Understanding Less Common Pelvic and Hip Injuries in Sports

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Goals of Lecture

Studies show that Hip/Pelvis injuries account for 5-10% of sports injuries in high school aged athletes

We know that a majority of these injuries are muscle or tendon strains, or are overuse injuries

This lecture will look at other causes of hip/pelvis pain in young athletes expanding the differential of athletes presenting with pain or injury in this region

Afterwards, will understand common presentations of these other hip/pelvis injuries, how to best evaluate, and common treatment for each diagnosis

Case #1

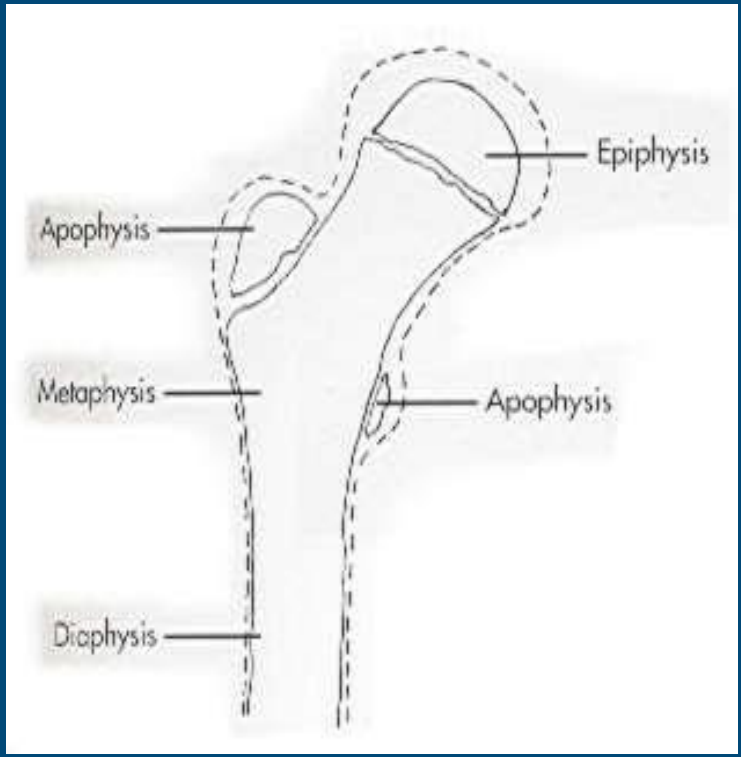
13 yo male soccer player presents with pain to the anterior aspect of the right hip that started 2 days ago. Patient says that during his most recent soccer game he went to kick the ball during a free kick when he felt a pop in the anterior aspect of his right hip. He could bear weight on the leg after, but could not continue to play secondary to pain. He currently describes a sharp pain to the front of the right hip any time he lifts up his right leg like when he is getting out of the car, and going up stairs.

On exam he has full range of motion in the hip, but it does cause general pain through these motions, greatest with hip flexion. He has 4/5 strength with resisted hip flexion with this recreating patients pain. 5/5 strength in other motions, but all cause some general discomfort to front of hip. He has point tenderness to his right AIIS, but no where else on exam. He is neurovascularly intact.

Pelvis and Hip Avulsion fractures

Anatomy of the Pediatric Bone

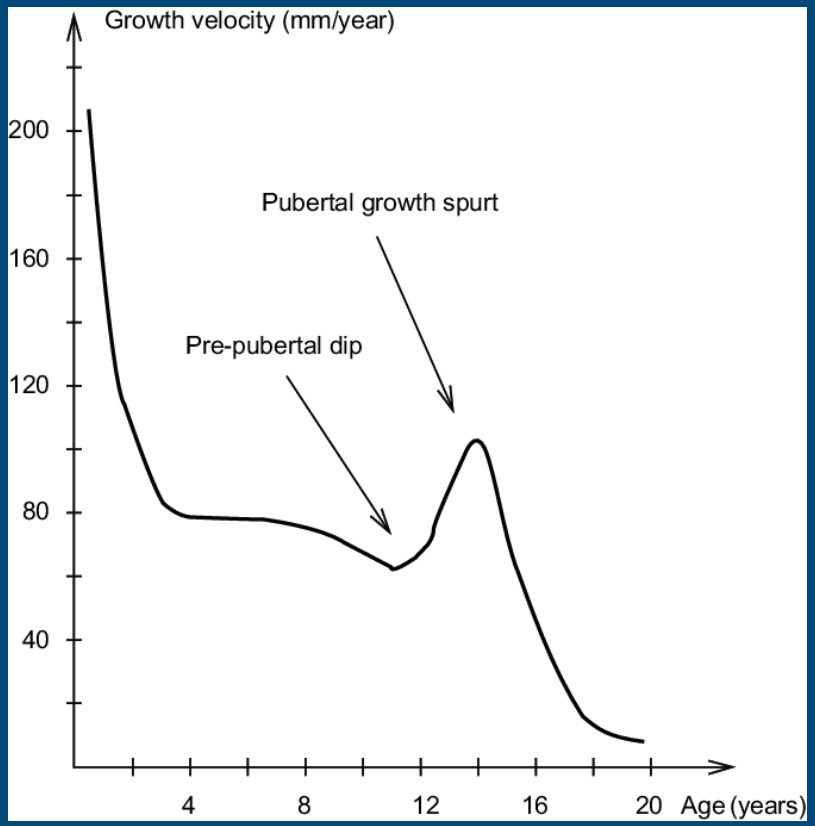
- Epiphysis
- **Physis**
- Metaphysis
- Diaphysis
- **Apophysis**



- Physis are the weak link
- Ligaments and tendons are strong relative to bone at physis

Pelvis and Hip Avulsion fractures

Anatomy of the Pediatric Bone



Why does this set up for increased injury risk:

- Physes are in rapid phase of growth and less resistant to tensile shear
- Decrease in age adjusted bone mineral density that occurs before peak height velocity

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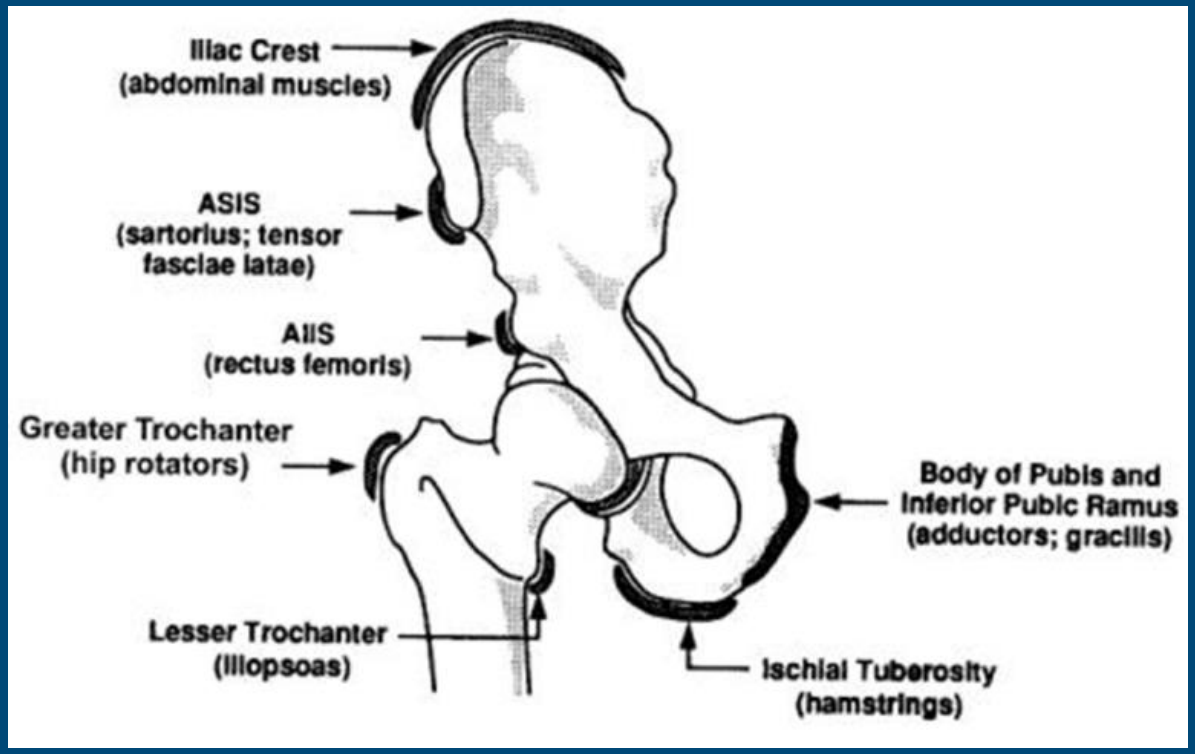
Pelvis and Hip Avulsion fractures

Anatomy of the Pediatric Bone



Pelvis and Hip Avulsion fractures

Age of Appearance of Pelvic Apophysis

Females	Age of Appearance
Greater Trochanter	<2
Lesser Trochanter	6.5 (5.9-8.6)
Ischial Tuberosity	12.6 (10.5-13.9)
Anterior Inferior Iliac Spine	14.0 (9.8-15.9)
Iliac Crest	14.4 (11.3-15.9)
Anterior Superior Iliac Spine	15.0 (11.3-16.8)
Symphysis Pubis	17.6 (12.5-19.1)

Males	Age of Appearance
Greater Trochanter	4.1 (3.2-4.7)
Lesser Trochanter	10.9 (8.6-12.1)
Anterior Inferior Iliac Spine	13.6 (11.1-15.3)
Ischial Tuberosity	14.0 (12.5-15.2)
Anterior Superior Iliac Spine	14.0 (12.6-15.3)
Iliac Crest	14.0 (12.6-15.3)
Symphysis Pubis	19.8 (16.3-21.1)

Pelvis and Hip Avulsion fractures

Age of Closure of Pelvic Apophysis

Females	Age of Closure
Lesser Trochanter	12.6 (11.3-13.9)
Anterior Inferior Iliac Spine	14.5 (11.3-15.9)
Greater Trochanter	15.0 (10.4-16.8)
Anterior Superior Iliac Spine	15.8 (13.6-16.8)
Ischial Tuberosity	20.2 (14.0-25.1)
Iliac Crest	23.3 (15.8-25.8)
Symphysis Pubis	27.2 (19.5-30.4)

Males	Age of Closure
Lesser Trochanter	14.1 (13.9-16.9)
Anterior Inferior Iliac Spine	16.3 (13.9-17.5)
Greater Trochanter	16.8 (13.9-18.0)
Anterior Superior Iliac Spine	18.0 (16.0-18.8)
Ischial Tuberosity	20.6 (16.0-23.8)
Iliac Crest	21.6 (16.0-23.9)
Symphysis Pubis	26.2 (20.6-30.0)

Pelvis and Hip Avulsion fractures

Age of Closure of Pelvic Apophysis

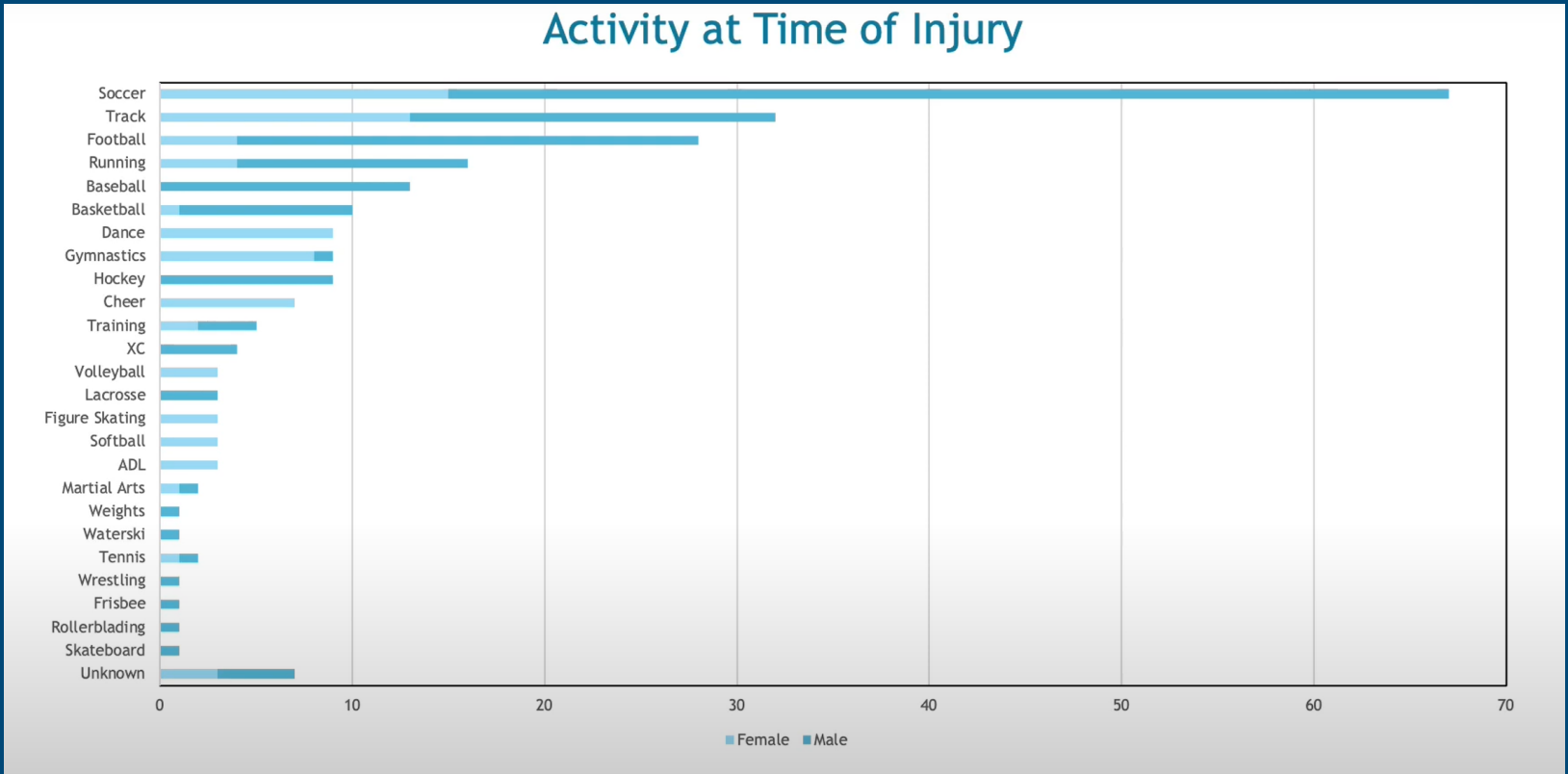
Females	Average Age of Appearance	Average Age of Closure
Lesser Trochanter	6.5	12.6
Anterior Inferior Iliac Spine	14.0	14.5
Greater Trochanter	<2	15.0
Anterior Superior Iliac Spine	15.0	15.8
Ischial Tuberosity	12.6	20.2
Iliac Crest	14.4	23.3
Symphysis Pubis	17.6	27.2

Males	Average Age of Appearance	Average Age of Closure
Lesser Trochanter	10.9	14.1
Anterior Inferior Iliac Spine	13.6	16.3
Greater Trochanter	4.1	16.8
Anterior Superior Iliac Spine	14.0	18.0
Ischial Tuberosity	14.0	20.6
Iliac Crest	14.0	21.6
Symphysis Pubis	19.8	26.2

Pelvis and Hip Avulsion fractures

Epidemiology of Pelvic Avulsion fractures

- Small study (242 cases over 19 year period in Michigan)



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Pelvis and Hip Avulsion fractures

Epidemiology of Pelvic Avulsion fractures

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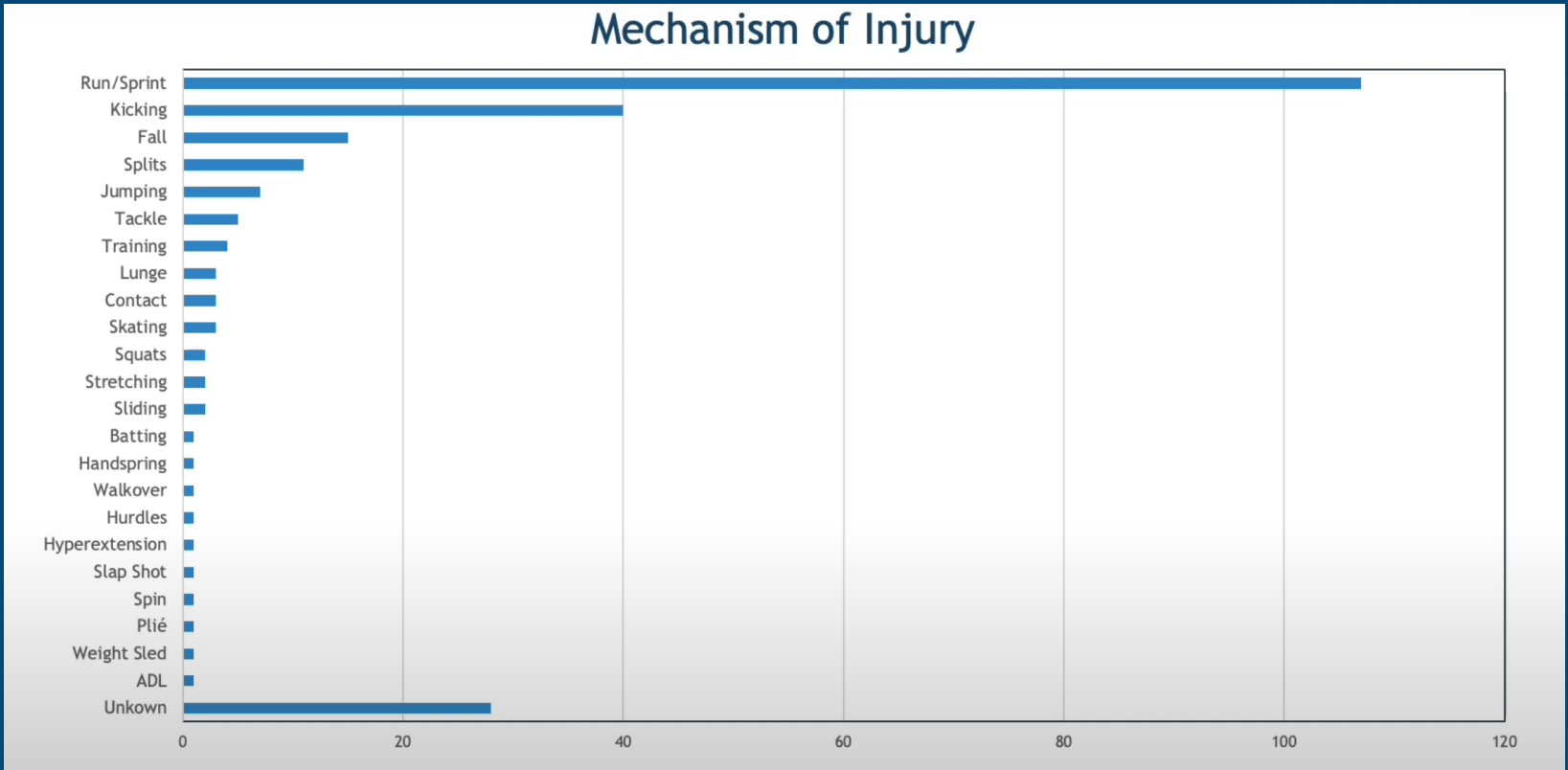

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Pelvis and Hip Avulsion fractures

Epidemiology of Pelvic Avulsion fractures

- Location
  - Anterior Inferior Iliac Spine 31.0%
  - Ischial Tuberosity 30.1%
  - Anterior Superior Iliac Spine 26.7%
  - Iliac Crest 8.1%
  - Lesser Trochanter 3.1%
  - Pubic Symphysis 0.9%
  - Greater Trochanter 0.1%

Site	Female	Male	Total
AIIS*	9 (11.2%)	51 (31.5%)	60 (24.8%)
ASIS	23 (28.8%)	49 (30.2%)	72 (29.7%)
IC*	21 (26.2%)	10 (6.2%)	31 (12.8%)
IT	24 (30%)	39 (24.1%)	63 (26.1%)
LT	3 (3.8%)	12 (7.4%)	15 (6.2%)
GT	0	1 (0.6%)	1 (0.4%)

*Significant difference in incidence between females and males

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Pelvis and Hip Avulsion fractures

Common Presentation

- History
  - Acute/sudden injury event with sprinting, kicking, jumping, etc.
  - May be associated with a “pop” sensation
  - Pain typically localized to avulsion site
  - May have difficulty bearing weight, but not always

- Physical Exam
  - Point tenderness to associated apophysis
  - Pain with firing muscle attached to apophysis
  - Pain stretching muscle attached to apophysis
  - May have limited range of motion
  - May have associated swelling and/or bruising

Moeller et al. 2022	
Pain at apophysis	(98.3%)
Weakness in muscle attached to involved apophysis	(85.1%)
Painful ROM	(47.1%)
Reduced ROM	(31.0%)
Limp	(22.7%)

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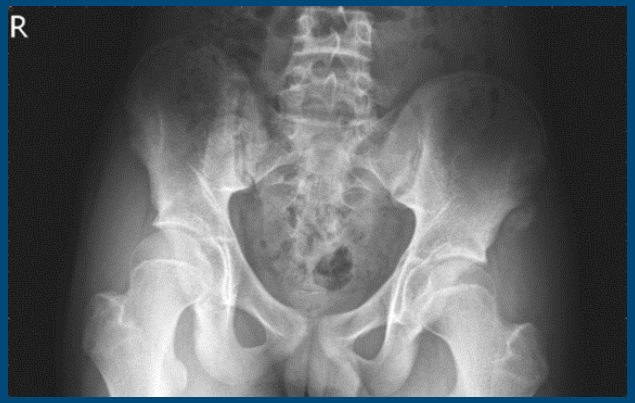
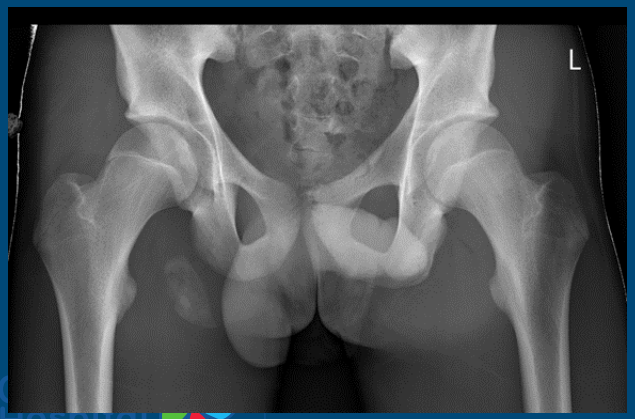
Pelvis and Hip Avulsion fractures

Work-up

- Have initial suspicion for injury
  - Pain to palpation of apophysis after sudden event (with or without a “pop”)
- Obtain x-ray and refer for further evaluation





Pelvis and Hip Avulsion fractures

Treatment

- Non-operative
    - If fracture displacement is under 2cm displacement (?)
  - Rest
    - Crutches if having pain with walking
  - Range of Motion Exercises
  - Stretching and strengthening exercises
  - Progressive Aerobic exercise
    - Stationary Bike/Elliptical → Jogging → Running → Change of Direction → Progressive Burst activities

  - Average Return to Sport 6-8 weeks (?)

- Operative
  - Avulsion fractures >2 cm displacement (?)

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Pelvis and Hip Avulsion fractures

Causes for Delay in Diagnosis

- Patients with a “pop” more likely to seek earlier care
  - 33% patients reported a pop, 66% of those with “pop” diagnosed in first week
  - Patients diagnosed at 15+ days significantly less likely to have experienced a “pop”
- Ischial Tuberosity avulsion more commonly delayed than other areas
  - Ischial tuberosity 36.6 days vs. 11-14 days
- Basketball players had greatest delay to diagnosis
  - Basketball 43.5 days vs. 13-16 days, (Ballet/Dance 34.3 days)
- No difference between males and females
- Family delay in seeking care most common cause for delay

Pelvis and Hip Avulsion fractures

Concerns with Delay in Diagnosis

Delay Group	Age years ± SD	Time to Dx days ± SD	Duration of Care days ± SD	DRTPA days ± SD
Group 1 (dx days 0-7)	14.59 ± 1.65	3.52 ± 2.24	45.51 ± 26.03	48.96 ± 25.85
Group 2 (dx days 8-14)	14.53 ± 1.60	11.75 ± 2.46	47.44 ± 21.83	59.07 ± 21.97
Group 3 (dx days 15-21)	14.87 ± 1.33	19.97 ± 1.99	47.48 ± 25.32	67.93 ± 26.07
Group 4 (dx days 22-30)	15.18 ± 1.22*	28.43 ± 2.45	53.66 ± 36.03	82.31 ± 36.66
Group 5 (dx days 31+)	14.55 ± 1.42	69.23 ± 37.69	48.82 ± 33.17	116.93 ± 54.09

DRTPA- Duration for Clearance/Return to Play activities

- Duration of care not did not show a statistically significant difference
- RTP difference for an athlete of 49 days to 117 days is significant

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Pelvis and Hip Avulsion fractures

Take Home Points

- Acute pain in pelvis/hip in young athletes with tenderness to the bone should be evaluated in clinic with X-rays
  - May or may not have history of “pop”
- Discuss with athlete and their family the importance of early diagnosis in overall recovery
- Discuss the importance of getting X-rays and not just evaluation
- Majority are treated conservatively, but early diagnosis and proper rehab program are best way to get athletes back to sport in timely manner

Case #2

15 yo female ballerina presents to clinic with complaints of popping in her left hip that started 1 month ago. She doesn't recall any specific injury but says that often during dance class she will get a pop sensation to the lateral aspect of the left hip. She doesn't get pain with it, but she is concerned because she feels like something is shifting around in her hip. It does not seem to prevent her from doing any of the activities she needs to do for dance, but because it is not improving, she is worried she might have injured something.

On exam she has full range of motion in the hip without pain. When flexing her hip, you feel something shift on the lateral aspect of the hip, but she does not feel pain. She has 5/5 strength in the hip without pain. She does have a positive Ober's test, indicating some tightness in her IT band.

Snapping Hip Syndrome

Also known as Coxa Saltans or Dancer's Hip

Characterized by an audible or palpable snapping/popping sensation during movements of the hip joint

Classified into two main categories

1. External snapping hip (most common form)
   - Most commonly IT Band moving over greater trochanter
2. Internal snapping hip
   - Most commonly iliopsoas tendon moving over the anterior aspect of the femoral head
     - Can be over the iliopectineal eminence, or iliopsoas bursa
3. Intra-Articular snapping hip (?)
   - Term used that could indicate labral tear as a cause, or intra-articular loose body
   - Those entities are now referenced as separate entities

Snapping Hip Syndrome

Epidemiology

- Approximately 5-10% of population affected
- Majority experience "painless" snapping
- Commonly associated with overuse
- Female vs. Male
  - External snapping hip- no significant differences between M and F
  - Internal snapping hip- more common in F than M
- Sports/Activities
  - Gymnastics and Ballet most prevalent
    - Study evaluating 87 elite ballet dancers, 91% had some degree of snapping hip (Lewis et al 2010)
  - Weightlifting, soccer players, runners
  - Activities that involve frequent hip rotation

Snapping Hip Syndrome

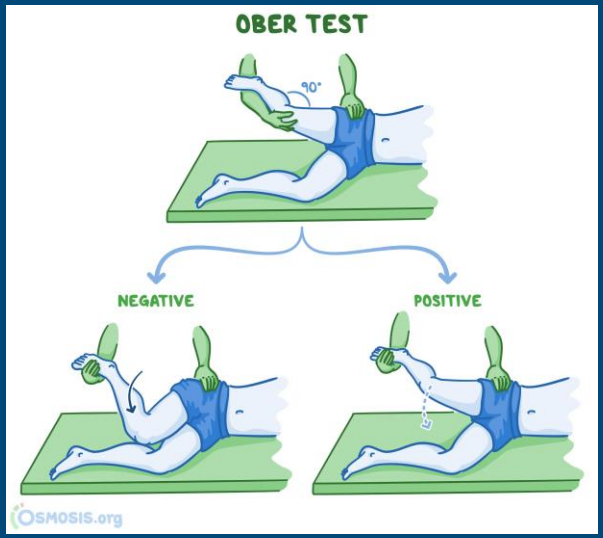
Common Presentation

- History
  - Complaints of "popping" in hip (with or without pain)
  - Can point with one finger where "popping"/pain is coming from
  - Usually know maneuver that can recreate "popping" sensation
  - Symptoms more chronic in nature
    - If painful, usually pain is progressing over time

Snapping Hip Syndrome

Common Presentation

- Physical Exam
  - External Snapping Hip
    - Often has a visible "popping" motion
      - "External Snapping hip is one you can see from across the room, internal snapping hip is one you can hear from across the room"
    - Can often feel "snapping" when palpating over the greater trochanter region as hip is actively flexed
    - May or may not be tender around greater trochanter and IT band region
    - Ober's Test
      (Used to diagnose IT Band tightness)
      - With patient lying in lateral position, stabilize the iliac crest
      - Flex knee to 90 degrees, then abduct the leg and extend at the hip
      - In this position, let knee lower towards table
      - Test is positive if knee is unable to adduct back to anatomic neutral position



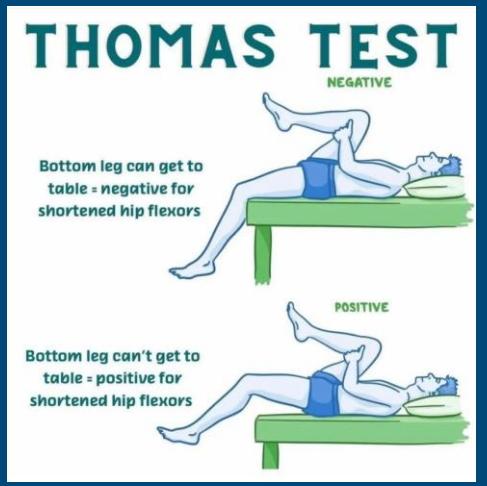
Snapping Hip Syndrome

Common Presentation

- Physical Exam
  - Internal Snapping Hip
    - Snapping may be reproduced by passively moving hip from a flexed and externally rotated position to an extended and internally rotated position
    - May or may not be tender around iliopsoas tendon, region of femoral head

Thomas Test

- assess length and flexibility of hip flexors, primarily iliopsoas
- Patient lies in a supine position
- First check for any excessive lumbar lordosis
- Patient then pulls knee of unaffected side to chest with other leg extended on the table
- Examiner stabilizes pelvis
- Positive if extended leg lifts off of table



Snapping Hip Syndrome

Common Presentation

- Physical Exam
  - Internal Snapping Hip

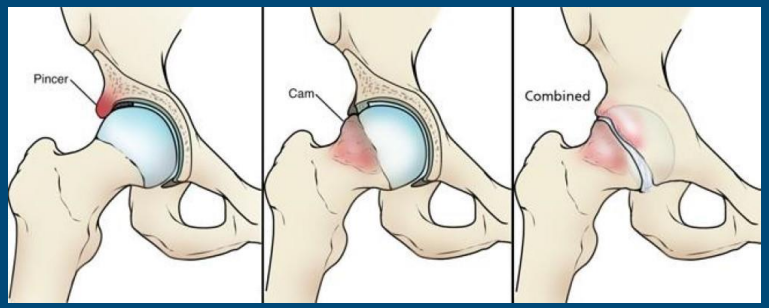
    Stinchfield's test
    - Assesses iliopsoas or intra-articular pathology
    - Patient lies supine on table
    - Have patient flex their hip to 20-30 degrees with knee fully extended
    - Have patient resist downward force applied by examiner
    - Positive if creates pain to anterior hip/groin

Snapping Hip Syndrome

Evaluation

- Imaging
  - Can be helpful (especially in cases when pain is present), but not necessarily needed initially
  - Ultrasound
    - Point of care ultrasound can allow dynamic study to demonstrate snapping of both external and internal snapping hip
  - Xrays
    - AP/Frog leg view of pelvis
    - Can help evaluate for FAI bone lesion,

      or loose body
  - MRI
    - Can be helpful evaluating for other pathologies
      - Labral tear, Bursitis (Iliopsoas, greater trochanteric), tendinitis, loose body, synovitis



Snapping Hip Syndrome

Management

Snapping without Pain

- Does not require any specific intervention
  - Athlete education of process is helpful
  - Can start stretching exercises for tight muscles, core strengthening (hips and glutes)

Snapping with Pain

- Start with conservative treatment
  - Activity modification, stretching, physical therapy, NSAIDS
  - Can consider corticosteroid injection
    - Prolonged symptoms or impacting daily activities
- Operative cases
  - Other pathology found on MRI (Labral tear, FAI, loose body)
  - Resistant cases (rare)
    - Iliopsoas tendon release, IT band release, excision of bursa

Snapping Hip Syndrome

Take Home Points

- 5-10% of population is affected, but most are cases with out pain
- Education of diagnosis/pathology for athletes is very helpful
  - Popping without pain is okay
- Helpful to start stretching and core strengthening program even if painless snapping/popping
  - Try to reduce progression

Case #3

14 yo female cross-country athlete who presents with right sided hip/groin pain that she first noticed 3 weeks ago. She doesn't recall any specific injury, but says that she will get an aching pain that originally just bothered her when she was running, and would go away soon after she stopped running. Now it seems to take longer and longer for the pain to go away after she stops exercising. She points to the anterior aspect of the hip as its location, but she is not able to pinpoint it to one spot. This is her first year doing cross-country, and she mentions the team first started their training for the season 4 weeks ago with the team heading up to Big Bear for initial training.

On exam she has full range of motion in the hip but does get pain at the end range of motions. She has 5/5 strength in the hip with resistance in all directions, but again slight discomfort with all motions. She has point tenderness in the region of the femoral neck. She walks with a normal gait, but does get discomfort when asked to do a single leg hop on that side.

Femoral Neck Stress Fractures

- Caused by repetitive loading of the femoral neck without proper time for body to recover
  - Stress fractures: abnormal load on normal bone, or normal load on abnormal bone (RED-S)
- Femoral Neck Stress Fractures make up 3-5% of sports related stress fractures (9% of lower extremity stress fractures)

- Sports/Activities
  - Military personnel (Cadet training, JROTC?)
  - Cross country or track and field
    - Also gymnastics, ballet dancing, basketball
  - High training volume and intensity

- Risk Factors
  - Female > male
  - RED-S
  - FAI
    - Associated with 50% of femoral neck stress fractures
  - Lower BMI
  - Decreased bone mineral density

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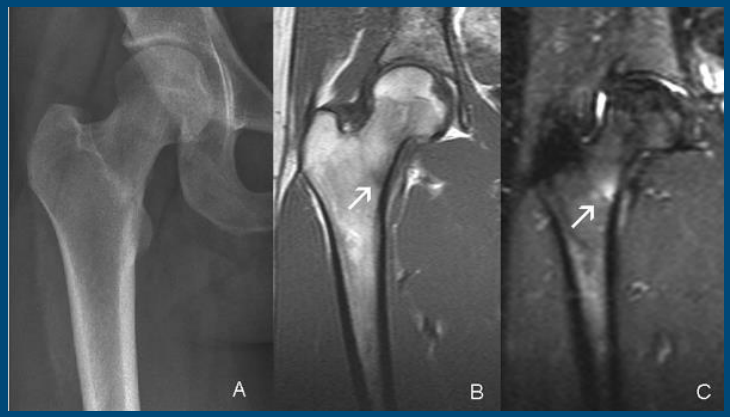
Femoral Neck Stress Fractures

- Common History
  - Gradual increase in anterior groin region (87%)
    - hip, thigh, even gluteal
  - Pain increases with impact activity (running, jumping, etc.)
  - Pain goes away with stopping activity
    - May progress to pain all the time, can even be at night
  - High intensity training (running, jumping, etc.)
    - Significant change in the amount of training/activity

- Common Physical Exam findings
  - Often full ROM, but pain with extreme hip motions (79% of FNSF)
    - Decreased motion as stress injury progresses
  - Tenderness directly over femoral neck (62% of FNSF)
  - Some studies showed log roll test and straight leg raise (pain in hip) as provocative tests

Femoral Neck Stress Fractures

- Imaging
  - X-rays
    - AP and Frog leg views
    - Signs often subtle (sclerosis, linear lucency)
    - 66% of cases do not show changes on Xray on original presentation
    - One study showed it took around 6-8 weeks for stress related changes to show on X-ray (Bencardino et al 2002)
  - MRI
    - Gold standard for imaging
    - Should be ordered if xrays are negative and high suspicion for femoral neck stress fracture
    - Starts as ill defined Hypointense area on fat saturated images and Hyperintense area on fluid saturated views



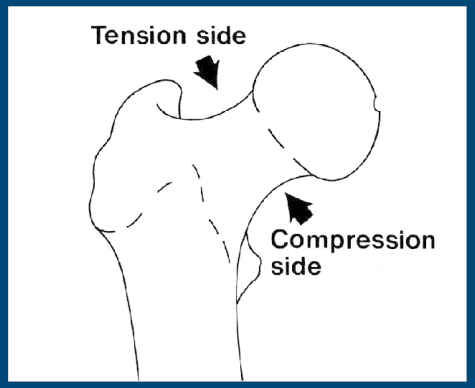
Femoral Neck Stress Fractures

- Treatment
  - location (compression vs tension side)
  - extent of fracture (complete/>50% femoral neck width vs incomplete/<50% femoral neck width)

  - Non-Operative
    - Compression and tension sided stress changes on MRI (as long as no fracture line is seen)
    - Compression side fractures if fracture <50% of femoral neck width

    - Non-weightbearing on crutches in most cases initially, but can progressively weight bear as pain allows
    - Often can resume sports activities around 12 weeks, but this is all based on clinical symptoms and radiographic union

  - Operative
    - Tension sided fractures
    - Compression side fractures if fracture >50% femoral neck width
    - Compression sided fractures with Hip effusion on imaging
      - 8x risk of progression
    - Compression sided fractures that are getting worse



Femoral Neck Stress Fractures

Take Home Points

- Have high clinical suspicion in endurance and high impact athletes with insidious onset hip pain, worsened with activity
- If high suspicion, and negative xrays, MRI is gold standard for diagnosis

Take Home Points

Overuse injuries and muscle strains are very common causes of hip pain in young athletes

However, it is important to keep on your differential other causes of pain, and to make appropriate referrals and work-up as indicated

Time is important in working with athletes as they all want to return to their activities as soon as possible, so initiating timely and efficient work-up and treatment is essential to getting them back to what they love

THANK YOU

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References

- Parvaresh KC, Upasani VV, Bomar JD, Pennock AT. Secondary Ossification Center Appearance and Closure in the Pelvis and Proximal Femur. J Pediatr Orthop. 2018 Sep;38(8):418-423. doi: 10.1097/BPO.0000000000000836. PMID: 27442214.
- Moeller JL, Galasso L. Pelvic Region Avulsion Fractures in Adolescent Athletes: A Series of 242 Cases. Clin J Sport Med. 2022 Jan 1;32(1):e23-e29. doi: 10.1097/JSM.0000000000000866. PMID: 32941369.
- Yeager KC, Silva SR, Richter DL. Pelvic Avulsion Injuries in the Adolescent Athlete. Clin Sports Med. 2021 Apr;40(2):375-384. doi: 10.1016/j.csm.2020.12.002. Epub 2021 Feb 5. PMID: 33673893.
- Moeller, James L. MD. Pelvic Avulsion Fractures in Adolescent Athletes: Analyzing the Effect of Delay in Diagnosis. Clinical Journal of Sport Medicine 32(4):p 368-374, July 2022. | DOI: 10.1097/JSM.0000000000000977
- Musick SR, Varacallo MA. Snapping Hip Syndrome. 2023 Aug 4. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 28846235.
- Giai Via A, Fioruzzi A, Randelli F. Diagnosis and Management of Snapping Hip Syndrome: A Comprehensive Review of Literature. Rheumatology. 2017;7(4). doi:10.4172/2161-1149.1000228
- Stracciolini A, Yen YM, D'Hemecourt PA, Lewis CL, Sugimoto D. Sex and growth effect on pediatric hip injuries presenting to sports medicine clinic. Journal of Pediatric Orthopaedics B. 2016;25(4):315-321. doi:10.1097/bpb.0000000000000315. PMID:27058819
- Lewis CL. Extra-articular snapping hip: A literature review. Sports Health. 2010;2(3):186-190. doi:10.1177/1941738109357298. PMID:23015936

References

- Walker P, Ellis E, Scofield J, Kongchum T, Sherman WF, Kaye AD. Snapping Hip Syndrome: A Comprehensive Update. Orthopedic Reviews. 2021;13(2). doi:10.52965/001c.25088. PMID:34745476
- Shaw KA, Moreland CM, Hunt TJ, Barkley C, O'Brien F, Jackson KL. Femoral Neck Stress Fractures in Athletes and the Military. J Bone Joint Surg Am. 2022 Mar 2;104(5):473-482. doi: 10.2106/JBJS.21.00896. PMID: 35234724.
- Fullerton L R, Jr., Snowdy H A. Femoral neck stress fractures. Am J Sports Med. 1988;16:365–377. doi: 10.1177/036354658801600411.
- Robertson GA, Wood AM. Femoral Neck Stress Fractures in Sport: A Current Concepts Review. Sports Med Int Open. 2017 Mar 15;1(2):E58-E68. doi: 10.1055/s-0043-103946. PMID: 30539087; PMCID: PMC6226070.
- Bencardino J T, Palmer W E.Imaging of hip disorders in athletes Radiol Clin North Am 200240267–287.vi–vii
- Boscainos PJ, Cousins GR, Kulshreshtha R, Oliver TB, Papagelopoulos PJ. Osteoid osteoma. Orthopedics. 2013 Oct 1;36(10):792-800. doi: 10.3928/01477447-20130920-10. PMID: 24093694.
- Kerbel, Yehuda E et al. “Epidemiology of Hip and Groin Injuries in Collegiate Athletes in the United States.” Orthopaedic journal of sports medicine vol. 6,5 2325967118771676. 11 May. 2018, doi:10.1177/2325967118771676