to bone, mostly pulmonary.

INFECTIONS

Pyogenic Osteomyelitis
Chronic Sclerosing Osteomyelitis
Brodie's abscess
Septic Arthritis
TB
Cystic Tuberculosis
Syphilis
Tabes dorsalis
Actinomycosis
Sporotrichosis
Brucellosis
Leporsy
Salmonella Osteomyelitis
Maternal Rubella Syndrome
Septic Hip

CLASSIFICATION OF LYTIC BONE LESIONS

Under 30 lesions - EG, NOF, ABC, SBC, & Chondroblastoma
No Periostitis - Fibrous Dysplasia, Enchondroma, NOF, SBC
Epiphyseal - Infection, Chondro, GCT, EG, mets & myeloma
consider subchondral cyst
ABC diaphyseal but may approach end
Multiple - FEEMHI
Sclerotic lesions - often regressing lytic lesions, under 30
NOF, EG, SBC, ABC, chondro,
over 40 = mets
osteiod osteoma, fibrous dysplasia, infection, brown tumors.

POSTTRAUMATIC LYTIC LESIONS

Myositis ossificans - aggressive histology can mimic sarcoma
circufrencial calc w lucent center
pathognomonic
CT shows best, can have periosteal rxn
no ill-defined periph, or central calc
between muscle fibers, not within

Avulsion injury - seen at insertion sites, delayed films help
Cortical desmoid - prob an avulsion of the medial supracondylar ridge, periostitis poss, hot on nuc
often occur in young people, histo can sim sarcoma

Subchondral cysts - geodes
assoc w degenerative dz
assoc w joint narrowing, sclerosis, etc
assoc w CPPD crystal dz, rheumatoid, & avasc nec

Discogenic Vertebral Dz - a schmorl's node variant
sclerosis of vert end plates, lytic or mixed poss
always assoc w osteophytosis

Fracture - if not set can have exuberant callus
Pseudodislocation of the humerus - fx w hemarthrosis
blood distends joint & displaces head inf, no disloc
axial veiw key to detection, can aspirate for blood

Tietze's Syn - costochodritis of the rib
causes bulbous painful swelling due to periostitis.

NORMAL VARIANTS
Dorsal Defect of the Patella - lytic defect in upper out quad
mimics chondroblastoma, inf, or osteochondritis dissecan

Pseudocysts - paucity of trabecula at G tuberosity of Humerus
hyperimia II' to shoulder pain causing dissuse
no sclerotic margin or wide zone of transition
also seen in mid calcaneus, tuberosity of radius also

Os Odontoideum - unfused dens which may be post trauma
smooth well corticated inf margin

Osteopoikilosis - mult sclerotic foci assoc w epiphysis
familial bone islands, can mimic mets but no lytic proc.

Musculoskeletal Infections

INFECTION
NO discriminating factors, sclerotic border #1
periostitis, soft tissue assoc, expansile, all possible
if adj to articular surface cartilage loss & eff poss
Bony Sequestra - seen w this, EG, and fibrosarcoma
Crosses Disk like Gorham's Vanishing Bone & Renal Osteodystrophy

Pyogenic Osteomyelitis - 75% in kids, blood born staph aureus
No anas between metaph & epiphy plates at 2yrs to maturity
More vigorous periosteal rxn in kids due to lose periost
Main cause of nec bone due to vasc disruption Soft tissue component seen at 2-3days, fat planes blur
Bone changes start after 10 days, Lg ST component assoc

Metaphysis #1, susceptability inc w size of bone
NO joint involvement
Sequestrum - necrotic bone residual, forms late
Involucrum - Sheath enclosing sequestrum
Skull - Hx of frontal sinus Dz, Trauma or mastoiditis
Moth eaten pattern, no sequestra
Vertebral - usually involves endplates, can cross Disk
collapses symetrically due to post element involvment
No kyphosis as seen w TB, less extensive
Paraspinous abcess freq complication, LOOK FOR IT
Penetrating injury & drug abuse #1 causes
Pseudomonas - seen in penetration inj of foot
Salmonella - assoc w sickle cell, S. Aureus still #1
Chronic Granulomatous Dz in Child - mult sites of osteomyelitis bacteria are phagocytized but not properly killed

Chronic Sclerosing Osteomyelitis - often nearly sterile
Reactive process left over, lytic component variable
Lg ST component w breaks in cortex
Cartilage thinning & Juxtarticular osteoperosis assoc
Sinus tracts freq - fibrosarcoma can develop in tract
Epidermoid ca also seen in tract

Brodie's abscess - sclerotic sharp margins, freq periosteal R
Metaphyseal - dist tibia #1, cavity in spongiosa, elongated along shaft
freq serpentine tracts to cortex, good for DDx from osteoid osteoma
In-111 & Ga-67 less sensitive, detect acute osteomyelitis better
Afebrile & pain free possible, rare in spine
Septic Arthritis - cart errosion due to collagenase from leukocyte
Autoimmune response to damaged cart, further resorption
Fibrin deposits inhibit cart nutrition & metabolism
TB - hematogenous spread to Metaphysis, extends to Joint
Progressive bone destruction & subarticular osteoperosis
Well localized Abcess, Cold due to slow inflam process
Casseating lesions - calcify, pathog when paraspinous
Spine & Hip #1 - Always see muscle atrophy
upper thoracic in kids, lower & lumbar in adults
Kyphosis - errodes ant 1/3 of vert body, 90% angle
preserve post elements
Non-casseating types - M. Kansasei & Scrofulaceum
Cervical nodes mostly, rare bone involvement

Cystic Tuberculosis - Symetric long bone involvement in child
Mult well defined ovoid lytic lesions
NO periosteal rxn except in late phase

Syphilis - bone changes w congenital & III' aquired forms
Gumma - oseous necrosis which heals w fibrosis & inflam
Lytic lesions - Tibia, vomer & calvaria #1, adj thickening freq
can cause lucency in diaphysis of any long bone
Trophic lesions, symetric deposits in periosteum
Congenital form - exuberant periostitis @ birth
heal spontaneously or responds rapidly to PCN
minimal soft tissue component
Fragmentation & infarction of long bone metaphysis
DDx scurvy
Tabes dorsalis -Gummatous deposits in cortex of ant tib
thickening & increased density of any long bone poss
Onset at 20-30 y/o, pathognomonic if bilat
Assoc w neuropathic process
Aquired III' form - periosteal rxn less evident
Clavicles - cortical & endosteal new bone
Calvaria - Mixed lytic/sclerotic lesions ant & lat
Neuropathic lesions - in Lower ext & Spine
II' to trauma, Tabes Dorsalis assoc w this
Check Serology - VDRL, Treponemal Antibody

Actinomycosis - Anerobic G+ bacilli, permeative aggresive pattern
#1 in thorax, spine & metaphysis of long bones
Does not cross disk space, craniofacial form from tooth
Abdominal form starts in cecum or appendix - liver abcess
"Mycetoma" - tumorlike ST swelling & draining sinus
most commonly seen in the foot following puncture wound

Sporotrichosis - fungus aquired from plants thru skin wounds
causes septic arthritis & joint destruction, lytic bone lesions poss
Brucellosis - causes exuberant "parrot beak" osteophytes of spine

Leprosy - 2 forms caused by mycobacterium leprae
Lepromatous - 5% have bone changes, neuropathic type
Neural leprosy - 64% have bone destruction
Cystic lesions in fingers w II' sclerosis severe contracture or bone loss, not both
Calc in Radial or Ulnar nerve pathognomonic

Salmonella Osteomyelitis - esp in sickle cell child <2y/o

Maternal Rubella Syndrome - "Celery stick" around knee at 8mo
longitudinal metaphyseal bands, NO periostitis
50% have PDA & hepatosplenomegaly

Septic Hip - B strep in neonate, H. flu in infant, S. aureus in child
present w fever and immobile joint, X-ray N initially
Effusion displaces med aspect of head >1mm relative to opposite
Aspirtation for Dx, Emergent arthrotomy & open drainage for Tx
high risk of cartilage destruction, 15% assoc w head osteomyelitis.

Bone Forming Benign Lesions

1. Enostosis -Bone islands can mimic sclerotic met if >1cm
1) oblong w axis along stress plane
2) Well difined spicules extend to N bone along margins
May grow very slowly, can have inc uptake on nucs Rare in children

2. Osteopoikiolosis - Small islands of compact bone, ASYMPTOMATIC
involves spongy bone of epiphysis & metaphysis in long bone
NO inc activity on bone scan
Important to surgeon due to inc Keloid formation

3. Osteopathia Striata - linear bands of sclerosis at metaphysis assoc w osteopoikiolosis, no inc uptake on nuc scan

4. Melorheostosis - Thickened & enlarged cortical bone
Haversian canals present but abn, inc marrow cellularity
"Candle Wax" excrescences along outer cortex
Pain, Contractures & limb shortening occur
often in a single lower limb
Scleroderma like skin lesions poss over osseus lesions
Bone scan intensly hot

5. Bone infarct - Always diaphysometaphyseal in long bone
Dense amorphic calc initially, lucent 10 days later
Sclerotic "serpentine" border good for DDx from EG
Benign type pereosteal rxn poss, permeative app poss
NO endosteal scalloping, NO cysts, NO malig transformation
freq underlying disorders - sickle cell, SLE, Gaucher's
Pancreatitis, atherosclerosis,

Emboli
MRI demonstrates a serpiginous sharp black border
Presents w Pain

Epiphyseal-metaphyseal Osteonecrosis - infarct assoc w steroid use
possible due to microscopic emboli from fatty liver or marrow expansion

6. Juxtacortical Chondroma - arise between cortex & periosteum
Medial aspect of prox humerus, femur or tibia metaphysis NO contiguous marrow cav, Saucerization of cortex
variable ST mass, sclerosis & periosteal Rxn - Dx w Bx

7. Osteochondroma - Osteocartilagenous Exostosis, to joint
Most common benign neoplasm, rare malig transformation
MRI - shows intact low intensity cap on both T1 & T2
Thicker the cap the more likely to transform
Arises from bone surface w hyaline cartilage cap
Cortical & Marrow CONTINUITY key to Dx, away from epi
30% on femur, Sx due to size, often lobulated
Spine - can cause scoliosis, grow into canal
Sessile form can sim Juxtacortical chondroma on humerus
Aquired II' to truama also
Subungual Exostosis - assoc w trauma to fingers

Trevor's Dz - Osteochondroma in joint, swell & deform, unilat

Hereditary Multiple Exostoses - Auto dom, seen younger
Variable severity, may be asym, 20% malig transformation
Bowing deformities, shortened bones, Madelung wrist deformity

8. Osteoid Osteoma - not tumor or infection, unkown etiology
Cortically based sclerotic lesion <2cm, pt under 30
Nidus within a small central lucency, 2/3 around knee
if nidus in medula or joint less sclerosis seen, 20%
joint eff if lesion intracapsular
if nidus in periosteum see periostitis like malig
may resemble sequestrum or disappear if calcifies
Spine - prefers appendages, FREQ painful Scoliosis
DDx - Brodies Abcess #1 in sclerotic lesion w nidus
use Bone scan, Double Density sign due to nidusNORMAL VARIANTS

Dorsal Defect of the Patella - lytic defect in upper out quad
mimics chondroblastoma, inf, or

osteochondritis dissecan

Pseudocysts - paucity of trabecula at G tuberosity of Humerus
hyperimia II' t
MRI - shows NO ST component
Spontaneous regression,
NEVER seen over age 30
Resection curative, NO malignant potential
Pain at night releived by aspirin

9. Osteoblastoma - rare, Giant osteiod osteoma, >2cm
Expansile bubbly lesion, Sclerotic margins poss, sim ABC
can have speckled calc
Usually in post elements of spine, NO soft tissue mass
Can recur but more likely to be osteosarcoma 2nd time
more lace like osteoid matrix seen

10. Osteoma - slow growing benign tumor of sinuses & cranium
protruding mass of dense bone, usually incidental
can cause sinusitus, HA or exophthalmos if lg
Arises from cortex, freq no haversian sys
Multiple Osteomas assoc w Gardener's Syn
polyposis, dental lestions, desmoids & seb cysts also.

Malignant Bone Tumors

DIFFERENTIATING MALIGNANT FROM BENIGN

1) Zone of transition - most reliable, seen w every lesion
Narrow - benign w few exceptions
this includes sclerotic margins
Wide - aggresive, usually because they are fast acting
Permeative - multiple sm holes w no clear border
Round cell tumors - m myeloma, reticulum cell sarc
EG, Bone infarct & infection occasionally

2) Cortical Destruction - can be missleading alone
cortex replaced by benign fibrous or chondroid matrix
infection, & EG also cause this
giant cell tumor & ABC can thin cortex so not seen

3) Periostitis - II' to irritation, very nonspecific patterns
benign - thick wavy formation, EG or inf may be agg
aggresive - lamellated, amorphous, or sunburst
Codman's triangle often seen at leading edge
can not thicken if malignant
may thicken in late stages of healing if benign

4) Axis of orientation - unreliable
benign - in long axis of long bone

Ewing's sarcoma is a clear exception
malignant - round lesions
fibrous cortical defects are often round however

5) Arteriography - helps define ST vs bone involvement
Demonstrate Neovascularity - pathognomonic of malig
Arterial cutoffs & Venous lakes
Guide Bx away from necrotic regions
AGE GROUPS
1-30) Ewing' sarcoma, Osteosarcoma
30-40) parosteal sarcoma, Fibrosarcoma, Malignant giant cell Reticulum cell sarcoma (primary lymphoma of bone)
40+) Mets, Myeloma, Chondrosarcoma

PATIENTS 1-30 YEARS OLD
Ewing's Sarcoma - Mysenchymal prolif from marrow, 5-30y/o
Major Long Bones - #1 in child, Permeative & Diaphyseal
50% in flat bones - more common in adolescents
NO bone or cart formation, freq hem & nec
Freq periostitis, Onion skin #1, causes bone thickening
ST component in 90% - more freq & larger than osteosarc
Painful, severe systemic Sx early in Dz
30% present w Mets - Lung #1, skeletal #2
DDx - Reticulum cell & neuroblastoma mets sim
EG or infection more likely if thick periostitis

Intramedullary Osteosarcoma - #1 primary bone tumor, 2:1 male
Metaphyseal 80%, diaphyseal 10%, 75% occur around knee
epiphyseal very rare, flat bones 10%
Destructive w freq reactive sclerosis, breakout from med
ST component freq, cumulus cloud of calcified osteoid
75% cross epiphysis & joint, 20% w intramedullary skips
Diaphyseal form often present w Fx, bad prognosis
MRI - evaluate ST component, encroachment on joint, vasc
Pulmonary mets assoc w Pneumothorax, skeletal mets rare
Pain & elevated alk phos, Assoc w Pagets Dz

Well-Differentiated Osteosarcoma - #1 at dist femur
histo similar to low-grade parosteal osteosarcoma
simulates desmoplastic fibroma

Telangiectatic osteosarcoma - lytic only, better prognosis, sim ABC
small areas of osteoid key to Dx, smaller tumor load

Osteosarcomatosis - multifocal w very bad prognosis

Burkitts Lymphoma - Sim ewings or reticulum cell in child assoc w CMV virus, good survival

Rhabdomyosarcoma - present at 5yrs, 50% head & neck, pelvis #2
freq mets to lung, nodes & liver, one in 20% but rare direct extention

PATIENTS 30-40 YEARS OLD
Parosteal Osteosarcoma - less deadly, extracortical bone dep
Originates form the periosteum & grows outside the bone
once cortex is penetrated it is a central osteosarc
ST calc with a central distribution in the mass
Postmed dist femur #1 at site of adductor insertion
imitates a cortical desmoid (avul) benign avul inj can appear very malig
Dense Centrally w cleavage plane between it & cortex
Cauliflower like, may not see conection to cortex
** DDx - Myositis ossificans can imitate but dense peripherally

Periosteal Osteosarc - cotical, no medul invasion, rare
Saucerized cortex, intense periosteal Rxn
Poorly diferentiated, predominately Chondroblastic
prognosis better than intramedullary osteosarcoma

Gnathic Osteosarcoma - older pts, less aggressive

Fibrosarcoma of Bone - usually pure lytic, variable aggresive
Expansile in medullary cavity, freq associated calc
Sequestrum poss, NO periosteal rxn, NO ST mass
#1 around knee, Diaphyseal every where else

Malignant Fibrous Histiocytoma - same appearance, see ST

Desmoid - low grade, usually well defined, slow growing benign periostitis w thick spicules, thick septa
no met, but extensive local invasion

Periosteal Fibrosarcoma - invades cortex, medullary II'
Fibrosarcoma of Soft Tissue - invade bone II'

Malignant Giant Cell Tumor - 15% are malig, primarily 30-40
Dx w recurrance, or met to lungs
histology is identical to benign variaty

subarticular, closed epiphysis, eccentric, sharp zone

Reticulum Cell Sarcoma - l' lymphoma of bone, male 2:1
Permeative pattern identical to ewings sarc
#1 around knee & prox tibia, Rarely expansile
can involve a lg amt of bone w no sytemic symptoms
l' Hodgkins & Lymphosarcoma are variants, very rare
Hemagiopericytoma - rare vasc tumor, benign or malig
Lytic & expansile but permeating pattern poss
Histo sim to Glomus Tumor

Chordoma - 55% sacroiliac, 25% clivus, 20% cerv spine esp C2
Grossly expanding, highly aggressive w lg ST mass
Slow growing, met late w NO skeletal met, fatal.

PATIENT OVER 40
Metastatic Disease - include in any DDx if pt over 40
Pain presents in 60%, Fx if >2cm or >50% of dia
Hypercalcemia - mets #1 cause in hosp pts
Hypertrophic Osteoarthropathy - Lung #1, mesothelioma
Sclerotic multiple foci #1 for breast and prostate
Hodgkins - the only lymphoma w sclerotic mets
Ivory Vertebra - Paget's #1, mets & Hodkin's #2
Prostate also presents w freq periosteal rxn
Renal Cell Ca - 90% Blown out lytic expansion
25% present w mets, NO calc, Periosteal Rxn
Thyroid - Lytic, 8% present w bone mets
Lung - 80% lytic, more often blastic if sm cell, 15% w bone
Lymphoma - NHL can be l', 75% lytic & metaphyseal
can be aggressive, Perosteal rxn, ST mass & path Fx in 25%
Hodgkin's - always met, assoc w sclerosis & Ivory Vert
Neuroblastoma - Permeative metaphyseal lesion, periosteal Rxn
often symetric & sim Ewing's, leukemia or osteomyelitis

Myeloma - Aggressive, bubbly lytic pattern esp in ribs
Plasma cell prolif in red marrow, edosteal errosion
Polyneuropathy, Organomeg, Enocrine, M-protien, Skin
#1 cause of extraplueral masses @40
Pelvis, thoracic & lumbar spine freq, skull rare
collapses vert body, effects marrow not post elements
Diffuse Form - Osteoporosis #1 presentation, rarely sclerotic
Bone Survey nît nuc scan

Plasmacytoma - presents 10yrs younger (over 35)
preceed mult mye by 3-5 y
Chondrosarcoma - Intramedullary type #1, geographic permeative
Lg lytic component, ring & arc chondroid matrix
#1 in prox long bones, aggresive w flat bone
ST mass is large, slower growing than osteosarcoma
lung mets #1, skeletal rare
Assoc w Enchondroma, Osteochondroma & Pagets
Low grade lesions indistinguishable even w path
Also sim Bone Infarcts
ST component is key to DDx from enchondroma
Always presents w PAIN, enchondroma may not
Lidocaine in joint stops DJD pain, not lesion pain
hotter than ant iliac crest on nucs, enchondroma not
Selenium75 - good for ID of tumors w cart matrix
Freq cartilaginous lesion of ant ribs in adults

Periosteal Chondrosarcoma - larger ST mass, no medulary comp
sim periosteal chondroma or sessile osteochondroma

Clear Cell Chondrosarcoma - less aggresive w sclerotic rim
Present 30-40, improved prognosis, can be totally lytic
Epiphyseal & often confused w a chondroblastoma
MRI - very high T2

Mesenchymal Chondrosarcoma - Very aggresive, lg ST component
Present 20-30, often assoc w prev intrmedullary chondrosarc
Can be pure ST, multifocal islands of malig cartilage
Myxoid type - also pure ST, poor prognosis, avg 50yrs

Benign Causes of Periosteal Elevation

1. Hypertrophic Pulmonary Osteoarthropathy - clubbing
Subperiosteal new bone, Metaphysis only, NO epiphyseal
Caused by pulm mass, l' bone or met, Benign cause poss

2. Familial Pachydermoperiostosis - assoc w clubbing

3. Caffey's Dz - Infantil Cortical Hyperostosis, before 6mo
ST swelling, Immature laminar bone adjacent to cortex
Etiology may be viral

4. Scurvy - Subperiosteal Hemorrage in healing phase, P 6mo

5. Sarcoid - Elevated phalangeal lytic lesions, Endosteal sclerosis

Soft Tissue Disease

MALIGNANT SOFT TISSUE TUMORS

1. Malignant Fibrous Histiocytoma - #1 malig ST tumor, 40-70
Presents as painless soft tis mass >5cm
3 cell types, spindles predominate, histiocytes
Giant cells also poss, malig or benign
Poorly defined calc, poss involvement of adj bone
Can cause scalloping of outer cortex of adj bone
Osseous MFH rare - geographic lytic lesions
No periosteal rxn or sclerosis
Closely related to fibrosarcoma, identical app
DDx - Liposarcoma, but no fat present in MFH
Synovial Sarcoma can also cause scalloping

2. Liposarcoma - #2 ST mass, presents at 40-60yrs, rare in child
Extremities & retroperitoneum, 5-10yrs earlier in extremities
Low Grade - well differentiated, cannot met, local recur
synonymous w Atypical Lipoma, ALWAYS has fat
retroperitoneal form assoc w freq recur, bowel obs & death
Myxoid Type - most common, 50% have visible fat by CT
MRI - benign cyst like app poss, freq assoc hem
Round Cell Type - poorly diff hypercellular form
Dedifferentiated Liposarcoma - refers to mixed types

3. Fibromatosis - Extraabd Desmoid of deep & superficial tissues
In general the deeper the growth, the worse the prognosis
Shoulder #1, errodes outer cortex of bone if deep
Aggressive Infantile Type - discovered before 2yrs
no met but locally aggresive & recurs
All are very vasc w intense enhancement, NO necrosis

Dupuytrens Contracture - Palmar Fibromatosis, ulnar side
If removed while cellular will recur, wait until fibrosed

Infantile Myofibromatosis - Myoblastic & fibroblastic lesion
Bone lesions common, poor prognosis if mult & deep

4. Synovioma - Synovial sarcoma, predominatly a spheroid ST mass
#1 at knee, hands & feet also
Originate from tendon sheath,

rarely assoc w joint
joint masses are not malig
Calc 30%, Bone errosion freq, occur up to 2cm from joint

BENIGN SOFT TISSUE TUMORS

1. Lipoma - Mature fat in 40-60y/o, female predominance
95% solitary, Tumor fat not available for metabolism
CT - -65 to -120HU mass, well circ w NO enhancement
thin fibrous strands poss, if extensive think fibrosarc

Neural Fibrolipoma - aka lipomatous hamartoma of median nerve
Most in young adults, present w pain & paresthesia
Macrodactly - freq in 2nd or 3rd digit

Lipoblastoma - cellular immature lipoma, infants before 3yrs
Superficial ST & extremities
CT - sim liposarcoma but not seen in young pts

Angiolipoma - encapsulated w vasc stroma & fibrin, young adults
rare infiltrating form seen w no capsule, hemangioma like

Lipomatosis - diffuse overgrowth of mature adipose tissue
presents before 2yrs, often in foot or hand
bony hypertrophy freq, nerve not affected

Hibernoma - brown fat lipoma, extremely vascular on angio
occur in young adults, scapula & axillary region #1
extremely rare in pure form

2. Hemangiomas - Benign Vasc neoplasm, fibrous tiss & Fat freq
Plain Film - ST mass w assoc cortical holes poss
cortex remains intact unlike permeative round cell proc
Phlebliths often assoc
MRI - flow voids, Lace like pattern of FAT in interstitium
Cavernous hemangiomas often larger w less nonvasc tissue

3. Elastofibroma - Benign REACTIVE tumor like lesion of chest
Comma shaped mass under scapula & chest wall in elderly pt
II' to mechanical friction, usually asym, freq bilat

4. Synovial osteochondromatosis - benign synovial meteplasia
mult loose calc bodies in joint pathognomonic
loose bodies not always calc, mimics villonodular syn
erosions of the acetabulum may be seen

5. Pigmented Villonodular Synovitis - benign synovial swelling
Subarticular errosions w Joint swelling & pain
Lg subchondral cysts w NO joint space narrowing typical
CALC NEVER SEEN assoc w this process, NO osteoperosis
see section on benign joint processes

6. Baker's Cyst - synovial cyst between semitend & med gastroc m
MRI will show fluid, II' to med meniscus tear

7. Tumoral Calcinosis - mult calc deposits near major joints
Etiology unknown, occurs in young blacks
Multilobular & Cystic, Milky Ca+ phosphate fluid present

8. Radiation Myositis - T1 images show N fibrofatty septations
T2 shows inc signal due to inflama etc

9. Thickening of Heal Pad - seen w corticosteroid excess, Cushings
also seen w acromegaly, abn if >21mm

SOFT TISSUE CALCIFICTATION

1. Myosistis Ossificans - Trauma, rim of cortical bone

2. Dermatomyositis - Collagen vasc Dz, linear & confluent ST Ca+
Hands, Axilla, Inguinal & chest wall most freq
Lymphadenopathy, Spenomegaly, Rash & eventual death
atony & dilation of esophagus
DDx scleroderma & RA - bony changes sim but less marked
Joint contracture, but NO terminal tuft resorbtion
Assoc w malig, genital Ca in females
NO assoc elevation in serum calcium levels
Juvenile form - most resolve spontaneously, 40% mortality w/ o Tx

3. Scleroderma - Fluffy calcific deposits
Calcinosis Cutis - from tight overlying skin
Dist phalangeal resorbtion, Penciling & Autoamputation

4. Werners Syndrome - Osteoporosis, ST Atrophy & Calc
Neuropathic changes & DJD
Premature ageing, short stature & arteriosclerotic probs

5. Leporsy - Calcifiction in Nerves only

Metabolic Bone Disease

OSTEOPENIA

Osteoporosis - diminished bone quantity in otherwise N bone
Aging - 95%, postmenopausal females
Steroids - Exogenous more common than Cushing's
also assoc w exuberant callus formation
Plain Film - Cortical thinning #1 sign, middiaphysis 2nd metacarp
Permeative Pattern - can result from dissuse, sim Ewing
cortex riddled w holes, Ewing originates in medullary
thin transverse trabeculae & accentuated vertical trabeculae
No assoc lab abnormality, elev of urine hydroxyproline poss

Pseudopermeative pattern in cortex has 2 other causes
Hemangioma - hyperemia II' to inc flow & tunneling
Radiotherapy - usually lg holes but can be small

Osteomalacia - due to defect in Vitamin D metabolism
Dietary, Absorbtion problem, Liver Dz or Renal Dz
excess nonmineralized osteoid, always assoc w bone pain
Prominent trabeculae replace normal small structural type
Looser's Zones - unmineralized osteoid seam on concave side

Renal Osteodystrophy - #1, fails to convert 25-OH-D3 to 1,25-OH-D3
2 mechanisms contribute to assoc osteopenia - Vit D prob & II' HPT
Renal tubular dysfxn causes Vit D resistant type
Fanconi Syn - tubules spill phosphate
Glomerular Dz - Retain phosphate causing dec Ca+
II' hyperparathyroidism induced by dec Ca+ level
Ca+ Def & hyper or hypophosphatemia assoc
Changes of HPT more common in older pt rather than rickets
Dietary - Inadequate Vit D intake, rare before 1y/o
Defective fat uptake - prevents transport of Vit D
Sprue or defective bile salts
Liver - fails to convert vit D to 25 OH cholecalciferol
Hepatic Osteodystrophy - seen in alcoholics

Ricket's - Osteomalacia in an immature skeleton
Cartilage fails to mature in enchondral bone growth
Loss of zone of provisional calcification, Dist femur #1
Inc space between metaphysis & epiphysis, wide physis
Cartilage overgrows in long & lat dimensions

Flared irreg epiphysis, Metaphy cupping, diaphy bow
Squared & flattened post calvarium, basilar invag
Periosteal elev, pain, coarse trabec
Rachitic Rosary - overgrowth of cart in ant ribs & wrist
Looser's Fx - poorly mineralized bone laid w remodeling

Hypophosphatemia - Inherited defect in alkaline phosphatase activity
extracelluar accumulation of inorganic phosphate causes osteomalacia
Sx - same as rickets, symptoms can improve with maturation
Adult form - 50% have slow onset with no childhood Dz
ST calcification seen in all forms but most pronounced in adult
Enthesopathy - prominent bone spurs at tendinous insertions
CPPD arthropathy freq, indistinguishable from idiopathic type
Infantile Form - always lethal, NO ossification of skull, AUNT MINNIE

X-Linked Hypophosphatemia - previously called vit D resistant rickets
Proximal tubules fail to resorb filtered phosphate
Osteomalacia & insufficiency Fx common, presents after 1st year
Periosteal Hyperostosis freq, actually see inc bone mass in adults
Enthesopathy - bone formation at liagament & tendon attachment freq
Defective dentin formation causes freq tooth problems

Non-Hereditary Hypophosphatemia - oncogenic osteomalcia
most commonly due to mesenchymal tumor

Hyperparathyroidism
Primary Hyperparathyroidism
90% Adenomas, 10% hyperplasia or mult glands
Osteoblasts stimulated to mobilize Ca+ from bone
HYPERcalcemia results & causes HYPOphosphatemia
Subperiosteal Bone Resorbtion - pathognomonic
Radial aspect of mid phalanges of 2nd & 3rd finger #1
can prog to spiculation & complete cortical resorb
Juxta-articular errosions - pubic syph & sternoclavic
Subchondral Bone Resorbtion - involves axial skeleton
osteoclastic resorbtion of trabeculae beneath cart
Microfractures result & can cause collapse
Brown Tumors - characteristic of I' but seen w II' also
Fibrous Tis & Giant cells replace

bone, expansile
May become sclerotic after Tx of HPT
Osteosclerosis - mostly in II', involves axial skeleton
"Salt & Pepper" skull - Trabecular Resorb & scleros
"Rugger Jersey" Spine - Subchondral bone sclerosis
Chondrocalcinosis - CPPD occurs in 40% of pts w I' HPT
Ligamentous laxity - atrophy of ligament & attachment
Seen best at syph pubis & SI, joints supported by ST

Renal Osteodystrophy - Secondary Hyperparathyroidism
Phosphate retained, Ca+ drops
HYPOcalcemia due to HYPERphosphatemia
Low Ca+ causes hyperplasia of Cheif Cells in Parathyroid
N Vit D metabolism disrupted causing osteomalacia also
Children - usually caused by congenital renal malform
Adults - urinary tract obs or chronic pyelonephritis
leads to glomerular failure & phosphate retention
Osteosclerosis more freq, Chondrocalcinosis less than I'
"Tumoral Calc" - extensive ST calc, more freq than I'
Hyperuricemia can also result causing II' Gout

Scurvy - Impaired Osteoid Formation, ST Ca+ phos deposites
Metaphyseal - Dense calc of metaphysis w prox zone of attrition
Trummerfield zone w the white line of Frankel
Pelkin's Fractures - Corner Fx of brittle metaphysis freq
Periostitis due to subperiosteal bleeding
Never seen before 6mo, maternal Vit C protective

Vinyl Chloride Exposure - Tuft resorbtion & SI ankylosis
Returns to N after exposure stopped

OSTEOSCLEROSIS
R) Renal Osteodystrophy - or any cause of HPT, but this #1
Subperiosteal bone resorb #1 sign
10-20% have sclerosis, etiology unkown

S) Sickle Cell Dz - sm percentage for unknown reason
assoc w bone infarcts & vert end plate step-offs

M) Myelofibrosis - myeloproliferative syn, prog marrow fibrosis in pt over 50
Anemia causes extramedullary hematopoesis & lg spleen
Assoc w Mets, Poisoning, chronic inf, AML, McCune-Albright

O) Osteopetrosis - generalized dense amorphous bone
N trabecular structure obliterated, NORMAL MANDIBLE
Defective Osteoclasts - fine l' spicules persist
medulla filled, die from anemia & infection
denser prox due to greater growth prox
growth spurts cause lucent bands
clasts keep only during slow growth
Infantile Form - CN compression, throbocytopenia, death
Adult Form - 50% asym, recurrent trans Fx ll' to brittle
CN foramen narrow, mastoid air cells obliterated
Erlenmeyer Flask long bones -clublike & flarring end
Longitudinal metaphyseal striations
end plate fibrosis, sandwich vert

P) Pyknodystosis - Toulouse-Lautrec Syn, an artist w the Dz
Auto Dom, short w HYPOPLASTIC MANDIBLE
Dense pointed dist phal pathagnomonic, 2:1 male
Sutures spread & persistent wormian bones seen

M) Metastatic Ca - prostate & breast #1, Hodgkins also
assoc w cortical destruction or lytic lesions

M) Mastocytosis - Mast cell accum in mult organs, 50% occur at <6mo
Uticaria Pigmentosa- skin rash is #1 Sx, 90%
assoc w LUEKEMIA, pancytopenia, hepatomeg, lymphadenopathy
Hematopoetic marrow process, X-ray detectable in 70%
Trabecula Thickened from medullary side, Axial skeleton l'
Scattered sharp sclerotic foci, areas of rarefacation
assoc w thickened sm bowel folds, bone pain seen in <30%

P) Paget's Dz - rarely diffuse, 20% monostotic, any bone can be affected
Bone ENLARGEMENT & cortical thickening, 3 phases
Osteolytic, Sclerotic bone formation & Mixed
ll' bone has no haversian sys, Fx & avulse easily
Thickened haphazard trabecula, freq bowing
Prog end to center w Flame shape, Tibia only exeption
Fibula never involved
"Banana fractures" & partial fractures on convex side
SLOW progression, rapid changes considered malig degeneration
Pelvis - Ileopectineal line must

be thickened
Medial migration of femoral head poss, sim RA
Skull - Osteoperosis Circumscripta, early lytic process
"Cotton-wool" Thickening & Enlargement, blastic phase
Impingement of Cranial Nerves assoc
Basilar Invagination, no inc ICP assoc
Spine - Dense picture frame vert, appendages involved
Symetric collapse poss, "vertebra plana", sim EG
Striations may mimic hemangioma but usually sclerotic
Sarcomatous Degeneration - <1%, to Osteo, chondro or fibro undiff w elements of all 3 freq, osteo #1
Only time Sarcomas of Skull occur
Giant Cell Ca - Only time they occur in older pt's
ALL occur in the skull & facial bones
Tumors more likely to metastasize
Nucs - marked uptake w active blastic
Neoplasm - cold on bone scan, hot on gallium
MRI - not indicated, inc fat intensity on T1
LAB - Increased Alkaline Phosphatase levels
Inc Ca+ causes renal calculi & Nephrocalcinosis
Urinary hydroxyproline levels also inc
High output cardiac failure due to mult tiny AVM's

A) Atheletes - II' to inc stress

F) Flourosis - II' to dietary intake, rare
assoc w ligamentous calcification, esp sacrotuberous

OTHER CAUSES OF DENSE BONES

Hypervitamanosis A - Cortical thickening of Tubular bones
Diaphyseal & symetric, diffuse periosteal Rxn
NO subperiosteal hem seen, NO mandibular involvement
Metaphyseal spurring & Increased ICP
Assoc w itching, dec appetite, hard tender lumps on ext
Hepatosplenomegaly, anorexia, alopecia
never seen under 1y/o
DDx - Ricketts, Caffey's, Syphillis, healing Scurvy

Hypervitaminosis D - affects adults & children opposite
Child - Thickening of provisional zone of calc & Cortex
Adult - Osteoporosis & tumoral ST calc esp at joints

Hyperphosphatemia - "Juvenile

Paget's Dz", auto rec in Puerto Rican's
Fusiform expansion of Spongiosa, no normal maturation
Dwarfism, bowed bones, wide irreg epiphysis sim to rickets
Skull enlarged w Sclerotic patches, Cranial Nerve deficits
Biconcave vert bodies, Cystic lesions poss

Hypoparathyroidism - HYPOcalcemia & resulting neuromusc Sx
Parathyroid defeciency - usually II' type, Iatrogenic
Osteosclerosis & calveral thickening is I' manifestation
Basal Ganglia & SubQ tissue calc also

Pseudohypoparathyroidism - end organ resistance
Characteristic short stature, round face, obesity & MR result
Hypocalcemia & Hyperphosphatemia but elevated PTH level

Pseudopseudohypoparathyroidism - clinical syndrome, NORMAL labs

Cushings - Axial Osteoporosis #1, 3:1 female
Assoc w adrenal hyperplasia in adults
Vertebra - Prom vertical striations, Dense cupped endplates
Fx's heal w excessive callus (esp RIBS), mult bone infarcts
Calveria stippled, demineralized sella
Adrenal tumors in children - delayed skeletal maturation

Thyroid Acropachy - periosteal rxn & thickening of tubular bones
fuzy periostitis on radial side of metacarpals & mid phalanges very distinctive
Present HYPO or euthyroid w exopthalmos & pretibial edema

occurs years after Tx for hyperthyroidism

Cretinism - Hypothryoid from birth, Delayed Skeletal maturation
Endosteal cortical thickening obliterating marrow cavity
Irreg ossifacation esp in femoral epiphysis
Vert bodies flat & hypoplastic, esp T12-L1 causing KYPHOSIS

Acromegaly - Eosinophilic Adenoma #1 cause, equal in sexes
50% show Skull thickening esp at base, 20% w N sella
Periosteal Apositional bone formation in long bones
Exagerated tuberosities, generalized ST thickening, esp heal pad to >21mm
Premature Oteoarthritis - cartilage thickens then dies due to inadequate blood supply, post vert scalloping

Vert - post scalloping in 30%
Enthesopathy - "Spade Digits" & lg spurs of distal metacarpals

Post Radiation Tx - Pattern matches ports, ST calc assoc

Worth Syndrome - Auto Dom, Endosteal Hyperostosis
Endosteal thickening of tubular bones obliterating marro
Osteosclerosis of skull begins at base, extends to face
Mandible freq involved, pelvis & ribs not involved
Spine - primarily post elements thickened

Lead Poisoning - can create dense metaphyseal line
abnormal remodeling of tubular bones possible
widened cranial sutures due to inc intracranial pressure possible

Englemann' Dz - Progressive Diaphyseal Dysplasia, not familial
Rapid prolif of new cortical bone, symetrical thickening
Sim paget's but Diaphyseal only, stops at metaphyseal line

Pachydermoperiostosis - Hypertrophic Oteoarthopathy, Auto Dom
M>>F, middle age, lg thick skin folds, enlarged paranasal sinuses
Irreg periosteal proif of phalnges & dist long bones - CLUBBING
Epiphysis & metphyseal regions of tubular long bones #1
cortex thickens but NO narrowing of medullary cavity
can have acro-osteolysis, progression ceases after several years
DDx - pulm osteoarthropathy (painful) & thyroid acropachy

Osteitis Condensans of the Clavicle - thickend trabecula due to stress
normal joint space maintained, clavicle head may be expanded
increased density confined to lower medial clavicle, UNILAT
pain & swelling but no skin inflammation

Congenital Bone Disease

CONGENITAL BONE DISEASES
Subperiosteal new bone can be seen in N infants

Scoliosis - Adolescent type most common, multifactorial inheritance
Congenital Scoliosis - look for assoc vert body anomalies, hemi or butterfly
Idiopathic Scoliosis - usually convex to the right, L assoc w other anomali
15% assoc w congenital heart Dz

Wedged vert body at apex of curve,
I' curve forms w II' curves above & below
8:1 female, starts P 10y/o & stops w cessation of growth
NF-1, TB, Osteoid Osteoma, Marfan's
Wilm's - due to radiation necrosis of ipsilateral apophysis

Infantile Cortical Hyperostosis
- marked cortical thickening
<6mo old, acutlely ill, irritable - probably infectious
Metaphysis spared, Freq exacerbation & remission
resolves completely within a few months
Vert bodies also spared

Osteogenesis Imperfecta - bad osteoblasts, poor osteogenesis
Collagen also abn, Fibroblast cultures for Dx
Tarda - (Types I), Auto Dom, BLUE Sclera, least severe form
NO congenital fractures but Ribbon Ribs & Deafness
Long bones - Diaphyseal Bowing, Cyst-like lesions
Skull - Wormian bones ALWAYS seen, Basilar Invagination
Fx freq w Exuberant callus formation, NO IUGR by US
No further fx usually occur P puberty
"Popcorn" metaphysis - cystic lesions pathog for OI
Type IV - similar but mild deaf & bowing, No blue sclera
Congenita - (Types II & III), Auto Rec, accordian bones, II lethal
Thin skull
Wedge or bow-tie vert bodies

Pseudohypoparathyroidism -
End organ resistance to hormone
Heritable syndrome w 3 components
1) Skeletal abn - Manifestations of HYPOparathyroidism
Osteosclerosis, Calverial thickening
Dwarfism - Shortened & bowed long bones
Shortened 4th & 5th metacarpals & distal thumb phalanx
2) Soft Tissue Calc - Basal Ganglia, Dentate nuc, skin & subQ
Broad Facies, Mental Retardation & Cataracts also assoc
3) Abn Blood Chemistry - LOW Ca+, HIGH phos
Turner's Syndrome - XO, Delayed epiphyseal fusion
Shortened 4th & 5th metacarpals, Shortened ulna
"Drumstick" metacarpals & phalanges
Cubitus Valgus - large medial femoral condyle
Odontoid hypoplasia & small sella tursica
"Squared" vertebra - shortened A-P diameter
Horseshoe Kidney, Coarctation of the aorta & Infantilism

Syphilis - Trophic depostits of endochondral bone
Zone of provisional Calc widens, lucent fibrous zone prox
"Saber shin" - severe form of subperiosteal bone growth occurs everywhere but ant tibia most common
Charcot joints & minimal ST component, rapid response to PCN
DDx - scurvy & ricketts, but pt too young

Hereditary Osteocartilaginous Exostoses - effects long bones exostoses are not as large or spike-like as isolated form
Madelung deformity of wrist - Paired bones show dif growth
Supernumary Digits & radial head dislocation
Chondrosarcomatous Degeneration - occurs in 20%, esp hips

Tuberous Sclerosis - Cortical thickening, can sim pagets
Flat osteomatous protuberances on cortex
Paraventricular tubers, Renal masses, Pulm infiltrates
Zits, Fits & Nitwits, lytic lesions poss but rare

Neurofibromatosis - Von Recklinghausens (NF-1) assoc w bone
Family Hx #1 presentation, Fx w pseudoarthrosis also
ST dysplasia induced by abn nerves - Elephant Man
ABN TRABECULATION PATTERN, "Ribbon Ribs", mult NOF
Ossification centers & digits can have marked overgrowth
UNILAT ANTERIOR bowing of distal leg
(osteogenesis is bilat, fetal malposition causes post bow)
Extensive subperiosteal hem w exuberant callus poss
Bizarre facial dysplasia - Sphenoid #1, orbit asymetry
Post orbit does not develop, Poss II' to optic gliomas
Sharply angled Scoliosis - worsens even P growth stops
Scalloped post vert bodies - mult spinal meningoceles
small vert body, long sclerotic post elements
"Dumb-bell" tumors - widen formena & erode pedicles
Focal Gigantism of a digit
Cafe Au lait spots, gliomas, lesch nodules of iris
Renal artery Stenosis & Neurofibrosarcoma poss
Blount's Dz - Osteochondrosis Deformans Tibiae
lat dilocation of tibia, wedge-shaped deformity of medial tibia
Infantile Form - physiologic bowing fails to straighten w growth
Histo shows disturbed medial epiphyseal endochondral oss
Juvenile Form - less common,

segmental arrest of medial growth plate
usually unilat, affects children 8-15yrs

Gaucher's Dz - Auto Rec, Dec lysosomal Hydrolase
Glucosyl Ceramide accumulates in RES organs, 3 forms
Adult - #1, mult spleen nodes, pulm & hepatic fail, death
Juvenile - 2-6yrs, mild w predominate neurologic Sx
Infantile - hepatosplenomeg, severe neuro, early death
90% have bone Sx - Avasc Nec, Osteomyelits, Myelofibrosis
"Erlenmeyer Flask" - marked cortical thickenig at dist fem
"Fish Mouth" vertebra, bone infarcts, Periosteal Rxn
mult sharply demarcated lytic lesions poss

Mucopolysaccharidoses - lysosomal storage disorder
Morquio's - the only one NOT assoc w mental retardation
type IV, skeletal changes predominate, auto rec
"Bullet" shaped vert w gibbus due to dysplasia of L1 or T12
"Wineglass" pelvis & iliac wing flaring, dwarfism
shortened & thickened metacarpals & carpals
Premature degenerative arthritis, corneal opacities
Hurler's - type I, gargoylism, auto rec, dwarfism, MR after 1-3yrs
main Sx are neuro, "bullet" vertebra are seen though less
calverial thickening, J shaped sella, frontal bossing
Scaphocephaly due to closure of sag suture
Claw hands, thick flaring ribs

Hemolytic Anemias - Thalassemia, sickle cell, Non-spherocytic
Congenital, causes profound marrow hyperplasia
Widened Spongiosa w coarse trabecular pattern, thin cortex

Hadju-Cheney - Primary Acroosteolysis, tufts never develop, osteoporosis
Wormian bones & Kyphoscoliosis
Acroosteolysis also occurs w scleroderma, frost-bite & burn
Pyknodysostosis, psorisis & Pachydermoperiostitis

Holt-Oram Syn - Cardiomelic syndrome, Auto dom, effects upper ext only
assoc w variety of clavicle, sternum, radius anomalies
Hands #1 - carpal coalition, absent thumb etc
Heart defects predominatly conductive, septal #1 structural defects
Marfan's Syndrome - auto dom defect in collagen cross linking

Generalized Osteopenia, Dolichocepahly, prominent jaw
Thumb & 1st toe disproportionatly long, pes planus
Scoliosis in 60%, Scheuremann Dz, Dural ectasia w post scalloping
ligamentous laxity, premature osteoarthritis, slipped cap fem epiphysis
Cardiovascular - cause of death in 90%, recurrent biliary obs
Occular lens dilocation, cystic lung Dz, recurrent pneumothorax

Homocystinuria - familial defect in collagen synthesis, simulates Marfan's
arachnodactaly, scoliosis & post scalloping of vert bodies in both
Osteoporosis occurs w this but not Marfan's
ligamentous laxity present but no joint contracture as in Marfan's

Macrodystrophia Lipomatosa - macrodactyly due to neural fibrolipoma
increase in size of all elements & structures of one or more digits
fibrofatty tissue infiltrates epineurium, growth stops at puberty

Polydactyly - Preaxial means lateral, index or thumb duplication
Postaxial - medial, more common 5th digit duplication
Syndactyly - most commonly involves the 3rd & 4th digits

Infantile Coxa Vara - proximal focal femoral neck defeciency, unilat
causes varus deformity of femoral neck, widened growth plate
child presents w lurching painless gait

Madelung Deformity - volar angulation of distal Radius
relatively long ulna & radial-ulnar space widened
forms a V shaped radial & ulnar articulartion w carpals
carpal angle decreased, volar subluxation
II' to premature fusion of radial physis, assoc w trauma
also seen w Turner's & multiple enchondromatosis

Radial Ray Defects - rare, 40% assoc w VACTERL anomalies
can be absent thumb or entire radius

Klippel-Feil Syndrome - Fused cerv & upper thoracic vertebra

Sprengel's Deformity - scapula elevated & fused to cervical vertebra

Congenital Posterior Bowing of Tibia - foot dorsiflexed
etiology unkown, progressive improvement w growth

eventually becomes staight w minimal shortenening

Skeletal Dysplasias

SKELETAL DYSPLASIAS

Disturbance of bone growth
Rhizomelic Dwarfism - proximal limbs, humerus & femur, achondroplasia
Mesomelic Darfism - shortened intermediate seg
Acromelic Darfism - distal shortening, asphyxiating thoracic dysplasia
Micromelic Dwarfism - shortened entire limb, jeune syn, thanatophoric

Achondroplasia - Rhizomelic Shortening (prox long bones)
Scalloped post vert bodies as seen in acromegaly
Foramen Magnum small - Hydrocephalus causes lg head
Narrow dist spinal canal - causes prob w minimal herniation
Short pedicles & narrow intrapedicular distance MUST be present
Flattened Acetabular Angle & Iliac wings

Spondyloepiphyseal Dysplasia - Auto dom, dwarfism from spine & hips
DDx - Morquio's, several distinguishing features
presents at birth, morquio's seen at end of first year
deficient ossification of pubic bones & narrow pelvic angle, not flared
varus deformity of hips, Morquio's has valgus
NO involvement of the hands
Corneal detachment rather than corneal clouding

Multiple Epiphyseal Dysplasia - irreg mottled calc of epiphysis
late onset of dwarfism, mild limb shortening
Premature DJD, short palanges, auto rec w NO shortened lifespan
minimal spine effects DDx from Spondyloepiphyseal dysplasias
DDx - stippled epiphysis also seen w cretinism & warfarin embryopathy

Metaphyseal Chondrodysplasia - severe short limbed dwarfs all have Erlenmeyer flask deformity extending to diaphysis

Schmid Type - most common, AutoDom
widened epiphysis, cupped metaphysis & coxa vara
mimics Vit D refractory Rickets

Metaphyseal Dysplasia - Pyle Dz, often tall & asymptomatic
effects long bones esp in hand & medial clavicle, genu valgum
splaying of ends w thinned cortex

Chondroectodermal Dysplasia
- Ellis-van Creveld Syn
Accelerated Skeletal maturation
Polydactyly & congenital heart
Dz freq, Septal defects #1
Nails, hair & teeth ALWAYS involved
Cleidocranial Dysotosis - delayed ossification of midline structures
large head w Wormian bones, hypoplastic sinuses, bossing, lg mandible
hypoplastic chest, medial & lat portions of clavicle don't fuse
delayes ossification of symphysis pubis
spina bifida occulta, varus hip, short radius

Cretinism - congenital Hypothyroidism, Delayed skeletal maturation
Stippled Epiphysis, may remain open indefinetly, wide sutures & fontanelles
Demineralization but dense vertebral margins
Calvarial thickening, caxa vara, wedge vert bodies in adulthood
NO skeletal change w adult onset

Angiovenous Dysplasia - AVM, hemangioma or venous malformation
most asym, may cause overgrowth of affected limb due to inc flow
can cause focal bone errosions, look for phleboliths

Hip Dysplasia - femoral head cartilage <50% covered by acetabulum
usually displaced post & lat, will eventuall migrate superior
1) seated at rest, lax w stress, 2)subluxated, 3)dislocated
Most important is to determine if it is reducible or not
Dynamic US Scanning - neutral 1st then stress during flexion & adduction
Transverse view - head centered over & touching triradiate cartilage
femoral metaphysis inferior & ischium superior make cup for head
Coronal view - gluteal muscles will be seen lat to iliac bone & head
Abduction will demonstrate if hip is reducable
MRI - may show iliopsoas tendon within joint if dislocated
Inverted Limbus - labrum hypertrophies & turns inward to joint prevents relocation, arthrography shows loss of "rose thorn" pg760 ACR37
Femoral head ischemia - head rotates superior causing valgus deformity
occurs at younger age than Legg-Perthes
look for shallow acetabulum &

widened "teardrop" seen w chronic process
Weberg Angle - adult head should be centered in acetabulum
angle between vertical & line to upper margin of acetabulum
both lines originate in center of femoral head, 20-46deg N, smaller bad

Proximal Focal Femoral Deficiency - dysgenesis of prox femur
probably II' to in utero vasc accident, most unilat, isolated anomaly
70% have ipsilat fibular agenesis
prob due to same vasc accident
present as unilat short limb, no pain
US - shows a cartilage connection between head & shaft in mild form
severe form has no connection or no femoral head
acetabulum shallow or absent due to dysplastic femoral head
Apert's Syndrome - Acrocephalosyndactyly
Craniosynostosis of coronal suture resulting in brachiocephaly
also hypoplastic ant fossa, prominent sella turcica & choroid calcification
midface hypoplasia, hypertelorism, hydrocephalus
Syndactyly - results in "mitten hand" & "sock foot"
Symphalangism - progressive obliteration of interphalangeal joints
fusion of other joints as well including tarsals & carpals

Arthritis and Benign Joint Processes

BENIGN JOINT PROCESSES

Synovial Osteochondromatosis - usually monoarticular
Metaplasia of the synovium - cartilage deposits on synovium
Calcium deposits in cartilage, Knee, hips & elbows #1

Pigmented Villonodular Synovitis
hemosiderin deposited causing fibrosis & Synovial prolif
Monarticular degeneration of knee #1, hip #2
most commonly effects extraarticular tendon sheaths
Periarticular cystic degeneration in hands & feet freq
85% have osseous lytic lesions & cortical errosions
Lg subchondral cysts w NO joint space narrowing typical
NO CALC & NO Osteoperosis, articular cartilage preserved until late
Resembles nonossified synovial osteochondromatosis
DDx - Synovioma, sim distribution & ST mass
errosions more smooth & no pe-

riosteal rxn

Sudec's Atrophy - Reflex Sympathetic Dystrophy, shoulder-hand syn
1) onset of painful & stiff shoulder or hand joints, lasts 6mo
2) Shoulder improves but hand continues to burn, ST wasting
3) last stage may be 3-6mo or chronic, contractures, skin atrophy
Nucs - shows inc flow & uptake, plain film shows osteopenia P 6wks
Trauma is often intial event, severity does not influence outcome
Tx w corticosteroids & sympathetic block w meds or surg
Aggressive Osteoporosis is hallmark
DDx - dissuse osteoporosis, no ST wasting or skin atrophy assoc

Septic Hip - B strep in neonate, H. flu in infant, S. aureus in child
present w fever and immobile joint, X-ray N initially
Effusion displaces med aspect of head >1mm relative to opposite
Aspirtation for Dx, Emergent arthrotomy & open drainage for Tx
high risk of cartilage destruction, 15% assoc w head osteomyelitis
X-ray - <35% sensitivity, 1mm is sig for poss infection, need of aspiration
US - 90% sensitive for effusion, best in sagittal plane
echogenicity of the fluid does not relate to need for aspiration

Lyme Disease - JRA type presentation possible if no Tx
Erythema Migrans rash at site of deer tick bite, Spirochet

Gorham's Vanishing Bone - massive osteolysis II' to hemagiomatosis
bone resorbed & replaced by angiomatous tissue, crosses joints & disk
effects children & young adults, any bone involved
no pain or expansile mass assoc, no Tx effective.

Collagen Vascular Disease

NO joint destruction

Scleroderma - Tight overlying skin causes calcinosis cutis
Dist phalangeal resorb - pencil-ing & acroosteolysis
ST calc but less than dermatomyositis
NO osteoperosis

Dermatomyositis - nonsuppurative inflam myopathy
Onset 4-11yrs, Edema of SubQ tissues first Sx
Muscle also presents w edema & loss of fat-musc planes

Eventual fibrosis, calc & contracture
ST calc in linear confluent pattern
seen in hands, axilla, inguinal & chest wall
Bone undergoes dissuse resorbtion
NO terminal tuft resorbtion, malig joint contracture assoc
Fever, rash, lymphadenopathy, splenomegaly & death assoc
Atony & dilation of the esophagus

Systemic Lupus Erythematosus - Alignment changes, NO ERROSIONS
Boutoneire Deformity - lax joint capsules esp at MCP joints
reducable ulnar deviation typical
Nonerrosive peripheral polyarthritis w sim distribution as RA
Calc of tendenous insertions poss

Mixed connective tis Dz - sclero, SLE, polymyositis & RA
Osteoporosis & soft tissue wasting
No erosions

Trauma

CERVICAL SPINE

Prevertebral soft tissue - 3mm from C1-C4, smooth contour
Anterior vertebral bodies - interuption indicates serious inj
Spinolaminal line - disruption could indicate cord injury
C1 ant arch should be no more than 2.5mm from dens (5mm kids)
Nerve Root Avulsion - most common in dist cerv spine

Jefferson's fx - split C1, CT to demonstrate all fx points
Unstable only if Trans lig disrupted, seen if >7mm spread
rarely assoc w an odontoid fx

Rotary fixation of the atlantoaxial joint - follows mild tra
C1-C2 move en mass, lat spaces unequal even w/o rotation

Clay Shoveler's fx - avulsion of lower spinous process
excesive force to the superaspinous ligaments

Hangman's fx - bilat neural arch fx of C2, ant Sublux of C2 on C3
hyperextention & extraction injury, unstable but cord decomp
prevertebral ST swelling but NO facet dilocation
ant inf corner fx of C2

Hyperextention Teardrop Fx - avulsion of ant inf corner by ant long lig, C2 #1
Usually no displacement of vert body

Hyperflextion Teardrop Fx - ant inf corner crushed anteriorly,

body retropulsed
one of the most severe & unstable, cause ant cord syn - quad & loss of pain

Unilateral locked facet - apophyseal ligaments rupture
flexion & rotation inf, facets overide, rarely bilat

Ant Subluxation - hyperextention, 20% have delayed instability
kyphotic angulation w narrowed ant disk space, wide post

Instability - inability to withstand physiologic loads
Intervertebral space widened, horiz displacement >3.5mm
angulation >11deg, disruption of facets, mult fx's

LUMBAR SPINE
Seat belt injury - ant compression of L1 or L2

Smith's fx - fx of post body

Chance fx - results from flexion, 10% assoc w bowel damage
failure of the post & middle spinal columns
ant failure also poss

Spondylolysis - fx of the pars interarticularis of lamina
fx in neck of scottie dog on obl view
often occurs in toddler yrs, not always significant

Spondylolisthesis - bilat pars fx, sup sublux ant to inf

HAND
Bennett's fx - fx at base of 1st metacarpal into carpomet joi
thumb adductors cause sliding, must be surgically fixed
psuedo-bennett's fx - no involvement of the joint

Rolando's fx - com fx at base of 1st met w joint involed

Mallet Finger or Baseball Finger - avul at dorsal base of dist phal extensor digitorum insertion
makes surg fix mandatory
flexs w/o opposition due to loss of extensor

Volar Plate Fx - fx at the base of the mid phalanx along the volar aspect

Gamekeeper's thumb - avul of ulnar side of 1st prox phalanx

WRIST
80% of axial loading force on radius
any radial fx can result in positive ulnar variance

Lunate/Perilunate Dislocation - ligaments to capitate disrupt
Dorsal perilunate dislocation -

capitelum & carpals dorsal
3x more common than lunate disloc, 75% assoc w Fx

Lunate dislocation - lunate pushed volar to radius
manipulation can change one to the other
pie shaped lunate seen on AP view
permanent median nerve damage can result from lunate
assoc w capitate, radial styloid, & triquetrum fx
Can cause dorsal instability of the wrist

Ulnolunate Impaction Syn - pos ulnar variance flattens med lunate
triangular fibrocartilage thinned & often torn by long ulna
subchondral degen cyst develops in lunate due to impaction

Kienbock's Malacia - avasc nec of lunate
assoc w negative ulnar variance, short ulna

Hook of Hamate Fx - need carpal tunnel view, parralel to palm
usually due to fall onto an outstreched hand
prof baseball, tennis, & golfers
can lever of hook
Ulnar Nerve which lies adjacent & outside tunnel often damaged
CT may be helpful

Fracture of Scaphoid - avasc nec of prox frag common

Dorsal Instability of Wrist - disruption of dorsal radiocarpal ligaments
60% due to scaphoid fx, 10% due to triquetral fx (dorsal chip seen)
ligament inj such as rotary sublux of scaphoid or perilunate disloc also
AP film - often shows widening of scapholunate joint
Lat Film - key to diagnosis of dorsiflexion instability
shows volar angulation of lunate & capitate displaced volar (post)
lines drawn thru vert axis of lunate & scaphoid angle >80deg (N 30-60)
Palmarflexion instability - Ant displaced capitate & palmar angulation of lunate

Rotary sublux of Scaphoid - ruptured scapholunate lig, scaphoid rotates volar
lat view shows horizontal orientation of scaphoid
gap between scaphoid and lunate on AP view - "Terry Thomas Sign"

Triquetral fx - avul chip seen on dorsum of wrist patognomonic
occurs at dorsum and may cause dorsal instability of the wrist

horizontal compresion assoc w perilunate diloc, capitate &/or scaphoid Fx

Carpal Tunnel - carries median & ulnar N, Radial & Ulnar art
Flexor digitorum Profunda deep & superficialis over
Flexor dig Longus goes over flexor retinaculum, inserts to palmar aponeurosis
Carpal tunnel syndrome - most common in obese middle age women

Carpal-Ulnar Dislocation - ulna & triquetrum no longer aligned

deQuervain's Stenosing Tenosynovitis - affects the extensors over radial styloid
abductor pollicus longus & brevis, MRI shows fat planes inflammed
pain occurs w thumb movement, most in young female during lactation

FOREARM
Colle's fx - dorsal ang of dist radius/ulnar styloid fx

Smith's fx - volar ang of dist radius/ulna fx

Plastic bowing deformity - bend but no break
must be surgicaly broken & reset or lose sup & pronation

Monteggia's Fx - ulna fx, (90% proximal) & prox radius disloc
must examine prox radius or aseptic nec may result
Positive Ulnar Variance - can result from any radial fx

Galleazzi's Fx - radial fx w disloc of distal ulna

Essex-Lopressti Fx - radial head fx w dislocation of dist radial ulnar

Barton Fx - Fx of the dorsal articular margin of dist radius

ELBOW
Fat pad displaced from post fossa following fx
child usually supracondylar, adult usually radial head
Children can have effusion without Fx - Dr. Ozonoff

CRITOE 1,5,7,10,10,12 - order & age of epiphysis ossification elbow
Capitulum, Radius, Internal epicondyle (med),Trochlea
Olecranon & External epicondyle (lat)
All but lat epi fuse by 16yrs, 18 - lat fused
Come Rub My Tree Of Love - Erin Masada's pneumonic

Ligamentous Injuries
Ulnar Collateral Lig - most important, resists valgus stress
Ant thick cordlike, middle aponeurotic, post thin & tran
freq stressed in pitchers
Annular Ligament - stabalizes radial head in pronation & sup
Dislocation - radius & ulna together #1
Nursemaids - reduced w supination & ext rotation
Radial head freq w ulnar Fx
Common Flexor Tendon - from med epicondyle, can avulse
Extensor Tendon - inflam causes Tennis Elbow, esp anconius muscle

Olecranon Bursa
Subcutaneous - freq assoc w housemaids elbow & trauma
Subtendinous - assoc w pitcher injuries, chips in fossa

Pseudodefect of the Capitulum - defect in postlat articulation on MR
mistaken for osteochondral lesion or fx
True osteochonritis would be located more ant in cart

Essex-Lopresti Fx - Radial head Fx w dilocation of dist radial ulnar joint

Volkmann's Contracture - complication of a supracondylar fx
vascular compromise from brachial art injury or swelling
muscle & nerve ischemia results in flexion contracture of hand & wrist

Biceps Tendon Rupture - most common tendinous injury
pt unable to flex biceps, pain over radial tuberosity

Little Leaguer's Elbow - osteochondral injury to capitellum due to repeated valgus stress

SHOULDER
Neer Classifications for Fx's - based on # & angulation of frags
One Part - 80%, surgical neck fx w no displacement
Two Part - Fx of surgical neck w displacement
>45deg angulation or >1cm apart, ORIF required
Three Part - greater or lesser tuberosity avulsed & displaced
Four Part - both greater & lesser tuberosity displaced
devascularization of humeral head

Ant dislocation - #1, ext rotation and abduction
head seen inf and medial to the glenoid
Hill-Sachs deformity - Fx of postlat head of hum, 50%
caused by inf lip of glenoid, dis-

loc likely to recur
Bankart deformity - frag off inf glenoid, less common
Axillary Nerve Injury assoc

Post dislocation - more dif to Dx, use scapular Y or Axillary veiw
AP view - may be N, lose overlap of glenoid & head, sm space seen
look for lesser tuberosity avul or Fx of post rim of glenoid
Reverse Hill-Sach's - trough Fx of ant-medial aspect of humeral head poss

Traumatic hemarthrosis - blood displaces head inf medially
CT may be helpful in fully evaluating a joint fx

Rotator Cuff Tear - narrowed subacromial space when chronic
Contrast to subacromion & subdeltoid bursa on arthrogram

PELVIS
Acetabulum - CT needed to show free frags and subtle fx

Sacrum - fx 50% of time w pelvis fx, dificult to see
look for interruption of the arcuate lines
stress fx can appear sclerotic in osteopenic pt, CT

Malaigne Fx - SI diastasis assoc w pelvic ring Fx
60% chance of significant injury elsewhere in the body

FEMUR
Femoral Head Dysplasia - abn fem head & acetabular relationship
Etiology - Familial or anatomic variance, crowding or breech
90% effect females
Laxity of capsule allows head
Sublux & compress posst labrum eventually may dislocate

causeing labrum to flip down
II' acetabular dysplasia follows if not corrected
Pavlik Harness - holds in flexion & ext rotation
US - greater than 50% of fem head should be in acetab

Femoral neck stress fx - dif to detect esp in elderly
type 1 - sclerosis w/o fx line evident, bedrest for tx
type 2 - sclerosis w fx line evident, int fixation
type 3 - displaced fx evident

Long Bone Stress Fx - may present as sclerosis, NO Bx
repeat in 1-2 wks, CT & MRI helpful

Femoral Muscle Avulsions
Sartoius - ant sup iliac spine
Rectus Femoris - ant in iliac spine
Hamstrings - ischial tuberosity

KNEE

Collateral Ligaments - Medial attached to the meniscus, tears more freq
Medial Collateral Ligament - tear assoc w segond & ACL injury
Lateral has 3 parts - fibular collateral, iliotibial collateral & arcuate

Meniscul Tears - horiz Tears degenerative, vert tears post traumatic
Medial meniscus more likely to tear than lat, posterior > anterior
assoc w med collateral, ACL & Segond injury
Bucket Handle - inner portion of lat meniscus displaced intracondylar
Discoid Meniscus - more likely to be lat, prone to tear
more common in children, ie lat tears #1 in child

Pitfalls of Meniscul Tears - ligament insertions
Humphry's lig - passes just ant to PCL, inserts post lat meniscus
Wrisburg Lig - passes just post to PCL, inserts post lat meniscus
oblique form post horn of lat meniscus to med fem condyle
Transverse Lig - connects the med & lat ant menisci
Popliteus Tendon - inserts on lat fem condyle, passes postlat meniscus
Ant medial meniscus is 1/2 the size of the posterior medial

Synovial Cysts - extrusion of synovium w no communiction seen
Ganglion Cyst - assoc w tendonous synovial compartments
filled w gelatenous fluid, often appear intramuscular
Bakers Cyst - between semimem tendon & med gastroc head
free communication to joint space, seen on arthrography
occasionally causes entrapment of the peroneal nerve
rupture can cause pain & swelling similar to thrombophebitis

Meniscal Cyst - comm w joint via meniscus tear, usually lateral
gelatinous fluid prevents visualization w arthrography
Inclusion Cyst - seen w an intact miniscus

Plica - adhesive band to dist femur, seen best w effusion
Medial Patellar Plica - most likely to cause Sx
Superior plica - between suprapatellar tendon & femur
lateral placa - between lat coll ligament & femur

Pes Anserinus - attachment of semitend, gracilic & saratorius
attaches to medial tibia, N bursa should not be seen

ACL Tears - external rotation & abduction
Segond's Fx - longitudinal fx of post & lat tibia
occurs just dist to tibial platue, always seen w ACL tear
Deepening of the lateral femoral sulcus - 100% specific
Medial Meniscus & Medial Collateral lig complete triad
Tibial Platue Fx - assoc fibular fx
tends to be adjacent to tibial fx
rarely cause damage to popliteal art, 5% get peroneal nerve palsy
Types - compression, split, combined or bicondylar
knee instability develops in 30% within 2yrs, 50% get DJD in 15yrs
20% assoc w meniscal tear, may interfer w reduction
Tx - if <4mm displaced use brief immobilization & range of motion early
poor outcome assoc w >10deg of varus angulation
collateral lig tears must be repaired to reduce laxity
50% require open reduction & internal fixation

Patella Alta - pattella subluxed superior due to pattellar ligament disrup

Knee Prosthesis - anatomic alignment crucial to stability
femoral component 7deg valgus +/- 3deg, tibial 90deg to long axis
tibial component also tilts 10deg post to allow complete flexion
Normal Long Term Appearance - two common changes
Lucency bone prosthesis interface <2mm, esp at ant tibial region
Stress Shielding of Femur - due to nonuniform load transfer
linear band of inc bone density extending from portion of prosthesis
Failure - follows nonanatomic component placement or ligament laxity
Tibial loosens most often, tilts varus w subsidence of med plateau
Patellar component is the most common site of arthroplasty complication
subsidence occurs in 15% but it often stabalizes (ie infrequent "failure")
Infection - most serious complication, occurs in <2%
73% appear normal on plain film, abscence of signs does not exclude infec
Periprosthetic Fracture - assoc w osteopenia and rheumatoid arthritis
usually incomplete and appear as sclerotic lines of impaction
Particle Disease - granulomatous response to debris from wear & tear

FOOT & ANKLE
Cavus - elevation of the arch of

the foot
Plantus - flattening of the arch of the foot

Maisonneuve Fx - proximal fibula Fx which is often associated w ankle fractures
proximal films must always be obtained to rule this out
Dr. Abrahams asked me this question during oral boards

Inversion-Adduction Injury - Lat lig rupture or trans fx lat malleolus
angular forces from talus can cause obl fx of medial malleolus

Eversion Injury - Deltoid lig rupture & med malleolus Fx
Dist tibiofibular lig tear, fx of dist fib including spiral type
does NOT cause trans fx of lat malleolus

Jones Fx - trans thru base of 5th metatarsal
occurs II' to inversion-adduction also

Calcaneal Stress Fx - linear band of sclerosis in post calca
Boehler's angle - 30-40 deg N, lines drawn post & ant
not the best predictor of outcome, does not indicate ORIF
Alignment of the post articular surface predicts outcome
Coronal thin section CT best for assesment
Essex-Lopresti classification for Fx's - tounge type or joint depression type
result from forces at the angle of Gissane
75% have some intra-articular component, all assoc w lumbar fx

Talar Neck fx - forced dorsiflexion

Kohler's Malacia - avasc nec of tarsal navicular, poss N var seen in kids, Tx w immobilization

Lisfanc's Fx - fx dislocation of the tarsometatarsals
Med border of 2nd metatarsal aligns med border of 2nd cune
Bunkbed Fx - fx disloc of 1st metatarsal & medial(1st) cuneiform

Chopart Dislocation - talonavicular & calcaneo-cuboid joints dilocated
mid tarsal dislocation

Clubfoot - Usully Equinovarus, Navicular rotated med to talar head
lat veiw shows talus & calcaneus parralel

Flatfoot - hindfoot valgus, navicular rotated lat to talar head
Talus rotates downward in front w navicular near dorsum

Halx Valgus - great toe turned lat
Subtalr Dislocation - dist foot dislocates from fall onto inverted foot
talonavicular & talocalcaneal joints disrupted, medial #1 calcaneocuboid joint & ankle intact
poor outcome if assoc w talar Fx

Tillo Fx - lat epiphysis of distal tibia
occurs in adolescence when fuseing from med to lat

Tendon Tear on MRI - degeneration, partial tear & tendinitis appear sim
inc signal in substance of tendon, tendon enlargement seen w all 3
Peronius, Post Tibial & Flexor Digitorum - fluid seen in sheath
Post Tibial - rupture in women w rhuematoid, painful flat foot assoc
Flexor Hallucis Longus - sheath communicates w joint, eff may migrate
Ant Tibial Tendon - rupture rare, tenosynovitis in downhill hikers
Achilles - has no sheath so can be abn w no evidence of fluid on MRI

Navicular Fx - avulsion of cortical margin #1 midtarsal Fx
deltoid ligament attachment in mid upper margin
not significantly displaced, not a significant portion of articular surface

Hallux Valgus Deformity - lat deviation of entire 1st toe
sesamoids not centered over joint & medial 1st head prominence
Hallux Rigidus Deformity - DJD causeing loss of dorsiflexion

Hammertoe - fixed flexion contracture at prox interphalangeal joint
Claw toe is flexion of dist interphalangeal joint

PEDIATRIC TRAUMA

Birth Trauma - Clavicle fx #1, femur & humerus poss
usually spiral fx of diaphysis II' to breech
Undetected metaphyseal & epiphyseal fx freq
Good prognosis, pseudoarthrosis very rare

Battered Child - Metaphyseal avul or "Corner Fx" pathog
may see squaring of metaphysis, "bucket handle"
Perisoteal rxn exuberant, periosteum easily pulled free
Visceral injury & subdural hem assoc

Bowing Fracture in Child - due to longitudinal compressive force
assoc w fx of parralel bone, oc-

curs in naturaly bowing bone
forearm #1, leg #2, fix w manual manipulation

Salter-Harris Fractures
any fx involving the growth plate
I-VI
Zone of degen & transformation
weakest portion of plate
best place - no germ cells, supply from metaphysis
Epiphyseal blood supply critical to germinal matrix growth
20% of all childhood Fx, dist radius accounts for 50%
Dist femur & prox tibia 3%, but 50% of growth arrest

Type I - growth plate shear, best prognosis
Hip injury can mimic disloc, arthro will show cart head
dist Humerus Fx can sim disloc, epiphysis shifts en bloc
Radius remains aligned to capitelum oss center
True fx radius is not aligned w capitelum
Apophyseal injuries to elbow, sup acetabulum & ischial tub

Type II - Fx thru metaphysis into physis
Easy to reduce except at knee, tends to hem

Type III - Fx thru epiphysis into physis
Offset of articular surface complicates reduction
Tillo Fx - most common, lat epiphysis of distal tibia
occurs in adolescence when fuseing from med to lat

Type IV - Fx thru all 3 structures, difficult to align
Triplane Fx - prox tibial epiphysis fx in sag plane
maetaphysis Fx in Coronal Plane, epi in horiz plane
Bony bar - cross union between met & epi, arrest & twist

Type V - easiest to miss, only germinal cells crushed
Type VI - periosteal only, not X-ray Dx
Type VII - Osteochondritis desicans

Osteochondritis Dissecans - Type VII Salter-Harris Fx
chip Fx in articular surface of epiphysis, growth plate Normal
Adolescent males - 15-20yrs, never seen before 10yrs or after 50yrs
present w locking, recurrent swelling or aym
Osteochondral Fx from "nutcracker"
Medial femoral condyle lat portion in 75%, seen on tunnel view
talus & capitellum also, Lat femoral condyle very rarely affected
predisposes to early osteoarthritis

DDx - N ossification variant, epiphyseal dysplasia

Chondromalacia Patella - pain, errosion of cartilage in adolescent
due to mechanical stress, T1 MRI best for evaluation
called osteoarthritis in an adult.

MRI of Bone Marrow Lesions

MRI CHARACTERISTICS OF BONE MARROW LESIONS

Gradient Recalled Echo Images - partial flip angle followed by 180
effective trans relaxation (T2*) instead of T2
Susceptibility differences cause irreversible dephaseing, shortening T2*
Trabecula in marrow form inhomogeneous susceptibilities
loss of marrow signal results, not seen in diaphyseal region

Hemorrhage - Susceptibility from Iron products also causes signal loss

STIR - Short Tau Inversion Recovery, starts w an initial 180
a 90 is given when fat protons at their "null point", approx 350msec
a second 180 then rephases the protons
Increased marrow to lesion conspicuity results, esp in fatty marrow

FSE - Fast Aquisition Spin Echo, produces images w long TR in short time
k-space filling is altered by aquiring trains of 2-16 echoes after one 90 pulse
the TE becomes a midline value instead of a fixed value
middle lines of k-space are assoc w the greatest signal & highest contrast

Fatty marrow sustains a higher signal intensity than conventional Spin Echo
increased difficulty distinguishing fatty from red marrow
improved sensitivity using fat suppresion techniques

Fat Suppresion Techniques - use chemical shift between fat & water protons
they resonate at slightly diff frequencies due to enviroment differences
Fat is suppresed by using low intensity RF centered on fat resonance
fat magnîn is rotated mult times in the direction of the applied RF
This nulls the Z component of fat magnetization & blocks fat signal
routine spin echo or FSE sequence can then be performed on water

Marrow Distribution - Red is intermediate T1 intensity, fatty is bright
Infant pattern - homogeneous intermediate intensity in all long bones
childhood pattern - intermediate metaphyseal intensity up to 10yrs
Ossifying epiphyses always contain high intensity FATTY marrow
Adolescent Pattern - patchy transformation of metaphyseal marrow
Adult Pattern - fatty marrow in all portions of long bone
Red Marrow can be N in prox fem & humeral metaphysis
also seen in flat bones & axial skeleton, clivus is fatty though

Medullary Bone Infarct - occurs II' to ischemia
Acute appear as intermediate T1 & high T2
Chronic shows more defined borders, fibrous interface

Sickle Cell - frequently have extensive cellular replacement
Infarcts are freq complication due to sickles
Radiation Therapy - diffuse fatty replacement in field of port
follows 2000-4000 rads, edema & destruction of sinusoids intitally
DDx - anaplastic anemia, fatty replacement also but more patchy

Lymphoma - focal regions of dec marrow signal due to cellularity

Leukemic Bone - can have diffuse inc cellularity in active stage