

2024 Primary Care Hawaii Conference

Stress Fractures in the Active Patient

April 4, 2024
Jason D. Brayley, MD



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



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

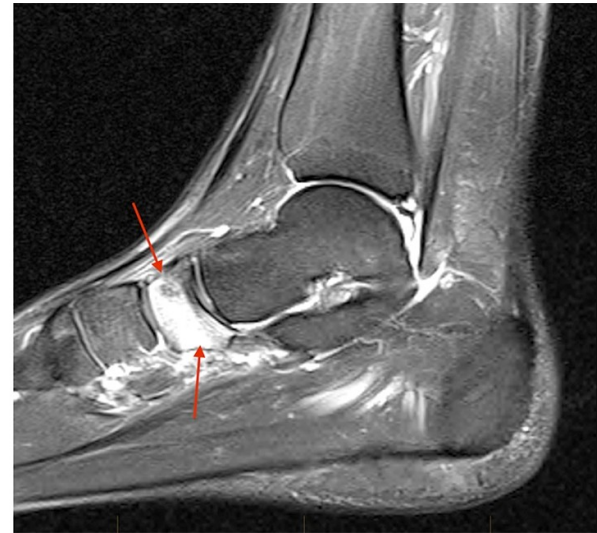


Wright AA, Risk factors associated with lower extremity stress fractures in runners: a systematic review with meta-analysis. Br J Sports Med 2015;49:4517



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 4th/5th 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



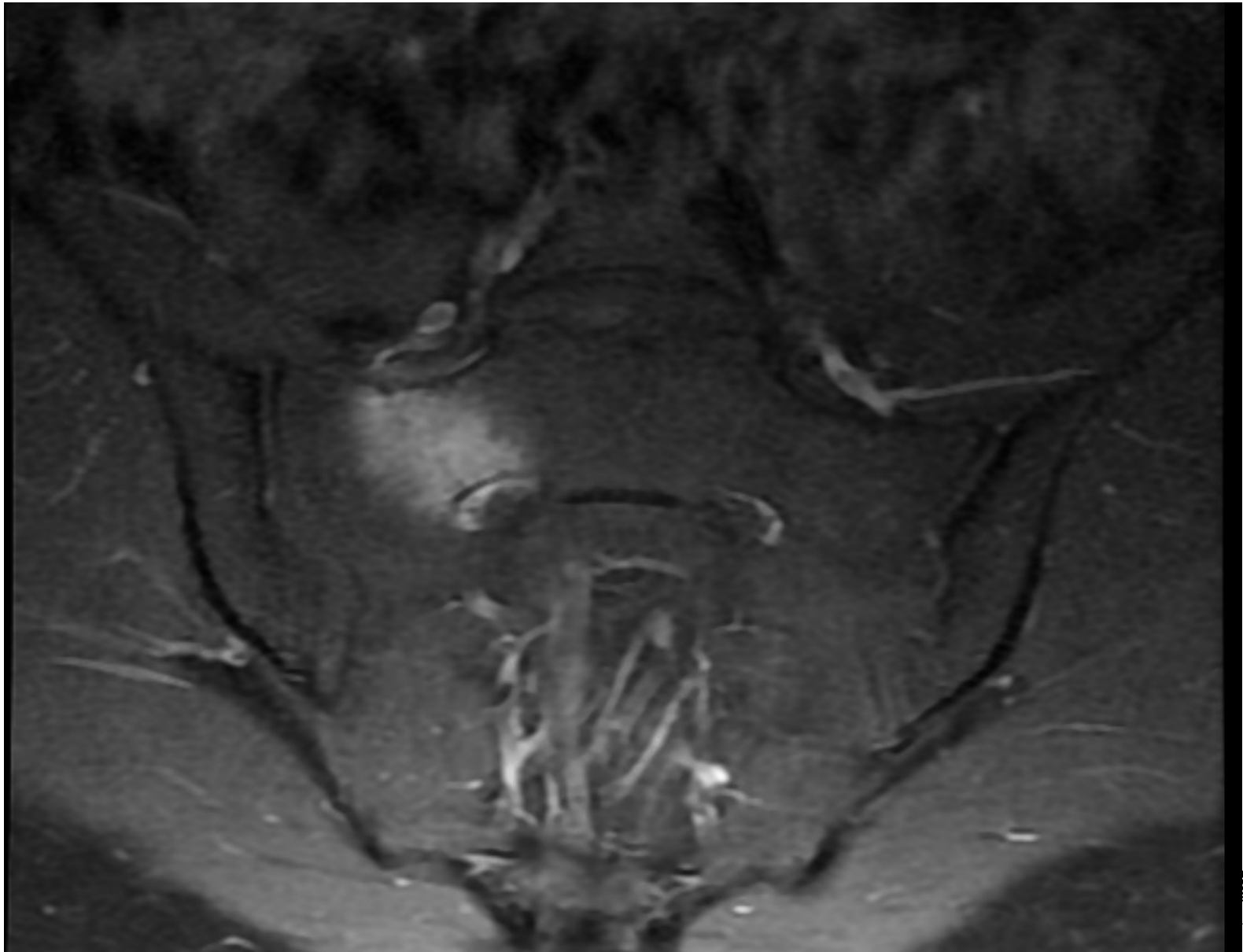
Trusted Team Physicians for the Sacramento Kings

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



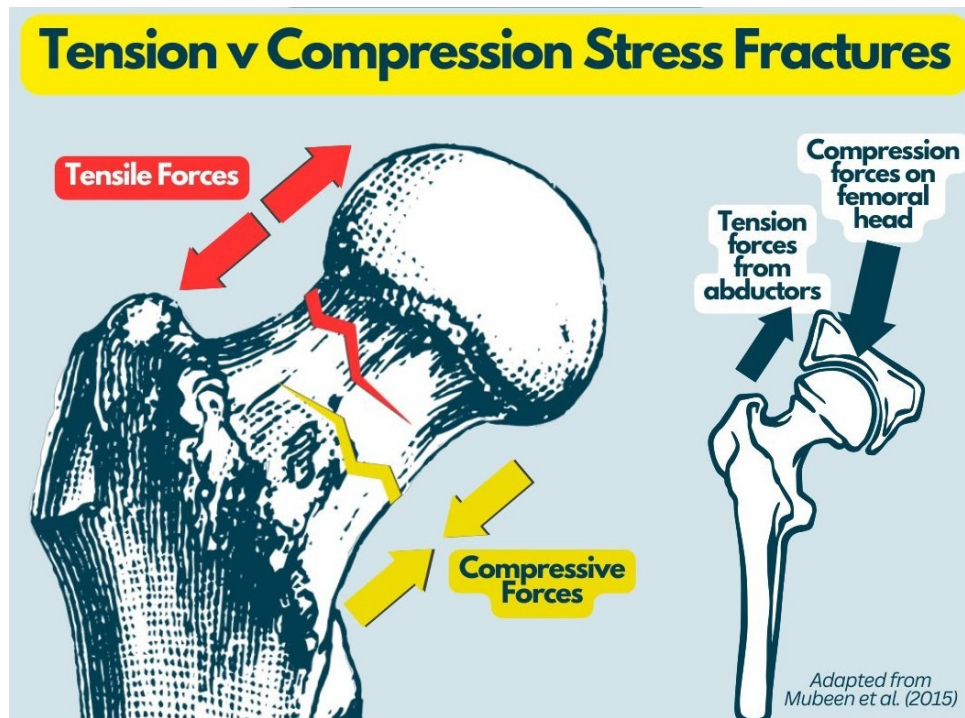
Stress Fractures – Femoral Neck

- 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

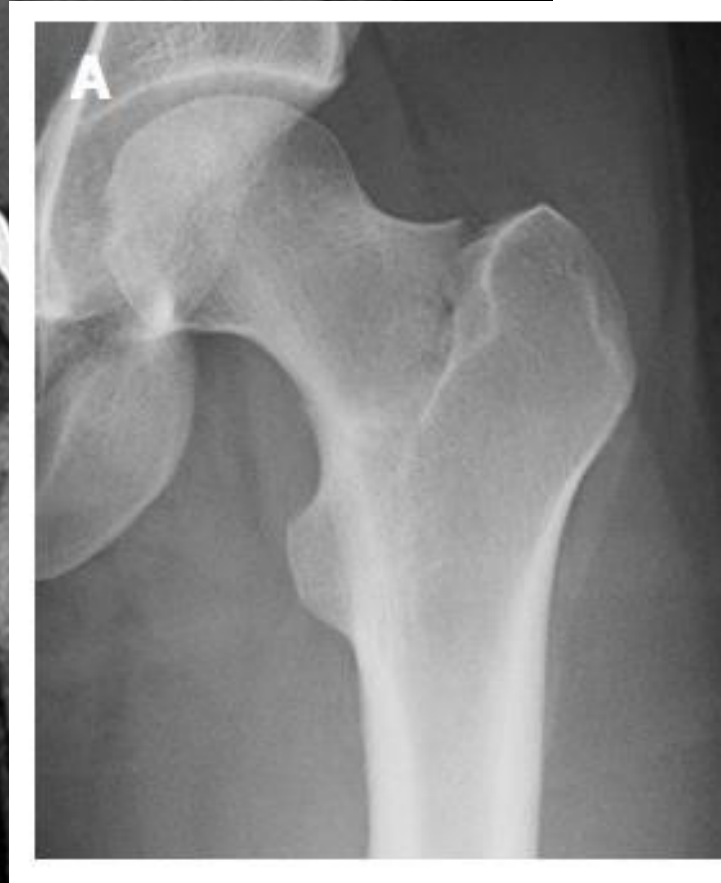
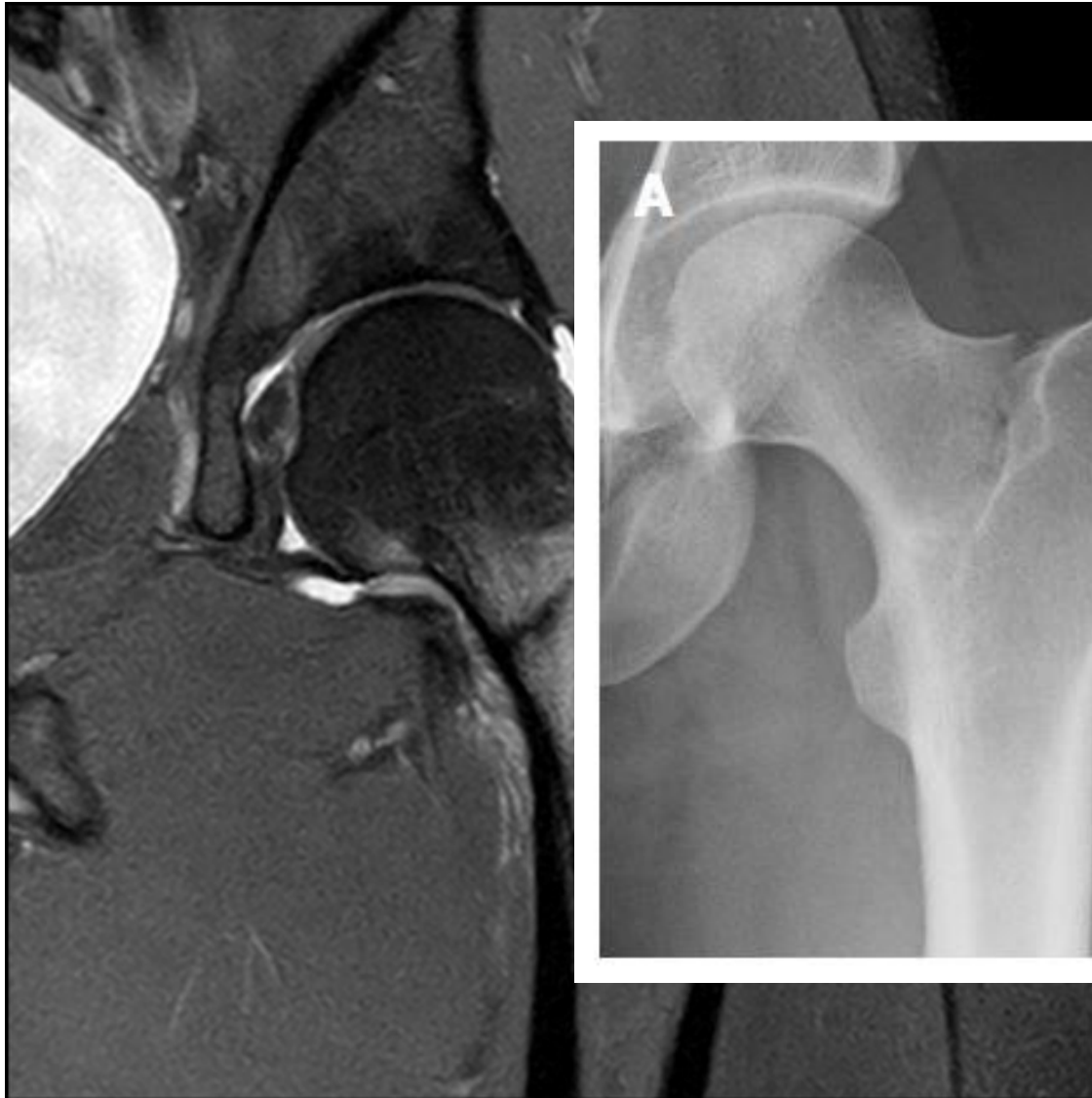
- May have antalgic gait, groin pain
- Difficult to palpate due to musculature
- Pain at end ranges of motion (mostly IR/ER, deep flexion)
- Hop test (positive if reproduces groin pain, cannot hop)



Stress Fractures (Femoral Neck) – Imaging



Stress Fractures (Femoral Neck) – Imaging



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

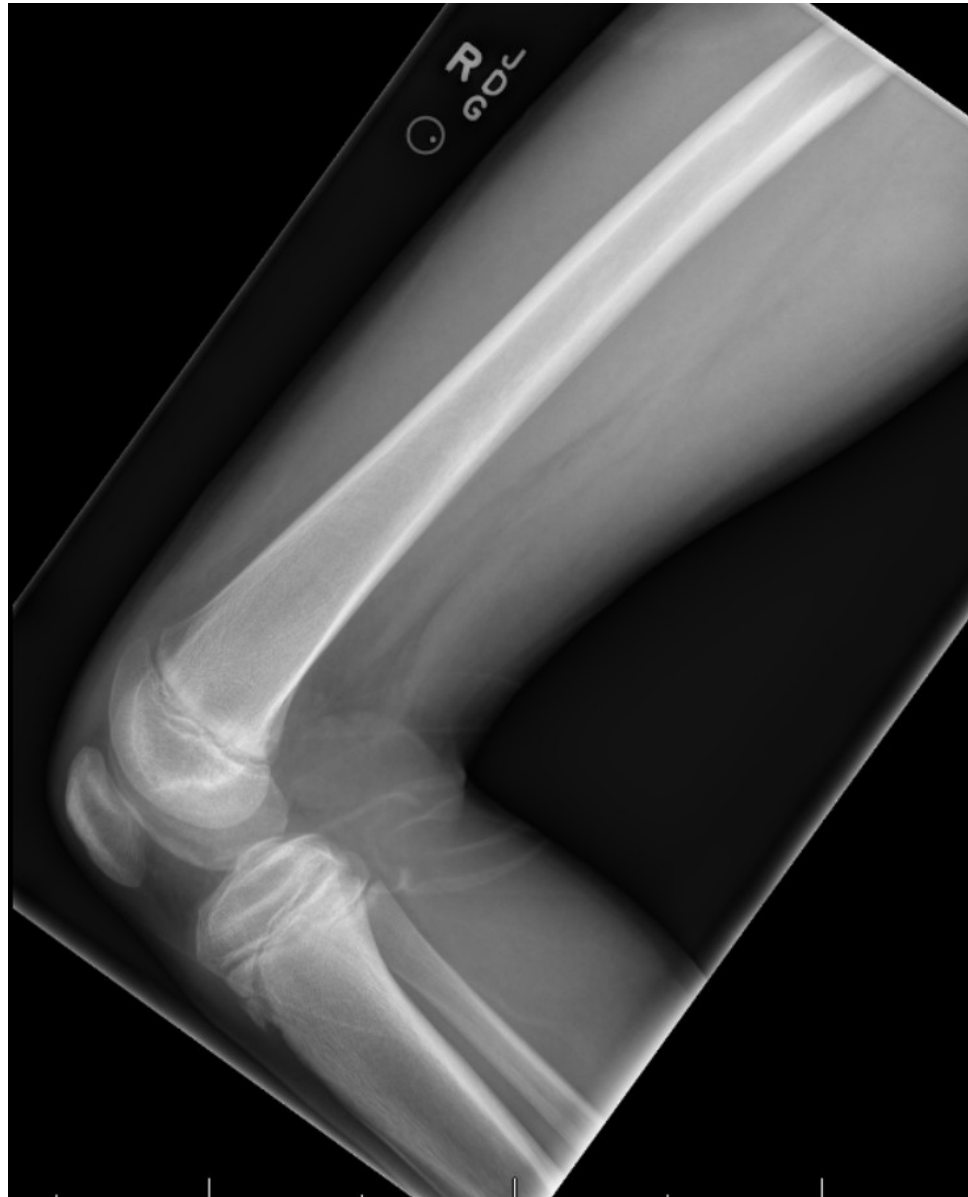


Stress Fractures – Femur

- 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



St

n



Trusted Team Physicians for the Sacramento Kings

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

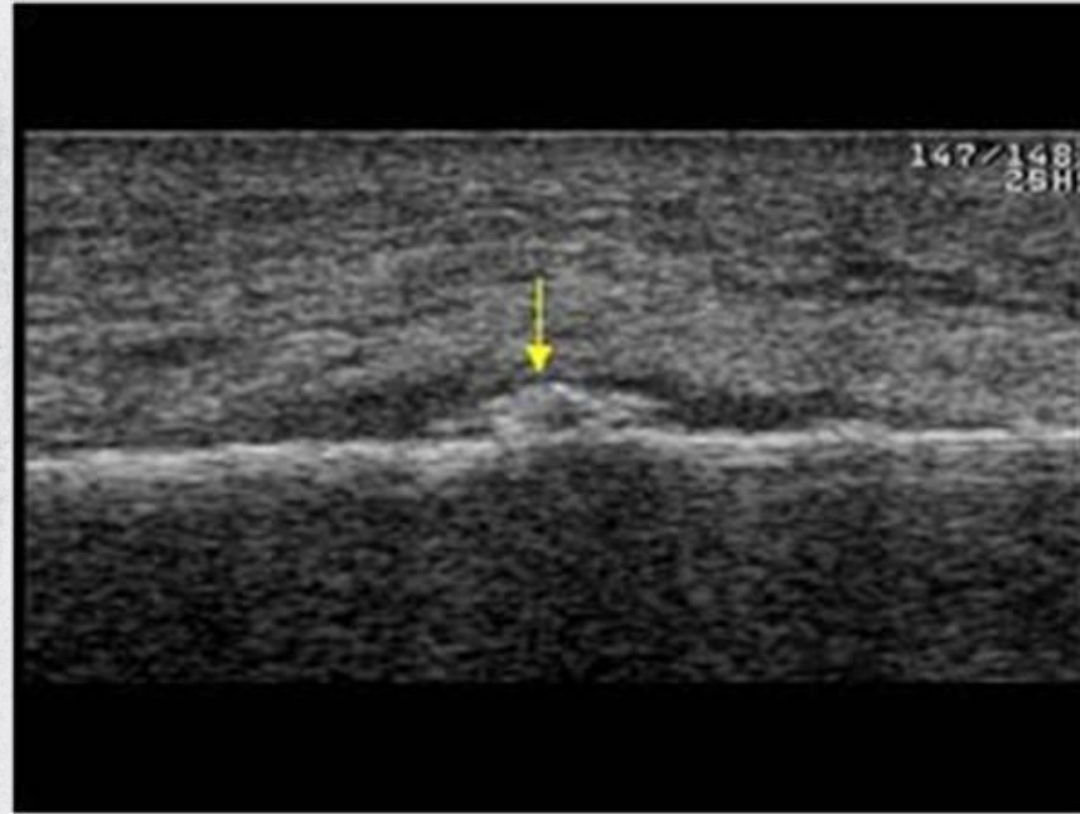
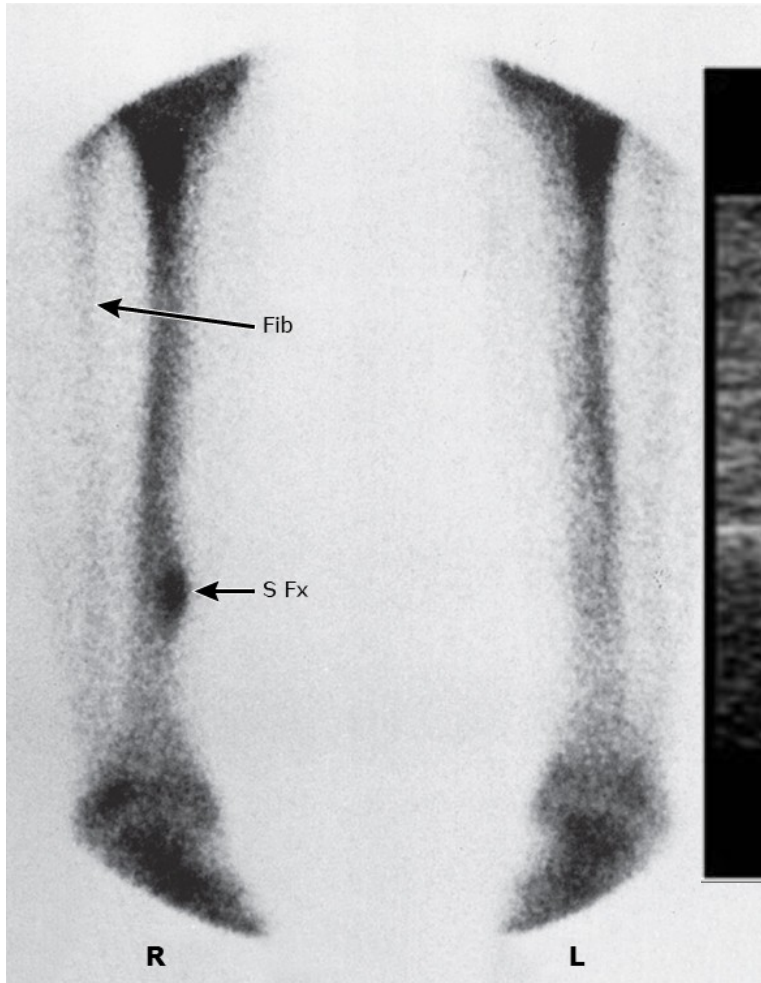
- Start with X-rays
- Periosteal elevation, cortical thickening, sclerosis, true fracture line are + findings
- Assess AP/lateral views
 - Anterior Cortex (tension side) of tibia are hardest to treat
- MRI when diagnosis needs confirmation
- MSK ultrasound may have role in experienced hands...
- Follow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



Stress Fractures (Tibia) - Imaging



Stress Fractures (Tibia) - Imaging



Stress Fractures (Tibia) - Imaging



Stress Fractures (Tibia) – Management

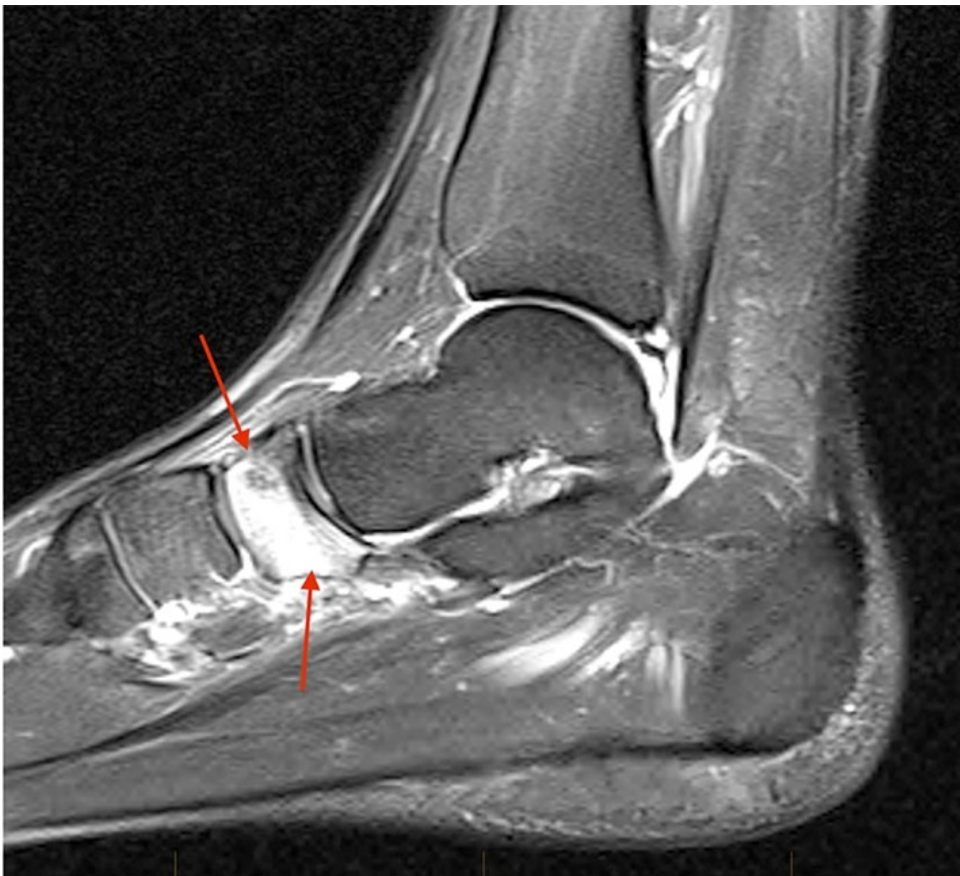
- Non-surgical management for most
- Consider referral for anterior cortex, “dreaded black line”, proximal tibia
- Generally do not need NWB (perhaps week by week)
- Consider walking boot if walking painful, long air splint
- Physical therapy
- Take supplemental calcium 1500 mg and vitamin D 800 IU daily 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



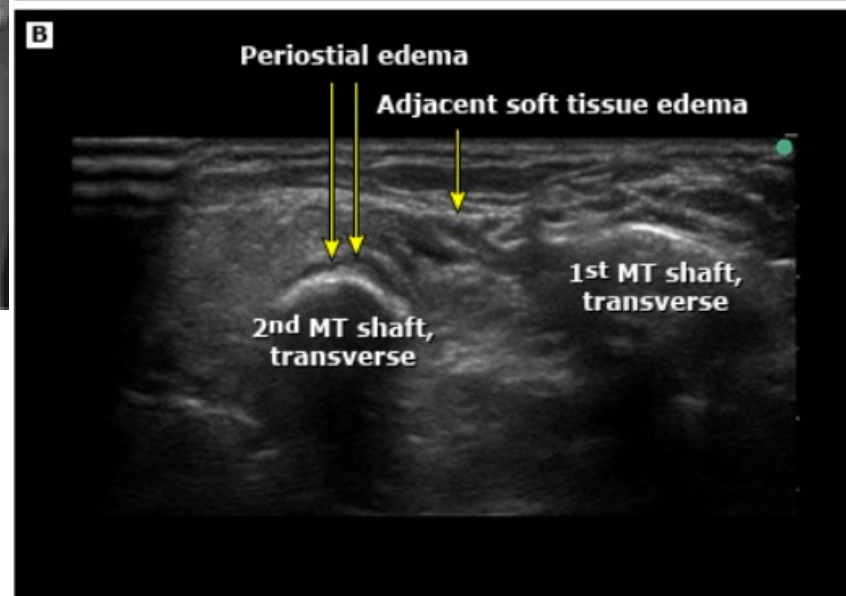
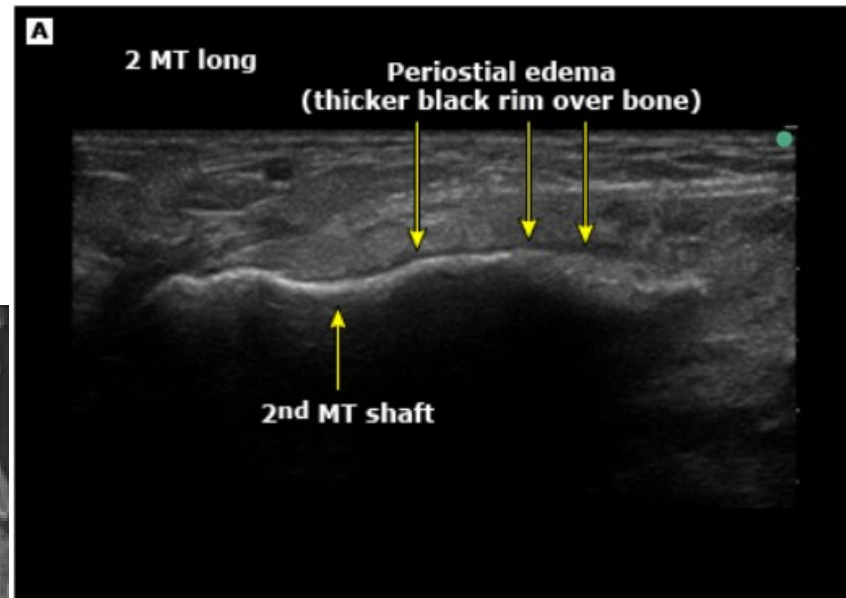
Stress Fractures (Tarsal Navicular) – Management

- 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

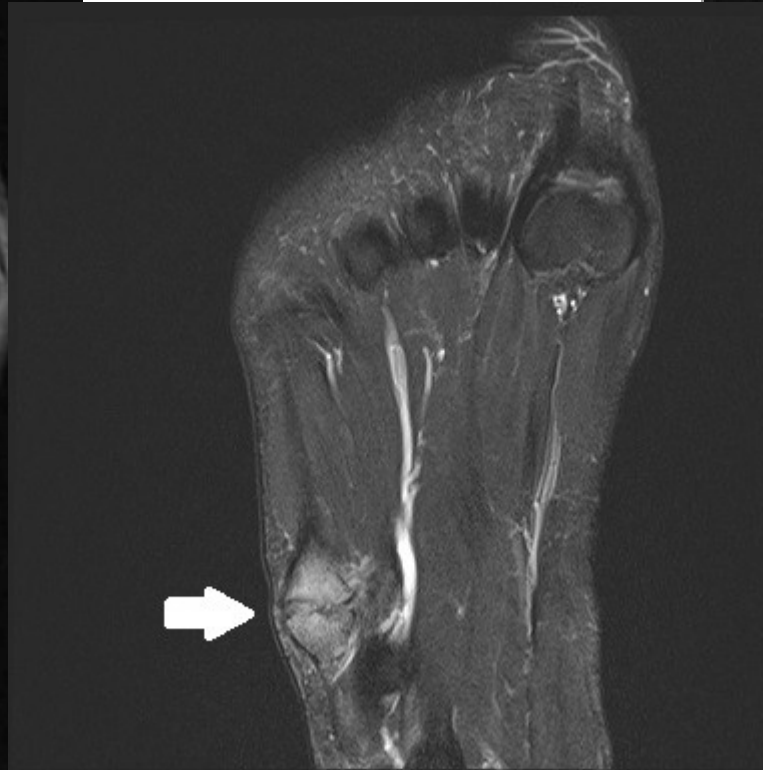
- Often presents with worsening forefoot pain
- Typically with mid-phase of stride to toe off
- Review for changes in training volume/activity
- May have focal swelling
- Exam with focal tenderness to palpation
- Early x-rays often negative
- MSK u/s may be helpful with pain of 6 weeks
- MRI/bone scan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

Stress Fracture (Metatarsals): Imaging



Attribution for images - UpToDate

Stress Fracture (Metatarsals): Imaging

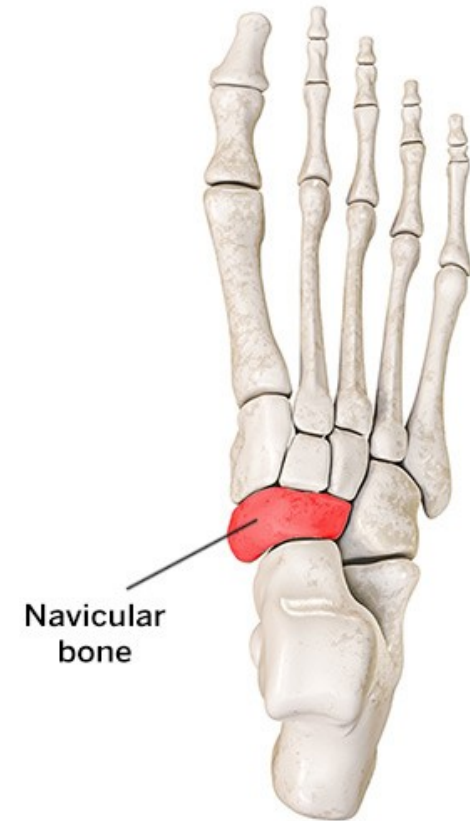


Stress Fractures (Metatarsal) - Treatment

- ***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

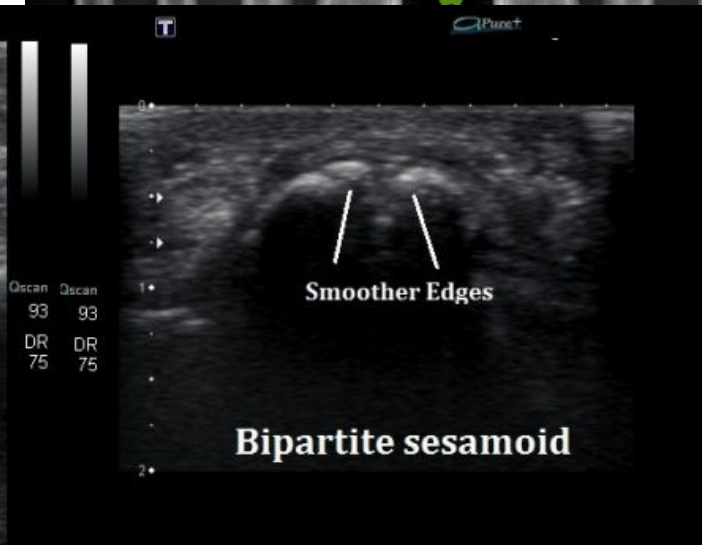
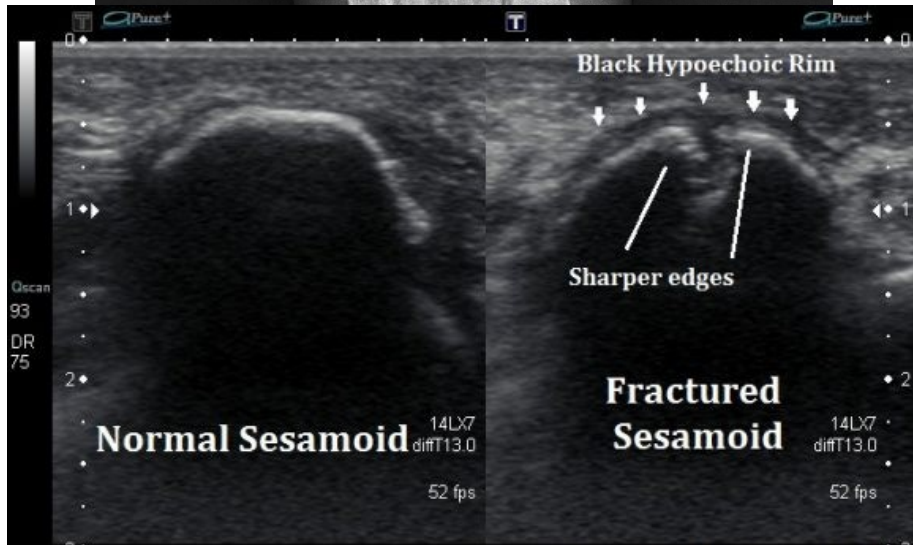


Stress Fractures – Sesamoid

- 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



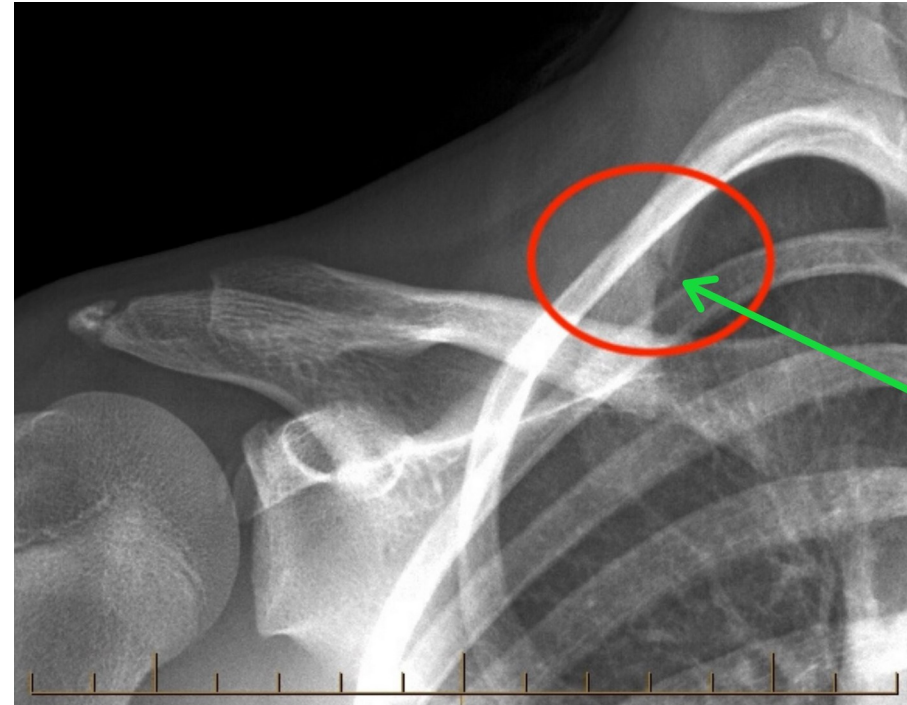
Long Axis of the Sesamoids

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
5 th 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 ^Δ site and low-grade severity on MRI/bone scan	19.3 weeks	
Low-risk site and high-grade [◇] 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

Wilder R, O'Connor F, et al. Running Medicine, 2nd Edition, 2017. Ch 21 Stress fractures.

DeLee, Drez, Miller. Orthopedic Sports Medicine, 5th Edition, 2020. Navicular Stress Fractures.

Warden SJ, Stress fractures: pathophysiology, epidemiology, and risk factors. Curr Osteoporos Rep 2006; 4:103.

Hoening T, et al. Return to sport following low-risk and high-risk bone stress injuries: a systematic review and meta-analysis. Br J Sports Med 2023; 57:427.

Whittle RS, et al. Distance travelled by military recruits during basic training is a significant risk factor for lower limb overuse injury. BMJ Mil Health 2022; 168:343.

Hoening T, Eissele J, Strahl A, et al. Return to sport following low-risk and high-risk bone stress injuries: a systematic review and meta-analysis. Br J Sports Med 2023; 57:427.

Mehta S, Zheng E, Heyworth BE, et al. Tarsal Navicular Bone Stress Injuries: A Multicenter Case Series Investigating Clinical Presentation, Diagnostic Approach, Treatment, and Return to Sport in Adolescent Athletes. Am J Sports Med 2023; 51:2161.

Shakked RJ, Walters EE, O'Malley MJ. Tarsal navicular stress fractures. Curr Rev Musculoskelet Med 2017; 10:122.



Thank you!



Trusted Team Physicians for the Sacramento Kings