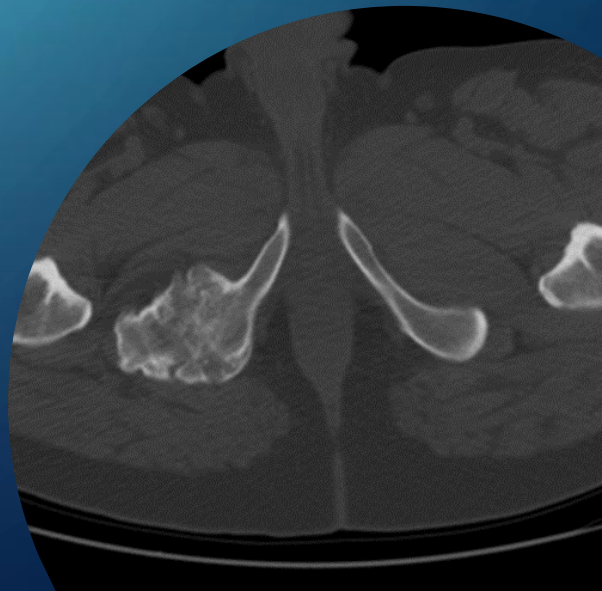
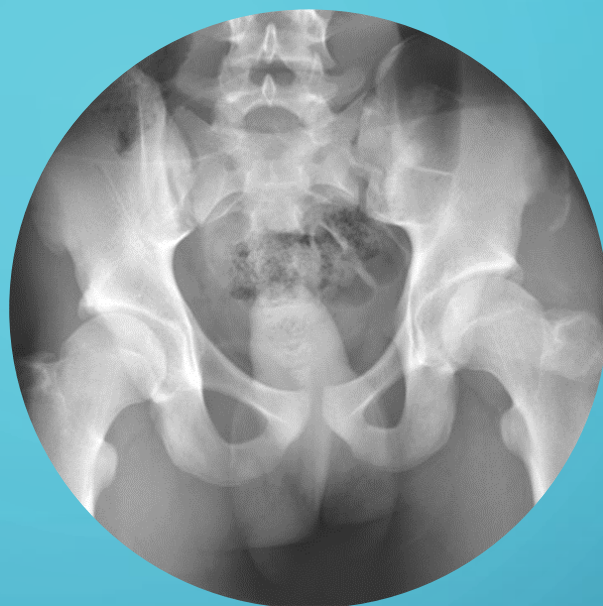




SPORT MED
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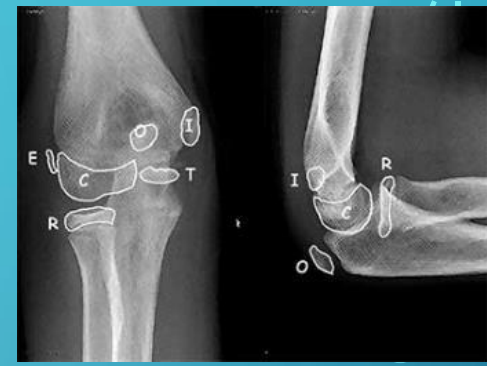
OSTEOCHONDROSES – PEDIATRIC BONE INJURY CLASSIFICATION

DR. NEIL DILWORTH

SPORTS & EXERCISE AND EMERGENCY MEDICINE

FRIDAY, NOVEMBER 14, 2025

FACULTY/PRESENTER DISCLOSURE



- **Faculty: Dr. Neil Dilworth**
- **Relationships with financial sponsors:**
 - **Neil Dilworth is the Director of Medical Device company – Safe Scope Inc. (Unrelated to today's conference)**

DISCLOSURE OF FINANCIAL SUPPORT



- This program has received no financial support
- Potential for conflict(s) of interest:
 - None Identified

MITIGATING POTENTIAL BIAS



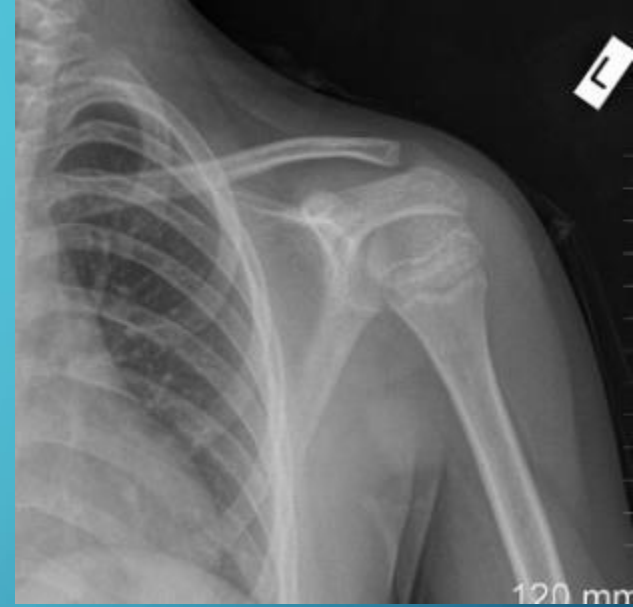
- Any conflict of interest noted in slides 1 and 2 have been reviewed along with presentation content prior to conference for potential bias
- If any issue of bias arises during the talk, audience members can raise issue with speaker and planning committee who are onsite to manage these cases

DISCLOSURES AND LIMITATIONS

- No financial disclosures
- No industry relationships

OBJECTIVES

- To explain the terminology of pediatric bone injuries
- To demonstrate an approach to apophyseal injuries
- To describe pediatric bone anatomy guides your diagnosis



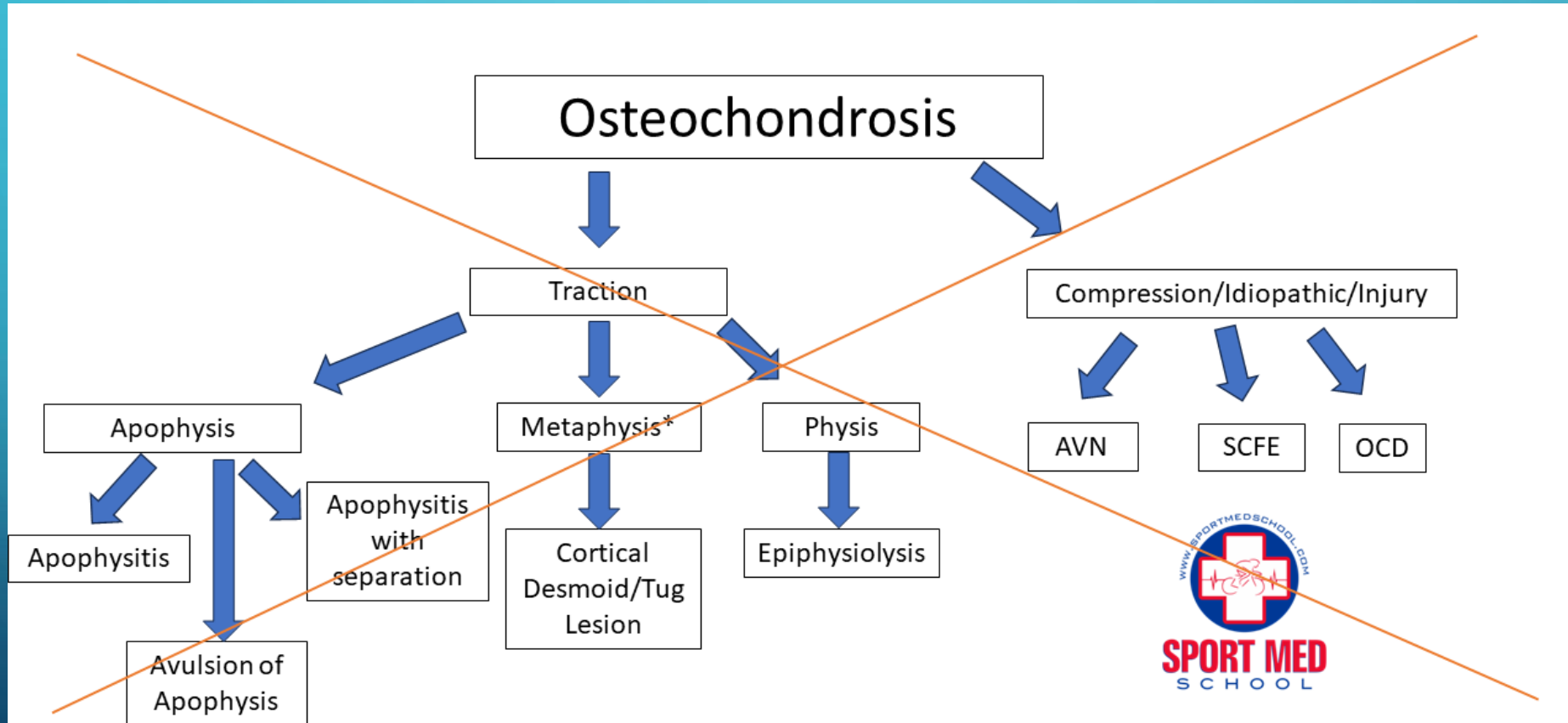
HOW DO WE DEFINE OSTEOCHONDROSIS?



DEFINITION CONUNDRUM

Source	Definition
Uptodate	Osteochondrosis refers to idiopathic avascular necrosis of children
Medscape	Self-limiting developmental derangement of normal bone growth, primarily involving the centres of ossification in the epiphysis. Degenerative or necrotic condition. Aseptic ischemic necrosis.
American Family Physician	Refers to degenerative changes in the epiphyseal centres of growing bones
Merck	Noninflammatory, noninfectious derangements of bony growth at various ossification centres occurring during development
Radiopaedia	Group of disorders that affect the progress of bone growth by bone necrosis

LITERATURE-BASED REFERRAL OF CONDITION AS AN OSTEOCHONDROSIS >3000 ARTICLES



AVN (Avascular necrosis) – Hip – Legg-calve-perthes, Foot - Navicular/Kohler's, MT/Freiberg's, Wrist - Radius, Lunate/Keinboch's,

OCD (Osteochondritis Dissecans) – Knee>Elbow>Talus>>>Humerus (Rare)

Cortical Desmoid/Tug Lesion – Femur, Tibia (Rare)

* - Osteochondromas are a separate process that may occur at this location not related to osteochondrosis

SCOPE OF PROBLEM

- Heterogeneity of bone changes, age group, and terminology
- Many common and uncommon pediatric bone-related injuries from sports can mimic bone tumours
- The lack of clarification of terminology is leading to inaccurate epidemiological findings in the pediatric population

HOW COMMONLY DO KIDS GET TENDINOPATHIES?

- 9.4% of injuries – 13.1% in U -14
- Is this a mischaracterization of the injury as a tendon issue as opposed to an apophyseal injury?

Le Gall F, Carling C, Reilly T, Vandewalle H, Church J, Rochcongar P. Incidence of injuries in elite French youth soccer players: a 10-season study. *Am J Sports Med.* 2006;34(6):928–38.

MISGUIDED FROM LITERATURE

EPIDEMIOLOGY OF INJURIES IN MALE AND FEMALE YOUTH FOOTBALL PLAYERS: A SYSTEMATIC REVIEW AND META-ANALYSIS

STUDY DETAILS



43 Studies included
9674 Injuries
2214549 Hours of exposure
+35000 Different players

INJURY INCIDENCE



2.8

TRAINING

14.4

MATCH



2.6

TRAINING

15.0

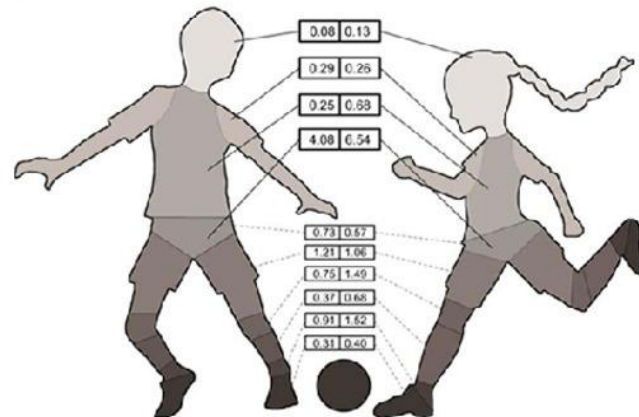
MATCH

MAIN FINDINGS



- I. Males tend to sustain predominantly muscle injuries to the thigh; females sustain joint and ligament injuries to the knee and ankle.
- II. The incidence of injuries increases with advances in chronological age in males.
- III. Elite male players present higher match injury incidence than sub-elite.
- IV. The quality of evidence for females is low, and thus more research is needed to fully explore the injury profile in this sex.

LOCATION



SEVERITY



Robles-Palazón et al. (2021)

Values represent incidences (number of injuries per 1000 hours of football exposure)

Pediatric males v. Adult females!

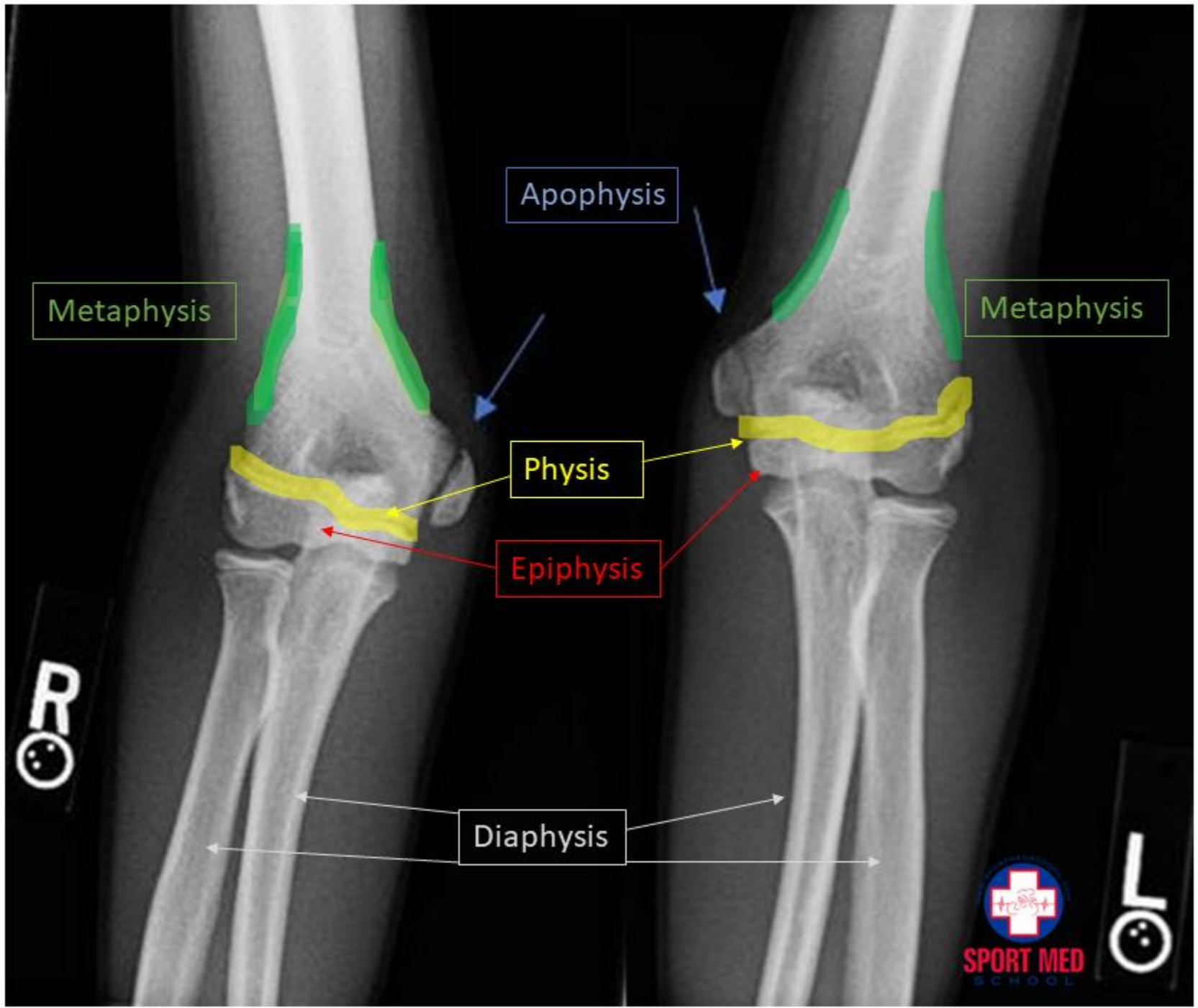
Based on comparison of 34 studies on males U12- U19

To Studies – Females older mostly U 15-19, tournaments as opposed to seasons

Robles-Palazón FJ, López-Valenciano A, De Ste Croix M, Oliver JL, García-Gómez A, Sainz de Baranda P, et al. Epidemiology of injuries in male and female youth football players: a systematic review and meta-analysis. J Sport Health Sci. 2022;11(6):681–95.



Figure 1—Frontal view of proximal femur in 2-year 4-month-old girl with pain in contralateral hip and gait disturbance shows two types of epiphysis: pressure epiphysis corresponding to femoral head epiphysis (*asterisk*) and traction epiphysis corresponding to greater trochanter epiphysis (*arrow*).



INTRODUCING THE ANATOMY BASED- CATEGORIZATION OF PEDIATRIC BONE-RELATED INJURIES

- Epiphyseal/Articulating bone Injuries – Osteochondroses
- Apophyseal Injuries
- Physeal Injuries
- Metaphyseal and
- Diaphyseal Injuries

Epiphyseal Injuries (Osteochondrosis)

Compression/Idiopathic/Injury

Avascular Necrosis

Hip – *Legg-calve-perthes*
Elbow – *Capitellum (Panner's)*
Wrist - *Radius*
 - *Lunate (Keinboch's)*
Foot
- *Navicular (Kohler's)*
- *2nd/3rd Metatarsal (Freiberg's)*

Osteochondritis
Dissecans

Knee>
Elbow (capitellum)>
Ankle (Talus)>>>
Humerus (head – v. rare)

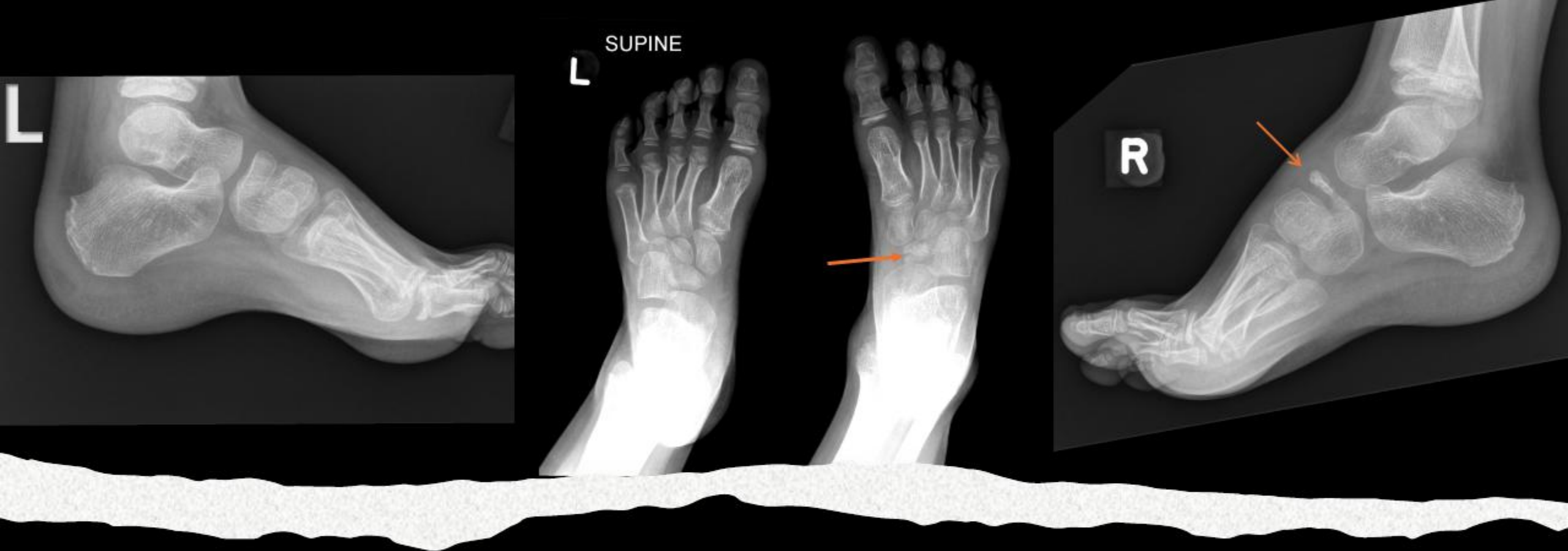


CASE 1 – 5 YO MALE UNABLE TO WB ON RIGHT X 3 DAYS



Xrays of Right Foot





Bilateral Xrays 2 weeks after onset
(Orange arrow – sclerosed navicular bone)

OSTEOCHONDROSIS

- Osteo - bone
- Chondros – cartilage
- Osis – denotes a state, condition, action
- Therefore an osteochondrosis should involve bone and the cartilage – epiphyses or bones in articulation

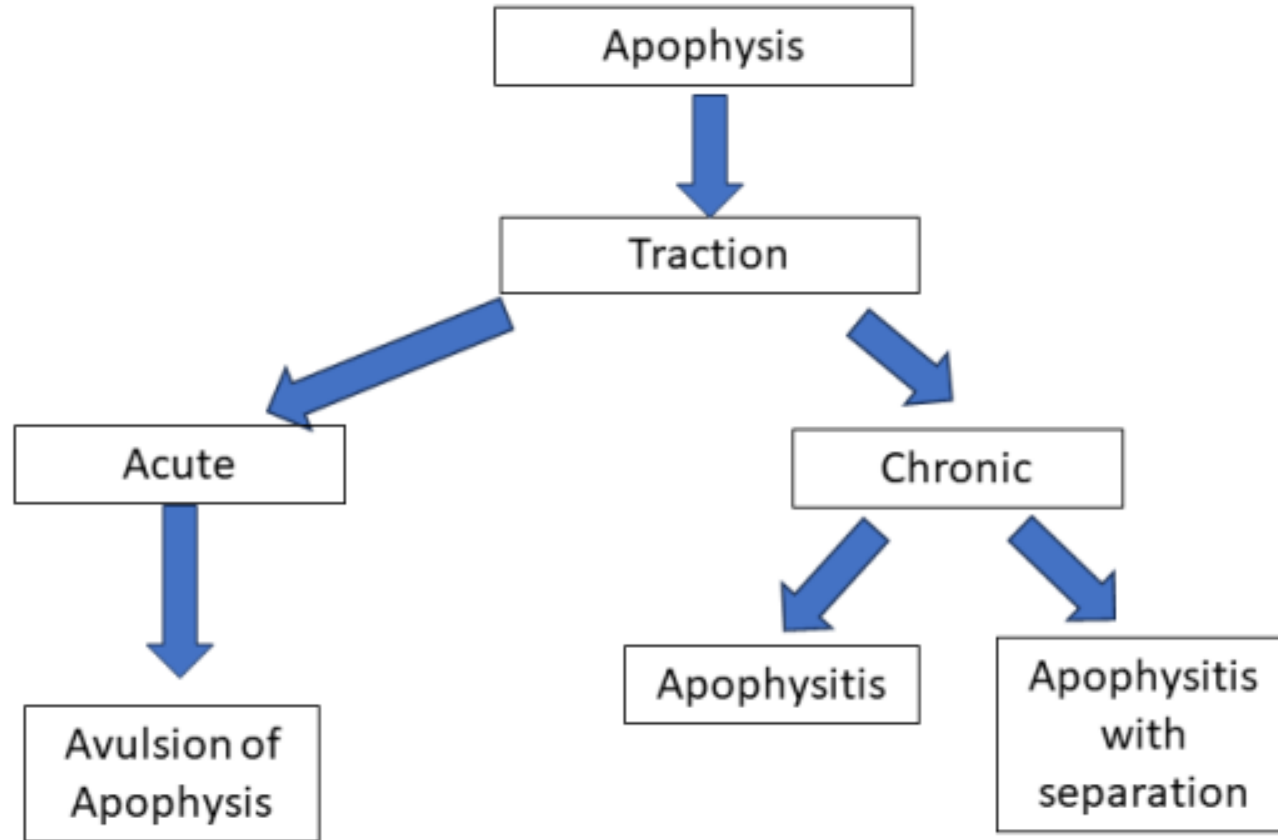
PATHOLOGY: EPIPHYSEAL NECROSIS (E.G. PERTHE'S)

- Necrosis disruption of blood supply, infarction of femoral capital epiphysis,
- Fragmentation – infarcted bone resorbed
- Reossification – osteoblastic activity
- Remodelling – Over 2 – 4 years

Dustmann HO. [Etiology and pathogenesis of epiphyseal necrosis in childhood as exemplified with the hip]. Z Orthop Ihre Grenzgeb. 1996 Sep-Oct;134(5):407-12

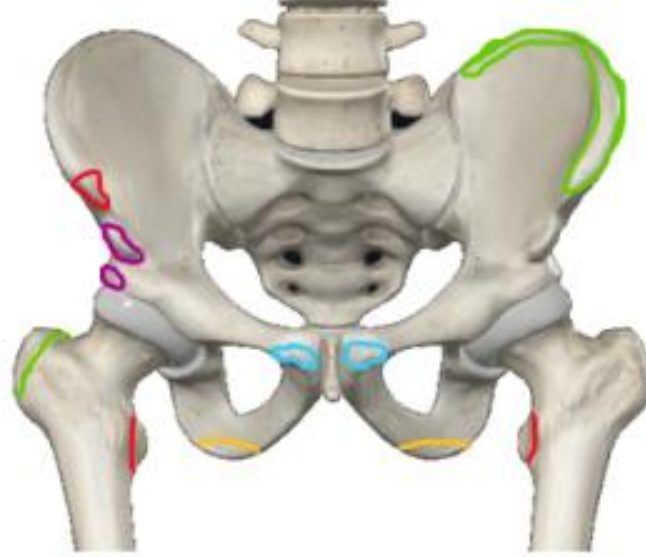


Apophysis injuries



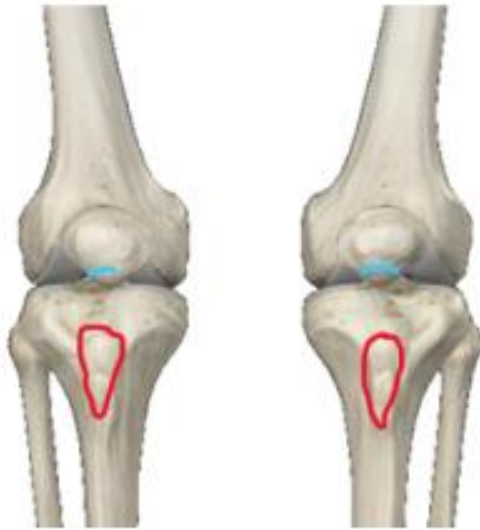
Pelvis

- **ASIS – Sartorius**
- **AIIS/Acetabulum – Rectus Femoris**
- **Pubic crest/tubercle – Adductor Longus/External Oblique**
- **Iliac Crest – External oblique/Iliacus**
- **Ischeal Tuberosity - Hamstring**



Femur

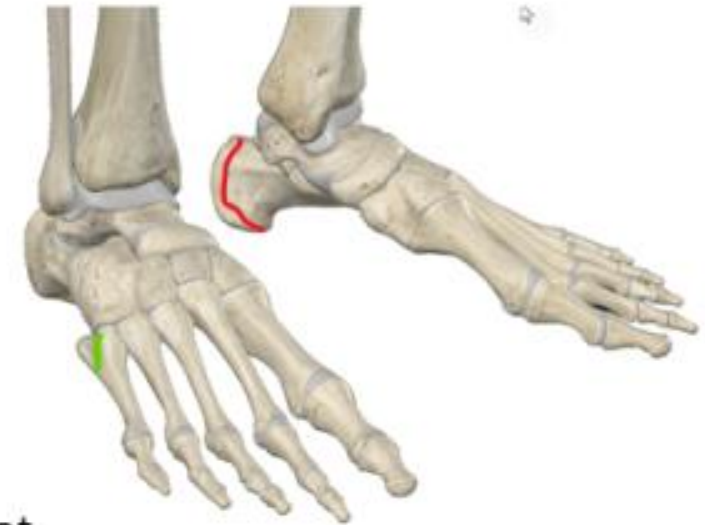
- **Lesser Trochanter - Psoas**
- **Greater Trochanter – Gluteus Medius/Gluteus Minimus**



LOWER LIMB APOPHYSITIS

Knee

- **Inferior Patellar Pole – Patellar Tendon - Sinding-Larsen Johansson**
- **Tibial Tuberosity – Patellar Tendon (Osgoode Schlatter Disease)**



Feet

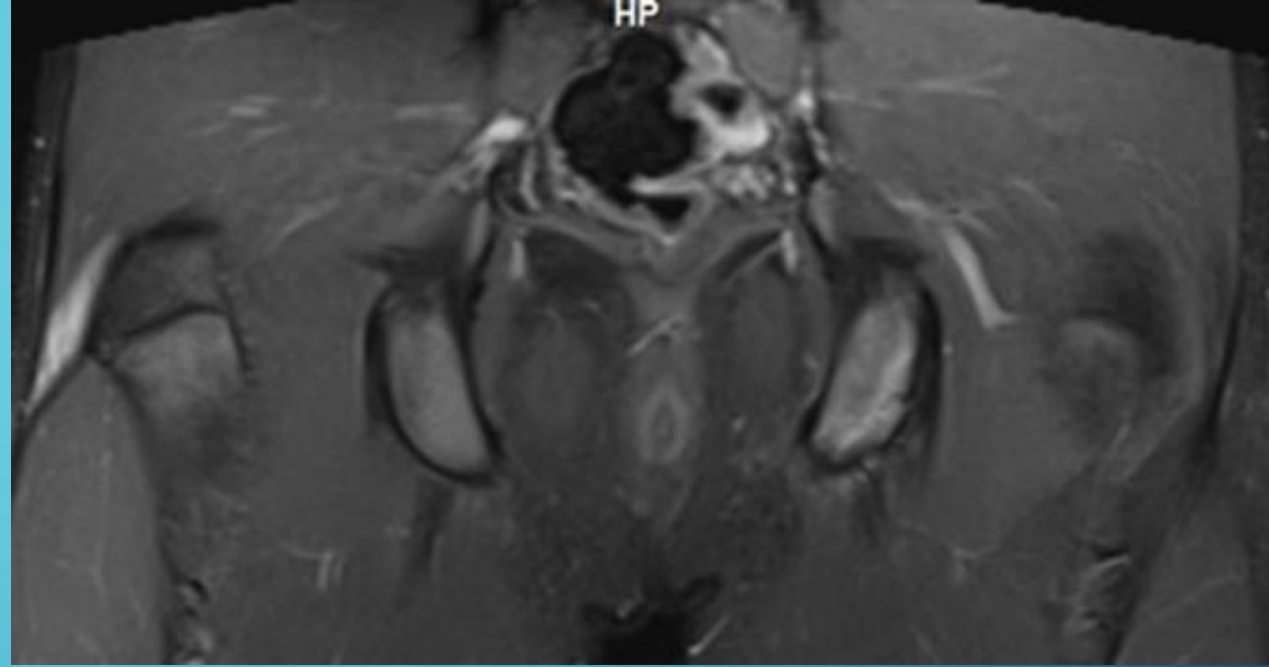
- **Calcaneal – Achilles tendon (Sever's Disease)**
- **5th Metatarsal – Peroneal tendon (Iselin's Disease)**



Lower Limb Apophyseal Injuries

APOPHYSITIS

- Increased osteoblastic activity
- Edema
- Proliferation of spindle cells and small vessels in the intratrabelcular spaces
- Inflammatory cell infiltration



Yamamoto T, Akisue T, Nakatani T, et al. Apophysitis of the ischial tuberosity mimicking a neoplasm on magnetic resonance imaging. *Skeletal Radiol* 2004; 33:737–740

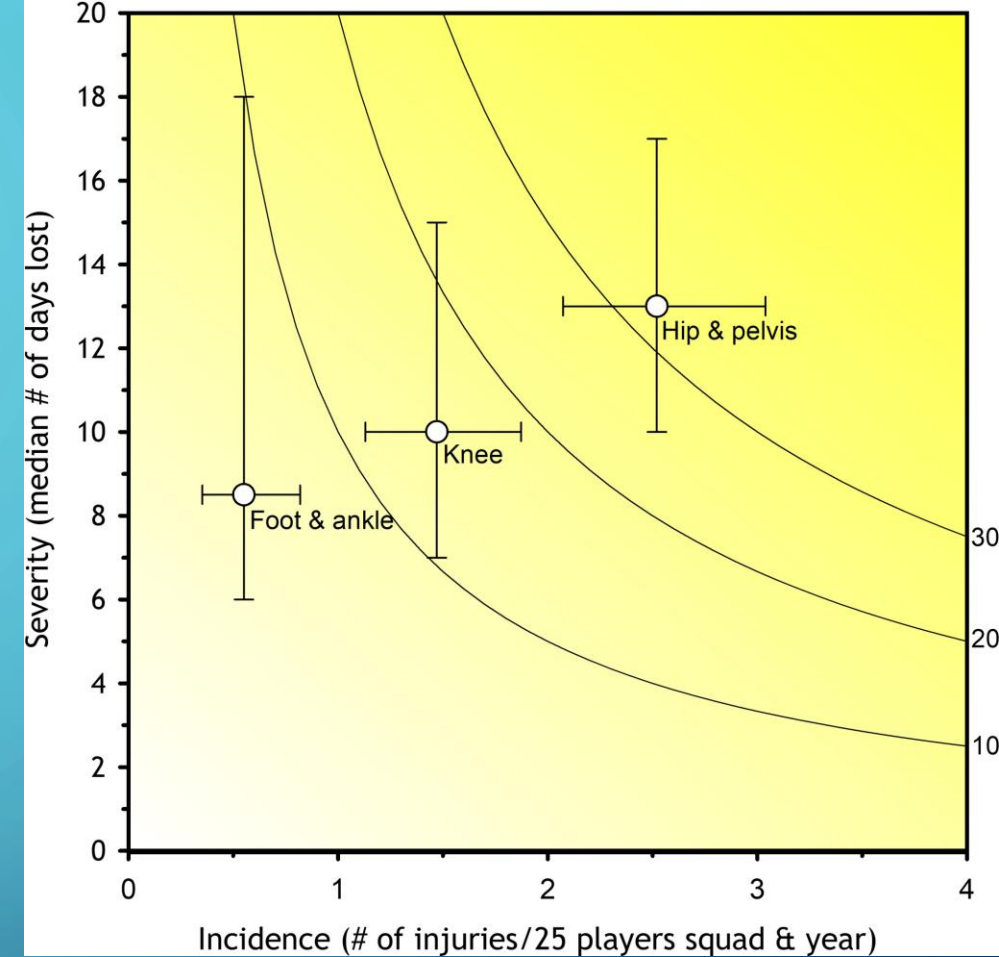
APOPHYSEAL INJURIES

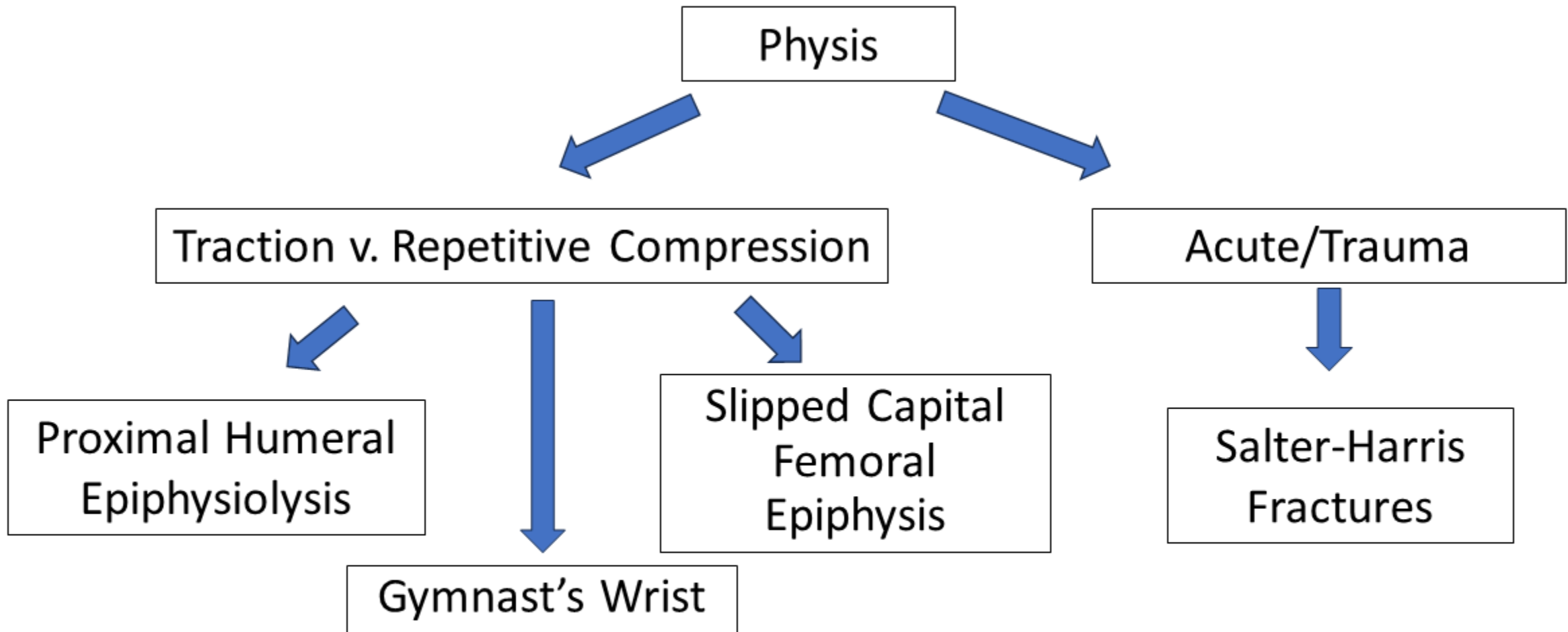
- Very common in growing athletes
- Result from overuse or acute injury
- Healing apophyseal avulsion injuries may mimic bone tumours

DOHA – ACADEMY STUDY

- 4 year prospective study
- 551 players (U9-U19)
- 84% were apophyseal injuries
- 90% affected lower limbs
- 60% occurred during training
- **TIME-LOSS INJURY – Avulsion 28d to 136d, apophysitis 8-14d**
- **86 days lost per squad of 25/ year**
- **Age Foot – Knee - Hip**

Materne O, Chamari K, Farooq A, Tabben M, Weir A, Holmich P, et al. Shedding light on incidence and burden of physeal injuries in a youth elite football academy: a 4-season prospective study. Scand J Med Sci Sports. 2022;32(1):165–76.







Physeal injuries

PHYSIS PATHOLOGY (E.G. SCFE, LITTLE LEAGUER'S SHOULDER)

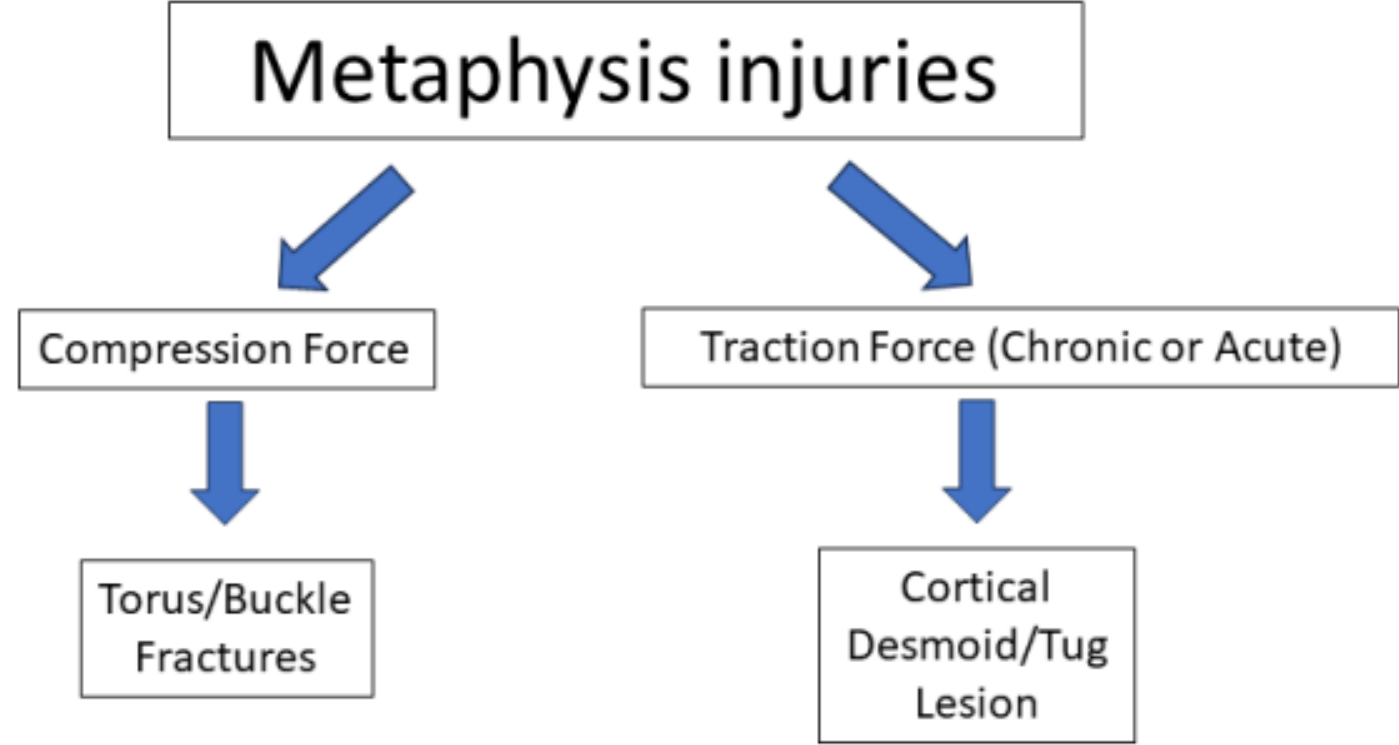
- Epiphysis stays within acetabulum, while metaphysis rotates externally with anterior translation. Shearing causes slippage at the hypertrophic zone of the physis. The physeal injury can lead to avascular necrosis of the epiphysis.
- Similarly in little league shoulder/proximal humeral epiphysiolysis – the external rotation force from final part of arm-cocking phase leads to shearing forces on the physis.

- 958 adolescents
- Aged 14-21
- MRI 1.5 T

Table 2

Ratio among subjects with completely closed growth plates (stage 5), by growth plate for males and females in each age group

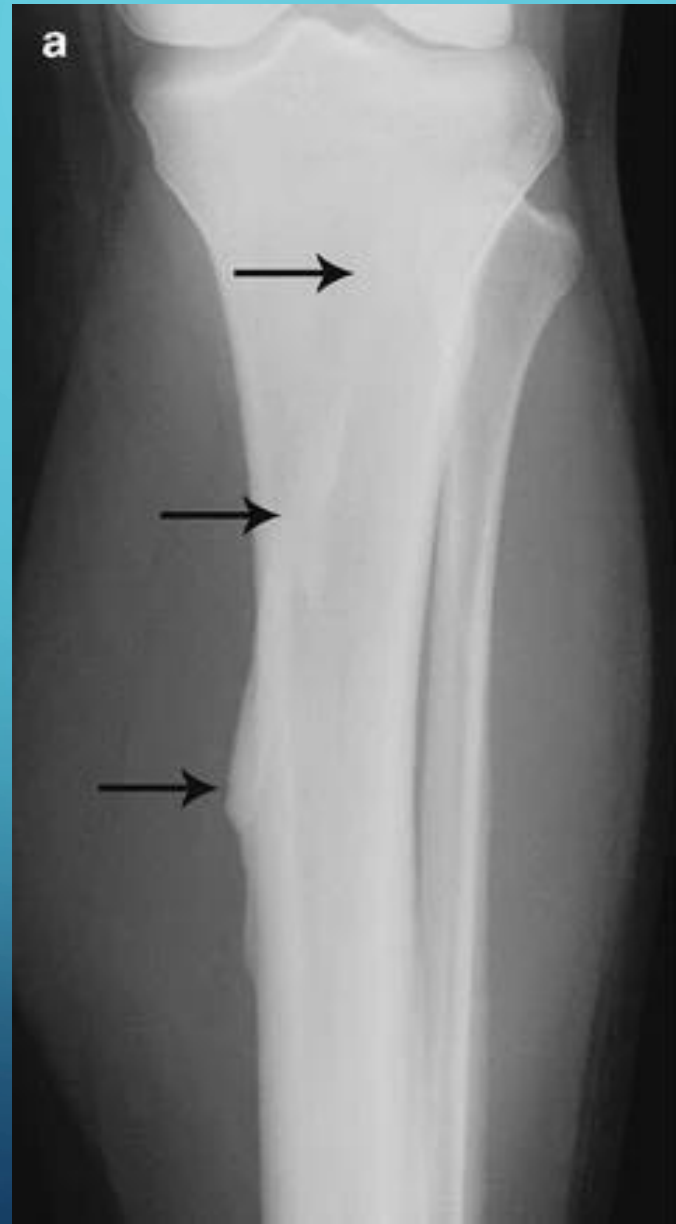
Gender	Age	Radius (%)	Femur (%)	Proximal Tibia (%)	Distal Tibia (%)	Calcaneus (%)
Male	14	0/59 (0)	0/60 (0)	0/60 (0)	3/60 (5.0)	11/60 (18.3)
	15	1/59 (1.7)	0/60 (0)	2/60 (3.3)	11/60 (18.3)	31/59 (52.5)
	16	5/60 (8.5)	10/60 (16.7)	12/60 (20.0)	35/60 (58.3)	46/60 (76.7)
	17	15/61 (24.6)	26/61 (42.6)	34/61 (55.7)	54/61 (88.5)	60/61 (98.4)
	18	34/57 (59.6)	48/58 (82.7)	50/57 (87.7)	57/58 (98.3)	58/58 (100)
	19	52/58 (89.7)	58/60 (96.7)	57/60 (95.0)	58/60 (96.7)	59/60 (98.3)
	20	53/54 (98.1)	54/54 (100)	54/54 (100)	52/54 (96.3)	54/54 (100)
	21	59/59 (100)	60/60 (100)	60/60 (100)	60/60 (100)	60/60 (100)
Female	14	3/62 (4.8)	6/62 (9.7)	12/62 (19.4)	31/62 (50)	44/61 (72.1)
	15	8/60 (13.3)	25/62 (40.3)	33/62 (53.2)	52/62 (83.9)	56/62 (90.3)
	16	26/60 (43.3)	42/60 (70.0)	53/60 (88.3)	55/59 (93.2)	56/58 (96.6)
	17	45/60 (75.0)	51/60 (85.0)	58/60 (96.7)	59/60 (98.3)	59/60 (98.3)
	18	55/61 (90.2)	59/60 (98.39)	60/60 (100)	61/61 (100)	61/61 (100)
	19	57/57 (100)	58/58 (100)	58/58 (100)	58/58 (100)	58/58 (100)
	20	57/57 (100)	57/57 (100)	57/57 (100)	57/57 (100)	57/57 (100)
	21	60/60 (100)	60/60 (100)	60/60 (100)	60/60 (100)	60/60 (100)



TORUS FRACTURES



CORTICAL DESMOID/TUG



Diaphyseal Injuries



Greenstick Fractures



Fractures



CLINICAL APPROACH

- In conjunction with the anatomical based classification
- A clear approach can then be utilized to categorize and diagnose pediatric bone-related injuries

HISTORY: TRACTION V. COMPRESSION

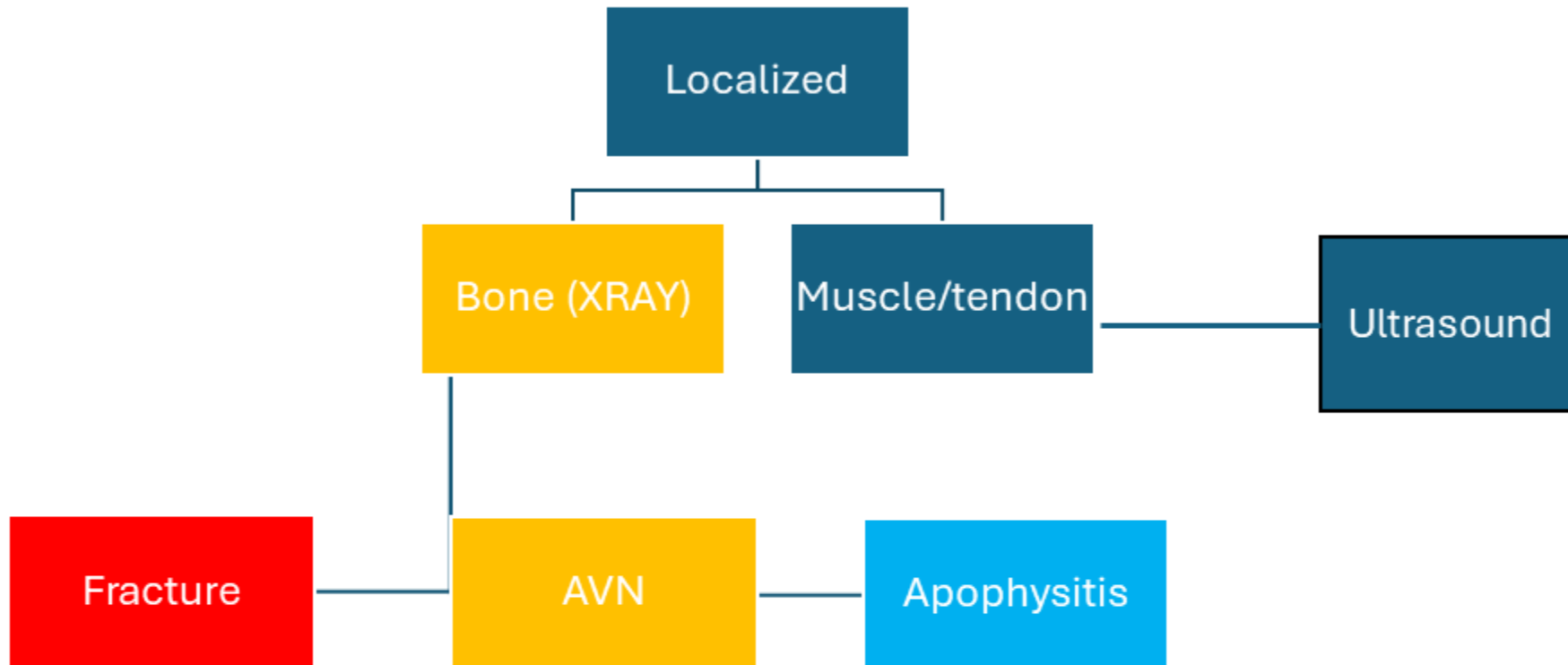
- **TRACTION** Apophysitis, Tug Lesions, Proximal Humeral Epiphysiolysis

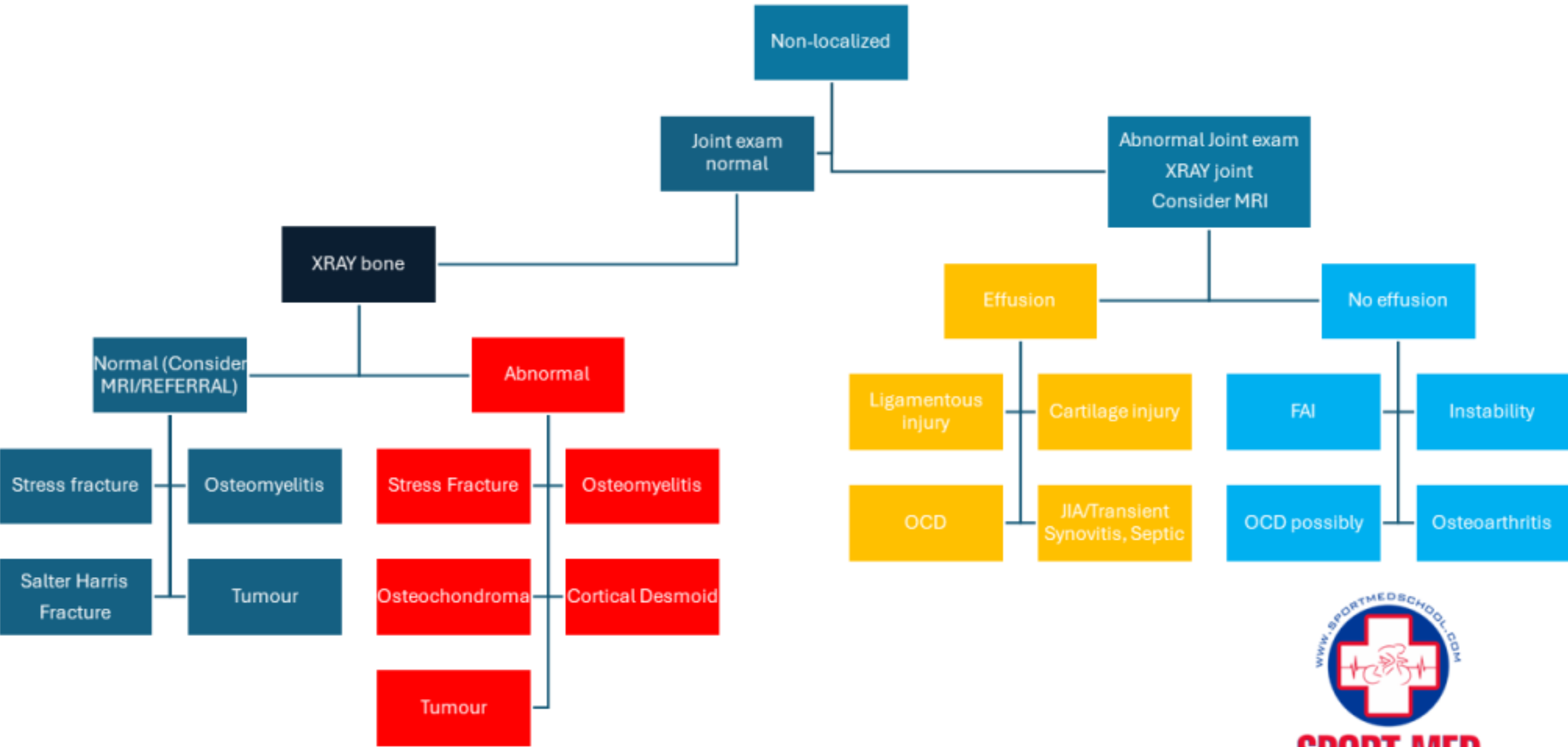
Versus

- **COMPRESSION** AVN (Freiberg's, Perthe's) Osteonecrosis Dissecans, Gymnast's wrist, Salter Harris, Torus/Greenstick

EXAM: PAIN LOCALIZED V. NON-LOCALIZED

- Swelling and heat are also very helpful
- Determining whether the pain is localized or not can aid next steps
- Most apophyseal injuries are easy to palpate and thus confirm your diagnosis





LONG TERM

- Epiphysis - ~50% of Perthes patients will develop pain and disability in 40s and 50s
- Apophysis – Osgoode patients can develop both long term biomechanical changes but also patellar femoral as well as chronic tibial tuberosity pain.
- Imaging abnormalities may last the patient's life time
- Inconsistent literature on natural history of many bone-related injuries

RECOMMENDATIONS

- Epidemiology studies of bone-related injuries *MUST* have:
 - Age OR age categories
 - Better defined terminology (thus proposing anatomy-based classification)
- Using an anatomy approach along with localized v. non-localized can aid in making clinical diagnoses
- Being aware of apophyseal injuries as a common injury in the growing athlete
- Consider bilateral imaging if uncertain of appearance –will help the radiologist as well!

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