

## ORTHOPEDIC DIAGNOSIS: COMMON ORTHOPEDIC DISEASES IN DOGS AND CATS

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## PERIOSTEAL REACTIONS: AGGRESSIVE VS. NON-AGGRESSIVE

- Dr. Google says ...



## INFLUENCING FACTORS TO HELP YOU DECIDE WHAT TYPE OF OSSEOUS LESION IS PRESENT

- Location of lesion
- Zone of transition
- Lysis or osseous production
- Periosteal reaction
- Joint involvement
- Mono or polyostotic
- Signalment of animal
- Not animal's or lesions "read the book"!



## LESION LOCATION

- Anatomic parts of a long bone
  - Metaphyseal (F)
  - Diaphyseal (G)
  - Physeal (D)
  - Epiphyseal (or joint involvement) (A)



## ZONE OF TRANSITION

- The area where an osseous lesion appears to stop and joins normal appearing bone
- Sharply defined (short) zone of transition (benign tendency)
- Poorly defined (long) zone of transition (malignant/aggressive tendency)



## LYSIS OR BONY PRODUCTION

- Bony lysis
  - Osteolytic activity predominates normal bone homeostasis, resulting in lytic changes or cortical or trabecular bone
- Bony production
  - Osteoblastic activity predominates normal bone homeostasis, resulting in new bone formation
- Both lysis and production can either be focal (regional) or diffuse (metastatic or systemic)



### TYPES OF BONY LYSIS

- Focal (regional)
  - Geographic lysis
  - Permeative lysis
- Diffuse (metastatic)
  - Osteopenia (osteoporosis)
  - Multiple myeloma



### NON-AGGRESSIVE OSSEOUS LESION

- Roentgen Signs of a Non-Aggressive Bone Lesion
  - Well defined margins
  - No periosteal reaction or non-aggressive periosteal reaction present
  - No bony lysis



### PERIOSTEAL REACTION

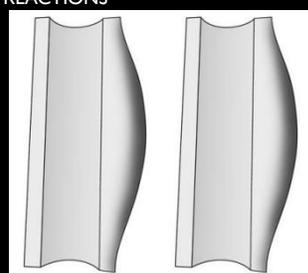
- Periosteal reaction is a result of how cortical bone reacts to an insult, resulting in periosteal elevation from the cortex to form various patterns of periosteal reaction. The type of periosteal reaction depends on the intensity, aggressiveness and duration of the insult and is also influenced by the age and overall health of the patient.

### TYPES OF PERIOSTEAL REACTIONS

- Non-Aggressive
  - Thin
  - Solid
  - Thick irregular
  - Septated
- Aggressive
  - Lamellated (onion skin)
  - Spiculated
    - Perpendicular
    - Sunburst
  - Amorphous
  - Codman triangle

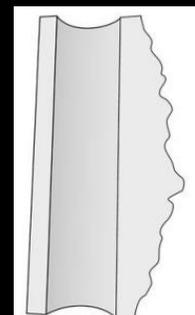
### NON-AGGRESSIVE PERIOSTEAL REACTIONS

- Thin or solid
- Smoothly margined
- Well defined
- Solid
- No underlying lysis of cortex



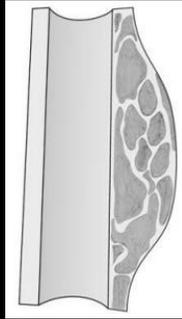
### NON-AGGRESSIVE PERIOSTEAL REACTIONS

- Irregular or wavy
- Well defined
- No underlying lysis of cortex



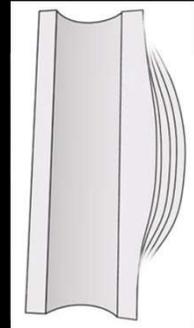
## NON-AGGRESSIVE PERIOSTEAL REACTIONS

- Septated
- Smoothly marginated
- Well defined
- Heterogenous interior (forming septations)
- No underlying lysis of cortex



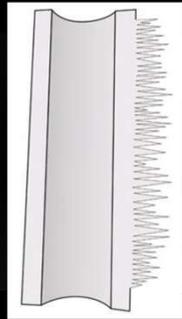
## AGGRESSIVE PERIOSTEAL REACTIONS

- Lamellated (onion skin)
- Smoothly marginated
- Well defined
- Concentric layers are present with alternating bone layers with parallel soft tissue layers
- No underlying lysis of cortex



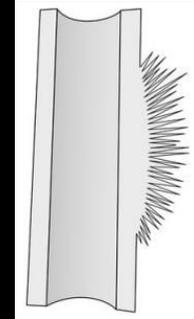
## AGGRESSIVE PERIOSTEAL REACTIONS

- Spiculated (hair-on-end)
- Irregular margins with peaks and valleys parallel to each other but perpendicular to the cortical bone
- Well defined
- May be poorly defined where it joins the cortical bone
- +/- lysis of cortex



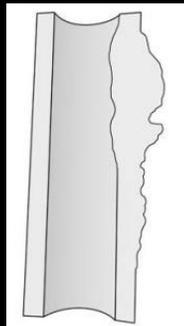
## AGGRESSIVE PERIOSTEAL REACTIONS

- Sunburst
- Irregular margins with peaks and valleys
- Well defined
- Bony spicules that appear to be coming from a central origin (shot from a cannon)
- No underlying lysis of cortex



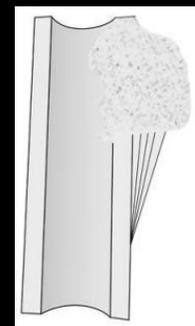
## AGGRESSIVE PERIOSTEAL REACTIONS

- Amorphous (disorganized)
- Poorly defined mixture of lysis and ill defined, irregularly shaped bone
- Very poorly defined margins
- Underlying lysis of cortex



## CODMAN TRIANGLE

- Caused by an aggressive lesion that is extending along the sub-periosteal space, disrupting Sharpey's fibers, allowing the periosteum to "elevate" away from the cortical bone as the disease progresses.



## JOINT INVOLVEMENT

- Cranial cruciate disease?
- Intracapsular effusion
  - Definite fluid accumulation within the joint space
- Lysis of the articular surface of the involved bones
  - Synovial cell sarcoma



## MONOSTOTIC OR POLYOSTOTIC

- Monostotic
  - Single lesion in only one bone
  - Large breed, metaphyseal, osteosarcoma
- Polyostotic
  - More than one lesion in multiple bones or multiple locations
  - Toy breed, articular surface lysis, auto-immune polyarthropathy (rheumatoid)



## SIGNALMENT AND BREED

- Signalment
  - Age
    - Older animals are more likely to have neoplasia
    - Younger animals are more likely to have infections (bacterial and fungal)
    - Hunting dogs more likely to have fungal disease
- Breed
  - Tumor factory dogs (Golden Retrievers, Boxers)
  - Large breeds more likely to have primary bone tumors



## NON-AGGRESSIVE OSSEOUS LESION

- Low-grade or chronic irritation wherein there is sufficient time for the periosteum to lay down new normal or near normal bone over the cortex. The cortex will appear thick or wavy but well defined.
- Common causes include low grade infection, callous formation in fracture healing or some slow growing tumors
- Roentgen signs of a non-aggressive bony lesion
  - No lysis
  - +/- bony production
  - Well defined zone of transition
  - No periosteal reaction or non-aggressive type periosteal reaction
  - Mild to no soft tissue swelling in the area of the lesion

## AGGRESSIVE OSSEOUS LESION

- Caused by the rapid irritative process that involves or invades under the periosteum in which the periosteum does not have time to lay down new normal bone before it is disrupted again. The cortex may appear lamellated, amorphous or sunburst like.
- Commonly caused by neoplasia, infection, periosteal hemorrhage from trauma.
- Roentgen Signs of an aggressive osseous lesion
  - Poorly defined zone of transition
  - Aggressive type periosteal reaction
  - Lysis of cortical and / or trabecular bone
  - Severe soft tissue swelling centered around the lesion

## OSTEOCHONDRITIS DESSICANS (OCD) OSTEOCHONDROSIS DESSICAN (OC)

- Cause
  - Sub-chondral ossification defect resulting in thickened articular cartilage, decreased oxygen availability, followed by sub-chondral bone defect and cartilage flap formation.
  - Flap may break off, float freely in joint space and mineralize (joint mouse)
- Signalment
  - Large breed dogs, 4-10 months, often bilateral

## OSTEOCHONDROSIS ANATOMIC LOCATIONS

- Caudal aspect of humeral head
- Medial or lateral condyle of femoral condyles
- Medial condyle of distal humerus
- Styloid process of fibula
- Medial or lateral condyles of trochlear ridges of talus
- Glenoid surface of scapula

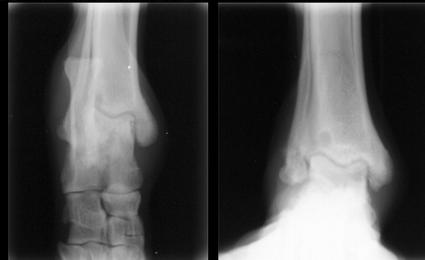
### OC SHOULDER



### OC TARSUS



### OC FLEXED CRANIAL CAUDAL

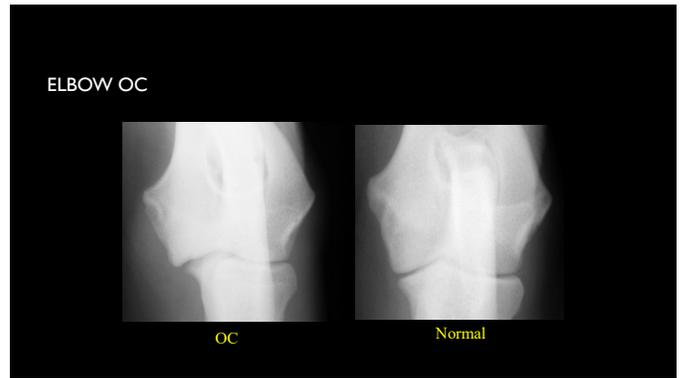
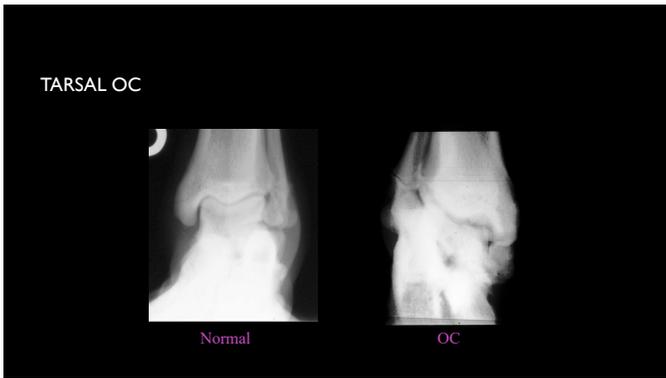


### FLEXED CRANIAL CAUDAL TARSUS



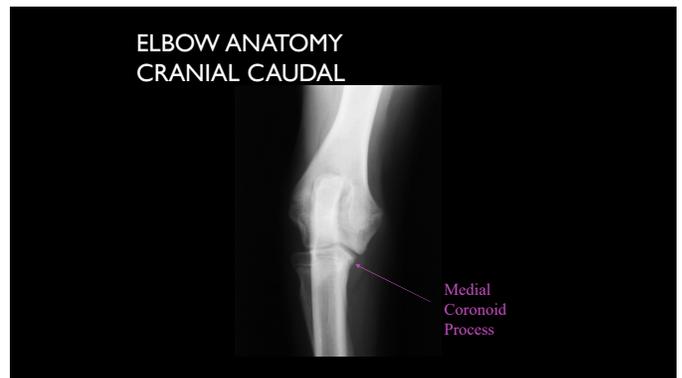
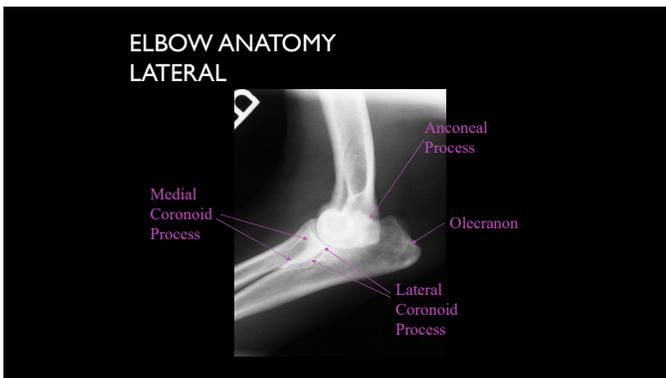
### FLEXED CRANIAL CAUDAL POSITIONING





- DEVELOPMENTAL ELBOW DISEASE IN DOGS
- Fragmented medial coronoid process (FCP)
  - Ununited anconeal process (UAP)
  - Osteochondrosis (OC)
  - Elbow incongruity

- FRAGMENTED MEDIAL CORONOID PROCESS
- Cause
    - Probably form of OC
    - Heritable
    - May lead to elbow incongruity or may be secondary to elbow incongruity
  - Signalment
    - Large breed dogs, 4-10 months
    - Shelties, middle aged to older
    - Often bilateral
    - Intermittent lameness



### FCP ROENTGEN SIGNS

- Flattened, roughened or poorly defined medial coronoid process
- Periarticular osteophyte formation of region of medial coronoid process, radial head and anconeal process
- Sclerosis of ulnar trochlear notch
- Rare to see actual "fragment"
- May see "kissing" lesion on adjacent humeral condyle

### FRAGMENTED MEDIAL CORONOID



### FRAGMENTED MEDIAL CORONOID



### FRAGMENTED MEDIAL CORONOID



### UNUNITED ANCONEAL PROCESS

- Cause – Unknown
- Signalment
  - German Shepherds
  - 5-10 months old
  - Often bilateral
- Views to get
  - Flexed lateral

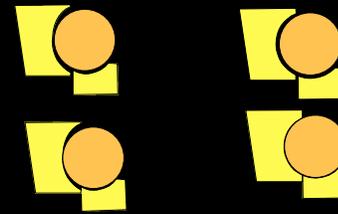
### UNUNITED ANCONEAL PROCESS

- Roentgen signs
  - Radiolucent line separating the proximal anconeal process from the ulna
  - DJD of the elbow
  - Note: Anconeal process normally arises from a separate ossification center and should fuse by about 5 months of age

## UNUNITED ANCONEAL



## CONGRUITY



## CONGRUITY?



Abnormal

Normal

## INCONGRUITY



- Premature closure of distal radial physis (70%)
- Premature closure of distal ulnar physis (80%)

## PANOSTEITIS

- Cause
  - Unknown, no known human equivalent
- Signalment
  - Medium to large breed dogs
  - <2 years, but can be seen at any age
  - "shifting leg lameness", wax and wane, mild to severe
- Views to get
  - Two views of each affected limb

## PANOSTEITIS

- Roentgen signs
  - Increased intramedullary opacity compared to contralateral limb
  - May be well defined or very vague
  - Usually in diaphyseal region of long bone, near nutrient foramen
  - Decreased endosteal definition
  - May or may not see faint periosteal reaction

## PANOSTEITIS



## HYPERTROPHIC OSTEODYSTROPHY (HOD)

- Cause
  - Unknown, viral??, nutritional??
- Signalment
  - Large breed dogs
  - 4-10 months of age
  - Can be extremely painful
  - Febrile
  - May actually die from complications (pneumonia, etc)
- Views to get
  - Two views of distal antebrachium and crus

## HYPERTROPHIC OSTEODYSTROPHY (HOD)

- Roentgen signs
  - Vague radiolucent, irregularly margined line parallel to the physis ("double physeal" sign) which is necrotic bone
  - Metaphyseal flaring – lacy bony appearance around physeal region which may extend proximally up the radius/ulna/tibia/fibula
  - Typically bilateral
  - Joint effusion

## HYPERTROPHIC OSTEODYSTROPHY

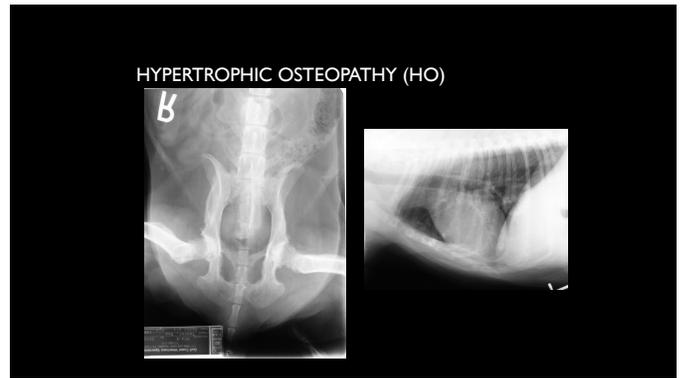


## HYPERTROPHIC OSTEOPATHY (HO)

- Cause
  - Increased blood flow to periosteum stimulates periosteal response
  - Associated with pulmonary mass lesions, but also heartworms, pneumonia and abdominal mass lesions
- Signalment
  - Older animals
  - Gradual onset of lameness, limb edema, usually involves at least two limbs

## HYPERTROPHIC OSTEOPATHY (HO)

- Roentgen signs
  - Well defined, pallisading periosteal reaction
  - Typically starts on metacarpals/metatarsals and spreads proximally
  - Extracapsular soft tissue effusion
  - No bone lysis, cortex intact

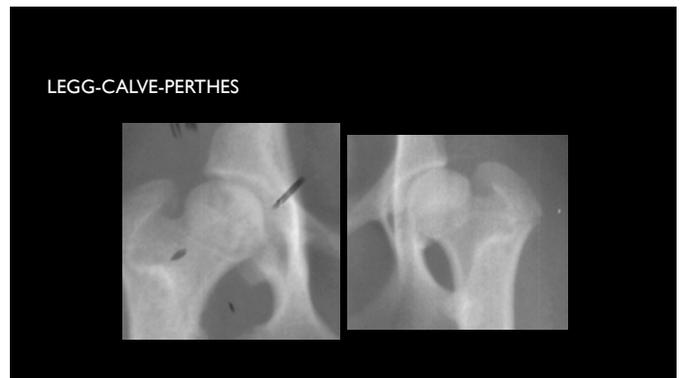


LEGG-CALVE-PERTHES DISEASE

- Cause
  - Disruption of normal blood supply to femoral head
- Signalment
  - Small breed dogs, 4-9 months
  - Slow progressive lameness
  - Usually unilateral

LEGG-CALVE-PERTHES

- Roentgen signs
  - Poorly defined areas of lucency in femoral head and neck
  - Indistinct capital physis
  - Increased coxofemoral joint space width
  - Will fill in over time
  - Chronically will see sclerosis and bony remodeling of the femoral head



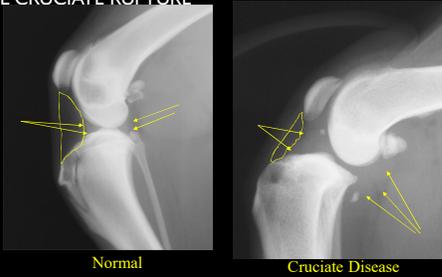
CRANIAL CRUCIATE RUPTURE

- Cause
  - Trauma to stifle, rough play
- Signalment
  - Dog or cat of any age, rare < 1 year
  - Acute moderate to severe lameness
  - Often bilateral in giant breeds

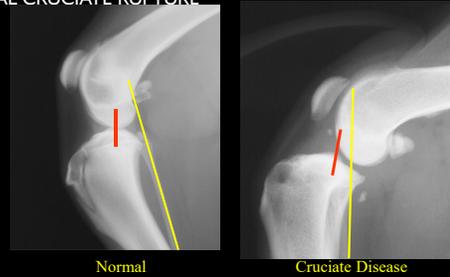
CRANIAL CRUCIATE RUPTURE

- Roentgen signs
  - Intracapsular effusion in cranial and caudal aspect of stifle joint capsule
  - Decreased size and definition of intrapatellar fat pad
  - Wispy appearance at fat pad/joint pouch interface
  - Cranial displacement of tibia with respect to femoral condyles ("tibial thrust" or "radiographic drawer sign")
  - Periarticular osteophyte formation of femoral trochlear ridges, proximal and distal patella, distal fabella or tibial plateau
  - Joint mice formation or small avulsion fragment

CRANIAL CRUCIATE RUPTURE



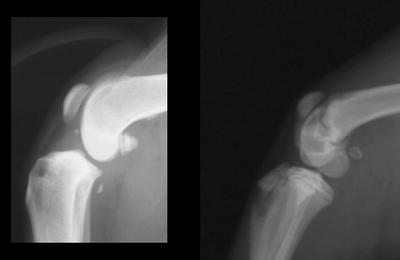
CRANIAL CRUCIATE RUPTURE



STIFLE DJD



POSITIONING IS CRITICAL



## PRIMARY BONE NEOPLASIA

- Cause
  - Osteosarcoma by far most common
  - Chondrosarcoma (flat bones)
  - Fibrosarcoma
  - Lymphosarcoma
  - Multiple myeloma
- Signalment
  - Biphasic distribution with peaks at 1-2 years then again in animals over 9
  - Large and giant breeds
  - Severe, 3 legged lameness

## BONE NEOPLASIA

- Primary
  - Metaphyseal location nearly always
  - "Toward the knee and away from the elbow"
- Metastatic
  - Diaphyseal most commonly (can be metaphyseal as well, but not as common)

## OSTEOSARCOMA (OSA)

- Roentgen signs
  - Metaphyseal location
  - Moderate to severe bony lysis of trabecular and cortical bone, some bony production
  - Aggressive periosteal reaction ("sunburst" pattern seen often)
  - Poorly defined zones of transition
  - +/- bone infarcts (may actually precede OSA)
  - Rarely crosses joint spaces
  - May have pathologic fracture

## OSA TIBIA



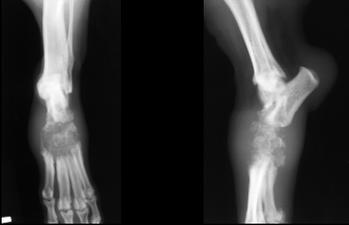
## OSA HUMERUS / DISTAL RADIUS



## SYNOVIAL CELL SARCOMA

- Cause
  - Unknown
  - Typically arises from tendon sheath or synovial lining
- Signalment
  - Older animals, gradual onset

SYNOVIAL CELL SARCOMA



WHAT DO YOU DO NEXT?

THORACIC FILMS !!



DO YOU NEED TO BIOPSY?  
NO !

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