Knee Injuries in the Adolescent Athlete – From ACL to Patellar Dislocation

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Disclosures

• Consultant for Orthopediatrics, but no $$ to disclose for this talk
• Review knee injuries in adolescent athletes
  – ACL
  – Anterior Tibial Spine Fractures
  – Meniscus Injuries
  – Patellar Dislocations
  – Fractures
• Review the history, physical exam findings and work up for
• Review the evidence-based treatment
Knee injury - Skiing

**Injury breakdown by classification**
- Sprain/Strain: 47.7%
- Fracture: 16.9%
- Laceration: 10.4%
- Joint injury: 6.5%
- Contusion: 12.1%
- Concussion/LOC: 4.4%

**Commonly injured areas**
- Knee: 33.4%
- Head/face: 13.5%
- Shoulder: 9.5%
- Lower leg: 8.6%
- Ankle: 6.1%
- Thumb: 4.4%
# Knee Injury – Downhill Mountain Biking

## Table 2: Sustained injuries in case of incident (n=494)

<table>
<thead>
<tr>
<th>Injury type</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion</td>
<td>316</td>
<td>64</td>
</tr>
<tr>
<td>Contusion</td>
<td>279</td>
<td>57</td>
</tr>
<tr>
<td>Torsion</td>
<td>72</td>
<td>15</td>
</tr>
<tr>
<td>Laceration</td>
<td>62</td>
<td>13</td>
</tr>
<tr>
<td>Strained muscle</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td>Fracture</td>
<td>32</td>
<td>7</td>
</tr>
<tr>
<td>Concussion</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Ligament strain</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Joint dislocation</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Joint inflammation</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Ligament rupture</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>23</td>
<td>5</td>
</tr>
</tbody>
</table>

## Table 1: Affected body region in case of injury (n=494)

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower leg</td>
<td>134</td>
<td>27</td>
</tr>
<tr>
<td>Forearm</td>
<td>121</td>
<td>25</td>
</tr>
<tr>
<td>Knee</td>
<td>103</td>
<td>21</td>
</tr>
<tr>
<td>Elbow</td>
<td>97</td>
<td>20</td>
</tr>
<tr>
<td>Hand</td>
<td>93</td>
<td>19</td>
</tr>
<tr>
<td>Shoulder</td>
<td>86</td>
<td>17</td>
</tr>
<tr>
<td>Thigh</td>
<td>85</td>
<td>17</td>
</tr>
<tr>
<td>Wrist</td>
<td>64</td>
<td>13</td>
</tr>
<tr>
<td>Hip</td>
<td>63</td>
<td>13</td>
</tr>
<tr>
<td>Ankle</td>
<td>43</td>
<td>9</td>
</tr>
<tr>
<td>Head/face</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>Ribs</td>
<td>36</td>
<td>7</td>
</tr>
<tr>
<td>Upper arm</td>
<td>33</td>
<td>7</td>
</tr>
<tr>
<td>Pelvis</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>Neck/cervical spine</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Foot</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Upper back</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Lower back</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Clavicle</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>Abdomen</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Others</td>
<td>21</td>
<td>4</td>
</tr>
</tbody>
</table>

ACL injury

- Twisting injury
- Pop
- Effusion
ACL Injury

- Xray
  - Plain radiographs
    - r/o fracture
  - Anterior Tibial spine
  - Segond Sign
  - OCD
  - Epiphyseal measurements
Anterior tibial spine fracture
Anterior Tibial Spine Avulsion Fracture

• Kids don’t get ACL tears
  – Not anymore
• Do still get fx
• Associated Injuries
  – 59% meniscal/chondral injury
• Treatment
  – Closed reduction and cast
  – ORIF
  – Arthroscopic ORIF

Incidence of Meniscal Injury and Chondral Pathology in Anterior Tibial Spine Fractures of Children

Justin J. Mitchell, MD,‡ Rebecca Sjostrum, MD,§ Alfred A. Mansour, MD,‖ Bjorn Irion, BS,‡
Mark Hotchkiss, MS,§ E. Bailey Terhune, BA,§ Patrick Caryl, BA,§ Jaime R. Stewart, MD,‖
Armando F. Vidal, MD,§ and Jason T. Rhodes, MD§
Diagnosis

• Imaging
  – Xray
    • Type I, II, III
  – MRI
    • Confirms PE
    • Associated injury
      – Meniscus
      – MCL
      – PCL
      – PLC
      – Cartilage
Treatment

- MRI
- Type II
  - Closed reduction
  - ORIF
    - Arthroscopic
- Type III
  - ORIF
    - Arthroscopic
Anterior Tibial Spine Avulsion Fracture

- Arthroscopic
  - Risk: Arthrofibrosis
  - Concomitant ACL Injury
    - 20% Type II Fractures
    - 15% Type III Fractures
  - ACL retear?
    - 16%
    - Equal for Type I, II and III
ACL: MRI
Treatment

- **Non-Op**
  - Meniscus tears and chondral injury
- **Operative**
  - Physeal sparing [non-anatomic]
  - Transphyseal [anatomic]
Immature ACL Tear

- Prepubescent Tanner 1 or 2
  - Male < 12
  - Females < 11
  - Physeal Sparing

- Adolescent w/ Growth
  - Tanner 2-3
  - Males 13-16
  - Females 12-14
  - Transphyseal w/ metaphyseal fixation

- Older Adolescent Closing Physes
  - Standard ACL
All Epiphyseal

- Anderson Technique
- Hamstring autograft
  - Allograft for back-up
Patellar Dislocation

- Congenital
- Traumatic
  - Multiple $\geq 3$
Work up

- Xray
  - 3 view knee
  - Standing hips to ankles
- MRI
  - TTTG
  - Chondral injury
- Rotational CT
- Gait lab
Treatment

- PT
- Brace
- Surgery
  - TTO
  - Guided Growth
  - Osteotomy
    - Rotational
    - Coronal
Dislocations

- Multiple traumatic
  - Patellar stabilization/realignment
    - MPFL Reconstruction
    - VMO Advancement
  - TTO
- Congenital
  - All the above
Meniscal Injury

- Discoid Meniscus
  - Congenitally enlarged meniscus
  - Presentation:
    - Pain and Popping
    - 5-15 yoa
  - PE:
    - Pop on extension
    - Joint line TTP
Discoid Meniscus

- Work up
  - Radiographs
  - MRI
  - Types
    - Complete
    - Incomplete
    - Wrisberg Variant

- Treatment
  - Arthroscopy
  - Repair
  - Saucerization
  - Transplant?
Fracture

- Fractures
- What bone?
- Where
  - Salter Harris
- Other injury?
- Treatment
- Cause?
Fracture/Dislocation

- Distal Femur
- Proximal Tibia
- Knee Dislocation
  - Multi-Lig knee injury
  - Vascular injury
  - Compartment Syndrome
  - Physeal Injury
SH II
Results/treatment

- Do Nothing
- Physeal Bar excision
- Epiphyseodesis contralateral physis
- Acute shortening contralateral femur
- Lengthening
Thanks!

Deadliest Trail In America