

Pediatric Sports Injuries

The Sports Medicine Core Curriculum Lecture Series
Sponsored by an ACEP Section Grant
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Pediatric Sports Injuries

Injury Risk Factors:

Extrinsic

- Facilitate the manifestation of injury
- Training methods
- Equipment

Intrinsic

- Predispose the athlete to injury outcome
- Biologic (previous injury)
- Psychosocial (life stress)

Pediatric Sports Injuries

Injury Risk Factors:

Modifiable

- Altered by injury prevention strategies
- Balance
- Strength
- Flexibility

Nonmodifiable

- Affect relation between modifiable risk factors and injury
- Age
- Sex

Pediatric Sports Injuries: Risk Factors

Adolescent growth spurt

Increased muscle-tendon tightness; decreased physical strength;
bone mineralization lags behind linear bone growth

Age

Faster, heavier, and stronger; more force on contact

Biologic Maturity

Chronologic age and biologic age may vary

Body Size

Heavier weight=greater force; absorbed through bones and joints

Coaching

Inexperience; improper training

Pediatric Sports Injuries: Risk Factors

Fitness

Proprioceptive ability, strength, endurance, flexibility, and adiposity

Gender

Example: basketball-related knee injuries- girls > boys

Previous Injury

Predispose to further injury; physiologic deficiencies result from initial injury or inadequate rehabilitation

Psychology

Life stress is a predictor of injury

Physeal Fractures

Skeletally immature

Physis is the transition zone between the metaphysis and the epiphysis in long bones

“Weakest link”

Salter-Harris Classification

Type I:

physeal injury or disruption; often without apparent radiographic abnormality; tenderness to palpation on physical examination is present even without radiographic abnormality in the skeletally immature, the SH I of the distal fibula is the most common acute injury of the foot and ankle

Type II:

most common; metaphyseal and physeal injury

Type III:

epiphyseal and physeal

Tillaux fracture is an example of a SH III fracture of the distal anterolateral tibial epiphysis; highest incidence among adolescents ages 12-14

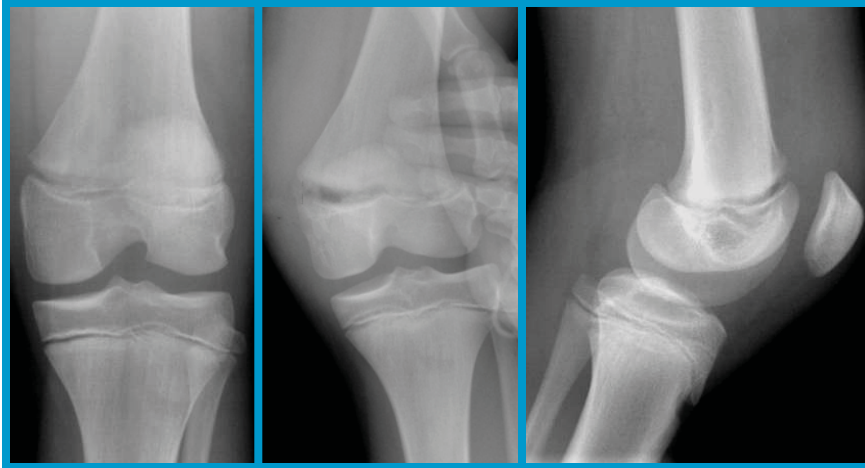
Type IV:

metaphyseal, physeal, and epiphyseal

Type V:

axial compression or delayed injury only apparent retrospectively

Salter Harris Injuries



Unstable Salter I



Tillaux fracture (III)

Buckle 'Torus' Fractures



***Bulloch et al. Validation of the Ottawa Knee Rule in children: a multicenter study.
Ann Emerg Med. 2003 Jul;42(1):48-55.***

2 to 16 years w/ knee injury < 7 days

750 enrolled: 670 with xrays

Mean age was 11.8 +/- 3.1 years

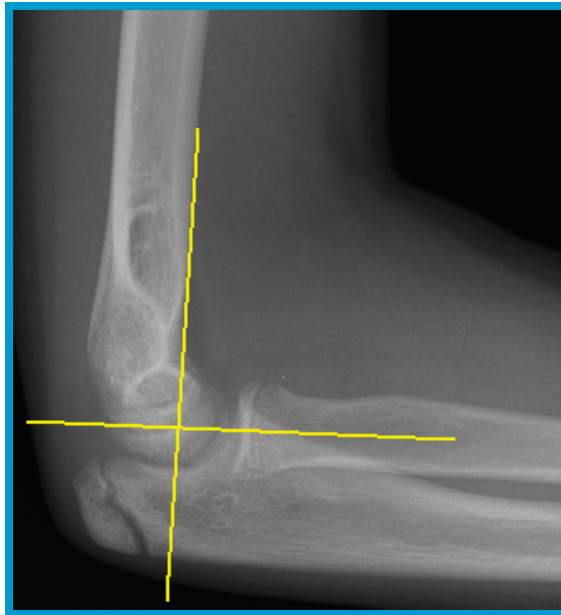
70 fractures

OKR 100% sensitive, 43% specific

Normal Elbow Radiology

Anterior Humeral Line- thru middle 1/3 capitellum

Radiocapitellar Line- along radial shaft intersects capitellum



Elbow ossification centers

Order of Appearance of the individual ossification

centers is C-R-I-T-O-E:

(F/M)

Capitellum

1 yo/2 yo

Radial head

3 yo/4 yo

Internal (medial) epicondyle

5 yo/6 yo

Trochlea

7 yo/8 yo

Olecranon

9 yo/10 yo

External (lateral) epicondyle

11 yo/12 yo

Fat Pad Sign or 'Sail Sign'

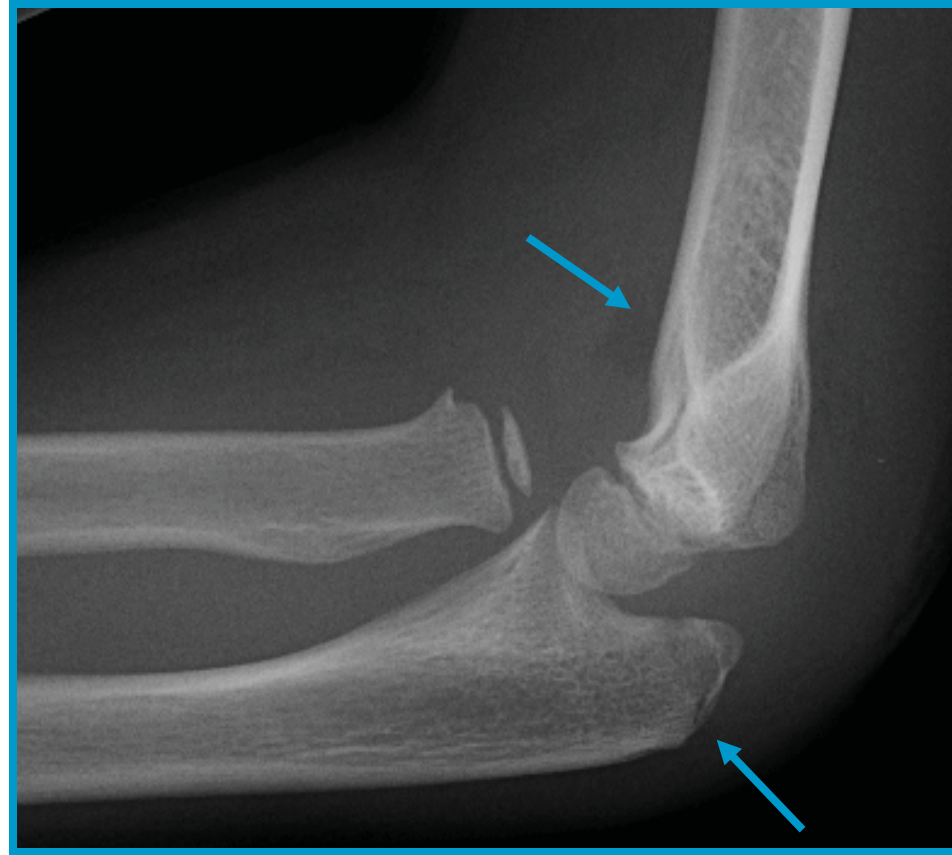
Effusion is associated with a fracture 70-90% kids

Risk of occult fracture is approximately 30%-75%

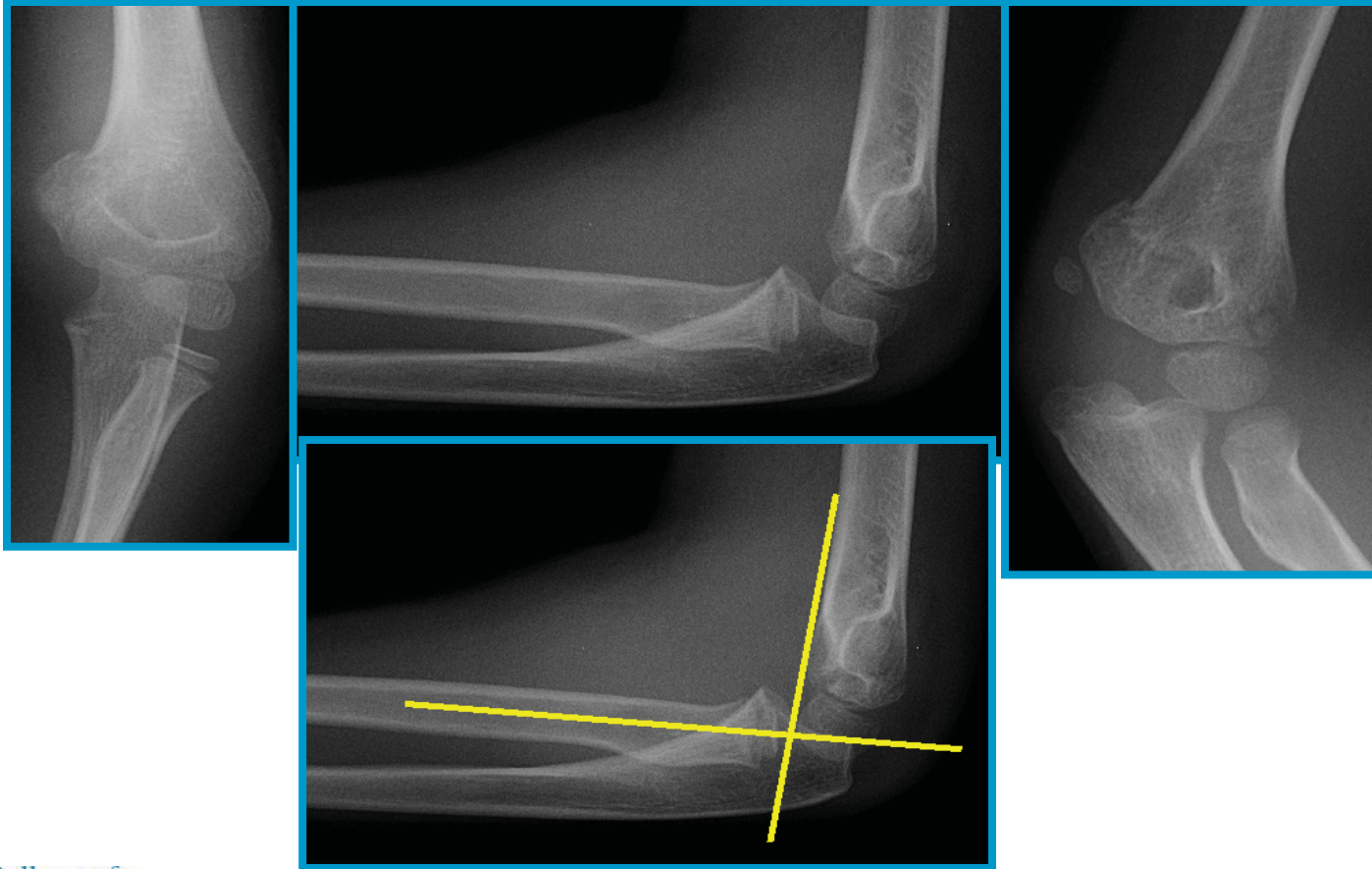
Posterior or elevated anterior fat pad abnormal



8 yo M s/p FOOSH: Radial head dislocation and ulnar fracture



Supracondylar fracture



Supracondylar Fracture

Cardinal signs of supracondylar fracture are

- 1) a posterior fat pad sign
- 2) posterior displacement of capitellum
relative to the anterior humeral line (94%)

Check Baumann angle in true AP view

*70% pediatric elbow fractures

Apophyseal Injuries

Apophysis: a growth plate that does not contribute to linear bone growth;
serve as attachment sites for muscle-tendon units

Avulsion injuries: more common than muscle or tendon injuries due to skeletally immature apophysis

Secondary Ossification Centers of the Pelvis and Hip (Apophyses)

Anterior superior iliac spine- sartorius

Anterior inferior iliac spine-rectus femoris

Ischial tuberosity- hamstring, adductor magnus

Lesser trochanter- iliopsoas

Greater trochanter- gluteal muscles

Iliac crest- abdominal tensor fascia latae,
gluteus medius, latissimus dorsi, gluteus maximus

Apophyseal Injuries (cont.)

Pelvis:

most common type; peak incidence: 14-18 years;
ischial tuberosity, anterior superior iliac spine (ASIS), and
anterior inferior iliac spine (AIIS) are the most common sites

Tibial Eminence Avulsion Fracture:

anterior cruciate ligament (ACL) insertion;
peak incidence 8-14 years

Osgood Schlatter:

traction apophysitis of the proximal tibial tuberosity at the insertion of the
patellar tendon; common among adolescent males following a growth spurt

Sever Disease:

calcaneal apophysitis at insertion of the Achilles' tendon;
common age is 9-11 years

Apophyseal Injuries (cont.)

Little League Elbow:

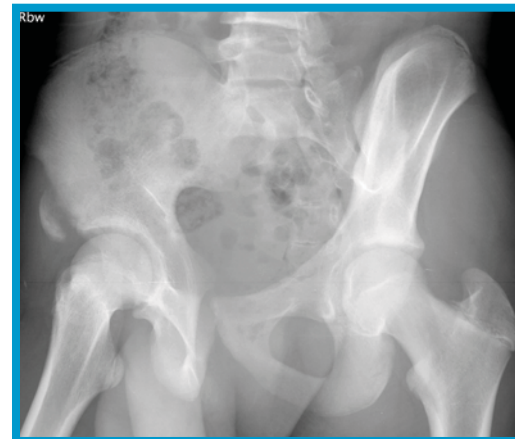
- medial epicondylar apophysitis secondary to repeated valgus stress from throwing;
- medial epicondyle has the longest exposure to medial distraction forces because it is the last ossification center to close.
- medial epicondylar avulsion fractures are the most common elbow injury during adolescence

Anterior Inferior Iliac Spine Apophyseal Avulsion Fracture

16 yo M elite soccer player

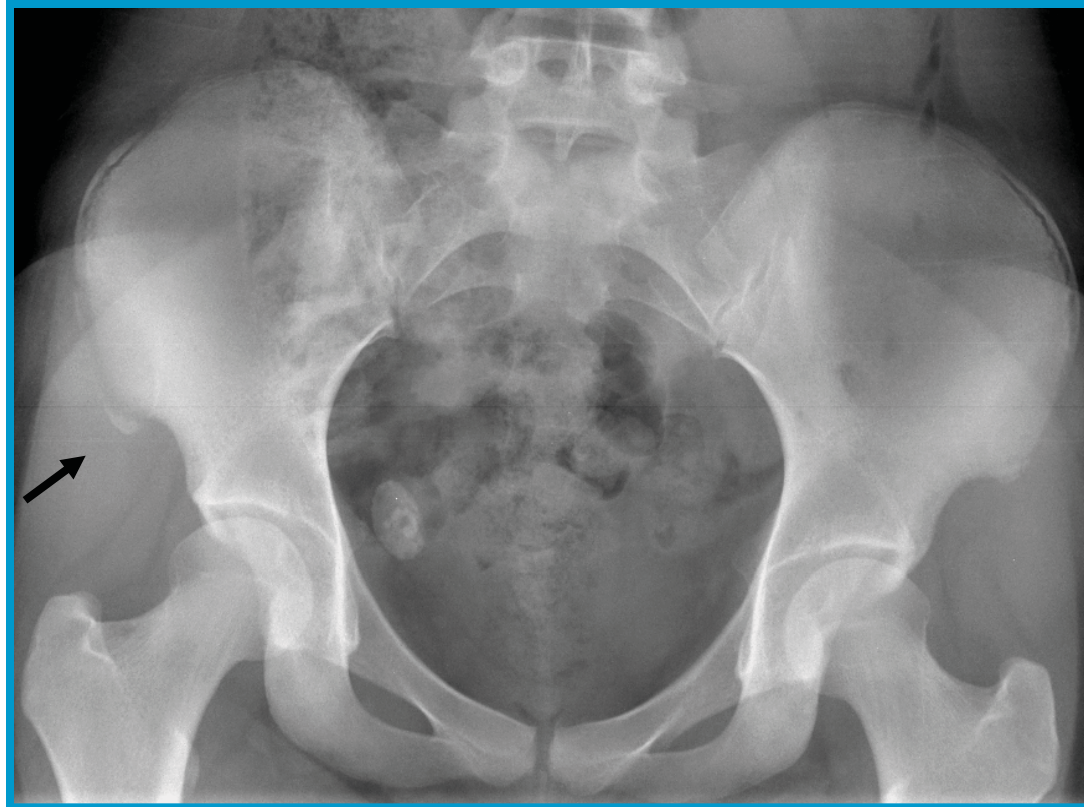
R hip pain x 2 weeks

‘Felt like I pulled my hip flexor’



*oblique views helpful

Case: 14 yo F w/ Hip Pain- Acute onset while kicking a ball: Anterior Superior Iliac Spine Apophyseal avulsion fracture



Osteochondritis Dessicans

Disorder in which a segment of articular cartilage, with its underlying subchondral bone, gradually separates from the surrounding osteocartilaginous tissue.

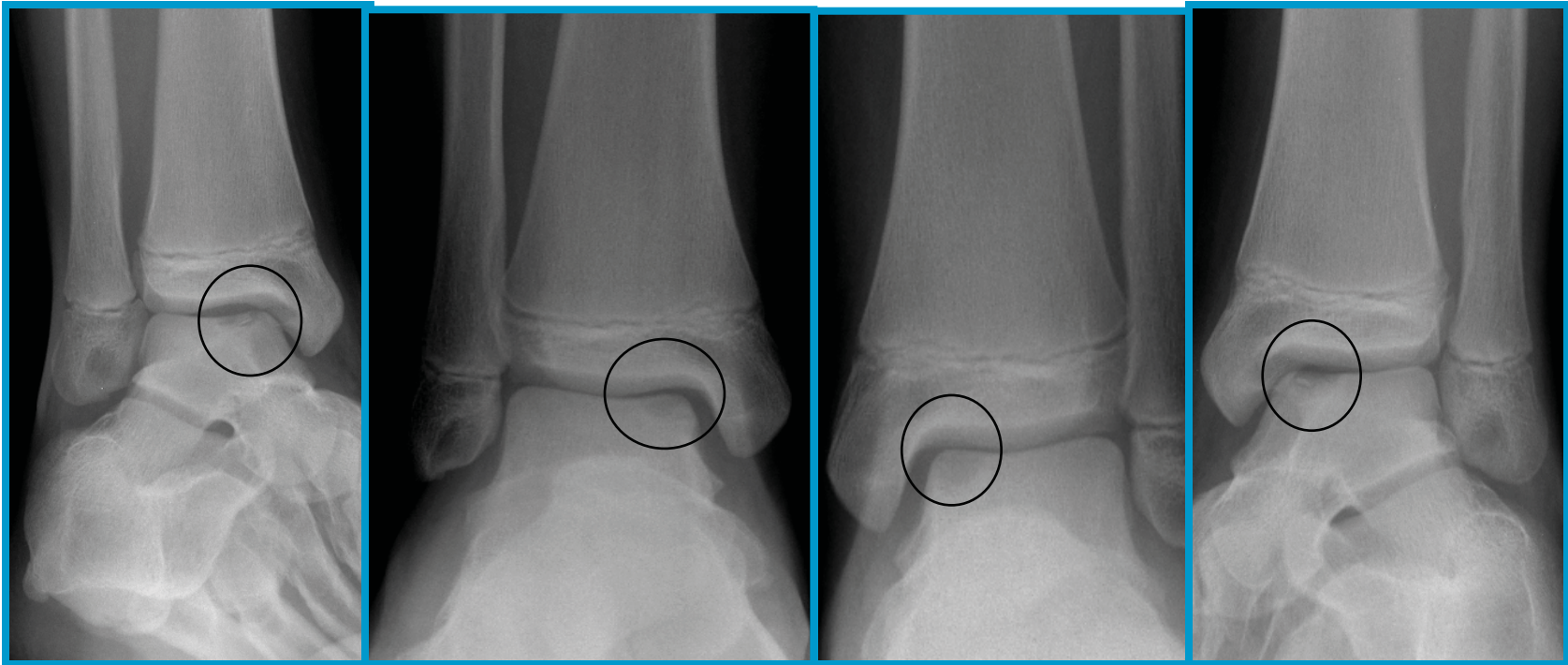
Common sites:

- Medial femoral condyle
- Superior surface of the talus
- Capitellum of the elbow

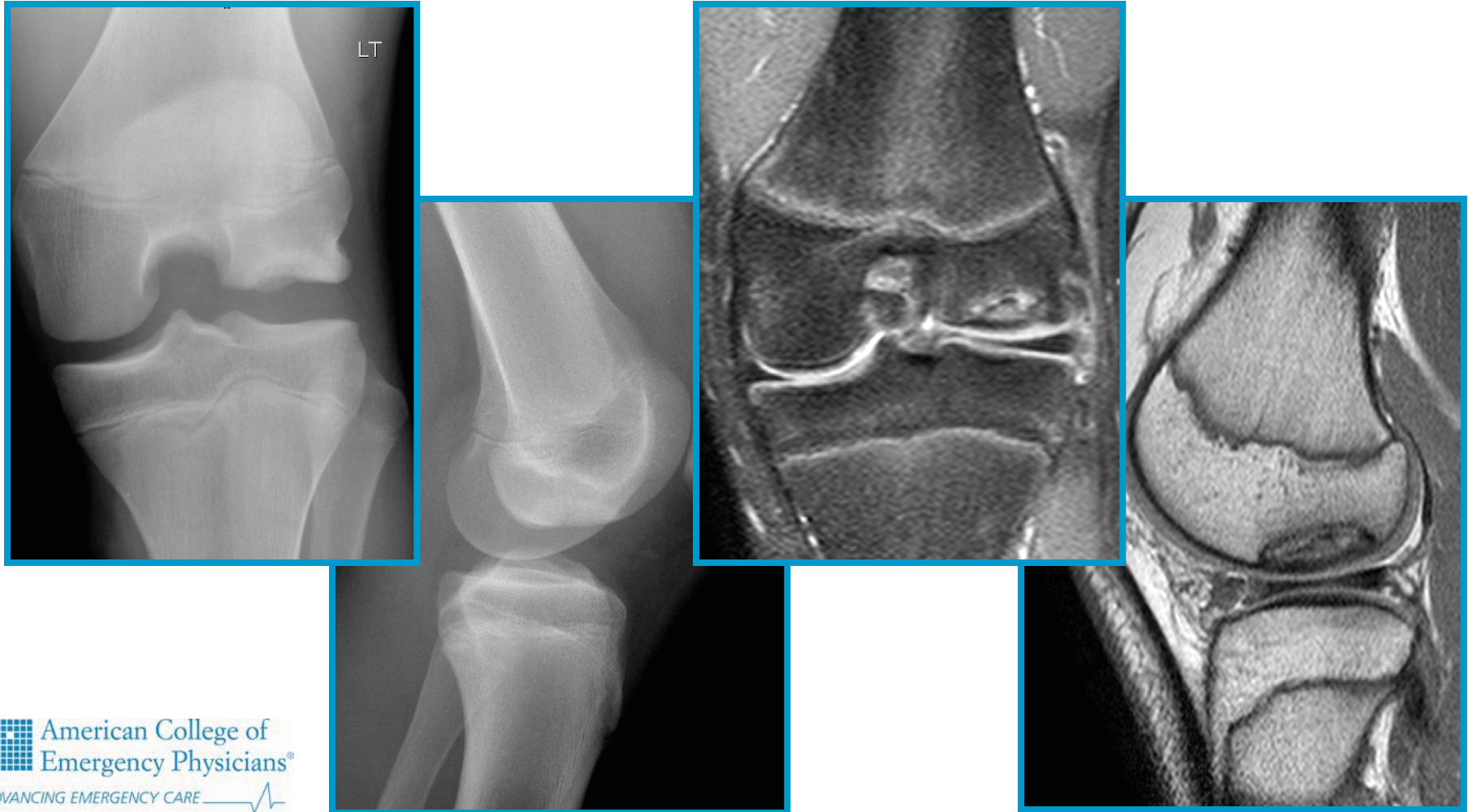
G.G. 14 yo M w/ subacute and chronic bilateral ankle pain x 2 years (OCD talus)

Right

Left



Case: M.T. 14 yo M w/ Chronic Knee Pain and Swelling (OCD knee)



OCD Elbow

Kibler, WB. *Pathophysiology of Overload Injuries Around the Elbow*. Clinics Sports Med. 1995;14(2):447-57.



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Osteochondritis Dessicans (OCD) a.k.a. Osteochondral Defect

Type I- no displacement, no fracture of articular cartilage
non weight bearing until radiographic healing and pain resolves

Type II- fracture of articular cartilage or partial displacement
Rx controversial

Type III- complete detachment of lesion w/ loose body
surgical drilling and curettage

Spondylolysis and Spondylolisthesis

Spondylolysis:

- Stress fracture
- Unilateral or bilateral defect (separation) in the vertebral pars interarticularis
- Evident on radiograph as a crack or ‘collar’ on the neck of the “scotty dog” (detects up to 30%)

Spondylolisthesis:

- Anterior slippage of the vertebral body resulting from bilateral defects

Spondylolysis

Prevalence of 4% to 6% in the general population

47% of young athletes sports clinic w/ Low Back Pain

Mechanism: repetitive pars overload in

extension and rotation +/- congenital factors

Pain increases w/ lumbar extension

Primarily involves lumbar vertebrae

~90% involve the L5 level

Case: M.D. 15 yo F Low Back Pain in an Adolescent Soccer Player x 2 months

No history of back problems.

Onset during soccer tryouts.

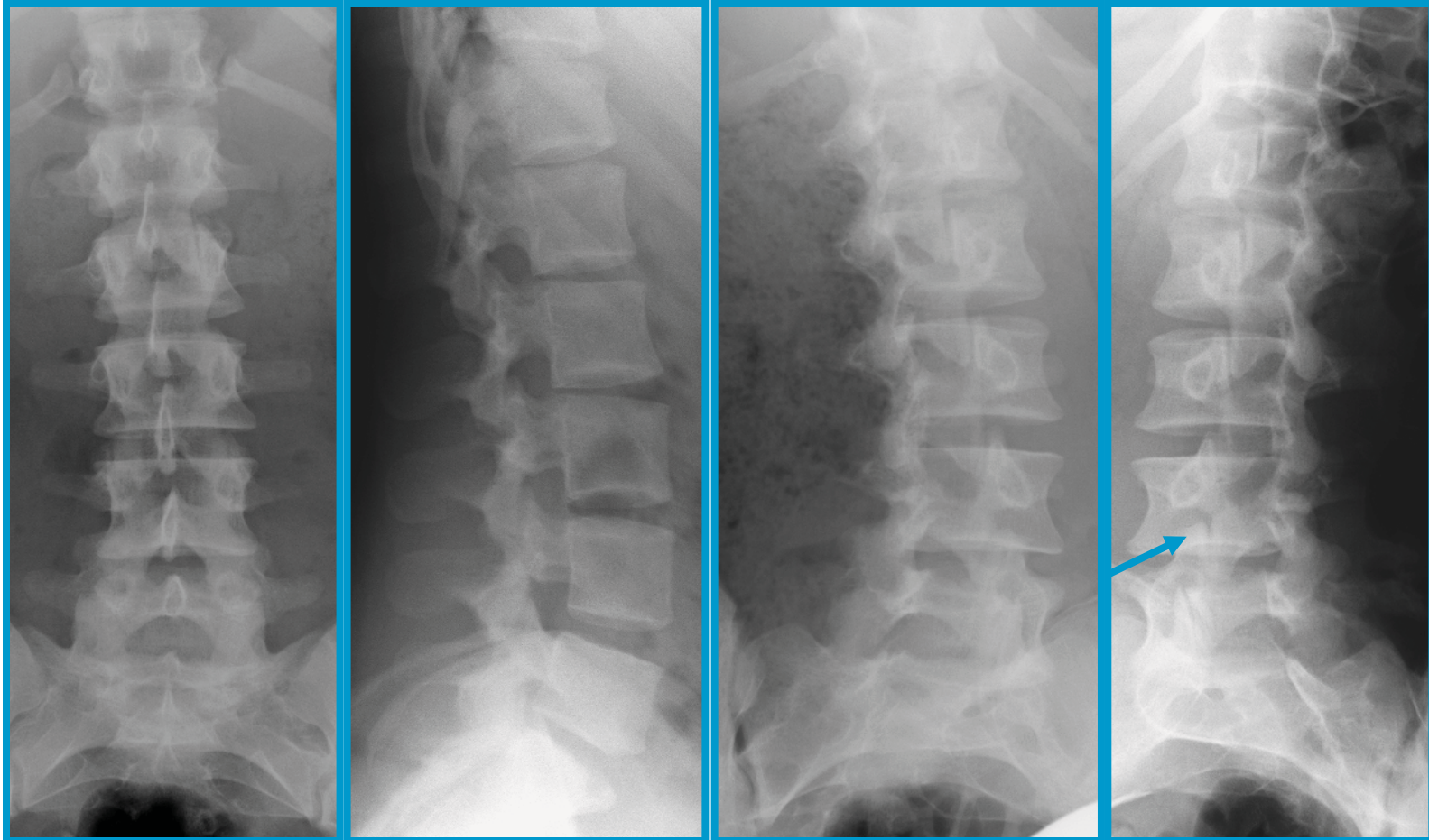
Pain is escalating.

Seen by ATC- diagnosis: 'pulled muscle'

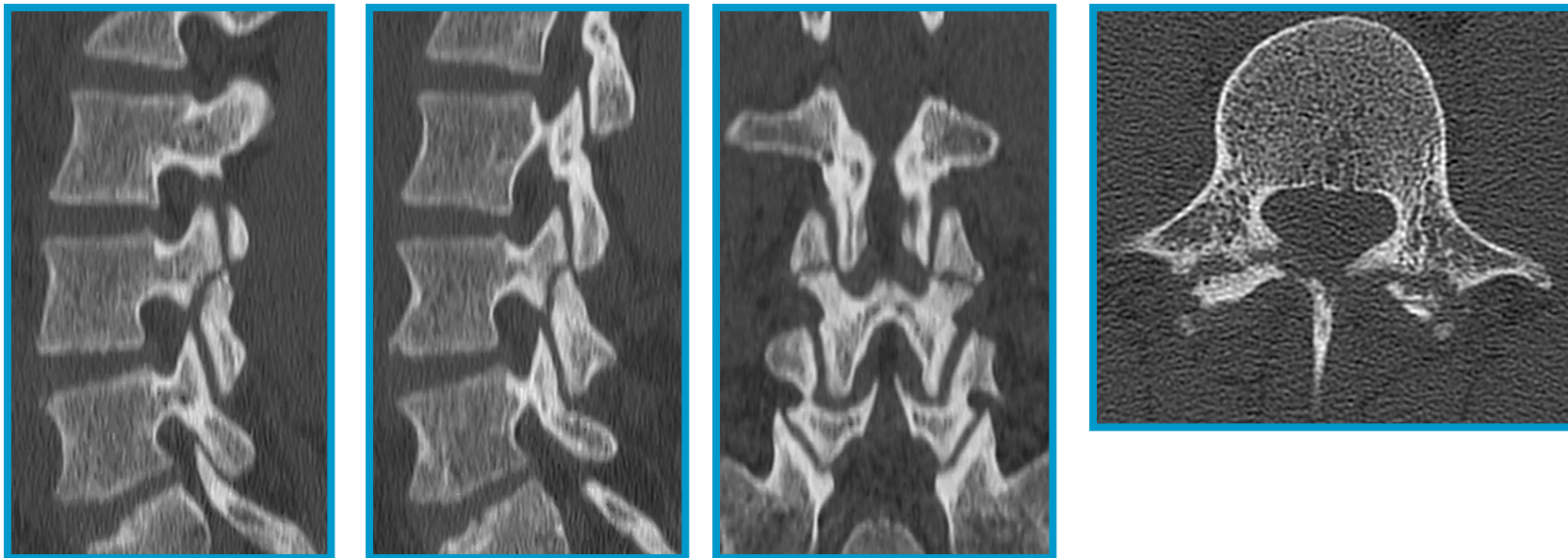
Seen by PCP diagnosis: 'sacroileitis'

Xrays by PCP were 'negative'

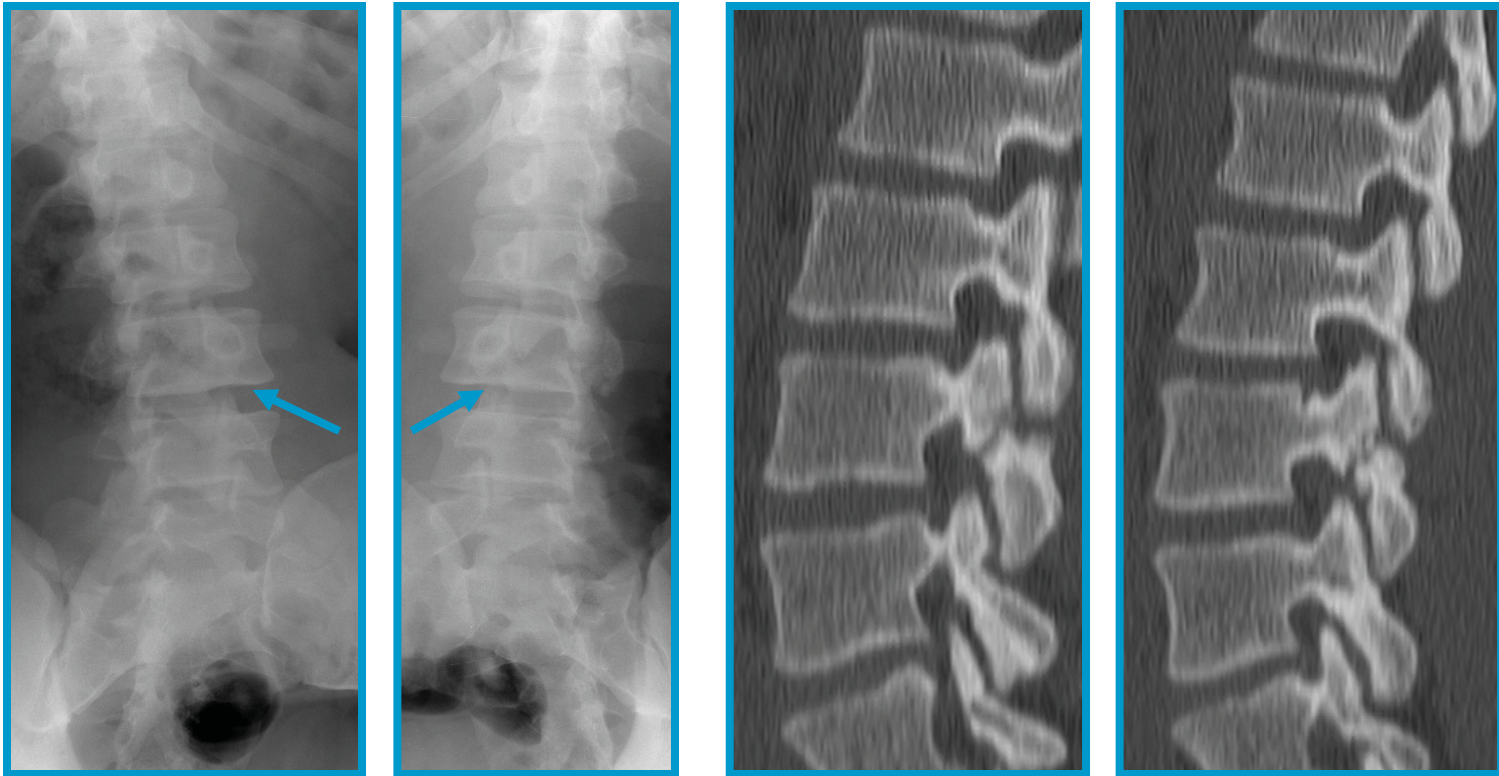
Exam: Pain with ROM spine, worse with extension.



CT scan confirms bilateral spondylolysis- L4



Case: L3 Bilateral Spondylolysis



Spondylolysis → listhesis

Risk factors for slip progression

- 1) spondylolisthesis > 20% to 30% at diagnosis
- 2) adolescence

4% to 30-50% are reported to progress to spondylolisthesis

Anterior Cruciate Ligament Injuries

ACL injuries are becoming more common as greater numbers of children and adolescents participate in community sports programs and more girls participate in collision sports, such as basketball and soccer.

100-200K ACL ruptures occur in the USA annually;
average incidence is 1 in 3,500

Skiers and football player rupture the ACL most commonly;
gymnasts sustain the highest rates of injury

Most common mechanism: hyperextension or valgus

Anterior Cruciate Ligament Injuries

ACL and gender

Female gymnasts, soccer players, and basketball players sustain significantly more ACL injuries than males (4-8X)

Quadriceps dominant deceleration

Increased valgus knee angulation with pivoting and deceleration

Estrogen

- effects upon strength and flexibility of soft tissues remains controversial

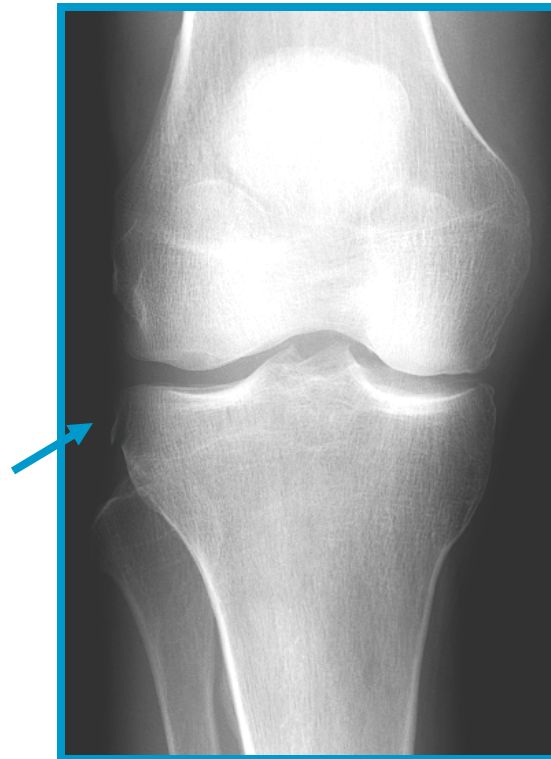
Discrepancies in Q angle and bone length

Decreased intercondylar notch width

Segond Fracture

Avulsion of the lateral capsular ligament

*pathognomonic for ACL tear associated

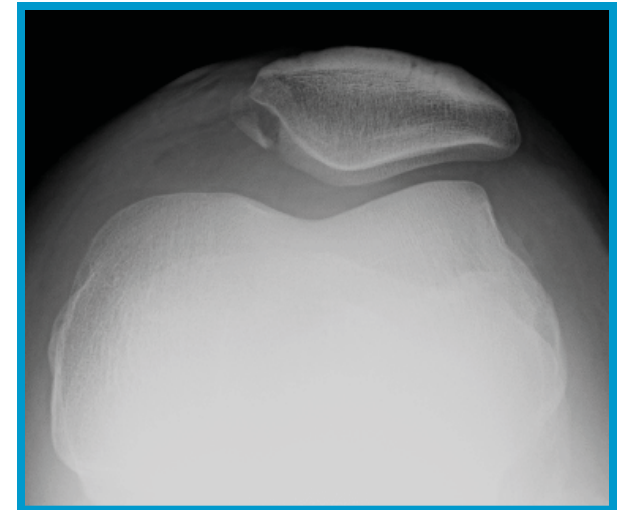


Patellar Dislocations in Children are Associated with Osteochondral Fractures

Sunrise view abnormal in 7 (54%) of 13 cases that included a history of subluxation or dislocation

Black et al. Usefulness of the skyline view in the assessment of acute knee trauma in children. Can Assoc Radiol J 2002;53(2)92-4.

*Intra-articular osteochondral fractures complicate approximately 5% of acute dislocations of the patella in children



Take Home Points

Be aware of injury mechanisms and injury patterns

A fracture can occur in the absence of trauma

Know where the physes are and ages of closure to help determine fractures radiographically

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