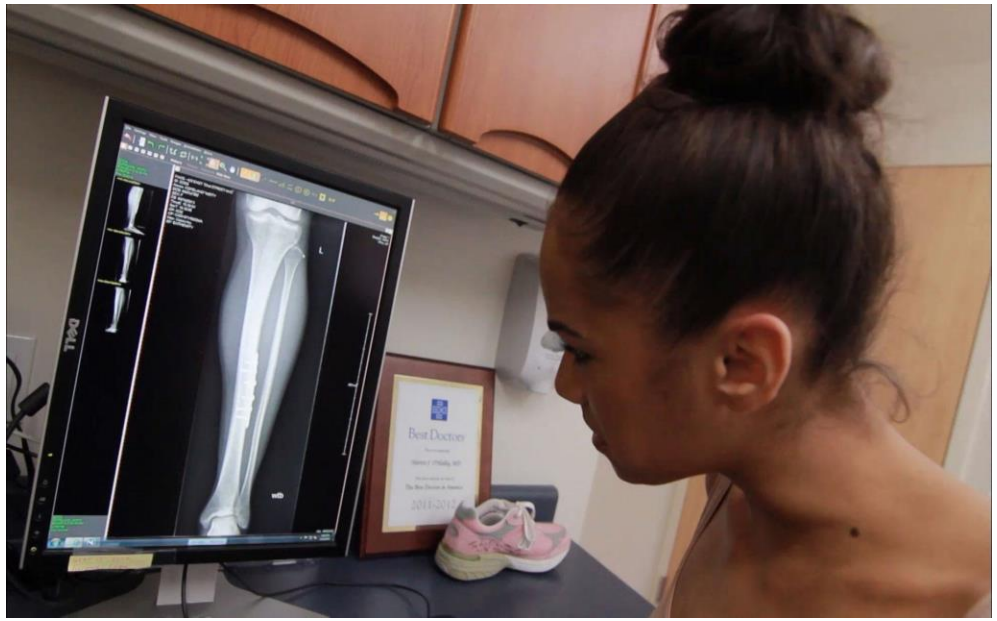
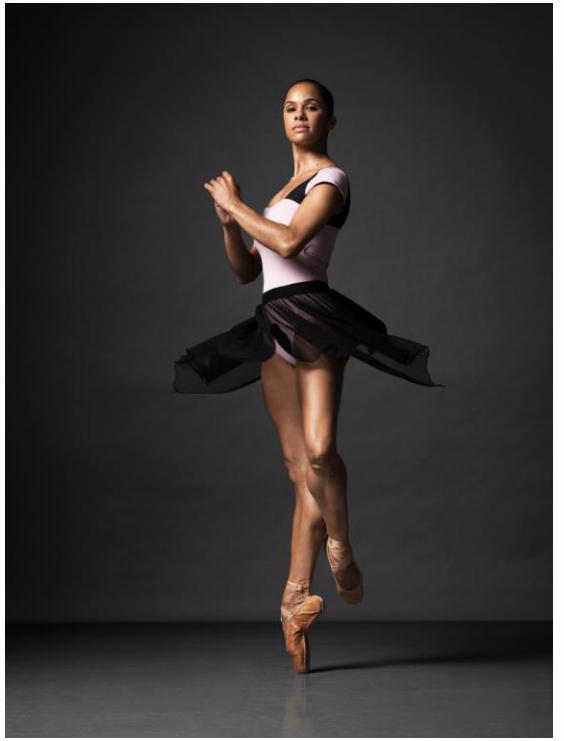


stress fractures

Carla Bridges, MD

Pediatric Orthopaedic Sports Medicine

dayton children's



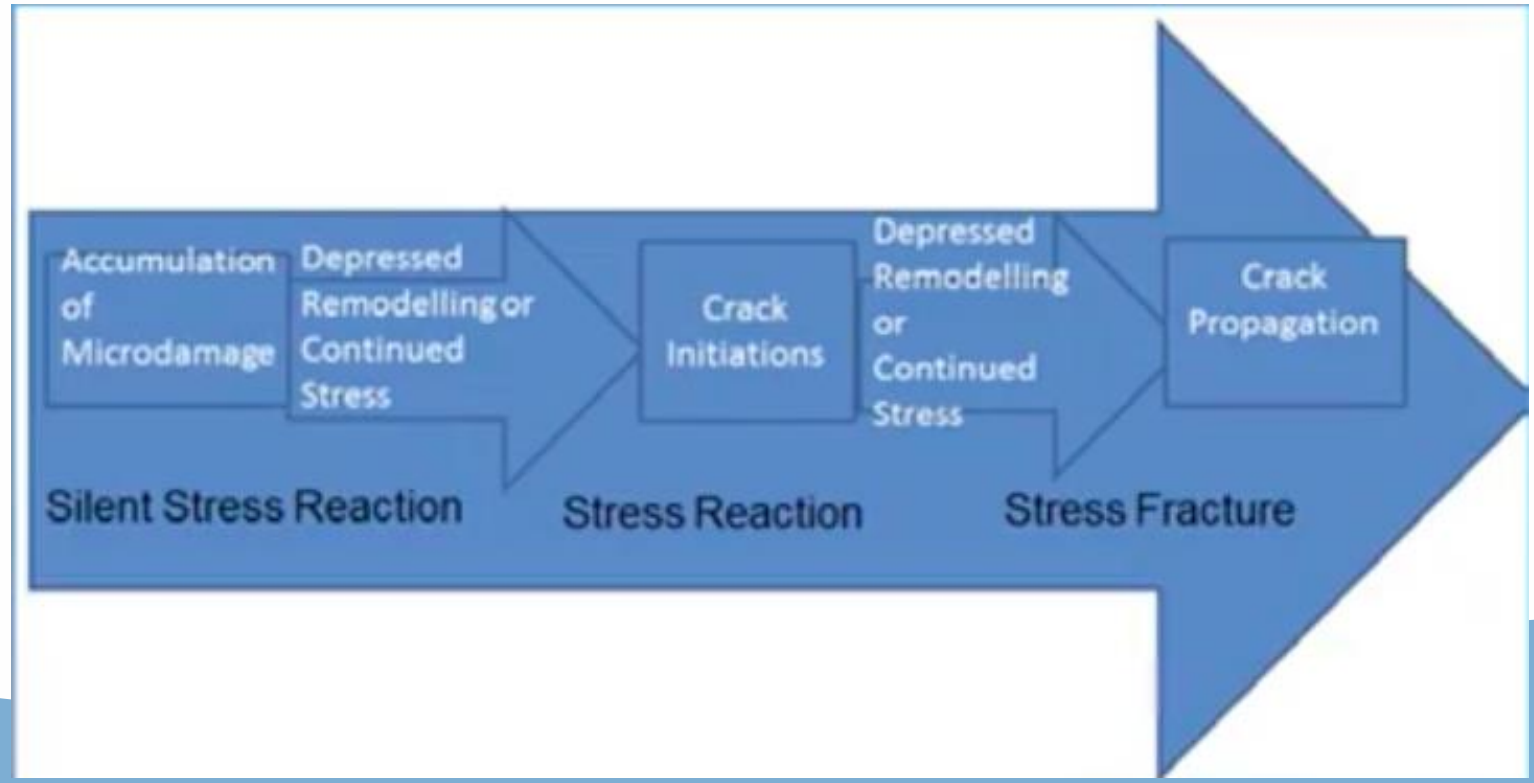
definition

- Stress Reaction = inflammation
- Stress Fracture = cortical break

pathophysiology

Adolescents 3X more susceptible to stress fractures than children.

- Repetitive stress over time
- Increased in activity level
- Bone remodeling unable to keep up with demands placed on the bone



Normal Bone → Abnormal Stress
Abnormal Bone → Normal Stress
Abnormal Bone → Abnormal Stress

dayton children's

normal bone → abnormal stress

Sports Specialization in Young Athletes

Evidence-Based Recommendations

Neeru Jayanthi, MD,[*†‡] Courtney Pinkham, BS,[†] Lara Dugas, PhD,[†] Brittany Patrick, MPH,[§] and Cynthia LaBella, MD[‖]

dayton children's

abnormal bone → normal stress

Journal of Foot and Ankle Surgery (Asia Pacific)
Volume 8 | Issue 2 | Year 2021

ORIGINAL ARTICLE

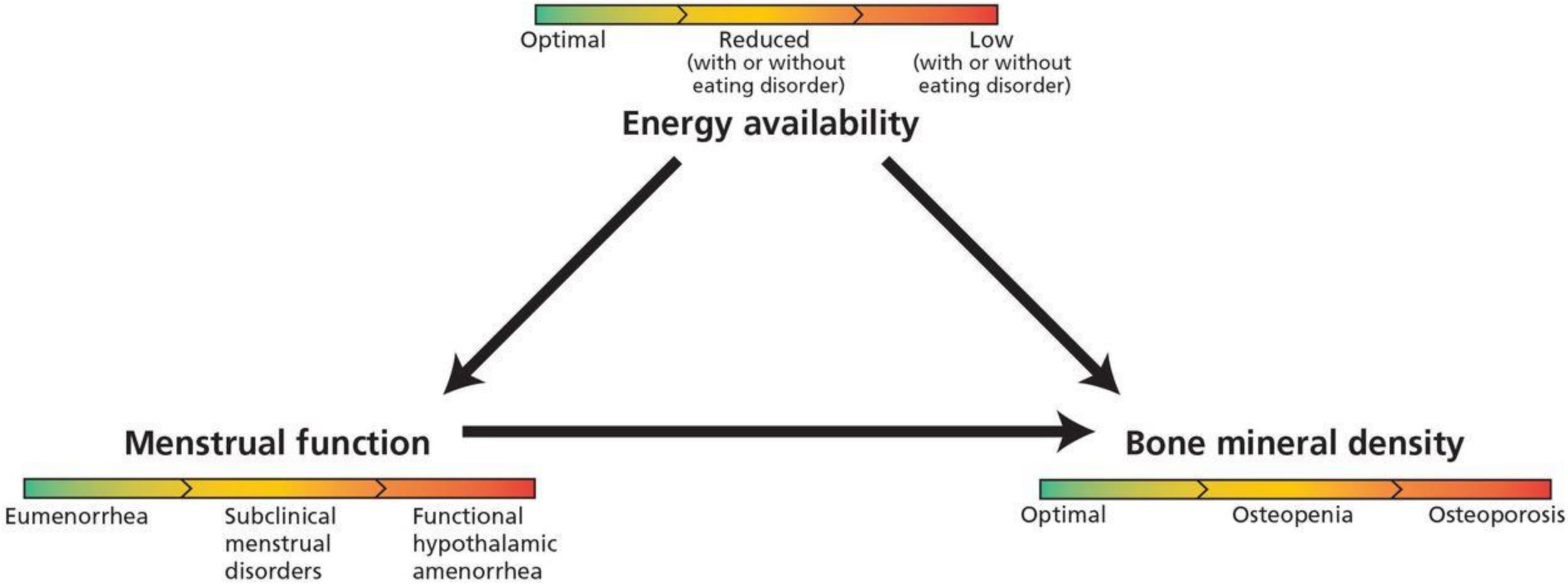
Stress Fractures: A Growing Concern during the COVID-19 Pandemic

Khalis Boksh[1], Linzy Houchen-Wolloff[2], Aqua Asif[3], Neelam Mangwani[4], Jitendra Mangwani[5]

[1,5]Department of Trauma and Orthopaedics, University Hospitals of Leicester NHS Trust, Leicester, Leicestershire, UK
[2]Department of Physiotherapy, University Hospitals of Leicester NHS Trust, Leicester, Leicestershire, UK
[3]Leicester Medical School, University of Leicester, Leicester, Leicestershire, UK
[4]Department of General Practice, Heatherbrook Surgery, Leicester, Leicestershire, UK

Corresponding Author: Aqua Asif, Leicester Medical School, University of Leicester, Leicester, Leicestershire, UK, e-mail: aqua@doctors.org.uk

abnormal bone → normal stress



dayton children's

pathophysiology

- **Extrinsic Factors**
  - Training load, pattern, surface
  - Footwear
  - Sports choice
  - Technique
  - Rest/Sleep
  - Nutrition
  - Smoking
- **Intrinsic Factors**
  - Age/Sex/Ethnicity
  - Bone Geometry/Minerality
    - Coxa vara
  - Lower extremity alignment
    - Genu valgum
  - Leg length discrepancy
  - Hormonal factors

relative energy deficiency in sports (RED-S)

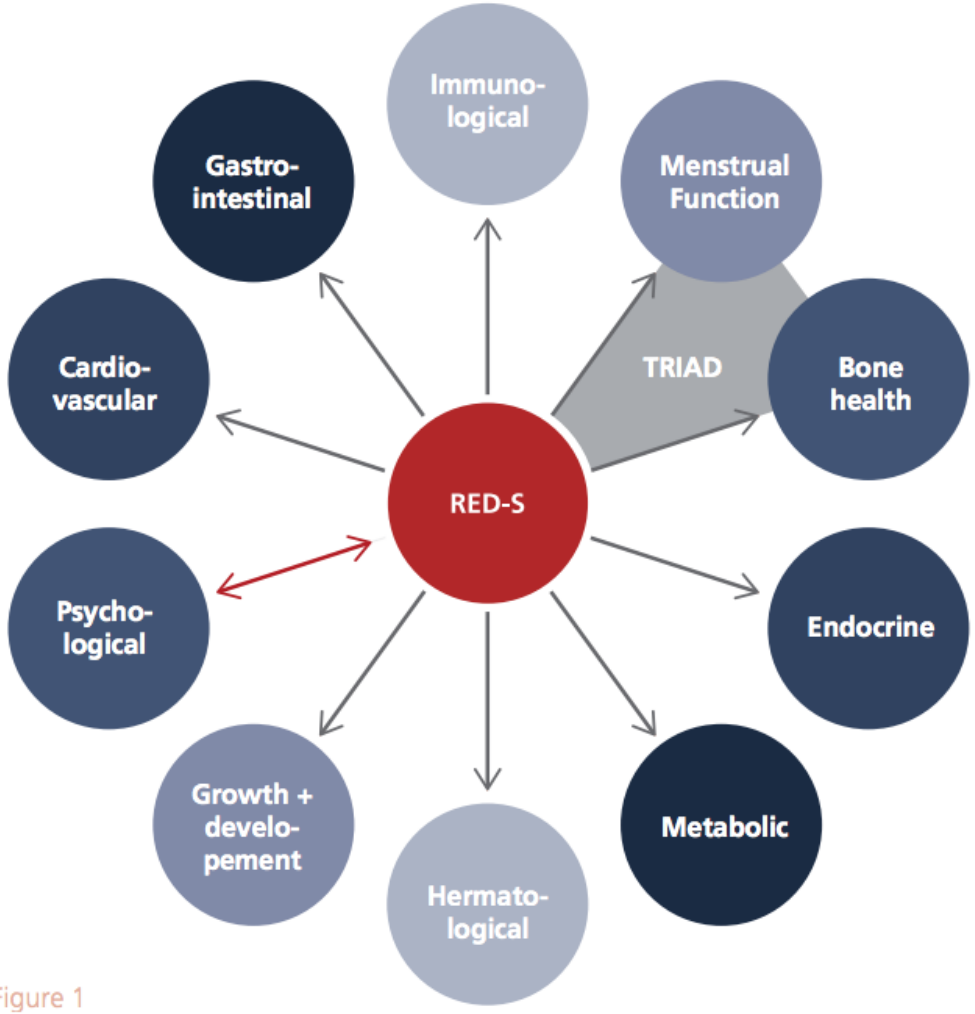
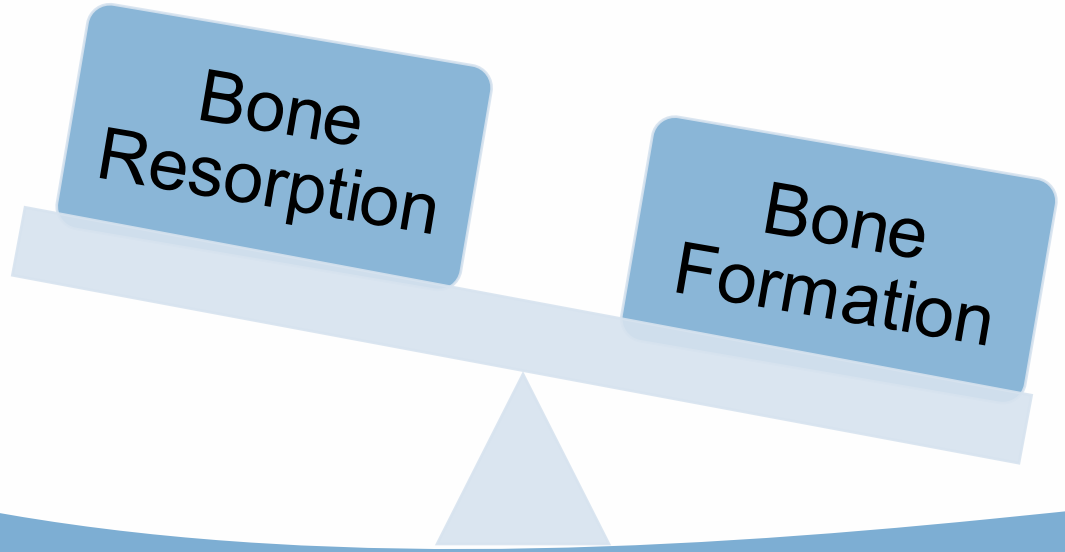


Figure 1

dayton children's

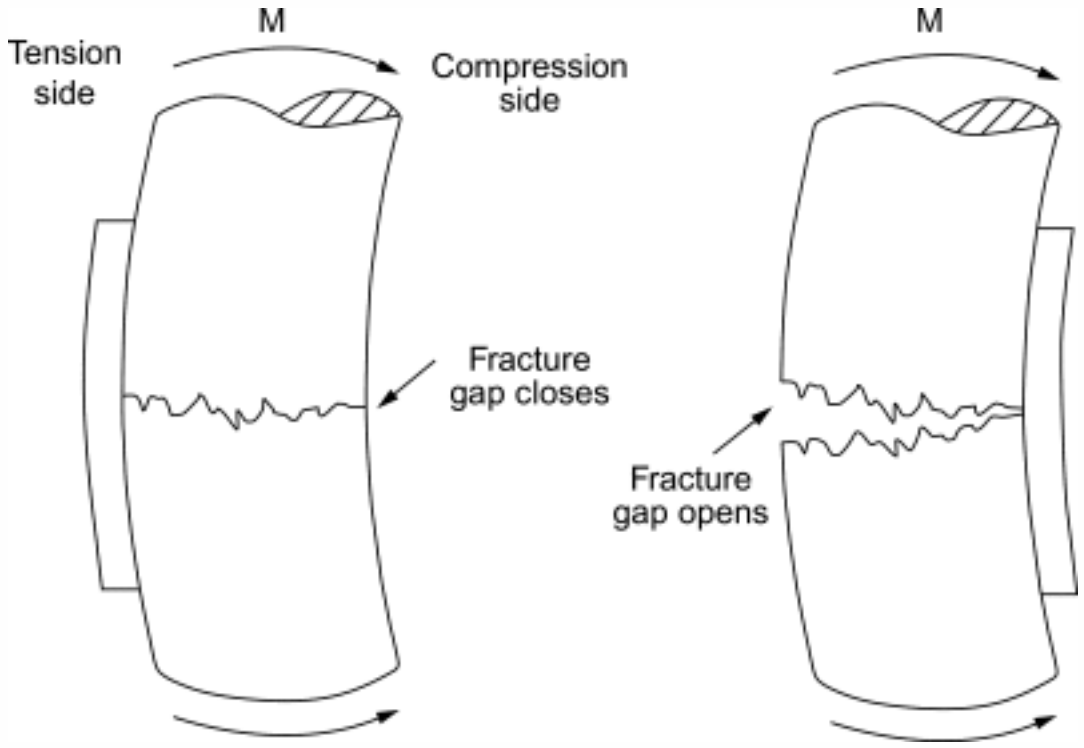
anatomy & biomechanics

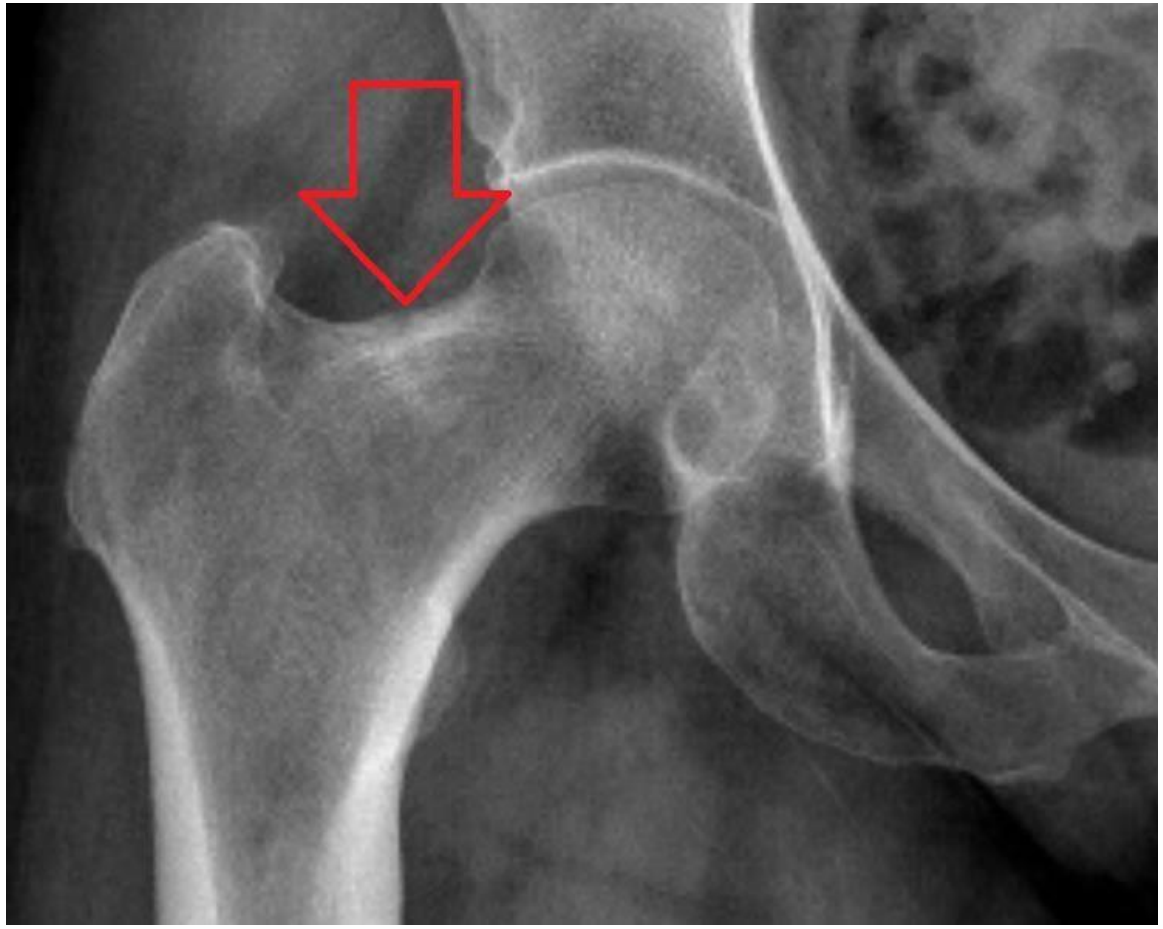
- Compression Failure



anatomy & biomechanics

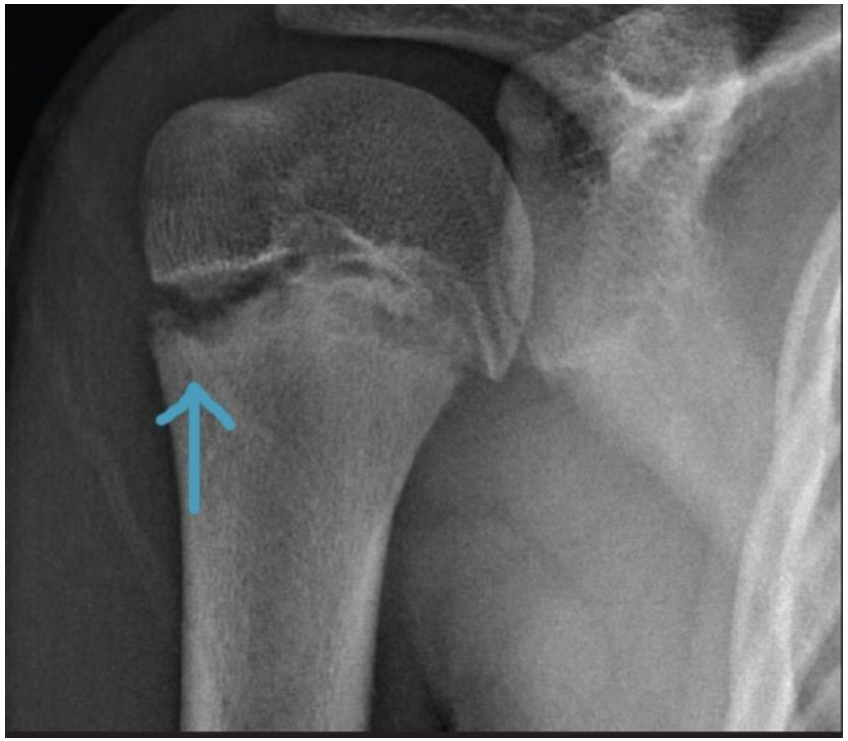
- Tension Failure





anatomy & biomechanics

- Growth Plate Stress Fractures/Reaction



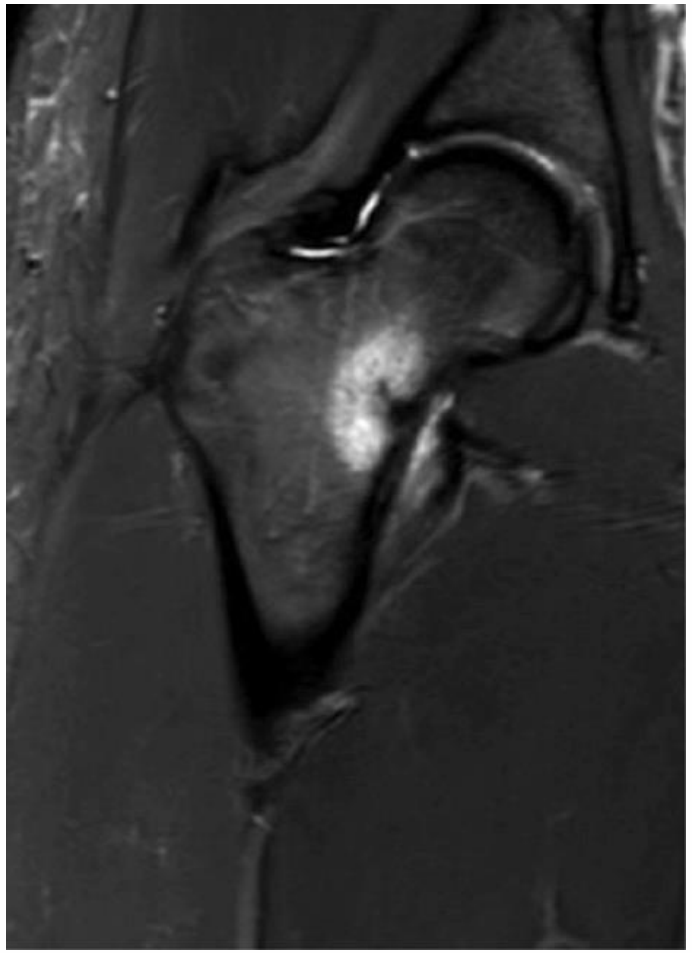
Common Sports and Sites of Pain Associated with Stress Fractures	
Sport	**Sites of Pain**
Baseball	Tibia, Humerus (shaft, proximal growth plate)
Basketball	Anterior cortex of the tibia, Navicular
Football	Lumbar Spine: Pars interarticularis
Gymnastics	Pars, Distal radius growth plate, Tib/Fib
Ice Skating	Distal fibula
Running	Tibial metaphysis (proximal & distal), fibula, navicular, femur (midshaft, distal, neck), sacrum
Soccer	Patella
Swimming	Proximal tibia
Tennis	Nondominant ulna, dominant side metacarpal
Volleyball	Ulna, Tibia

patient presentation

- HISTORY
- Change in activity level
  - Increase
  - Multiple sports
  - Decrease
- Pain
  - Ignored
  - Improves with rest
- PE
  - Focal bony tenderness
  - Pain with WB & ROM

diagnostic testing

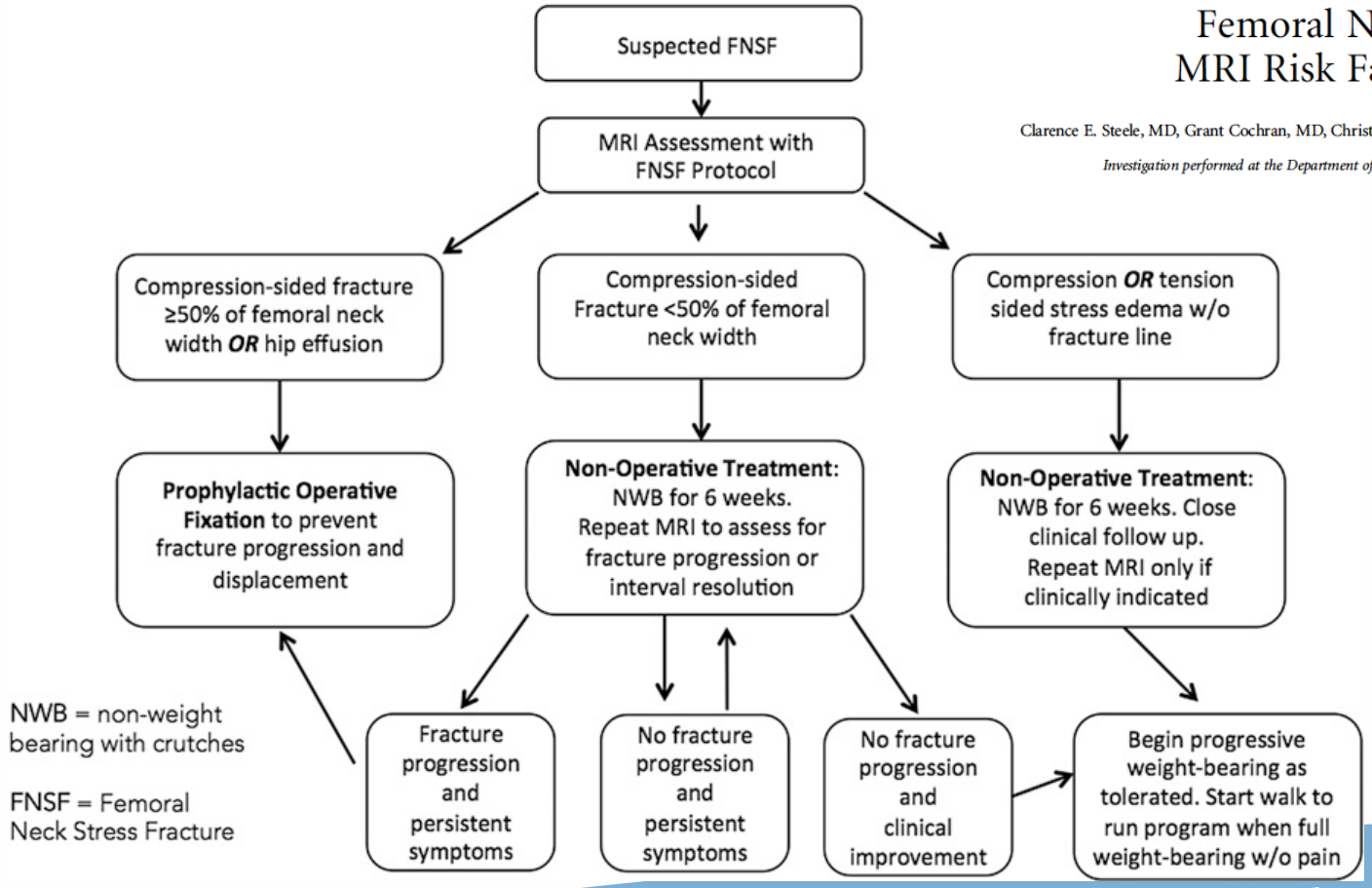
- X-rays
- MRI
- Bone scan
- CT



diagnostic testing

"…the presence of a hip effusion on the initial MRI screening is an independent risk factor for fracture progression and early prophylactic surgical intervention should be considered."

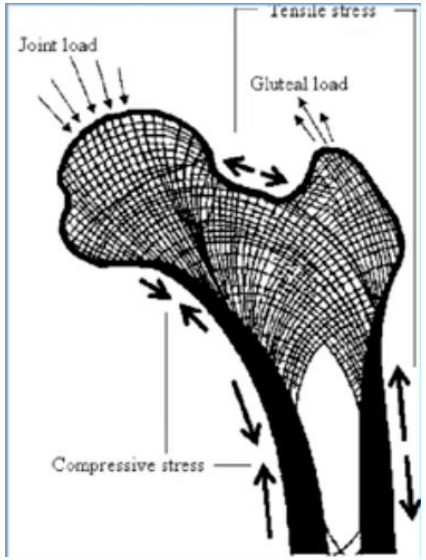
MRI-Based Algorithm for Management of FNSF



Femoral Neck Stress Fractures:
MRI Risk Factors for Progression

Clarence E. Steele, MD, Grant Cochran, MD, Christopher Renninger, MD, Bradley Deafenbaugh, MD, and Kevin M. Kuhn, MD

Investigation performed at the Department of Orthopedics, Naval Medical Center San Diego, San Diego, California



labs

- **Males**
  - CBC
  - CMP
  - TSH/FT3/FT4
  - Testosterone
  - Vit D
  - PTH
- **Females**
  - CBC
  - CMP
  - TSH/FT3/FT4
  - Testosterone
  - Vit D
  - PTH
  - LH
  - FSH
  - Estradiol
  - DHEA

treatment

Non-op:

Stress reaction
Incomplete fracture
Compression side <50% FN width
Neg hip effusion
No hx of treatment

- Rest (3+ mon)
- NWB or TDWB (6+ wks)
  - crutches, walker
- Immobilization
  - Boot, cast, splint, brace, orthotic
- Equipment modification

- Electronic bone stimulation
- Sleep Hygiene
- Smoking cessation
- Nutritional counseling
  - Calcium, Vit D
- Treat abnormal lab findings & abnormal menstrual cycles
- Seasonal training
- Repeat MRI
- PT: Walk to run sports protocol

treatment

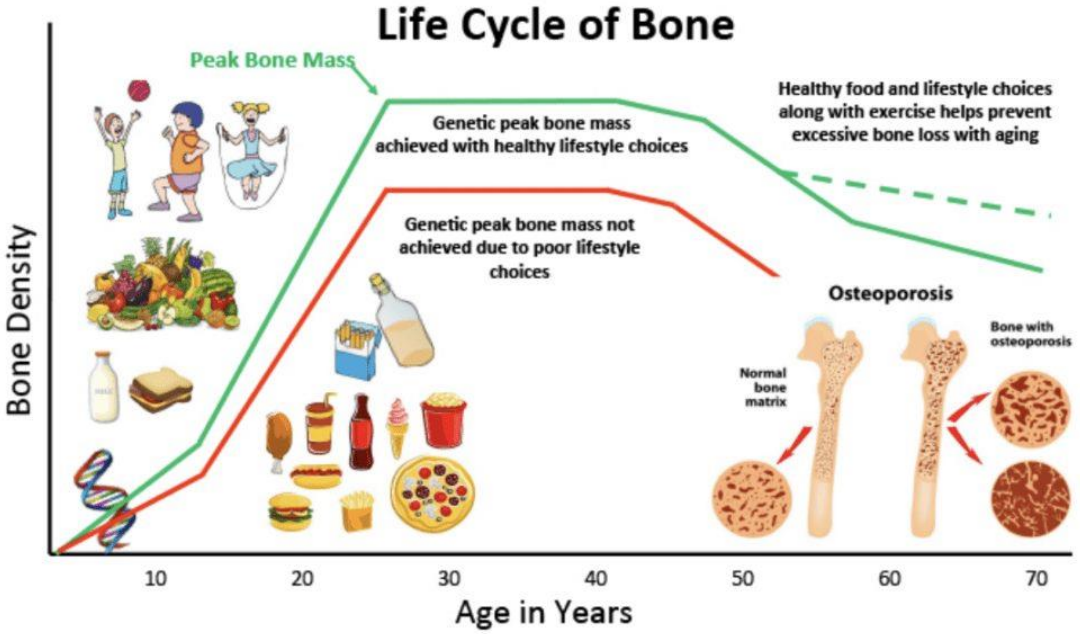
- **Operative:**
  - Complete fracture
    - Compression side >50% FN width
  - Tension sided fracture
  - Pos hip effusion
  - No improvement with non-op treatment

rehabilitation

- Program maintaining general physical fitness
- Strength and CV fitness while protecting injured area
- After being asymptomatic for 6 weeks, slowly presume previous activities
- Must remain asymptomatic to resume full activity

prevention IS KEY!

- Peak bone mass (PBM)
  - Greatest amount of bone an individual can attain
  - Reached in late teens-early 20's
  - Children & adolescents who have higher PBM reduce their risk of osteoporosis later in life



prevention

Position Statements on Early Sport Specialization from Various Societies

Topic	American Academy of Pediatrics[6]	American Medical Society for Sports Medicine[1]	American Orthopaedic Society for Sports Medicine[5]	Fédération Internationale de Médecine du Sport[9]	International Olympic Committee[10]	National Athletic Trainers' Association[7]	National Strength and Conditioning Association[8]
Position on early sport specialization	DISCOURAGED						
Psychosocial and physical risks of early specialization	INCREASES RISK OF INJURY AND BURNOUT						
Benefits of early, diversified training	NUMEROUS						
Appropriate age of specialization	LATE ADOLESCENCE						
Exception sports	DIVING, GYMNASTICS, FIGURE SKATING						

AOSSM Early Sport Specialization Consensus Statement

Robert F. LaPrade,* MD, PhD, Julie Agel,[†‡] MA, ATC, Joseph Baker,[§] PhD, Joel S. Brenner,[‖¶] MD, MPH, Frank A. Cordasco,[#**] MD, MS, Jean Côté,[††] PhD, Lars Engebretsen,[‡‡§§‖‖‖] MD, PhD, Brian T. Feeley,[¶¶] MD, Daniel Gould,[##] PhD, Brian Hainline,[ab] MD, Timothy E. Hewett,[c] PhD, Neeru Jayanthi,[d] MD, Mininder S. Kocher,[ef] MD, MPH, Gregory D. Myer,[ghij] PhD, FACSM, CSCS*D, Carl W. Nissen,[klm] MD, Marc J. Philippon,[nopq] MD, and Matthew T. Provencher,[rstu] MD, CDR, MC, USNR

dayton children's

summary

- High-index of suspicion
- Good history
- Pain with WB, better with rest, and tenderness on exam
- Advanced imaging and labs
- Respond to rest
- Gradual supervised return to activity