Stress Fractures

Melissa A. Christino, MD
Orthopaedic Surgery & Sports Medicine
Children’s Orthopaedics of Atlanta

Disclosures
• None

Agenda
• Stress Fractures
  – Mechanism
  – Evaluation and Management
• “Beware” Stress Fractures
  – Femoral neck
  – Tibia Shaft
  – 5th Metatarsal Jones
  – Spine: Pars
• Physeal Fractures
• Conclusions
Stress Fractures

Overuse Injuries

- Growing bodies are subject to overuse injuries
  - Increased sports participation in younger athletes
  - Earlier sports specialization

- Activity related pain often responds to physical therapy, rest, orthoses, and NSAIDS

- Pain unresponsive to simple measures should be further evaluated

Stress Fractures

- Repetitive microtrauma weakens bony architecture
  - Stress Reaction: weakening/edema of bone without cortex
  - Stress Fracture: cortical involvement

- Generally occurs in normal bone
Risk Factors

- Increased activity
- Repetitive stress
- High intensity training
- Athletes who fail to “ease in” to training program
- Biomechanical abnormalities (alignment)
- Hormonal imbalance
- Dietary deficiencies
- Female adolescents*

Female Athlete Triad

Most Common Sites

- Tibia
- Navicular
- Metatarsal
- Femur
- Spine
<table>
<thead>
<tr>
<th>Upper Extremity</th>
<th>Associated Sports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scapula</td>
<td>Gymnastics, tennis, volleyball, swimming, softball, ski-club.</td>
</tr>
<tr>
<td>Humerus</td>
<td>Running, basketball, cricket, bowling, volleyball, boxing.</td>
</tr>
<tr>
<td>Radius</td>
<td>Distance running, basketball.</td>
</tr>
<tr>
<td>Ulna</td>
<td>Running, throwing.</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>Running, throwing.</td>
</tr>
<tr>
<td>Femur—neck</td>
<td>Distance running, jumping, ballet.</td>
</tr>
<tr>
<td>Patella</td>
<td>Distance running, hurdles.</td>
</tr>
<tr>
<td>Tibia—plateau</td>
<td>Running, ballet.</td>
</tr>
<tr>
<td>Tibia—shaft</td>
<td>Running, aerobics, cross-country, ballet.</td>
</tr>
<tr>
<td>Navicular</td>
<td>Long-distance running, marching, pole-vaulting.</td>
</tr>
<tr>
<td>Metatarsal—base</td>
<td>Running, basketball, long-tyre running, football.</td>
</tr>
<tr>
<td>Sesamoid bones</td>
<td>Running, ballet, basketball, skating.</td>
</tr>
</tbody>
</table>

**Stress Fractures**

- **Mode of failure**
  - Compression
    - Multiple impact forces
    - Response is bone absorption followed by formation
    - If activities are modified, bone may heal
    - Heals faster and more reliably
  - Tension – more prone to completion of fracture
    - Anterior tibial cortex
    - Femoral neck
    - Spine

**Stress fractures**
Evaluation

• History
  – Pain with activity lasting more than a week
  – Initially, pain at end of activity
  – Will eventually become more constant
  – ADL pain is worrisome
  – Activity level and/or recent changes in activity
  – Menstrual history important
  – Dietary history
  – Previous stress fractures

Evaluation

• Physical exam
  – Tenderness to palpation over affected bone
  – Pain with percussion of bone

Evaluation

• Radiographs
  – Often are negative initially
  – If suspicious, should repeat x-ray in 2 weeks, looking for callus

• Failure to see on x-ray may prompt other diagnostic tests
  – Bone scan
  – MRI*
Radiographs

• 14yo male basketball player

Radiographs

• 13yo female cross country runner
  • 3 week h/o medial knee pain

X-rays 2 weeks later...
**Treatment**

- Eliminate stress
  - If it doesn’t hurt with ADLs, activity restriction is likely enough
  - Pain with ADLs may signify impending fracture → more aggressive workup, protected WB, crutches, cast, etc.

- Surgery is rarely needed
  - Nonunion
  - Fracture
  - Tension sided stress fracture in high risk area

---

**Treatment**

- Return to play after no symptoms for 3-4 weeks
- Gradually increase activity up to prior level
- Return to competition when can practice 3-5 days at full strength without symptoms

---

**“Beware” Stress Fractures**
Femoral Neck Stress Fracture

- **History**
  - Persistent groin discomfort
  - Worst w/ activity
  - Endurance sports
  - Female athletic triad

- **Physical Exam**
  - Painful hip ROM
  - Pain with heel strike

- **Imaging**
  - X-ray
  - MRI, CT, Bone scan

- **Treatment**
  - Inferior neck – Compression Side
    - Most common
    - Non-weightbearing 4-6 weeks
  - Superior neck – Tension side
    - ORIF

- **Prognosis**
  - Can progress to unstable fractures and AVN if not treated appropriately

Tibial Stress Fracture

- **Most common lower extremity**
- **Runners, jumpers**

- **Locations:**
  - Posteromedial – compression side
    - Tend to heal well conservatively
  - Anterior – tension sided, decreased vascularity mid-tibia
    - Risk of delayed union, nonunion, completion of fracture
    - Bone stimulator may be helpful
    - Surgical intramedullary nail for refractory or progressive cases
5th Metatarsal “Jones” Stress Fracture

- Proximal metadiaphyseal area of base of 5th metatarsal
- Dancers, basketball, football, soccer
- High risk for delayed union, nonunion, refracture due to poor blood supply
- Initial management non-operative
- Early surgical treatment with compression screw now being advocated for athletes

Spondylolysis: Pars Stress Fracture

- Extension based back pain
- Gymnasts, dancers, divers, football lineman
- Most common at L5
- Often bilateral
- Initial treatment (6-12 weeks)
  - Activity modification/rest
  - Bracing
- Progression leads to pars defect, can lead to spondylolisthesis

Physeal Fractures
Salter Harris 1 Physeal Fractures

- Transphyseal plane of injury
  - X-rays negative or show physeal widening
- Repetitive stress at growth plate
  - Stress fracture equivalent
  - Physis can be the weak point of chronic stress
- Tenderness directly over growth plate
- Will heal with time/rest/immobilization

Salter Harris 1 Physeal Fractures

- Most common
  - Throwers- Proximal Humerus
  - Runners- Proximal/Distal Tibia
  - Gymnasts- Distal Radius
  - "Ankle Sprains"- Distal fibula

Salter Harris 1 Physeal Fracture

- 12yo male right handed baseball pitcher with right shoulder pain.
Physeal Fractures

• 10yo female gymnast with 5 weeks right wrist pain

Conclusions

• Stress fractures are common overuse injuries in child/adolescent athletes
• High index of suspicion with continued pain or tenderness directly on bone
• MRI is the diagnostic test of choice, x-rays often negative
• Most stress fractures are successfully treated non-operatively except for those in high risk areas for fracture or areas with compromised blood supply

Thank you!

mchristino@childrensortho.com