Bone Stress Injuries of the Hip and Pelvis

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Disclosures

• I, Siobhan Statuta, have nothing to disclose.

• I am a member of the Female Athlete Coalition.
Objectives

• Understand the presentation of hip and pelvic stress fractures.

• Understand how to manage these conditions.

• Be able to think outside the box in preventive aspects.
Bone

- Dynamic – Wolff’s Law
  - Osteocytes
  - Osteoclasts
  - Osteoblasts
Stress to Bone

- Normal Stress
  - Load and stress applied with adequate time to remodel (Wolff’s Law)

- Stress Reaction
  - Repetitive loads without adequate time to allow healing/remodel
  - Osteoclastic > Osteoblastic
  - Microfractures

- Stress Fracture
  - Cortical break
Risk factors

**Intrinsic**
- Age
- Race
- Gender
- Fitness level
- Alignment
- Leg length discrepancy
- Muscle imbalance
- FAT/ RED-s
- Biomechanics
- Other
  - Genetic factors
  - Endocrine factors
  - Metabolic conditions

**Extrinsic**
- What sport
- Training regimen
  - Hours/ week?
  - Cross-training?
  - Running downhill
- Surfaces
- Shoes
- Equipment
- Environmental conditions
- Psychological factors
- Smoking
Epidemiology

• Sports medicine clinic visits for stress fractures: 0.7-20%
  » Kahanov, Eberman, Games. Diagnosis, treatment, and rehabilitation of stress fractures in the lower extremity in runners. 2015.

• Military recruits: 3.9% of annual injuries ($$$ research)

• Army, most common injured site: lower limb, 40.3%
Epidemiology

- NCAA: Descriptive epidemiology study (2005/6-2012/13)
  Published 2017:
  - 11,778,145 athlete exposures... 671 stress fractures reported
  - Overall rate 5.70 per 100,000 athlete exposures
    - Highest rates: (per 100,000 AE)
      » Female XC: 28.59
      » Female gymnastics: 25.58
      » Female outdoor track: 22.26

Epidemiology

• High School Students?
  – ~0.8% HS athletes sustained a SF
  – 1.54 per 100,000 AE
  – Highest rates: (per 100,000 AE)
    • Female XC: 10.62
    • Female Gymnastics: 7.43
    • Boys XC: 5.42

Location, location, location…

- Depends on the sport.
- Runners:
  - Tibia: 33%
  - Tarsal bones: 20%
  - Metatarsals: 20%
  - Femur: 11%
  - Fibula: 7%
  - Pelvis: 7%

» Saunier, Chapurlat. Stress fracture in athletes. Joint Bone Spine. 2018
Hip & Pelvis
Pelvic Stress Fracture
Pelvis

• Represent 1-2% of all SF

• Most common site: inferior pubic ramus

• Causes:
  – Adductor magnus repetitive contraction
  – Pulls from origin on the pubic ramus when hip in extension
Pelvis: Presentation

- **History:**
  - Overuse
  - Groin pain exacerbated with activity
  - Localized tenderness

- Pain referred to buttock, low back, groin, thigh
Pelvis- Exam

• Exam:
  – Inspection: antalgic gait
  – Palpation: +TTP over pubic ramus
  – ROM: full, may have pain with:
    • Hip ER
    • Resisted adduction
  – Special tests: + Hop, + Single leg stance
Pelvis- Diagnosis

- AP x-ray
- Bone scan
- MRI
Pelvis: Recovery

• Return to participation:
  – 7–12 weeks with conservative treatment

  » Kahanov, Eberman, Games. Diagnosis, treatment, and rehabilitation of stress fractures in the lower extremity in runners. 2015.
Pelvis - Prevention

- Think about risk factors!
- Military data:
  - 1991-1993, Australian Army recruits
    - Pelvic SF rate M: 0.1%
    - Pelvic SF rate F: 11.2%
- Preventive strategies:
  - March speed reduced (7.5 to 5 km/h)
  - Runs on softer surfaces
  - Individual step length promoted
  - March/run formations more widely spaced
  - Interval-running training
- Pelvic SF incidence decreased to 0.6%
  
Iliac Wing Stress Fractures
Iliac Wing Stress Fractures

• Rare
• 4 case reports
  – 2 involving the SI
  – 2 sparing
• Distance runners
• Bony failure?
  Abdominals
  vs
  Abductors on iliac crest
Sacral Stress Fracture
Sacral Stress Fracture

- Estimated incidence 1.3 - 5.6%
- Difficult to recognize, diagnose
- Most common:
  - female distance runners
Sacral Stress Fracture

- Complaints variable and vague:
  - Diffuse pain
    - Sacrum
    - Low back
    - Pelvis/ buttock area
  - Pain exacerbated with
    - Impact loading
    - Directional change
  - More pronounced with training
  - Improves w rest; returns w activity
  - Night pain
Sacral Stress Fx: DDx

- Sacroiliitis
- Spondylolysis (pars defect)
- Piriformis pain
- SI joint dysfunction
- Back strain

- Radiculopathy
- Scoliosis
- Juvenile disc disorder
- Scheuermann’s kyphosis
Sacral Stress Fracture

Physical Exam
- Inspection: + Antalgic gait
- Palpation: + TTP of sacrum
- ROM: normal hip/ L-spine
- Neuro/ Sensation: normal
- Special Tests:
  - + Hop
  - + FABER’s
  - - SLR
  - + Gaenslen’s
  - SIJ distraction/ compression

Imaging
- XR commonly negative
- MRI vs CT
Sacral Stress Fracture

Denis Classification System

• **Zone 1**: Sacral wings w/o extension to the foramina or central sacral canal. Can affect the lumbosacral nerve roots.

• **Zone 2**: Involves sacral foramina; no impingement on central sacral canal.

• **Zone 3**: Involves central sacral canal. Often presents with saddle anesthesia and loss of sphincter tone.
Sacral Stress Fx: Treatment

• Load management!
  – WBAT until able to ambulate w/o pain (10-14d)
  – Non-impact XT for ~6-8wks
  – 12 + wks to heal totally

• Address modifiable RF:
  – Pelvic obliquity
  – Core strength (SLS, resistance band bird-dogs, SL heel lifts)
  – FAT/ RED-s
Femoral Neck Stress Fractures
Proximal Femur

- Unique stresses on neck
  - Neck-shaft angle: 135-140°
  - Forces distal, downward
- Standing, walking, running
- Location:
  - Greater troch: lateral aspect hip
  - Groin: hip
Forces on the femur

- Hip stresses:
  - Trabeculae arranged to support vertical load
  - Forces going downwards
  - Concentration of forces:
    - **Compression**: bend towards
    - **Tensile**: break/ split
  - Ward’s Triangle
Femoral Neck Stress Fractures
Tension Side SF

- BAD
- Make NWB
- Send to Ortho
Compression Side Stress Fracture

- **Variable:**
  - Compressing it
    - Self healing (already positioned)
  - Degree extension of fatigue line
    - < 50%: conservative
    - > 50%: surgical
Compression Side SF

Collegiate runner: treated initially conservatively (crutches ttWB only) x 2wks. No pain improvement. Underwent screw fixation.
Complete fracture
Femoral Neck Stress Fractures

• Diagnosis
  – Listen to the history! (training)
  – Groin pain (pointing to the groin)- can be vague
    • Standing
    • Walking
    • Running
  • Insidious onset
  • Tends to worsen as the day goes on; improves with rest
  • If active, stops them at a certain point
  • Nighttime pain
Femoral Neck Stress Fractures

• Inspection:
  – Antalgic gait, run (?!)
  – Swelling: more common in frank fracture
• Palpation: may have pain directly over fem neck region
• ROM: Pain with IR, pain on extremes
• Special Tests:
  – Axial load
  – Logroll
  – Fulcrum
  – FABER’s
  – Hop test?
Femoral Neck Stress Fractures
Fem Neck SF: Why do we care

• Risky Business…
  – Avg diagnostic delay of 14wks!
  – 20-27% result in displaced fem neck fx
  – Why?
    • Blood supply
    • Disrupted perfusion: femoral head dies
    • Arthritic: will require THR
    • Even if repaired, can develop AVN up to 5yrs out!
Femoral Neck SF:
Fem Neck SF: Imaging

- **Plain XR:**
  - Sensitivity 12-60%, Specificity: 88-96%
  - Views: AP pelvis & bil hip
    (AP hip and lateral hip… missing out! Always obtain a pelvis for comparison purposes)
  - Can pick up subtle things
Fem Neck SF: Imaging

- **CT scan:**
  - Better sensitivity/specificity
  - Downside: radiation

- **Bonescan:**
  - Highly sensitive; highly specific
  - Great study to use
  - Downside: ~200 CXR (lots of radiation); lacks detail

- **MRI:**
  - Great sensitivity; specificity variable
  - Picks up on BM edema, fracture lines
Return to Sport

- **Grade 1:** 6-8wks (7.4)
- **Grade 2:** 10-12 wks (13.8)
- **Grade 3:** 12-16 wks (14.7)
- **Grade 4:** >16 wks (17.5)

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Return to WB Activity

<table>
<thead>
<tr>
<th>Stress fracture</th>
<th>High risk/low risk</th>
<th>Average time to weight bearing activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sesamoid</td>
<td>High risk</td>
<td>6 weeks</td>
</tr>
<tr>
<td>Metatarsal</td>
<td>Low risk</td>
<td>4–6 weeks</td>
</tr>
<tr>
<td>Anterior tibia</td>
<td>High risk</td>
<td>6–8 weeks</td>
</tr>
<tr>
<td>Posteromedial tibia</td>
<td>Low risk (cortical break)</td>
<td>8–12 weeks</td>
</tr>
<tr>
<td></td>
<td>Low risk (minor injury)</td>
<td>&lt;3 weeks</td>
</tr>
<tr>
<td>Fibula</td>
<td>Low risk</td>
<td>2–4 weeks</td>
</tr>
<tr>
<td>Femoral neck</td>
<td>High risk</td>
<td>4–6 weeks</td>
</tr>
<tr>
<td>Femoral shaft</td>
<td>Low risk</td>
<td>6–8 weeks</td>
</tr>
<tr>
<td>Sacrum/pelvis</td>
<td>Low risk</td>
<td>7–12 weeks</td>
</tr>
</tbody>
</table>

Note: Data from 7,9,14,16,93,107–111

Evidence states

• 34 athletes (12M, 22F) → 61 bone stress injuries

• 3 major conclusions:
  – **MRI grade** and **BMD**: predictors of time to return to sport.
  – Bone injury at trabecular sites (fem neck, pubic bone, sacrum) also a/w prolonged return to sport.
  – Female athletes w oligomenorrhea/ amenorrhea had BSI’s of higher MRI grades compared to eumenorrheic athletes.


Treatment

• **Phase 1: Conservative**
  – Rest anatomical site
    • WBAT/ ambulation modification
  – Maintain aerobic fitness
  – Physical therapy
  – Oral analgesics
Treatment

• **Phase 2: Rehabilitative**
  – Ambulation
  – Cross-training
    • Focus on progressive return to full impact activities
  – Focus on
    • Muscular endurance training
    • Core and pelvic girdle stability
    • Balance/ proprioception
    • Flexibility
    • ? Gait retraining

2 weeks after pain-free
Return to Run

• Gradual increase to preinjury level over 3-6wks
• Relative activity modification guidelines
• Begin with 30-50% preinjury
  – Progress using 10% Rule
  – Monitor for pain, ROM, concerning si/sx
What’re we talking?

- Low risk, low grade: 61 days
- Low risk, high grade: 153 d
- High risk, low grade: 135 d
- High risk, high grade: 131 d

- XT
- Ensuring solid training base
- Stretching
- Terrain changes
- Hilly routes
- Road camber
- Replacing shoes 300-500mi
- Orthotics
- Enough stores?
- Dietary restrictions?
- Family history
- Modify training
- Menstrual status
- Modify surfaces
- Modify training
- Modify training
- Crosstraining
- Predisposing to injury?
Primary Prevention
Female Athlete Triad

![Diagram of Female Athlete Triad]

Relative Energy Deficiency in Sport

Energy Availability

- Nutrition
- Training
- Menstrual cycle in F
- Calculate BMI (<18.5)
- Adolescents- use the CDC growth charts/ percentage median BMI
MUST ask questions!

- Energy availability
- Menstrual history in females
- Sexual dysfunction
  - Decreased sex drive in women
  - Morning erections in men
Sports Dieticians
What else am I missing?

Any one of these hip or pelvic stress fractures?

... consider obtaining calcium, Vitamin D levels, and DEXA!
Workup?

**Basic**
- CBC
- CMP
- Mg, Phos
- TSH
- 25OH Vit D
- Iron studies
- Ferritin

**Low DEXA scores**
- Urine Calcium/ Creatinine
- PTH
- Alk Phos
- Celiac screen (Total IgA, TTG IgA)
- ESR, CRP
Vitamin D

• Synthesis: skin exposure to UVB light… activated to D3
• Affects are widespread:
  • Muscle protein synthesis, muscle strength, size, reaction time, balance, coordination, endurance, inflammation, and immunity
• RDA: 600 IU daily (LOW!)
• Sources: salmon, fatty fish, egg yolks, fortified foods
  • Much of the nutrient value lost in digestion
• Supplement w Vit D3 (cholecalciferol): more potent than D2
• Unprotected sun exposure (5-15min) between 10a-3p
  • Not true for northern latitudes (CVille!!)
Omega 3 fatty acids

- 2 major kinds
  - EPA (eicosapentaenoic acid): marine oils
  - DHA (docosahexaenoic acid): marine oils
  - ALA (α-linoleic acid): plant oils

- Body requires O3’s but unable to produce - requires exogenous source

- Dose:
  - Min: 650 mg EPA/DHA
  - Heart health: ~1g EPA/DHA
  - High TGs: 2–4 g EPA/DHA
Omega 3 fatty acids

• Benefits:
  • Improve cardiac function
  • Lower triglycerides
  • Lower blood pressure
  • Reduce inflammation

• When purchasing, pay attention to:
  • Amount of EPA & DHA: should be at least 50% of total O3’s
  • Look at serving size for this total
  • … and price per capsule
Treatment

- Look for the modifiable
  - Pre-training, pre-season
    - Aerobic fitness
    - Strengthening
  - Calcium, Vit D, antioxidants
  - Nutrition
  - Shoes
  - Cross-training
Be suspicious!

Long differential with any of these presentations. Athletes will convince otherwise.
Do no harm.
References


