2024 Napa Primary Care Conference
Stress Fractures in the Active Patient

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Trusted Team Physicians for the Sacramento Kings

Stress Fractures in the Active Patient

- Review the epidemiology, presentation, and risk factors associated for common stress fractures
- Describe appropriate evaluation and treatment recommendations
- Discuss the safe return of athletes and active patients back to physical activity and sports

Stress Fractures – Background and Epidemiology

- *Ultimate overuse injury…*
- Caused by repetitive stresses (tensile or compressive)
- Bone formation (osteoblastic) lags behind periosteal resorption (osteoclastic)
    - bone susceptible to microfractures
    - microfractures may propagate (generally symptomatic) and develop into a cortical bone discontinuity
- *Typically result from:*
    - small number of repetitions with a relatively large load
    - large number of repetitions with a usual load

Stress Fractures - Epidemiology

- <1% of the general population
- US Collegiate Athletes – 5.7 per 100k athletic exposures (AEs) over 10-year period
  - Highest rates in women's XC (28.6/100k AEs), women's gymnastics (25.6/100k AEs), women's track (22.2/100k AEs)
  - Metatarsals (38%), tibia (22%), low back/pelvis (12%)
  - Sports with both male/female participants: 2x rate in Females

Rizzone KH, et al. The Epidemiology of Stress Fractures in Collegiate Student-Athletes, 2004-2005 Through 2013-2014 Academic Years, J Athl Train 2017; 52:966

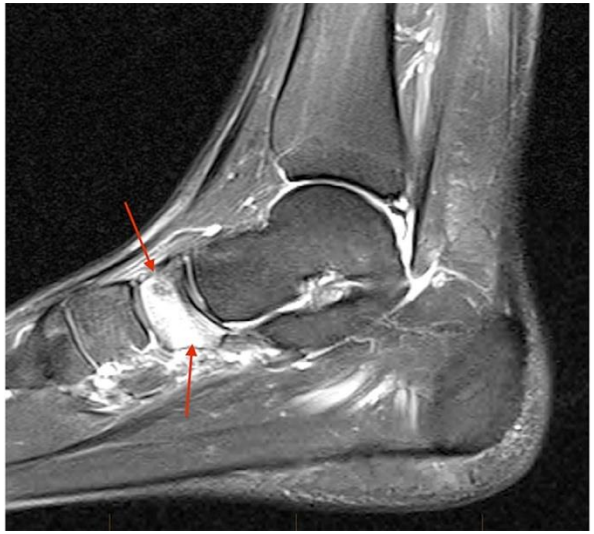
Stress Fractures – Risk Factors

- ***Prior stress fracture (most significant)***
- Low level of physical fitness
- Footwear
- Increased volume/intensity of physical activity
- Menstrual irregularity
- Lower BMI/BMD
- Calcium/Vit D poor diet
- Malabsorption
- Ages 17-26
- NSAIDs in prior 180 days

Wright AA, Risk factors associated with lower extremity stress fractures in runners: a systematic review with meta-analysis. Br J Sports Med 2015;49:4517

Stress Fractures – High Risk

- Spine – pars interarticularis
- Hip and thigh – Femoral head (tension side)
- Knee and leg – Patella, anterior cortex of the tibia
- Multiple sites of the ankle and foot:
    - medial malleolus
    - talus
    - tarsal navicular
    - proximal $4^{th}/5^{th}$ metatarsals
    - great toe sesamoids



Stress Fractures – Low Risk

- 2nd – 4th Metatarsal shafts
- Posterior/medial tibial shaft
- Proximal humerus/humoral shaft
- Ribs
- Sacrum
- Pubic Ramus

Stress Fractures – Differential Diagnosis

- Tendinopathy
- Muscle strains
- Ligament strains
- Nerve entrapment syndromes
- Exertional compartment syndromes
- Medial tibial stress syndrome (shin splints)
- Neoplasm
- Infection

Stress Fractures – Physical Exam

- Focal tenderness of the affected bone – ***most sensitive finding***
- May be subtle soft tissue swelling over stress fracture
- Fulcrum test: (imaging still needed)
- Tuning fork:
  - poor sensitivity/specificity
- Leg length discrepancy
- Joint ROM, strength/flexibility
- Limb alignment
- Foot type
- Core strength

Stress Fractures – General Considerations

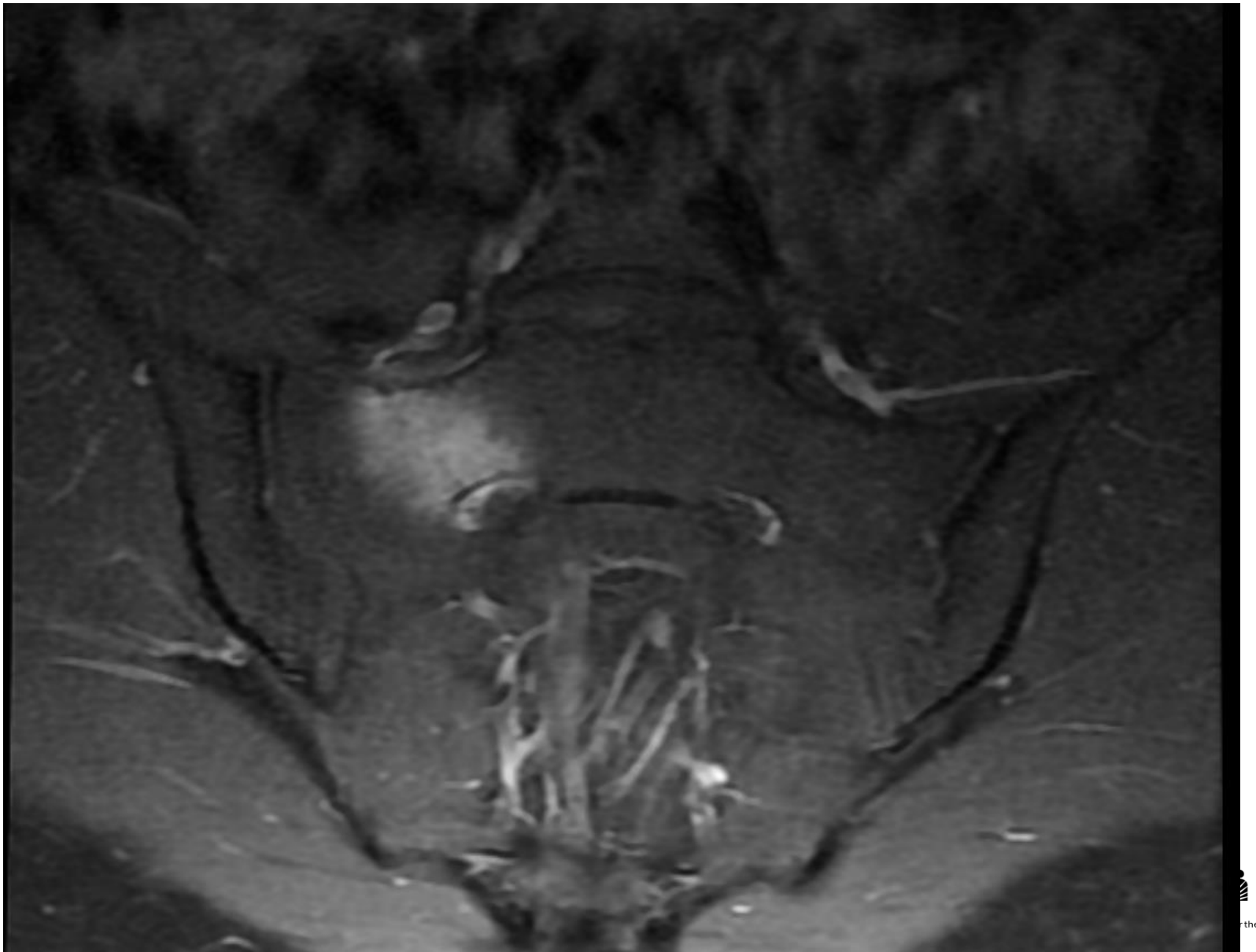
- Consider Risk Factors
- Exam
- Imaging…
- Once confirmed, check labs/DEXA
- Labs: CBC, CMP, TSH, PTH, 25-OH Vit D, urine Ca/Cr, SPEP (older patients), TTG IgA (celiac/low bone density)
- Sports Dietitian/PT/Gait Evaluation/Mental Health
- Clear expectations for return to sport
- Every fracture an opportunity to talk/educate
- Modified activities/time (4-week intervals x3-6 months)
- All pain-free activity is allowed

Attribution: Dr. Amy Powell (University of Utah) 2023

Stress Fractures – Case 1

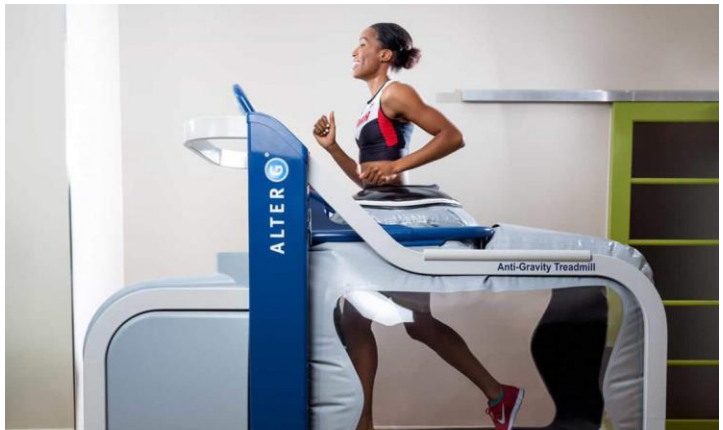
- 18 y/o Track and XC Runner
- 2 months of intermittent pain during rapid training progression
- Progressed during hilly XC Run
- Pain at rest, sitting, weight bearing
- Describes pain in the R lower back, SI/sacrum
- Denies radicular symptoms
- Exam with guarded lumbar flexion/extension/rotation
- Focally tender overlying the superior sacrum

Sacral Stress Fractures – Imaging



Case 1 – Sacral Stress Fracture: Treatment

- Cessation of all running
- Vitamin D: 26
- Calcium/PTH/CBC: normal
- DEXA: (family declined)
- REDs screening: + (Nutrition consultation)
- Cross training: pool, elliptical, Alter G
- Physical Therapy for strength maintenance, progressive loading



Stress Fractures – Femoral Neck

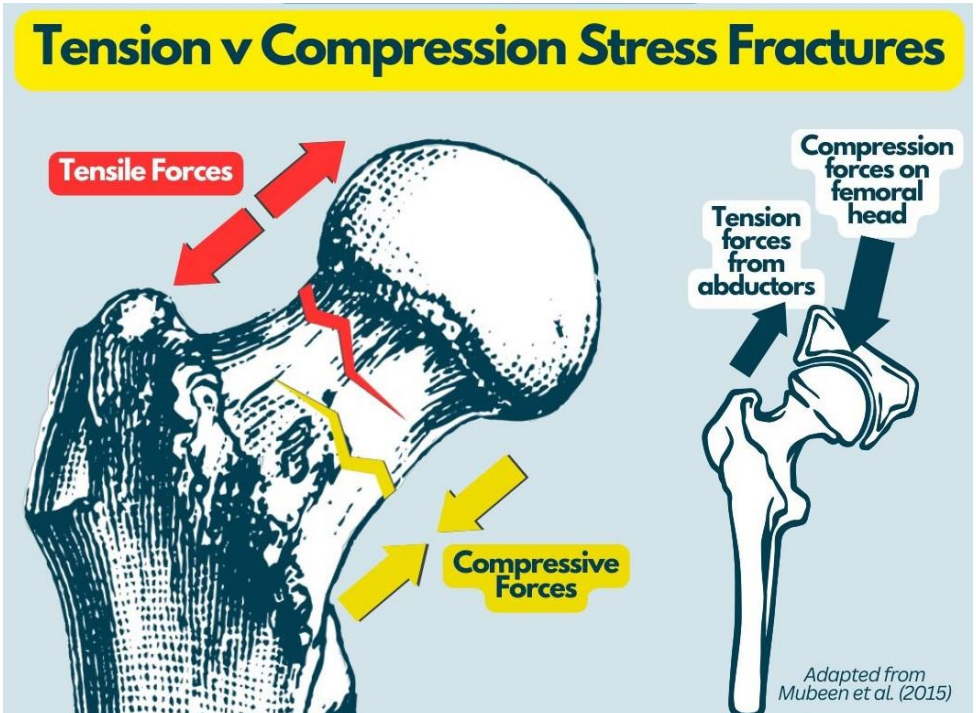
- Most commonly associated with running
- Females > Males
- Ages 5 to physically active patients in their 50/60's
- Poor fitness, sudden increase in activity, poor biomechanics
- Femoral neck stress fractures may occur on the superolateral (tension side) or inferomedial aspect (compression side) of the femoral neck

  - ***Tension side high risk!***

- *Femoral neck stress fractures typically present with vague anterior groin pain that develops or worsens with exercise or prolonged standing*
- Delay in diagnosis can lead to permanent disability

Stress Fractures (Femoral Neck) – Exam

- May have antalgic gait, groin pain
- Difficult to palpate due to musculature
- Pain at end ranges of motion (mostly IR/ER, deep flexion)
- Hop test (positive if reproduces groin pain, cannot hop)



Stress Fractures (Femoral Neck) – Imaging

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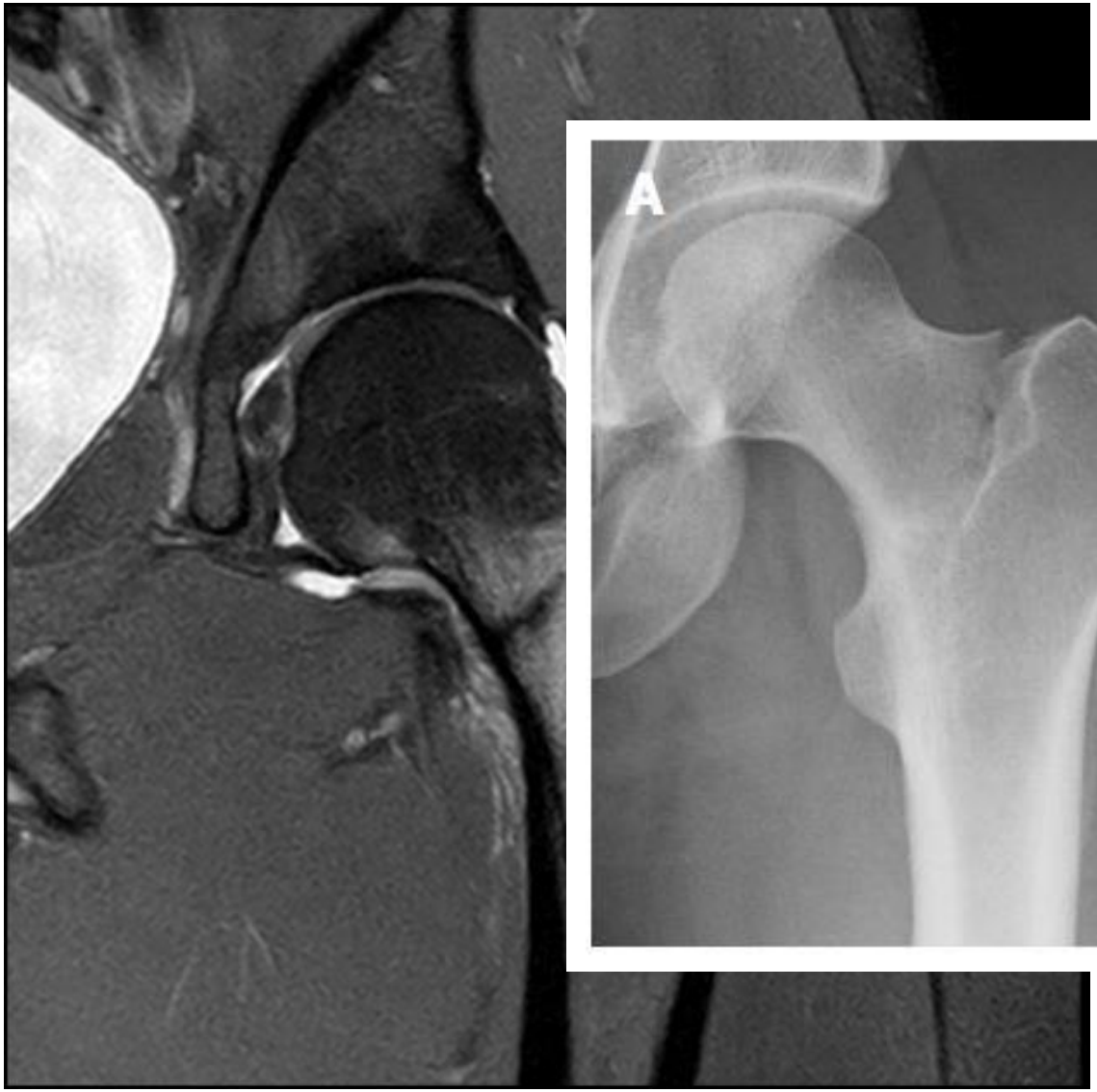

Stress Fractures (Femoral Neck) – Treatment

- **If tension side (superior/lateral):**
- NWB and Ortho consult within 24 hrs
- If displaced: immediate Ortho consultation
- Acetaminophen for pain control
- If tension side displaced and fixation performed: 3 weeks NWB, 3 weeks protected weight bearing
- If incomplete tension side treated non-operative (not typical, should be with surgical/SM consultation): bed rest 1-2 weeks, NWB/crutches 4-8 weeks

Stress Fractures (Femoral Neck) – Treatment

- **If compression side (inferomedial):**
- If 50% of width, consider surgery
- NWB/crutches x2 weeks
- Advance weight bearing as tolerated through week 4 (if pain, crutches x2 more weeks)
- May resume normal walking at 4-6 weeks if pain free
  - May start spin bike, swimming, aqua jogging
- Weekly xrays through week 4, then at 6/8/12 weeks
- Return to sports averages around 15 weeks

Stress Fractures – Femur

- 13 y/o AAU/school basketball athlete
- Progressive weight bearing pain of R femur
- Guarding/limping during practice
- Interfering with progression
- Upcoming tournament in 4 weeks
- +TTP R mid/medial femur
- +hop test/R leg
- +fulcrum

Stress Fracture (Femur): Imaging

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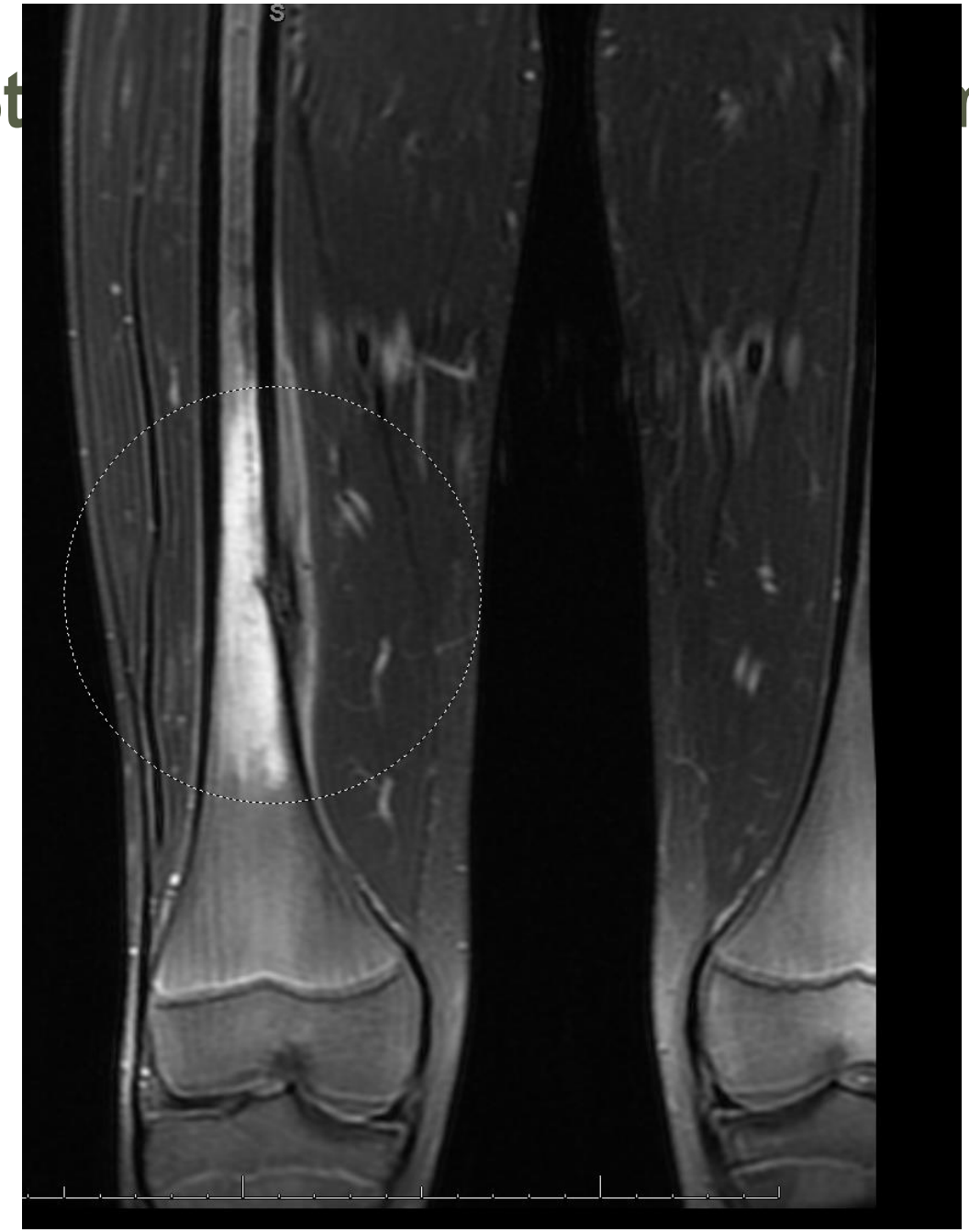


Stress Fracture Femur - Treatment

- ***In general, 12-week process:***
  - NWB/crutches x3 weeks
  - Weight bearing x3 weeks (swimming/limited strength of unaffected leg, no impact)
  - Advance WB x3 weeks, running straight line every other day (low volume)
  - Advance WB/sport specific drills x3 weeks
- X-rays every 3 weeks
- Negative fulcrum test every 3 weeks

Stress Fractures – Tibia

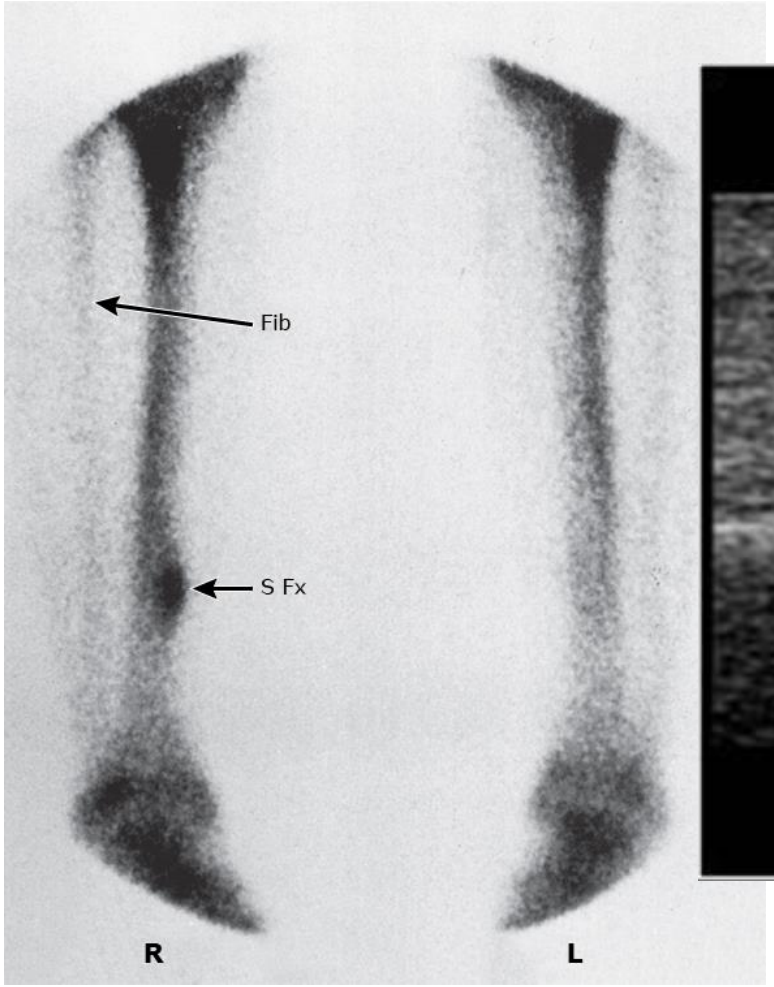
- Risk Factors:
  - **Activity related**: excessive training, poor footwear, irregular/hard terrain
  - **Biomechanical:** inflexibility/weak calf musculature, pes cavus/planus, leg length discrepancy
  - **Metabolic:** nutritional deficiencies, etc
- Most common with prolonged walking, running, jumping
- Gradual progression of pain over weeks to months
- Often confused with “shin splints” (diffuse)
- Pain typically very focal
- + hop test (inability to hop for 10 reps due to excessive pain)

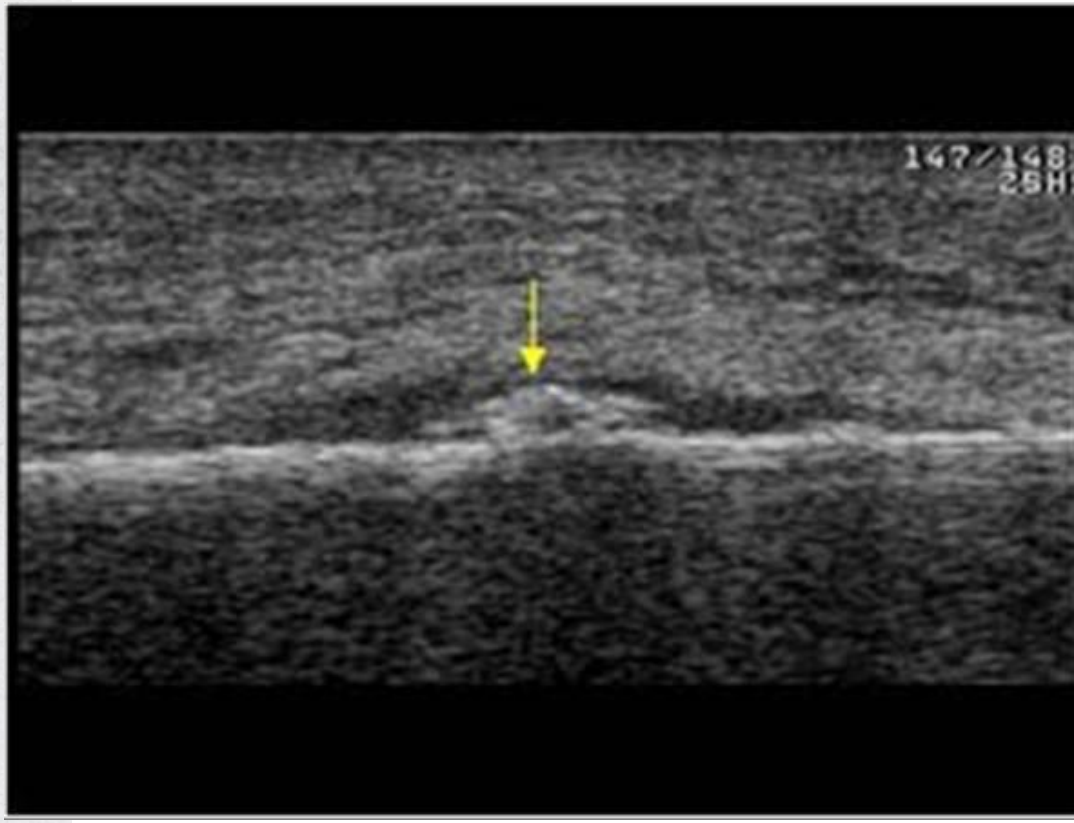
Stress Fractures (Tibia) - Imaging

- Start with X-rays
- Periosteal elevation, cortical thickening, sclerosis, true fracture line are + findings
- Assess AP/lateral views
  - Anterior Cortex (tension side) of tibia are hardest to treat
- MRI when diagnosis needs confirmation
- MSK ultrasound may have role in experienced hands…
- Follow up imaging rarely needed

Stress Fractures (Tibia) - Imaging

Stress Fractures (Tibia) - Imaging





Stress Fractures (Tibia) - Imaging

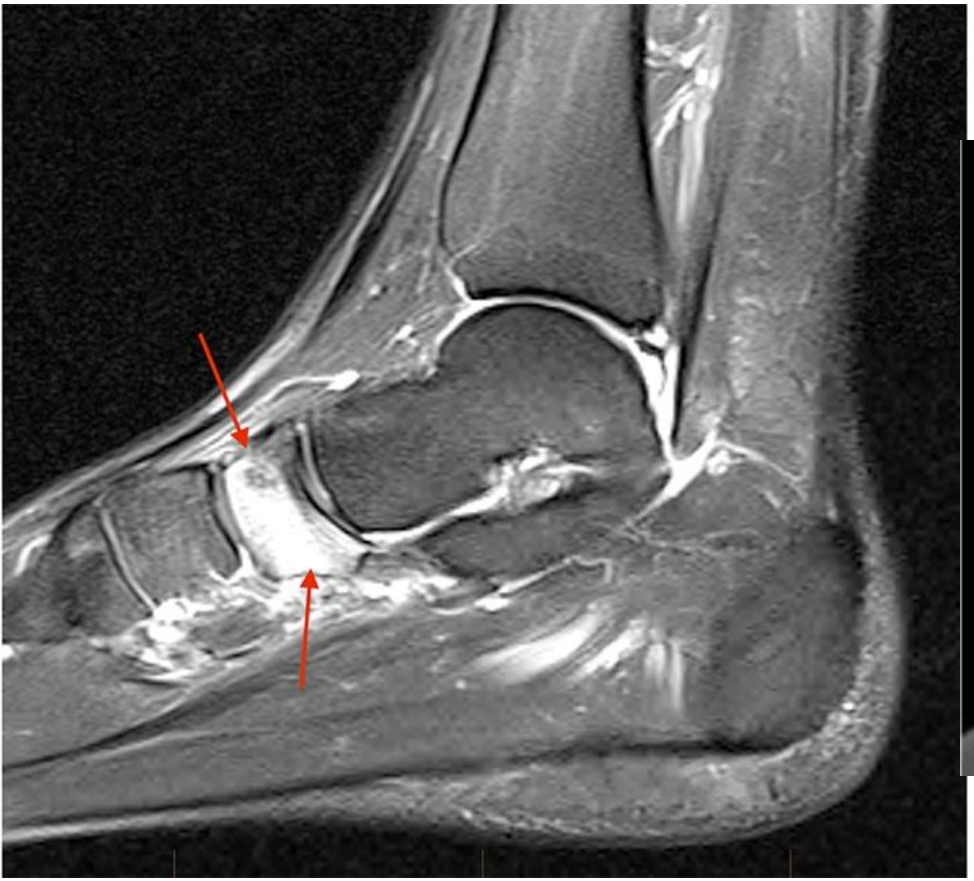
Stress Fractures (Tibia) – Management

- Non-surgical management for most
- Consider referral for anterior cortex, “dreaded black line”, proximal tibia
- Generally do not need NWB (perhaps week by week)
- Consider walking boot if walking painful, long air splint
- Physical therapy
- Take supplemental calcium 1500 mg and vitamin D 800 IU daily throughout rehabilitation
- 2 week follow up for athletes that need to return quickly
- Return to Sports: Medial/posterior tibial cortex: 6-12 weeks, Fibular (mid/distal): 6 weeks

Stress Fractures – Tarsal navicular

- Can be up to 10 months average before diagnosis
- Average age 25-29
- Poor training programs, footwear
- Female athletes appear at greatest risk
- Pain begins insidiously, develops to nagging deep ache
- Tenderness to palpation most relevant exam finding
    - pes cavus (high arch)
    - excess supination
    - forefoot varus/longer 2nd metatarsal

Stress Fractures (Tarsal Navicular) - Imaging



Stress Fractures (Tarsal Navicular) – Management

- Based on fracture type:
  - Type 0.5 – Stress reaction on MRI; CT normal
  - Type 1 – Fracture limited to dorsal cortex
  - Type 2 – Fracture line extends into navicular body
  - Type 3 – Fracture line extends from dorsal into plantar cortex

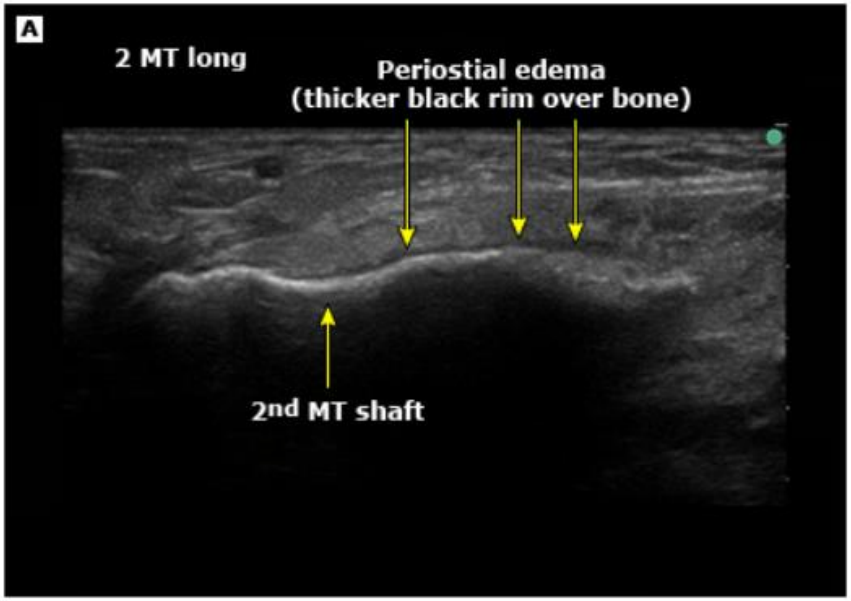
Stress Fractures (Tarsal Navicular) – Management

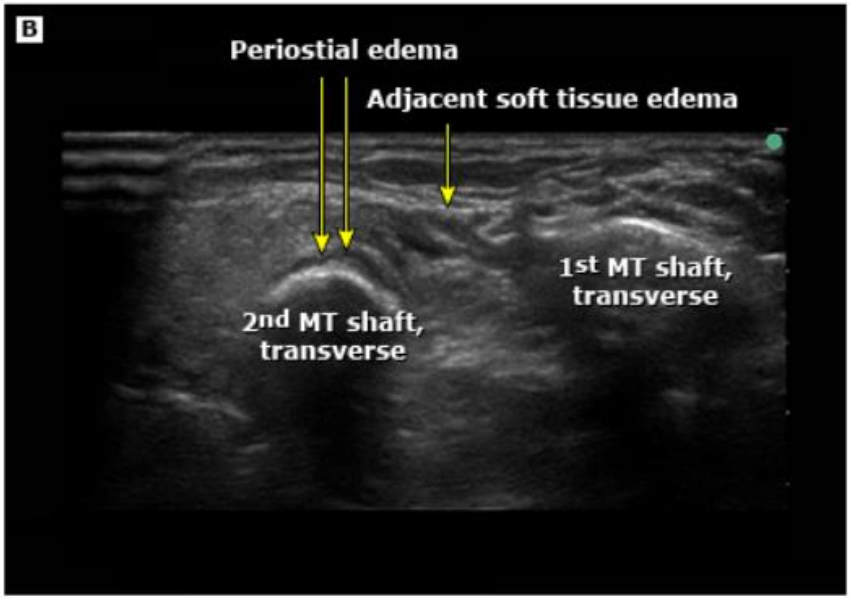
- Non-surgical management:
  - Type 0.5 – Stress reaction on MRI; CT normal (SL cast x3-6 weeks)
  - Type 1 – Fracture limited to dorsal cortex (SL cast x6 weeks)
  - Type 2 – Fracture line extends into navicular body (SL cast x6 weeks)
  - Type 3 – Fracture line extends from dorsal into plantar cortex (Surgical referral)
- ***Error on the side of consultation with Ortho/Podiatry!***
- With surgery – data to support return to play in 4 months (96%)
- Without surgery – 5 months (72%)

Stress Fractures – Metatarsal

- Often presents with worsening forefoot pain
- Typically with mid-phase of stride to toe off
- Review for changes in training volume/activity
- May have focal swelling
- Exam with focal tenderness to palpation
- Early x-rays often negative
- MSK u/s may be helpful with pain of 6 weeks
- MRI/bone scan most sensitive early imaging techniques (48-72hrs)

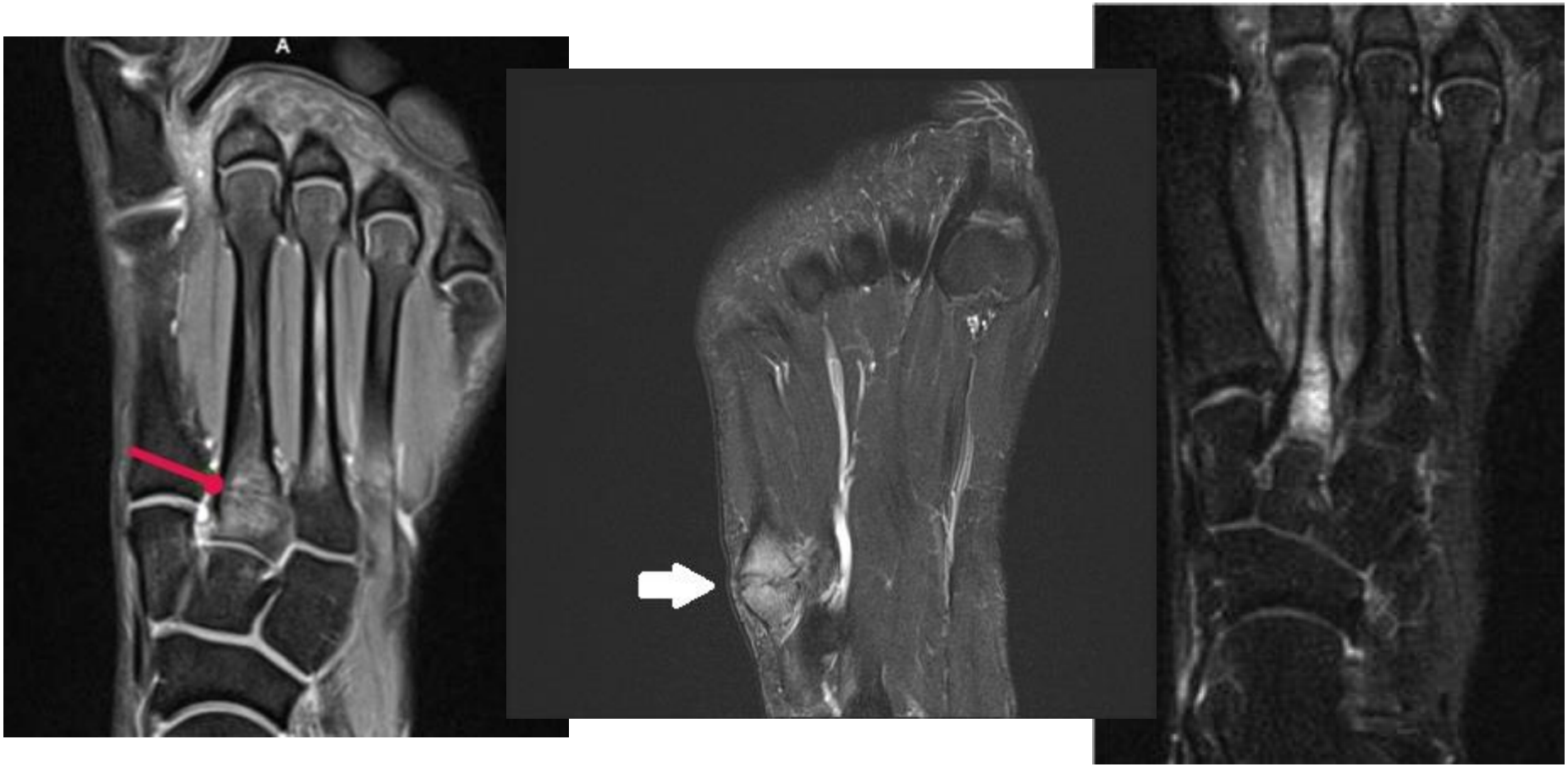
Stress Fracture (Metatarsals): Imaging





Attribution for images - UpToDate

Stress Fracture (Metatarsals): Imaging



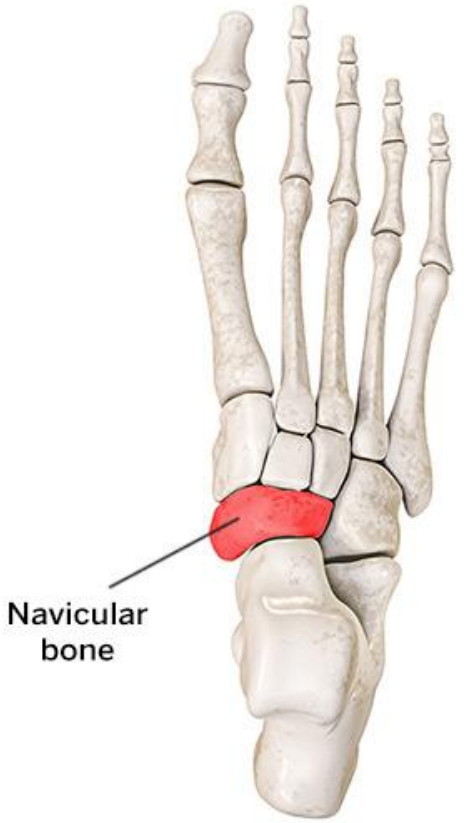
Br J Sports Med. 2023;57(7):427. Epub 2023 Jan 31.
Br J Sports Med. 2023;57(7):427. Epub 2023 Jan 31.

Stress Fractures (Metatarsal) - Treatment

- ***In general, 4 to 8-week process:***
  - NWB/crutch week to week with severe pain
  - Firm soled shoe/walking boot
  - Pool running, swimming, spin bike (if no pain at pressure site
  - Consider f/u in 2-3 weeks to assess pain, repeat images 4-8 weeks
  - Can be great opportunity for PT/Running specific conditioning
  - Avg return to sports: 78 days

Stress Fractures – Tarsal navicular

- Navicular “keystone” to medial column of foot
- Bears majority of load in tarsal complex during weight bearing
- Vascular/biomechanical properties make navicular susceptible to stress fracture
- Running/cutting/pivoting sports – highest risk
- Commonly missed due to:
  - absence of acute trauma
  - low level of pain
  - minimal swelling, inconsistent pain
  - difficulty of recognition on xray

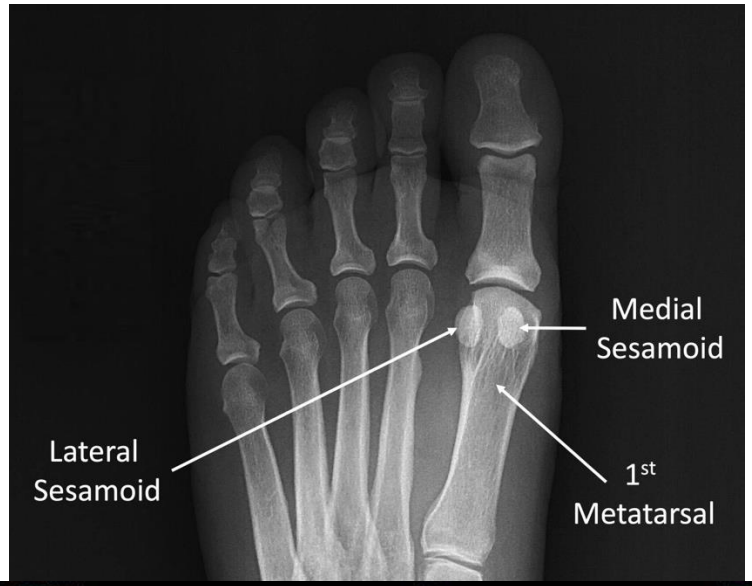


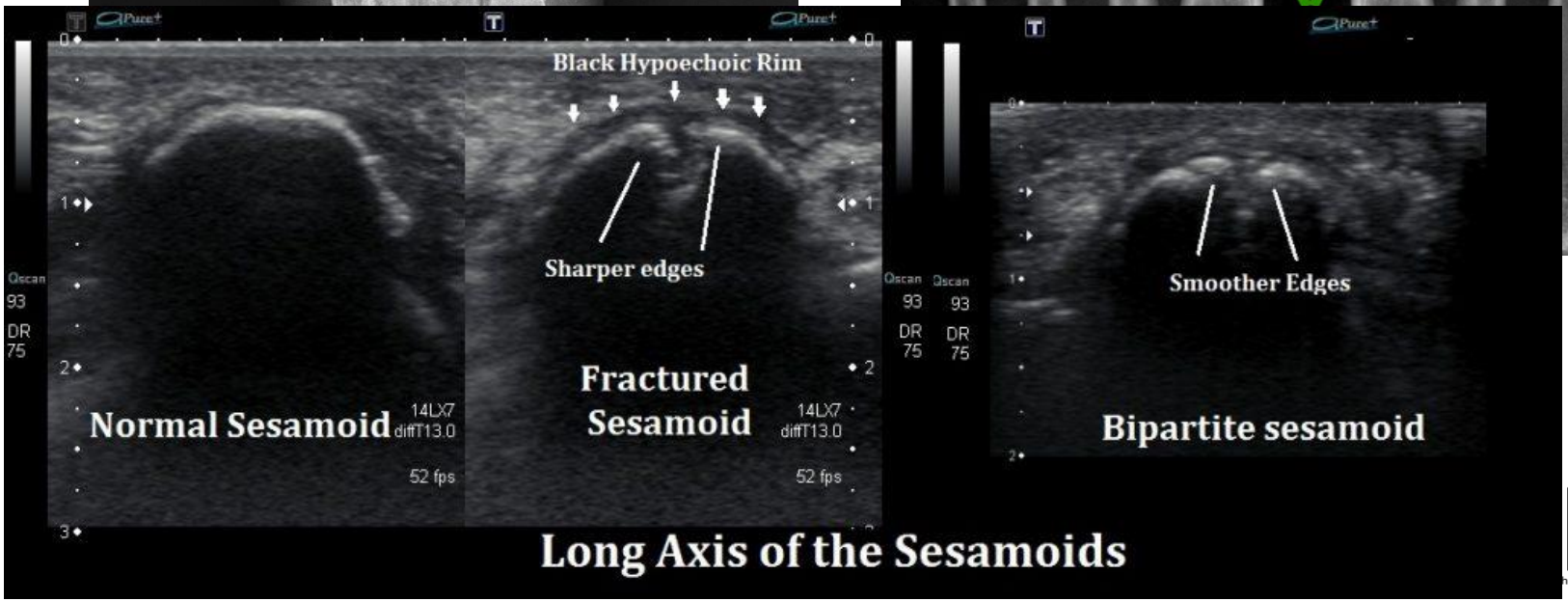
Stress Fractures – Sesamoid

- Sesamoid bones: embedded in flexor tendon under 1st MTP
- Protect tendon/enhance mechanics
- Long distance sports/rapid acceleration
- Poorly localized pain around great toe for several weeks
- Consider acute/traumatic fracture

- Differential: sesamoiditis, bursitis, FHB tendinopathy, MTP arthritis synovitis, MTP capsular sprain (turf toe)

Stress Fractures (Sesamoid): Imaging





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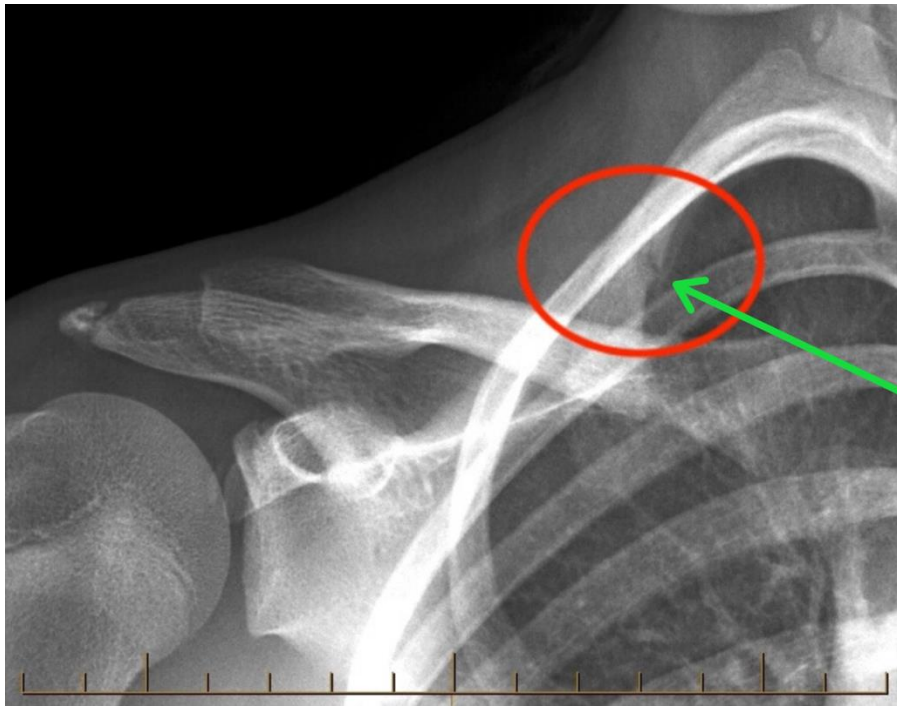
Stress Fractures (Sesamoid) - Treatment

- Open/displaced fractures (rare) – urgent ortho/podiatry referral
- Refer early with any doubt in weight bearing athlete
- Avoid WB activity
- Padding, firm soled shoe, boot use
- If pain free, molded orthosis 6-8 weeks
- If highly symptomatic stress fractures/acute: SLC for 4 weeks, transition to supportive device
- Typically 6 to 8-week process, advance slowly…
- Ortho/Podiatry consultation with any doubt

Stress Fractures – 1st rib

- 18 yo collegiate baseball player
- Vague shoulder pain with throwing
- Shoulder exam/imaging WNL
- Found on shoulder x-ray
- Rest, rehab
- Consider repeat imaging



Time and rate of return to sport after stress fracture

Stress fracture type	Average recovery time	Rate of return to full sports (%)
Tibia (posteromedial)	6 weeks (range 2 to 7)	98
Fibula	8 weeks	90
Metatarsals 1, 2, 3, 4 (not proximal)	11 weeks (range 3 to 12)	96
Pubis	11 weeks	96
5th metatarsal	12 weeks	95
Femoral shaft	12 weeks	95
Medial malleolus	15 weeks	93
Femoral neck (compression-side fractures treated nonsurgically)	15 weeks (range 4 to 32); average 7.4 weeks if MRI grade 1 and 15 weeks if MRI grade 2 to 4	55
Tarsal navicular	18 weeks	83
Low-risk site* and low-grade¶ severity on MRI/bone scan	8.7 weeks	
High-risk$^{\Delta}$ site and low-grade severity on MRI/bone scan	19.3 weeks	
Low-risk site and high-grade$^{\diamond}$ severity on MRI/bone scan	21.8 weeks	
High-risk site and high-grade severity on MRI/bone scan	18.7 weeks	

Attribution: UpToDate (Overview of Stress Fractures)

References

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Thank you!

Trusted Team Physicians for the Sacramento Kings