Pediatric avulsion injuries about the pelvis

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Apophysis

- Differentiate from Epiphysis: The end of long bones which undergo endochondral ossification to produce longitudinal growth of the bones. (i.e. “growth plates”)
- Apophysis refers to any eminence, tubercle or other protuberance where a major muscle tendon inserts.
- Not a major contributor to longitudinal growth, but play a major role in musculoskeletal kinesiology

Apophyseal Avulsion

- Soccer, gymnastics most common
- Also baseball, basketball, football, tennis, etc...

- Two major mechanisms
  - 1) Sudden violent concentric or eccentric contraction of the muscle attached to the apophysis
  - 2) Forceful passive stretch of an already contracted muscle that is attached to the apophysis

Apophyseal avulsion injuries

- Like and epiphysis (growth plate), an apophysis is usually the weakest link in the biomechanical chain in its particular region
- Also like an epiphysis, the failure is usually through a zone of the apophysis called the Zone of Hypertrophy

Wilkins, K. M.D. The uniqueness of the young athletes musculoskeletal injuries. Symposium...
Common Sites of Avulsion Fracture

◊ More Common
◊ Less common

Anterior Superior Iliac Spine

◊ Ossification at 13-15 years
◊ Fusion to ilium 21-25 years
◊ Attachment of sartorius and some TFL fibers
◊ Mechanism of injury from sudden pull of sartorius with hip in extension/knee in flexion

ASIS avulsion

MRI of ASIS avulsion
Ischial Apophysis

- Ossification begins around 14-16 years
- Fusion to ischium 18-21 years
- Insertion site of the proximal hamstrings to the ischium (semitendinosus, semimembranosus, biceps femoris)
- Injury normally occurs with flexed hip/extended knee, especially with eccentric load to hamstrings

Ischial Tuberosity avulsion

- Ossification starts 13-14 years
- Fusion to ischium 16-18 years
- Origination of the direct head of the rectus femoris
- Avulsion of AILS due to direct head of rectus. Pull generally occurs in early hip flexion (tension of direct head maximal)
- "Sprinter's fracture"

Anterior Inferior Iliac Spine

- Ossification begins around 14-16 years
- Fusion to ischium 18-21 years
- Insertion site of the proximal hamstrings to the ischium (semitendinosus, semimembranosus, biceps femoris)
- Injury normally occurs with flexed hip/extended knee, especially with eccentric load to hamstrings
**AIIS avulsion**

- Ossification starts at 13-15
- Fusion between 15 and 25 years
- Attachment of internal/external abdominal obliques, transversus abdominus, origin of gluteus medius and tensor fascia lata.
- Relatively rare injury in adolescents

**Iliac Crest Avulsion**

- Extension/adduction of hip and/or forceful lateral deviation of the spine/torso
Iliac Crest Avulsion Fracture

Obliques, gluteus medius, tensor fascia lata

Symphysis Pubis

- Origination of adductors (longus/brevis) and insertion/confluence with rectus abdominis
- Spectrum of injuries in this area include avulsion of adductors [most commonly longus]. "sports hernias", osteitis pubis, etc...

Pubic Symphysis Avulsion

Adductor Longus

Treatment

- Vast majority can be treated conservatively with rest, symptomatic weight bearing avoidance, progression into stretching and gradual return to activity.
- Generally return to play is limited for 6 weeks, but symptoms can last for 4-6 months.
- Some authors advocate for acute operative repair of avulsion fractures >2cm.
- Other reasons for surgical consideration:
  - Symptomatic non-unions or painful exostosis
  - Ischial tuberosity avulsion fractures causing neurologic symptoms (proximity to sciatic nerve)
Conservative Treatment

<table>
<thead>
<tr>
<th>Phase</th>
<th>Days Post Injury</th>
<th>Subjective Pain</th>
<th>Palpation Tenderness</th>
<th>Range of Motion</th>
<th>Muscle Strength</th>
<th>Activity Level</th>
<th>Radiographic Appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0 to 7</td>
<td>Moderate</td>
<td>Moderate to severe</td>
<td>Very limited</td>
<td>Poor</td>
<td>None, protected weight bearing</td>
<td>Ossous separation</td>
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<tr>
<td>II</td>
<td>7 to 14d</td>
<td>Minimal</td>
<td>Moderate</td>
<td>Improving with gentle exercise</td>
<td>Fair</td>
<td>Protected weight bearing, guided exercise</td>
<td>Ossous separation</td>
</tr>
<tr>
<td>III</td>
<td>14-20 to 30d</td>
<td>Minimal with stress</td>
<td>Moderate</td>
<td>Improving with gentle exercise</td>
<td>Good</td>
<td>Guided exercise, resisted</td>
<td>Early callus</td>
</tr>
<tr>
<td>IV</td>
<td>30 to 60d</td>
<td>None</td>
<td>Minimal</td>
<td>Normal</td>
<td>Good to normal</td>
<td>Limited athletic participation</td>
<td>Maturing callus</td>
</tr>
<tr>
<td>V</td>
<td>60 to return</td>
<td>None</td>
<td>None</td>
<td>Normal</td>
<td>Normal</td>
<td>Full activity</td>
<td>Maturing callus</td>
</tr>
</tbody>
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References


Thank you